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THE BALANCE-SHEET METHOD IN ECONOMIC STATISTICS

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Separate economic branches are studied by their own statistics: industrial, agricultural, transport, trade and other statistics, while the national economy as a whole (its structure and the relations between separate economic branches) is the subject of a special branch of science-economic statistics, which is a summary synthetic science based on a balance-sheet method.

The balance-sheet method is also used by branch statistics when specific, concrete problems are analysed, but here its significance is auxiliary. Thus, for example, in agricultural statistics this method is used in compiling balances of grain and forage; in industrial statistics — for balances of fuel and electricity; in transport statistics — for balances of goods transportation, etc. As a rule, all these balances are compiled on the basis of physical measurement and designated in wheight units (tons) and work units (power-hours, kilowatt-hours, ton-kilometres). Natural balances in brandh statistics have been used for a long time. But economic statistics emerged only recently and the application of the balance-sheet method to the study of the national economy as a whole began on the whole only in the XXth century.

The first distinguishing feature of the balance-sheet method which forms the basis of economic statistics is its value (monetary) character. In the last centuries the value method was used only when state budgets were compiled; in book-keeping it was used in compiling the balance-sheets of different enterprises. From the moment of its emergence

economic statistics pursued an entirely new objective: that of calculating the national economic balance-sheet. In solving this task the balance-sheet method makes possible an economic analysis of the whole national economy as an aggregate of different economic units (industrial, agricultural, transport and other enterprises), reducing their innumerable economic operations into definite homogeneous economic categories.

The use of the balance-sheet method is impossible without a detailed and scientifically grounded classification of economic operations and of the results achieved by different enterprises. Scientific classification of the elements of the national economy is therefore the second characteristic feature of the balance-sheet method in economic statistics.

The third and the most important characteristic feature of the balance-sheet method is the use of double counting and duplex accounts. All material values, for example, are considered according to their place in the receipts and expenditures of separate structural units and of the whole national economy.

The balance-sheet method in economic statistics uses widely the principle of duplex analysis. Thus in the process of circulation, the different elements of production are treated as components of capital outlays or as products distributed between other industries (elements of productive consumption) or between final buyers. A duplex study of the elements of the national economy takes place, for instance, when material values are considered from the standpoint of purchases made by enterprises, groups of enterprises or economic branches and from the standpoint of the sales by one economic branch to another.

The principle of duplex account is widely used in the comparison of such economic charateristics as cost and output of goods, social product and national income, production and consumption, accumulation and consumption, or in the study of structural economic relations between basic subdivisions of social production and between individual social groups of the population.

The characteristics obtained by such duplex accounting are arranged in the form of economic matrix of figures. Such a matrix arrangement of economic data is the fourth characteristic feature of the balance-sheet method in economic statistics. The statistical results of duplex accounting are arranged in the form of tables with two approaches (for example, production and consumption), i. e., in the form of a mutually combined symmetric table.

Sometimes these tables assume the form of a chess-board balance-sheet in which the subdivisions of the subject and predicate (items of the rows and the columns) of the table fully coincide, and the rows and columns are balanced. Chess-board forms are widely used in English and American economic statistics for input-output computions, which are a variation of the balance-sheet method. Some chess-board balance-sheets have a large number of subdivisions. For example, the United States Bureau of Labour Statistics made a chess-board balance-sheet for a study of the flow of goods and services in 1947; this balance-sheet provides for 500 subdivisions in the rows and the columns of the table. However there is an understandable tendency towards using the so-called "small matrices", which study principally large structural subdivisions in the national economy and do not require a table arranged in the form of a chess-board.

Large summary balance-sheet tables may be considered as consisting of elementary balance-sheet tables (quadrangles) orthogonally connected with one another. The orthogonal connection is usually done by superimposing the quadrangles horizontally, vertically, or crosswise. In the balance-sheet tables, as a rule, orthogonal balancing is achieved in the rows and columns or in their totals *. The orthogonal connection of the elementary balance tables (quadrangles) and orthogonal (at a right angle) balancing of the totals of the rows and columns are the fifth distinguishing feature of the balance-sheet method.

The characteristics of the balance-sheet method used in economic statistics cannot be confined only to a description of the main formal statistical features of its tabular arrangement. Of great importance is the determination of the so-called economic model of the national economy as a whole. This model is the subject of the balance-sheet method.

The results of a statistical and economical analysis of the structure of the national economy are in Soviet literature defined as balances of the national economy.

* See, e. g., «National Income and Expenditure», 1946—1952, (London, 1953), Table 13.

In Anglo-American and West-European literature other terms are used to define analogous investigations, for example, the national economic budget, economic table, national or social accounts, etc. All these notions have in common a numerical expression of the circulation of material values and services accompanied by an analysis of the structural interdependences between separate parts and subdivisions of the national economy.

When investigating the circulation in the national economy and its structure, Soviet statistics proceeds from the Marxist-Leninist theory of social production and in particular from Marx's scheme of large-scale reproduction.

The balance-sheet of the national economy is constructed on the basis of the following main premises:

1. Society cannot exist without labour input into social material production which supposes the appropriation by the society, in historically determined social forms, of the gifts and forces of nature which in the process of social production are fitted to the needs of man and to the needs of the whole society.

2. The national income is the part of the social product which remains after remunerating the input of previous embodied labour spent in the form of materials, fuels, etc. The national income is created only in the sphere of material production. The incomes of the members of a society obtained outside the productive sphere are derivative (secondary) and result from a redistribution of the income created in the sphere of material production.

3. In the non-productive sphere the income of a society is not created, but it is used for remunerating the labour of the workers and the material input of this sphere as well as for the accumulation of capital funds (e. g. appartment and cultural houses and other buildings) in the non-productive sphere; it is also used to increment of the circulating funds (reserves). The capital and turnover funds of the non-productive sphere are created in the sphere of production; the material outlays in exploiting these funds are covered at the expense of the annual product for society created in the sphere of material production.

4. The new value created in the process of material production takes two forms: the value of the product remunerating the workers which is equal to the value of the means

of existence of those employed in material production, and the value of the product for society which is used for broadening the scale of material production (accumulation in the productive sphere) and for maintenance of the non-productive sphere (consumption, accumulation and material input in the non-productive sphere).

5. The economic relations between separate groups of the population are considered as relations between classes, which are based on their production relations, i. e., relations of property on the means of production. Ownership of the means of consumption and household goods does not determine the class structure of society. Under capitalism the relations of property on the means of production lead to the rise of antagonistic classes: bourgeoisie, working class and peasantry. Under socialism, where state and collective-farm property on the means of production exists, there are friendly classes: the working class and peasantry. Under communism a classless society will be created which will be based on common all-people property on the means of production.

These initial premises lead to different methods of determining the national income than is accepted in Western-European countries. The difference consists in the fact that Soviet statisticians do not include the income, recieved in payment of various services, into the national income considering this payment as derivative (secondary) and to be effected only by redistributing the national income created in the sphere of material production.

The application of these initial premises leads to the construction of an appropriate model of the national economy. Of decisive importance to this model is the strict distinction between the sphere of material production, the non-productive sphere (services rendered to the population by organizations and institutions in the non-productive sphere) and the sphere of personal (individual) consumption (households).

The material sphere of production includes industry, construction works, agriculture, forestry, commercial fishery and hunting, transportation of goods, trade (in as much as it means the storing, sorting, packing and delivery of products to the population), state purchases of agricultural products and materials, material supply of enterprises and public catering.

The non-productive sphere comprises enterprises and

institutions of cultural and everyday life services: public education, public health, art, science, passenger transport, financial institutions (banks, insurance offices, savings-banks), public utility, administration, defence, etc.

Of great importance to the economic model of the national economy constructed by Soviet statisticians is the duplex approach to social production from the standpoint of its value and its material structure. The value aspect singles out the value of the previously embodied labour (provisions for the compensation of the consumed elements of production) and the new value created by live labour (subdivided into products remunerating the workers and products for society).

An analysis of the physical structure of social production singles out the following subdivisions:

1. Production of means of production (implements of production and subjects of work).

2. Production of means of consumption.

The economic model of the socialist society is expressed in the balance-sheets of the national economy which are annually compiled by statistical authorities on the basis of data contained in the annual reports of all the enterprises and institutions of the U. S. S. R. The economic model of the socialist society is also expressed in the plan balance-sheets compiled by the planning authorities for a future period (a year or a five-years period).

* * *

The balance-sheet method in economic statistics is widely used in analysing the changes, taking place in the structure of the national economy. For this purpose economic statistics constructs balance-sheets of the national economy (using the terminology accepted in Soviet statistics), in other words, a system of national and social accounts. The theoretical foundation of these balance-sheet constructions is the theory of reproduction of the social product which characterizes the remuneration in the course of social production the material outlays of embodied labour as well as the distribution of the newly created value, part of which forms the product for society used for the further enlargement of the scale of production and for consumption in the non-productive sphere.

In 1758 François Quesnay an outstanding french economist, published his famous "economic table" and in 1766 gave an additional analysis of this table. The table of 1766 consists of five lines connecting six initial points (which are also the return points), and characterize simultaneously the flow of physical goods and of currency in the process of exchange between the three basic classes of society: firstly — owners and rentiers; secondly — farmers; thirdly — manufacturers, craftsmen, merchants and professionals. In the Quesnay scheme the upper ends of the lines characterize the buyers and the lower—the sellers. The flow of physical goods and the exchange of services are shown by Quesnay not only graphically through lines, but also with the help of corresponding figures that express the volume of products sold or the size of the remuneration of the capital elements as well as the share of the social product passing from the sphere of circulation into the sphere of consumption

Karl Marx appraised the Quesnay economic table as a brilliant idea, although he scientifically criticized the main Quesnay's premises: an erroneous explanation by the physiocrates of the origin of surplus value as a "generous gift of nature". Following the doctrine of the physiocrates, Quesnay believed that the surplus product was created only in agriculture, while the class of industrial workers and craftsmen only compensated its own outlays into the process of production and its own expenditures of the means of subsistence consumed by this class.

The singificance of Quesnay's idea consists in his theoretical examination of the structure of the national economy as a process of reproduction of the social product. The national income and the net income of society (surplus value) are created in the process of reproduction, after compensation of the material outlays ("avances", using Quesnay's terminology). The surplus value is formed by remunerating out of the national income the means of existence consumed by the producers of the social product. Quesnay's genius manifested itself in his treatment of numerous individual economic acts in their entity, in their integrity, as relations between the principal classes. He attempted to give a quantitative characteristic of the circulation of commodities and services between producers and consumers, between the productive class and the class of proprietors. The monetary

flows in his tables was also correctly explained as being entirely conditioned by the circulation and production of commodities, in other words, by the process of capital circulation.

In his letter to F. Engles dated July 6, 1863 * K. Marx presented his own "economic table" with which he substituted Quesnay's table. Marx's economic table was based (as Quesnay's table) on the principle of simple reproduction, i. e., reproduction of the social product and the national income in invariable volumes. K. Marx arranges his table graphically as dotted and continuous lines characterizing the flow of material values created in the process of social production.

The principally new feature of Marx's economic table is the double approach to the analysis of the formation of the social product and national income. This double analysis consisted in a simultaneous study of all the elements of reproduction from two points of view:

1. the value approach envisaging the singling out of previously embodied labour in the form of the constant capital outlays (materials, fuels, depletion of the implements of work), the expenditure of live-labour in the form of variable capital outlay (for remuneration of labour power), and surplus value as the increment of the product created by the live-labour over the necessary means of existence;

2. the physic substance approach according to which all the output of products is subdivided into means of production (machines and materials) and the vital means of consumption.

In Marx's economic table the continuous lines characterize the replenishment of the constant and variable capital out of the social product, while the dotted lines represent the formation of the national income as a part of the social product as well as its distribution into wages, employers income, interest, and land-rent.

Marx's economic table of 1863 characterizes simple reproduction; therefore the surplus value is entirely consumed by the capitalists and no accumulation takes place. But later in the 2nd volume of "Capital" K. Marx elaborated his scheme

*) See Marx/Engels, Gesamtausgabe (Berlin, 1930), Dritte Abteilung, Band 3, SS. 148—152.

of simple reproduction and essentially supplemented it with a scheme of large-scale reproduction, which is also based on a two-sided analysis of the elements of production: from the value standpoint and from the standpoint of the two main subdivisions of social production (the production of means of consumption and the production of means of production). This latter standpoint determines the physical structure of production. The new and essential element to be introduced was the subdivision of the surplus value into the accumulated and consumed parts. The numerical examples of the Marx's model of large-scale reproduction can be represented in the following economic matrix of figures:

Matrix of the Marx scheme of large-scale reproduction *

T_1	C	V	Mq	Mp	P
I	4000	1000	500	500	6000
II	1500	750	150	600	3000
P	5500	1750	650	1100	9000
T_2	C	V	Mq	Mp	P
I	4400	1100	600	500	6600
II	1600	800	190	610	3200
P	6000	1900	790	1110	9800
T_3					
I	4840	1210		(1210)	7260
II	1760	880		(880)	3520
P	6600	2090		(2090)	10780

In the economic matrix of the scheme of large-scale reproduction the following designations are used: T_1 — the current stage of production, T_2 — the next production cycle, T_3 — the subsequent production cycle; the Roman figures I and II define the basic subdivisions of social production (I — the production of means of production, and II — the production of means of existence); the Latin letters P — value of the social product, C — outlay of past embodied labour (constant capital), V — remunerated part of live-la-

* K. Marx "Capital", v. II, (Chicago, 1913), pp. 596—600.

bour (variable capital under capitalism or the product remunerating the worker under socialism), M — the surplus product created in the process of production (surplus value under capitalism or the product for society under socialism).

The surplus product is subdivided into Mq — the accumulated part used for broadening the scale of production and Mp — consumed part of surplus product, i. e., the part of the income of the society which is mostly consumed in the non-productive sphere (e. g., by the capitalist as a profit).

The matrix form of the scheme of large-scale reproduction vividly illustrates the laws discovered by K. Marx as well as the mutual relations between individual elements of social production. In the case of simple reproduction the value of the product in row I is equal to the value of the product in column C, while the value of the product in row II is equal to the value of the product in columns V and M. On the basis of these equations K. Marx discovered a remarkable interrelation inherent in simple reproduction, according to which the material input into the production of means of consumption (C_2) equals the income of society created in the sphere of production of means of production ($V_1 + M_1$). In the case of large-scale reproduction the income ($V_1 + M_1$) created in the sphere of production of means of production must be larger than the material input (C_2) in the sphere of production of means of consumption.

V. I. Lenin attached great importance to this thesis and considered the interrelation between $V_1 + M_1$ and C_2 as being applicable "...even in pure communism" *. Lenin also noted another equation inherent in simple reproduction which he formulated as follows"... the total value newly created during a year (in both subdivisions) should be equal to the gross value of the product in the form of consumer goods"**

(i. e., $V_1 + M_1 + V_2 + M_2 = C_2 + V_2 + M_2$).

As for large-scale reproduction the equation of row I to column C is also valid if P_1 — the value of the product in row I (i. e., of the product existing in the form of means of production) is taken for T_1, while the value in column C — for T_2 (the subsequent production cycle). Similar equations hold true if P_2 — the value of the product in row II (i. e., of the product existing in the form of means of consumption is taken for T_1, while in columns V and Mp the totals of both subdivisions are taken for the period T_2. These interrelations can easily be illustrated by the numerical example cited above in the economic matrix of the model of large-scale reproduction.

These regularities of large-scale reproduction formulated by K. Marx and V. I. Lenin are confirmed by the experience acquired by the Central Statistical Office of the U. S. S. R. in the compution of balance-sheets of the national economy.

In his work "Concerning the so-called question of markets" * V. I. Lenin examined a version of the model of large-scale reproduction taking into account the technical progress, i. e., the increase in the organic composition of current outlays and the growth of the ratio between C_1 and V_1. In this work V. I. Lenin subdivided the production of means of production into two parts (according to the destination of the product):

a) for the sphere of production of means of production and

b) for the sphere of production of means of consumption. An examination of numerical examples allowed V. I. Lenin to formulate another extremely important regularity, namely, that in conditions of technical progress large-scale reproduction can be effected provided the growth of the production of means of production outstrips the production of means of consumption. Moreover, inside the sphere of production of means of production, the production for the needs of this sphere itself grows at a quicker rate than production for the sphere producing means of consumption **.

The new regularities of large-scale reproduction discovered by V. I. Lenin were of great importance for the planning of socialist industrialization in the Soviet Union, since they made it possible to transform an underdeveloped agricultural country into a mighty advanced industrial power within a historically short period.

In constructing balance-sheets of the national economy Soviet economists and statisticians rely on Marx's economic theory and on his model of large-scale reproduction.

* "Leninskiy sbornik" ("Lenin's collected works"), vol. XI, p. 349 (Moscow, 1929).

* V. I. Lenin, Concerning the so-called question of markets, (Moscow, 1954), pp. 10—11.
** Ibid, pp. 17 — 19.

But in the entirely new conditions of the socialist society there naturaly arises the acute need for profound theoretical investigation in the theory and practice of compiling tables and balance-sheets of socialist economy. Work in this sphere is continuing and Soviet economists and statisticians may have to overcome serious difficulties in future.

* * *

The first experiment in analysing the structure of the national economy and in compiling balances of the national economy (based on the accounting data of state statistics) was made in the Soviet Union in 1923—1924. The balance of the national economy was compiled by the Central Statistical Office of the U. S. S. R. in conformity with the government decision of June 21, 1924 and was published in 1926*.

In a summary table of the balance of the national economy the following economic branches were singled out: agriculture, industry, construction, trade, transport, non-productive sphere. Agriculture was subdivided into cultivation of land and meadows, livestock breeding, forestry, fishery and hunting. Industry was subdivided into mining and manufacturing industry. In the mining industry extraction and primary treatment of minerals (and separately of mineral fuels) were singled out. The manufacturing industry was subdivided into 11 branches. Moreover a separate account was taken of publishing. Agricultural, industrial, and constructional production was subdivided into the following balance-sheet groups: a) consumer goods, b) materials, c) fuels, d) implements of production.

A most important part of the summary table of the national economy was the account of the turnover of material values which characterized the production and consumption of the most important kinds of products in the economic branches as well as their circulation in the non-productive sphere. For each branch of agriculture, mining, and manufacturing industries and for construction both the amount and the list of products used by each branch were determined. But the chess-board balance-sheet of production and consumption was computed only for the three consolidated spheres of the national economy: industry, agriculture and construction.

The balance-sheet made it possible to compute the share of productive consumption by agriculture, industry, construction, transport and trade in the gross output available for distribution. The balance-sheet also made possible in the case of such economic branch the determination of the share of the gross output that went for personal consumption and for consumption by institutions of the non-production sphere. At the same time not only the distribution of the output of a given branch of production between other branches was determined, but also its material outlays, the expenditures on wages, remuneration for services of transport and trade and other items of expenditure (rent, taxes, etc.).

The compilers of the balance-sheet of the national economy stressed the importance of two aspects of the analysis of the structure of the national economy. The first aspect was the distribution of material values according to the branches of their production and consumption (designation) singling out productive consumption and final consumption. The second aspect was the compution of the total current outlays of different economic branches (input of materials, fuels and other material values, wages, the outlay of transport and trade into a given economic branch, taxes, etc.). But the compution of current outlays in each economic branch could only be partial in the first balance-sheet of the national economy.

After this first experiment the Central Statistical Office of the U. S. S. R. during thirty years annually compiles balances-sheets of the national economy based on the annual reports received from all the enterprises and institutions of the country. The accounting balance-sheets of the national economy are widely used by the planning authorities in constructing the planned balance-sheets of the national economy for the comming year and for the years of the nearest five-year period.

The experience accumulated during many years and the techniques of compiling the balance-sheets of the national economy was discussed at the All Union Conference of Soviet Statisticians held in June, 1957. The Conference discussed a report delivered by V. A. Sobol "The Principal Metho-

*) Balans narodnogo khozyaistva Soyuza SSR 1923-24 goda, (The balance of the Soviet economy 1923-24), Moscow, 1926.

dological Problems of the Accounting Balance of the National Economy". The conference decided in favour of inaugurating the compution of balance-sheets of the national economy in each Soviet Republic and also of commencing an annual study of interregional circulation of material values (mutual supplies of about a hundred Councils of People's Economy of different regions). A study of interregional transactions will be combined with a study of the interrelations between the different branches of industry and of the national economy.

In the recent years in various countries of the world the use of the balance-sheet method in studying the structure of the national economy is developing on an ever increasing scale. In 1933 in Germany a work by F. Gruenig * was published. On the basis of the available statistical data this work showed for 1929 the movement of the national product from producers to consumers taking into account the subdivisions of output into means of production and means of consumption. This work also estimated the value created in different branches of the national economy and showed the consumption of this new value in the productive and non-productive spheres.

In West-European literature it is considered that F. Gruenig anticipated the so-called "Leontief matrices"**. But it is necessary to note that Wassily Leontief's work was undoubtedly influenced by the compution of the first balance-sheets of the national economy of the U. S. S. R. (1923—1924) which he knew from literature.

In this respect it is worth noting that in the first balance-sheet of the national economy of the U. S. S. R. the main attention was devoted to the account of the turnover of material values which made it possible to determine not only the input coefficients of one economic branch into the production of another branch but also to find out the personal consumption (particular of households).

In 1941 Wassily Leontief's famous work was published. Its principal ideas were set forth by the author in 1931 before the National Bureau of Economic Research. In his book

* Ferdinand Gruenig, "Der Wirtschaftskreislauf", (München, 1933).

** See, e. g., the objections of E. Fuerst in his study "Matrix as a tool to macro-accounting", The review of economics and statistics, February 1955, № 1.

W. Leontief used the new method of input-output analysis. Being a variety of the balance-sheet method this method is a combination of two aspects of production analysis: the determination of the input in production of a given economic branch, and the investigation of the distribution of its output between other branches. Such a double analysis singles out the share accruing to final consumption in households, to institutions of the non-productive sphere, to capital investments into fixed and working funds, as well as to exports.

Using American census data W. Leontief compiled balance-sheet tables for 1919—1929 and later on for 1939 *. Moreover the Bureau of Labour Statistics compiled balance-sheet tables of the United States economy for 1947 (D. Evance and M. Hoffenberg) **.

The balance-sheet method of analysing the structure of national economy is at present also widely used in other countries of the world. A survey of these works is given in a special publication of the Economic Commission for Europe ***. Of special significance are the balance-sheet tables analysing the structure of the national economy of the United Kingdom (1947 and 1950) ****. The balance-sheet study of the national economy of France carried out by the Institute of Statistics and Economic Investigation of the Ministry of Finance, France ***** is also singular in character.

* * *

The balance-sheet tables which analyze the structure of the national economy usually are very complicated. They consist of a whole system of statistical tables. Usually the main summary balance-sheet table is also very complicated. In Anglo-American studies the summary balance-sheet tables are sometimes subdivided into four quadrangles.

* W. Leontief, "The structure of the American economy 1919—1929" Cambridge, 1941; and W. Leontief, "The structure of the American, economy 1919—1939", New York, 1951.

** D. Evance and M. Hoffenberg, "An Interindustry relations study for 1947„, The review of economics and statistics, May 1952.

*** European Economic Bulletin, v. 8, May 1956, Genova.

**** National Income and Expenditure, London, 1950 and 1953 respectively.

***** "Rapport sur les comptes de la nation" vol. II annexe 3, pp. 305—316.

The first (internal) quadrangle characterizes the purchases and sales relating to the subjects of work (materials, fuels) of diffferent branches of material production. This quadrangle has the form of a chess-board with the same subdivisions into branches both in the rows and in the columns. The columns show the material input into a given branch of production. The rows show the sales of the output of a given branch to other branches of production. Therefore the structure of industrial consumption for production purposes is characterized.

The second quadrangle in such tables shows the final consumers of the product of each branch (consumption by the population, consumption by institutions, formation of the fixed and working funds, exports).

The third quadrangle consists on the whole of the elements of national income (wages and the surplus value in the form of profits, rent and taxes). Here also data on imports and depretiation are usually placed.

The fourth quadrangle includes the items characterizing the internal accounts connected with the production and consumption of the national income.

Such a construction of the summary balance-sheet table is typical, for example, to the English studies published in the so-called „Blue books" *. The structure of the balance-sheet tables of the US national economy is analogous **. But usually in the USA the third quadrangle is reduced to one line „Household service" in which wages, profit, interest, rent, and depretiation are heaped together.

The economic tables in French literature which represent a chess-board balance-sheet have a very specific arrangement ***. Both the rows and the columns of the summary table have subdivisions which characterize the operations made by economic units (enterprises, institutions, individuals, etc.). In the subject and predicate of the table three kinds of account are considered according to the following operations: accounts of economic activities, payment accounts and the accounts of capital investments. In the accounts

* See the table for 1947 and 1950 in „National Income and expenditure" 1950 and 1953 respectively; London.

** See for example, W. Leontief, „Studies in the structure of the American economy" New York, 1953 and „Input-output analysis: an appraisal", New York, 1955.

*** Statistiques et études financières, № 100, avril 1957, Paris, pp. 424—425.

of economic activities the main branches of production, the leading subdivisions of the non-productive sphere (administration, service) and the population (hired workers and employees, non-gainfully employed population) are singled out. The main production branches are also destinguished in the account of capital investments. Especially detalled specifications are made in the sections of the balance-sheet dealing with various payments and transactions (commodity, credit, etc.) and with operations characterizing the redistribution of the income (taxes, subsidies, social insurance dues, compensation of losses, etc.).

The arrangement of the summary balance-sheet of the national economy of the U. S. S. R. differs essentially from the one used in Anglo-American and West-European countries. First of all the table of interrelations between the individual branches of production (mutual transactions, sales and purchases) is only auxiliary in the system of tables constituting the balance-sheet of the national economy. Its totals are included in the summary table only under three headings (production of the objects of labour, production of the implements of production and production of means of consumption).

The main characteristic feature of Soviet summary table is that in the horizontal rows it consists of three large subdivisions: 1) production of material values, 2) non-productive organizations and institutions and 3) population.

Material production in turn is subdivided into the following branches: industry, agriculture, forestry, construction, transport and communication, trade, state purchases and the provision of capital goods and materials to enterprises.

Moreover the sphere of material production is subdivided into social sectors: state, cooperative and collective-farm enferprises, auxiliary economies of collective farmers, workers and employees, economies of iindividual farmers and uncooperated craftsmen. The non-productive sphere consists of education, science, art, public health, housing and communal enterprises and communal services, as well as social organizations and institutions of state administration and defence.

In the population section workers, employees and peasants are distinguished.

In the sphere of material production (beside the subdivisions into the branches of production and into social sectors) the production of means of consumption and of means of production is differentiated (with further divisions of the latters into the means of production for the needs of this sphere itself and those for the production of means of consumption). As to the production of means of consumption, production for personal consumption is differentiated from production for the consumption of society as a whole.

The summary table also has entries characterizing the production of implements of labour, objects of labour and means of consumption. This subdivision is very important for the characteristics of the general structure of the social product.

As to the gross social product, the corresponding columns of the summary table have entries making it possible to determine the outlays necessary for reproduction (i. e., the social value). These data are subdivided into the input of previous labour (separately the depreciation of the implements of labour, and separately the input of the objects of labour) and the input of live-labour. The input of live-labour (which creates the national income) is calculated on the basis of the wage fund (the product for remunerating the workers) and the fund for social needs (the product for society). In the columns of the summary table the final utilization of the national product is also shown (with special reference to the compensation the consumption, the accumulation and reserves funds and to the losses.) In separate quadrangles of the summary table the social product is shown in production prices, consumption prices and in units of national value.

In view of all this the summary table makes it possible to determine deviations between costs and sales prices in different economic branches as well as to gauge the redistributions due to difference in sales prices of the producer and the consumer prices. The redistribution of the social product and the national income can also be studied by comparing data of various payments and receipts. In the auxiliary table for each branch of material production, for the non-productive sphere and for the population there is a comparison of payments and receipts effected through such channels as the state budget, the credit system, state insurance, social

insurance, savings-banks. Similar data is given concerning such payments as wages, remunerations for services, pensions, grants, scholarships, etc. The redistribution of the national income is also accounted by comparing the increase of or decrease in ready cash, debts, etc. Comparisons of incomes and expenditures in each economic branch and in the households make it possible to compile a balance of the redistribution of the national income.

The summary table shows the circulation of the social product based on a comparison in each economic branch of purchases and sales of output and also the redistribution resulting from the circulation of the national product.

The summary table also shows the balance of fixed and circulating funds by comparing their values in the beginning and at the end of the year and by takins into account the increase or decrease of the fixed and current assets as shown in the entry "final use of the social product".

The balance of work-done and of labour-power (as well as the balance of cash personal incomes and expenditures) is given in auxiliary tables.

The data on labour resources (the number of working personnel in the beginning and at the end of the year and the number of mandays worked) are usually given in the beyond the balance entries of the summary balance-sheet table. This makes it possible to express all the items of the balance-sheet in relative values regarding the available labour and material resources (fixed funds).

Thus the subject (rows) of the summary table provides an analysis of the national economy inside the sphere of the material production, in the branches of the non-productive sphere, as well as the class structure of the population. The productive sphere is analysed in three aspects distinguishing: a) the main subdivisions of social production (production of means of production and production of means of consumption), b) the principal branches of production (industry, agriculture, construction, transport and communication, supply and trade), c) the main social sectors (state sector, collective-farm and cooperative sector, auxiliary and personal economies of collective farmers, workers and employees, economies of individual farmers and non-cooperated craftsmen). In the predicate (columns) of the summary table an analysis is made in the following aspects: 1) division of

social production into the implements of labour, objects of labour and means of consumption, 2) dissection of popular production into input of the previous labour and input of the live-labour (with the singling out of the value of the product remunerating the workers and the product for society), 3) determination of the final use of the national product (compensation fund, fund of accumulation and reserves), 4) redistribution of the national income and of the product for society, 5) circulation of the social product. Despite such complicated subdivisions, the table consists of 25 elementary tables (quadrangles): this is a result of the subdivision of the subject and predicate of the table into five sections each.

In Soviet literature the methodology of compiling balance-sheet of the national economy is given in general works on economic statistics.

* * *

Examples of balance-sheet tables as they are compiled by Soviet, American, English and French economic statistics are given in the Appendices. A comparison shows the essential difference not only in the formal arrangement of the balance-sheet tables, but also in their contents.

The balance-sheet of the Soviet economy (Appendix 1) is based on the theory of reproduction of the social product according to its component elements in value form (provisions for the compensation of consumed elements of production, newly created value, and the value of the surplus product as a part of the newly created value) and in their physical form (implements of production, subjects of work, means of consumption). The analysis of the creation and growth of the social product, of its distribution and redistribution is the principal task pursued by the compution of the balance-sheets of the national economy of the U. S. S. R.

The essence of the balance-sheet of the American national economy (Appendix 2) is the analysis of the interdependence of industries in their mutual purchases and sales. The evaluation of the direct and indirect demand of one industry to another is the main task of the American balance-sheet tables. The distinguishing feature of this scheme is that no aggregating of the industries into larger economic groups is done. Industrial branches, construction, and agriculture do not constitute a special sphere of production of material values and the non-productive sphere is not singled out. Therefore I present the American table (see Appendix 2) a little differently than it was originally published. I tried to single out the larger subdivisions of the national economy by regrouping and summing up the rows and columns of the American table. The numbers of the rows and the columns of the original table are shown in brackets in the broader subdivisions grouped by me. From our point of view the principal deficiency of the American scheme is that it pays little attention to the distinguishing of the elements of the national income. In the "household" entry, for example, quite different economic categories are mixed: wages of workers, salaries of employees, capitalist profits, interest, rent and even depreciation allowances. In this table accumulation is also not clearly enough distinguished from consumption.

Of greater interest is the English table analysing the national economy (Appendix 3), which is distinctly divided into four quadrangles. But even in this table the third quadrangle (elements of the national income) and the second quadrangle (elements of the final consumption and accumulation) are insufficiently scrutinized. Soviet economists and statisticians think that the second and third quadrangles are of primary importance. One of the strongest sides of the English scheme is that it makes possible an analysis of the items of quadrangles II and III from the point of view of the branches which are examined in the first internal quadrangle (characterizing the interindustry flow of materials, fuels and services). As to the American table, the dominant, one might say, exclusive attention is paid to the first quadrangle while the second and the third quadrangles are vaguely subdivided; moreover, the rows and columns of these quadrangles often mix quite different economic categories.

In the French balance-sheet table (Appendix 4) the financial aspect of the structure of the national economy is predominant. This leads to an extremely detailed investigation of various mutual settlements, payments, and receipts.

* „Statistika" („Statistics") Moscow, Gostatizdat, 1956, P; pp. 452—453.

One of the merits of the French table is the special attention paid to the accounting of capital investments. But neither the French nor the Anglo-American tables subdivide the capital investments and the invested values into fixed and turnover funds of the productive sphere and separately of the non-productive sphere. Nor is there a clear differentiation between the means of production and the means of consumption. Changes in the national product are usually alienated from changes in the fixed funds.

The arrangements of the balance-tables which analyze the structure of the national economy renders it impossible to use the tables compiled by Western economists and statisticians for the analysis of such principal economic proportions as the relation between the sphere of production of means of production and the sphere of production of means of consumption, the quantitative relations between the provisions for the compensation of the consumed elements of production and the value of the necessary product (used for remunerating the value of the means of existence of the workers of the sphere of material production) as well as the value of the surplus product.

As a rule, the attention of Western economists and statisticians is entirely devoted to determining the coefficients that characterize the technical interrelations between individual branches of production as expressed in the direct and indirect demands of one economic branch to another; usually these demands pertain to services and to the objects of work (materials, fuels). This is, of course, an essential, but not the most important aspect of the analysis of the national economy. When calculating balances of the national economy it is more important to provide larger possibilities for social and economic analysis, singling out for this purpose the main subdivisions and taking into account the forms of property ownership and the class structure of the society.

While paying necessary attention to the interindustry relations coefficients based on the productive consumption characteristics (the first quadrangle of the Anglo-American tables), Soviet economists and statisticians rightly direct their attention to the study of the principal structural proportions of the national economy. Among them, for example, the proportions expressing the relations between the sphere of material production, the non-productive sphere and the

sphere of social consumption. Another example: the ratio between consumption and accumulation. Of great importance are the proportions which determine the organic structure of the outlay of social production, e. g., the ratio between the material outlays and the workers fund of wages in the sphere of the material production. Among the proportions of specific importance is the ratio between the surplus product (used to meet the social requirements and the needs of increasing the scale of reproduction) and the necessary product (consisting of the means of existence of the workers in the sphere of material production).

All these proportions are considered by the Soviet economists and statisticians not as constant, but as variables which change with the development of the productive forces of society.

Being a new and an intensively developing branch of economic statistics, the analysis of the structure of the national economy based on the balance-sheet method needs to be broadly and thoroughly discussed by the scientists of different countries, the more so because of the very serious differences existing now in the very approach to this complicated scientific problem.

Summary

1. The subject of economic statistics is the national economy as a whole and its structure. The balance-sheet method is its main method. Its main characteristic features are: a) the use of value characteristics; b) the widespread use of industrial and economic classifications; c) the use of double counting and duplex accounts of the elements of the balance-sheet; d) matrix arrangement of economic data; e) orthogonal balancing of economic indices and orthogonal matching of balance table parts (quadrangles). From an economic point of view the balance-sheet of the national economy is based on a numerical expression of the appropriate economic model. This model usually shows the basic structural subdivision of the national economy (into productive sphere, non-productive sphere and personal (individual) consumption) as well as the principal elements of the social product (provisions for the compensation of the consumed elements of production, newly created value subdivided into the value

created by work for oneself, and value created by work for society). Besides the value aspect of great importance is the examination of the physical forms of the social product (the production of the implements and the subjects of work and the production of means of consumption).

2. The theoretical foundation of the balance-sheet of the national economy is the theory of reproduction of the social product and the national income. For the first time the concept of simple reproduction of the social product was advanced by Quesnay in his famous „economic table" (1758—1766). In it the concept of surplus product as a part of the newly created value was also formulated. In 1863 and later in the second volume of his „Capital" K. Marx gave his own economic table by which he substituted the Quesnay table. K. Marx created a new scheme of reproduction based on a two-sided analysis of the national product and containing respectively a two-fold account of its elements: in physical and value form. K. Marx gave not only a table of simple reproduction but also of large-scale reproduction having divided the surplus product into accumulated and consumed parts. The scheme of large-scale reproduction was arranged by him in the form of economic matrix to characterize the elements and conditions of reproduction for the current and for subsequent production cycles. Analysing the scheme of large-scale reproduction in conditions of technical p ogress, V. I. Lenin elaborated the law of relatively greater growth in the production of means of production as compared with the production of means of consumption. K. Marx and V. I. Lenin also defined the laws regulating the structural interrelation between the elements of the national product in their physical and value forms.

3. An analysis of the structure of the national economy made in the 1923—1924 balance-sheet of the national economy of the U. S. S. R. (published in 1926) was the first experiment of this kind ever known in the world. This balance-sheet provided an account of the turnover of material values which characterizes the production and consumption of the most important goods according to economic branches and their turnover (circulation) in the non-productive sphere. In this investigation an attempt was also made to determine the functional cost of each economic branch. During the last 33 years the Central Statistical Office of the

U. S. S. R. annually compiles balance-sheets of the national economy which were based on the annual reports received from all enterprises and institutions of the country.

In Western countries a wide use of balance-sheet method began after the appearance of W. Leontief's work on the structure of American economy during 1919—1929. In this work he formulated a method of input-output analysis which is a variety of the balance-sheet method. Of special interest is the balance-sheet of the U. S. A. economy for 1947 drawn up by the Bureau of Labour Statistics and the balance sheet tables of the English national economy for 1947 and 1950. The French balance-sheet table compiled by the Institute of Economic Research of the Ministry of Finance is also worth of attention.

4. A comparative study of Soviet, American, English and French balance-sheet tables used for analysing the structure of the national economy shows that they differ essentially from one another not only in their formal statistical arrangement but also in their contents.

The Soviet balance-sheet tables strictly distinguish the productive, non-productiv and individual consumption spheres. The main task of working out a balance-sheet of the national economy of the U. S. S. R. is to reveal the creation and growth of the social product as well as its distribution and redistribution with special attention to the product for society. An analysis of the balance-sheet tables helps to determine the most important proportions of the U. S. S. R. national economy.

The American national balance-sheet concentrates its attention on the interdependence of industries in mutual purchases and sales. Its task is to determine the direct and indirect demands made by industrial branches to one another as to subjects of work and services. The English tables of national economy, which characterize the relations between economic branches from the standpoint of productive and personal consumption as well as from the standpoint of the elements of the national income, deserve serious attention. The French economic tables emphasize the financial aspect and therefore expecially single out mutual settlements, payments and receipts.

5. An analysis of the structure of the national economy on the basis of balance-sheet method is a new branch of sta-

tistical science. Therefore a discussion of its methodological foundations by the scientists of different countries is very important for the development of social sciences and especially of economic statistics. Such a discussion is especially important because at present there are serious differences in the approach to a scientific solution of the problem of analysing the structure of national economy.

INDEX METHOD THEORY AND PRACTICAL APPLICATION IN THE U. S. S. R.

by *T. V. Ryabushkin*

The main principles of index calculation were formulated in Soviet statistics about thirty years ago*. By that time extensive practical experience had been accumulated in calculating index numbers in various fields of economic activity. In the following years the sphere of index application was greatly broadened. In a brief report it is possible to dwell only on the most general questions of the theory of index numbers and on the most important features of the practical application of index numbers.

From the very beginning of its development Soviet statistics rejected the formal mathematical approach to the problem of index numbers. It considers index numbers first of all as an economic characteristics. Thus, the problem of index numbers is a problem of measuring correctly the corresponding economic processes. The selection of the mathematical forms of index numbers of their weights, etc., is determined by the character of these processes. The diversity of economic phenomena naturally must lead to diffeent methods of measurement. Therefore it is wrong to raise the question of selecting an "ideal" index number which could be equally applied to different economic processes and pheno-

* This is chiefly due to the works of prof. Starovsky. See the chapter "Index numbers" written by him for the course: "The Theory of Mathematical Statistics", M. 1930. The rôle of index methods of economic and statistical analysis was elucidated by academician V. S. Nemchinov in his course: "Agricultural Statistics with Foundations of the General Theory", M. 1945 (Section: "Index Method of Analysis").

mena. Often it is impossible to express all the distinguishing features even of a single economic process through one index number. In such cases it is necessary to create a system of index numbers which would allow, to a certain degree, to avoid a narrow and over simplified study of these distinguishing features. Moreover, the interdependence of index numbers within this system reflects the existing mutual dependence between the economic phenomena they measure. Considering index numbers as a certain average quantitative characteristics of the changes taking place in the phenomena, it is not difficult to see the index method as a further development of the method of averages in general *. It is not accidental that the same principle underlie both the selection of the kind of averages corresponding with the character of the totality of the phenomena under examination and selections of the kind of index number.

As distinct to usual averages which express the levels of the phenomena in a totality of elements homogeneous by their natural form, an index number characterizes changes in the level of the phenomena in a totality of elements heterogeneous by their natural form but having an economic unity (for example, a totality of goods differing by their use-value). This involves the problem of comparative measurement of these heterogeneous elements (or the problem of „weighting"); the solution of this problem again can be attained with the help of economic criteria**. Thus, in its general form any index number can be envisaged as a ratio of two or more characteristics, each of which in turn can be the function of two or more variables corresponding to definite economic factors equally related with each other. The comparative measurement of heterogeneous elements of a totality gives us the magnitude of a definite economic characteristics (although sometimes conditional). In such cases the methods of constructing index numbers are practically reduced to determining the influence exerted by the factor which is of interest

* The interdependence between the notions of index and averages is described in my work „Averages in Statistics" M. 1954.

** As a rule, Soviet statistics weights index numbers of qualitative characteristics (prices, cost price, labour productivity, etc. on the basis of quantitative (volume) characteristics of a current period and vice versa. But this rule cannot be considered as a universal formal requirement. It cannot be applied if it is not supported by the corresponding economic criteria.

to us (e. g., price changes) on the summary economic characteristics. Assuming that the other factors are invariable, it is not difficult to find the magnitude of this influence. Thus, comparing the total value of the volume of goods in the current period with the value of the same volume of goods at prices of the base period, we obtain a price index number. In this ratio one of the economic characteristics is the value actually observed by statistics (value of the mass of goods in the current period), while the second one is a conditional value. But this conditionality does not mean arbitrariness. The second economic characteristics reflects real processes as is evident from the fact that, comparing with it the first one, we obtain a measure of the economic effect of the change of prices on the national economy (e. g., estimation of the gain the population receives from price reduction) *.

After this brief theoretical discourse, the differences in approach to the theory and practice of index numbers in Soviet statistics and in the statistics of the U. S. A. and of most Western European countries will be clearer. Outwardly these differences express themselves, for instance, in the preference towards aggregative index and complete covering of the totality under examination or preference towards average forms and representative selections of products. But these outward differences reflect differences in the very approach to index numbers and also differences in certain features of the organization of statistical observation. As is evident from what has been said, Soviet statistics base the index method on the economic foundation of the methods of measurement. This foundation can be directly realized most easily in the aggregative index form. After this has been done the question of other index forms can be settled by means of comparing them with the aggregative index.

In principle no objections can arise against using a selections of goods (or any other selection) for obtaining index numbers as a variety of the statistical application of the sampling

* Thus, the old Paasche formula finds a strict economic foundations. It is characteristic that the theory of averages leads to the same results. Taking the value of goods in the current period $\Sigma p_0 q_1$ as a characteristic of the kind of average in the equation of average $\Sigma p_1 q_1 = \Sigma \overline{i} p o q_1$, (a later substituting $p_1 = i p_0$) we obtain the initial formula for a price index numbers $I = \frac{\Sigma p_1 q_1}{\Sigma p_0 q_1}$.

method. But in this case again it is necessary to be sure, that the index number based on a sample of goods, gives results which are close enough to the index covering the whole totality of goods. The use of the geometric mean, e. g., for calculating a price index number is objected by our literature in principle. Has the geometrical index any economic meaning? In most cases this question can be answered only negatively. Studying the changes, in prices statistics deal with a tontality, with a mass of goods. It is natural that the characteristics of separate goods can be aggregated immediately (their cost) or after weighting (prices). All this is reflected in the aggregative index. Multiplication of separate index numbers is meaningless, for it does not reflect any property or specific features of the price formation processes.

The aggregative index considered above is based on an invariable structure of the totality in question. Therefore it cannot directly reflect structural changes, e. g., changes in the goods structure of the retail turnover (sales). Therefore in cases when, despite the heterogeneity of the elements of a totality, it is possible to calculate the mean level of a characteristics, statistics widely use the method of comparing averages to characterize the dynamics. In these cases the changes in composition (structure) of the totalities will be automatically reflected by index numbers *.

General theoretical notes on the index method facilitate the understanding of the specific features of calculating index numbers of different economic characteristics. Let us dwell first of all on the price index which gives a good illustration of the specific features of the techniques used by Soviet statistics.

In capitalist countries a classic and most wide-spread kind of price index is the index of wholesale prices. On the contrary in the U. S. S. R. the most important is the index of retail prices. This difference can be explained by the fact that in

* A rather detailed study of these in prielple different kinds of index numbers was made by prof. Savinsky particularly in his course: „Industrial Statistics" (the latest edition issued in 1954). He also introduced the most widely used terms for designating these forms. Prof. Savinsky designates usual indices as indices of fixed composition and the ratio of mean levels as indices of variable composition. A classic example of the latter are the indices of labour productivity determined by calculating the ratio between product cost and the number of workers taken for different periods of time.

capitalist countries index numbers are of extreme importance in studying conjunctural changes. Moreover wholesale price indexes can be used in calculating the dynamics of the national income, etc.

In the Soviet economy, wholesale prices change according to plans and, as a rule, by separate stages, not extending at once to the whole volume of goods. The calculations of summary characteristics in view of this are based on somewhat different principles. Everyday registration of the fluctuations is of no great significance. Moreover these changes are systematically taken into consideration by the cost price index numbers of industrial production.

The index numbers of retail prices, on the contrary, play an extremely important role in registering the changes in the living standards of the working population. In this case the initial index form is the aggregative index with current weights (the Paasche formula), which directly take into consideration the economic consequences of price changes. But the practical use of this index form encounters rather serious obstacles first and foremost in the sphere of state and cooperative trade which makes up about 90 per cent of the whole retail turnover (sales). The point is that primary accounting in trading is based on a cost and not a quantitative principle. True, for a number of large-scale and more homogeneous goods there exist quantitative measures, but on the other hand in many other cases (especially when the assortment of goods is complicated), various trading organisations can give only summary price characteristics of the circulation of a definite group of goods. It might be possible to manage with such list of goods for which quantitative data are available, but Soviet statistics, as was mentioned above, tries as far as possible to cover by an index number the whole totality of goods.

In these conditions instead of an aggregative index form a harmonic index with current weights is selected ($I = \frac{\Sigma p_1 q_1}{\Sigma^1/_{ip_1 q_1}}$), which algebraically is identical with the Paasche formula and has precisely the same economic meaning. The index numbers express changes of prices set by the State. In many cases for all goods of a given group there is one index number (for example, the same percentage of price reduction). This makes the use of harmonic index forms is very convenient.

If the price reduction is planned for one or several goods of a given group and does not spread on the rest, then of course it is necessary to make special calculations to determine beforehand the group index; these calculations will be based on direct or indirect data as to the specific weights of the goods in the retail trade. In some cases, when no predetermined group index is available and the composition of the group is sufficiently homogeneous from the economic point of view, it is necessary to resort to goods-representatives the reduction of prices on these goods being an approximate characteristics of the group index. It is necessary to bear in mind that in economic calculations public catering, as a rule, is included in the volume of retail goods turnover.

The statistics of trade at collective-farm markets are quite different. They are obliged to use a method of selection instead of overall accounting. For these statistics it is easier to calculate the amount of goods sold than their cost. It is clear that in this case the set of goods serves as the initial base for index number calculation, while prices are determined by registering the fluctuations of prices at the collective-farm market during a fixed day.

Index numbers calculated according to the described method give a sufficiently clear idea of the change of prices of the whole mass of goods sold and therefore can serve as one of the general characteristics for the change in the standard of living of the whole population. The sources of data and the calculation techniques are modified when the living standards of different groups of the population are studied. These standards are characterized through the measurement of real wages or real incomes.

The characteristics of real wages to which our statiestics in the recent years attach special importance bordery with the problems of price indexes. Within this paper it is impossible to consider in detail the contents of the very notion of real wages. But it is clear that here also the specific features of the measurement problem will vary in accordance with the different objects of measurement. From the very beginning it is nesessary to say that the notion of real wages is not identic with the standard of living, although it is the most essential factor determining this standard. The practice and theory of Soviet statistics deal with two versions of the characteristics of real wages in a wide and narrow meaning of the word.

The first version is based on the volume of nominal wages calculated per one worker *. The second version takes into consideration the whole mass of material wealth and services which on a large scale the workers and employees receive free of charge or at low rates from trade union organizations and state institutions (free of charge medical assistance, free education, etc.). But in this case the taxes and duties paid by the workers and employees from their wages are deducted from the fund of nominal wages. Usually real wages in the broader sense include incomes received from kitchen-gardens, livestock on a personal farmstead, etc. All this forms a basis for the calculation of real incomes in which real wages, in the narrow sense of the word, are an essential but not the only element. The fund of nominal wages comprises all forms of remuneration for the labour of workers and employees including bonuses and money for annual leaves.

Next the price indices are taken into account in determining the dynamics of real wages. In this case the general index of retail prices mentioned above is not quite applicable because it relates to the mass of goods bought by the whole population and not only by workers and employees. Thus it becomes necessary to resort to the calculation of a price index which takes into account the structure of the consumption by separate population groups in accordance with budgetary data. The general price index is determined not by directly weighting the indices of commodity groups to find out their share in the budgets of the population, but by directly determing the volume of goods (in comparable prices) which constitutes the share of the workers and employees from the general volume of turnover. A great role in these calculation is played by the balance-sheets of money incomes and expenditures of the population. These balance-sheets are compiled not only for the total population but also separately for workers, employees and collective farmers. Then on the basis of comparable prices the volume of services rendered to

* Like in all other cases Soviet statistics proceeds here from the overall mass of elements of a totality examined, thus rejecting calculations of real wages on the basis of the rate of tariff, incomes of an artificial "average" family, etc. The details of real wages index calculation are described in M. Eidelman's article: "Methods of Real wages Index Calculation" in the journal "Viestnik Statistiki" No3, 1956.

the workers and employees is determined. Hereafter it is not difficult to obtain a general price index for the goods and services by comparing the volumes of their consumption in the base and current years. At present the task facing statistics is to improve further this index, giving special attention to its differentiation according to different groups of workers and employees.

In the practice of planning and accounting in the U. S. S. R wide-spread use is made of the index numbers of output cost prices (first and foremost of industrial output). Their construction is based generally on the same principles as the price indices. The economic meaning of these index numbers is that they express the results of the economic activities of enterprises or construction works by means of comparing actual expenditures on the production of goods with normative expeditures. Since accounting inside enterprises always makes possible the determination directly or indirectly of cost price per unit of a given product, the calculation of the cost price index is effected directly through aggregating, namely $I = \frac{\Sigma z_1 q_1}{\Sigma z_0 q_1}$ where z represents the cost price of a unit in the basis and current periods. Saving or over-expenditure by the enterprise is easily calculated with the help of this index. Nevertheless the compution of this index number for a more or less lengthy period of time encounters: serious obstacles in view of a rapid growth in industrial production and a change in the list of items produced. The cost price index differs from that of retail prices in that it is always calculated according to a strictly determined output assortment. The commodity composition of the entire retail turnover is rather stable. The changes in it must be practically taken into consideration only when comparing very long periods of time (we do not touch here the questions of changes in grading and quality of goods, etc.). On the contrary, the commodity composition of this or that industrial branch changes rapidly and rather considerably (except extractive and food industry). As an example we may point to the fact that in mechanical engineering the specific weight of comparable production is usually equal to about 50 to 50%, and in some branches falls to 25 to 30%. Owing to this, the cost price index number and other economic characteristics related to the whole list of produced items become incomparable.

As a rule, cost price index numbers are determined for two adjacent calendary years. At the same time the national economic plan determines the reduction of cost prices that should take place during a five-year period. A direct comparison between the initial and final period, if the list of items produced has changed greatly may lend, in a number of cases to erroneous conclusions. Multiplication of chain indices does not give better results. The idea is put forward of using other characteristics for the measurement of reductions in cost prices. In particular, economists and statisticians are experimenting with the ratio of cost prices in the gross or in the salable (cash) output. A change in this ratio might to a certain extent be a possible characteristics. Essentially this index number is a variety of the indices with variable composition. It is free from a close dependence on a permanent list of items produced. But this "freedom" is bought at a very expensive price. Now the change of index number is influenced not only by the cost of production level but also by the changes in the output structure and even in the ratio between the output cost elements. In this case the question of a system of output evaluation is also complicated.

Specific problems arise in calculating the index number of physical volume of output, the most wide-spread form of which is the index of industrial production. In the U. S. A. and Western Europe preference is given to the mean arithmetical form of this index calculated for a set of products according to the formula $I = \Sigma id$ (where d — is the specific weight of products in industrial production; the methods of determining this weight may be different).

In this case also Soviet statistics take as a basis the ratio between comparable characteristics of the volume of the whole production in the base and current years; algebraicaly the ratio is $I = \frac{\Sigma p_0 q_1}{\Sigma p_0 q_0}$. Although both cited formulas are algebraically identical, they express a difference in approach to the problem on index numbers. In the first case the index number is a certain mean characteristics of the dynamics of production in a selection totality which is then extended to the general totality. In the second case we deal with an accurate determination of the change in the whole mass of production in a given economic branch and in the whole natio-

nal economy. A certain base price (P_0) is not the only possible common measure of production.

Theoretically a more convenient measure would be the base expenditures of labour per unit of production (t). But practical difficulties with the all round determination of these expenditures deprive us of the possibility of calculating index numbers in this form. None the less it is indisputable that this is the method of the future.

The construction of the index of industrial production in the U. S. S. R. is specific in that the index number is computed directly by summing up the data included in the accounts of the enterprises. Each industrial enterprise in the U. S. S. R. always evaluates its production both in current and base prices because the planned total volume of industrial production is determined in base prices. Thus the problem of selection of products, weighting, etc., does not exist for our state statistics. In these circumstances an important methodological question is that of changing the list of items and of selecting the base price. During almost twenty five years the base prices for enterprises and state statistics were the prices of 1926-27. In their time they played a large positive role in strengthening the planned economy and in making numerous summary calculations. But as the list of items of production changed and the industry produced still larger and larger quantities of new products which had not been manufactured in 1926, the drawbacks of the system of evaluating in said prices manifested itself more and more clearly. For the new products (especially in mechanical engineering) it was necessary to take either the prices of the first year of their large-scale production or some calculated prices. Later on new prices were adopted for measuring the dynamics of production at first those of 1951 and then of 1956.

Our index numbers were criticized by some foreign economists and statisticians. Indices based on a set of products were put forward as a contrast. It is impossible to recognize this criticism as convincing, the more so that many of its arguments were based on misunderstandings. In this case the contrasting of index numbers covering the whole totality of products and index numbers based on a set of products is meaning less. Index numbers for raw materials and generally for large-scale homogeneous goods in conditions of rapid

industrial growth and variations of the lists of produced items cannot be recognized as sufficiently representative for the whole mass of industrial production. The use of different methods for registering the dynamics of the output of new industrial branches and new kinds of products is inevitable. The most suitable is the method of overall evaluation of the whole production in comparable prices, providing the latter are changed in view of changes in the price formation process.

The index numbers of physical volume of agricultural production are constructed according to the principles stated above. Only in this case it is calculated directly by the Central Statistical Office because agricultural enterprises do not make a double evaluation of their production. The considerably smaller list of items of agricultural production as compared with industrial makes it possible to centralize the evaluation of the whole mass of agricultural output in comparable prices.

The index numbers of physical volume of the national income which is considered by Soviet statistics as the net product created in the branches of material production is also calculated on the basis of evaluating the whole mass of national income in comparable prices. This is done by subtracting from the aggregate product of industry and agriculture and of some other economic branches the material expenditures in these branches (also in comparable prices). Here it is necessary to resort to many additional calculations and valuations, because the volum of material expenditures in comparable prices is not determined by the enterprises. Within this paper it is impossible and unnecessary to dwell in details on these calculations. The index of physical volume of turnover (sales) is determined by dividing the value of the mass of commodities by the price index. The present-day organization of the statistics of goods turnover in the state and cooperative trade does not give the possiblity of direct measurement in comparable prices.

Many interesting questions pose themselves in the analysis of the dynamics of labour productivity. Some of them still remain without a satisfactory solution. The difficulties connected with this analysis are partially due to the fact that it is not always possible to find an adequate statistical interpretation for the economic category of labour productivity. In its general form the level of labour productivity is

known to be a ratio between the volume of production and labour expenditure (i. e., $\frac{\Sigma V}{\Sigma T}$). The different contents given to the numerator and denominator of this formula gave birth to numerous characteristics of labour productivity. First of all the question arises whether it is necessary to calculate productivity only on the basis of current labour expenditures (expressed, for example, in man-days or man-hours) or is it also necessary to take into consideration past labour expenditures embodied in the product. The most energetic champion of the latter standpoint is academician Strumilin who thinks it possible to measure these labour expenditures at least by summing the ratio between the costs of the used materials, etc., and the average level of wages with the ratio between the product for society and the level of wages. The majority of Soviet economists and statisticians however consider that the notion of labour productivity is applicable only to living labour.

Till recently characteristics of labour productivity were computed by Soviet industrial statistics only for industrial workers. At the scientific conference held in December 1956 by the U. S. S. R. Academy of Sciences, the Central Statistical Office and the Ministry of Higher Education to discuss problems of labour productivity the question was raised of calculating additional index numbers having in view two versions: a) calculation of labour productivity for the whole body of workers, engineers and technicians and b) calculation of labour productivity for the whole personnel of workers and employees engaged in industry.

The production index (in price measurement) applied to the dynamics of labour productivity can be represented at least in three versions: a) in the form of gross output, b) commodity output and c) net output. The use of index numbers of net output for measuring labour productivity was widely discussed at the above mentioned conference. Strong objections were made against it. The use of this index numbers cannot be considered rational even from a theoretical standpoint. Labour productivity is expressed not so much in the newly created value as in the ever increasing amount of past labour embodied and transferred to the product. Thus the index number of labour productivity measured on the basis of net output will give a narrow characteristics of the changes

in production processes broungt about by technical progress. Moreover it will be alienated from the characteristics of the volume of production.

Of course in some cases the influence of price components comprising or determining the index number of gross output may give an erroneous idea of labour productivity. Theoretically it has long been proven that the best kind of index number for labour productivity is the one which is determined by calculating labour expenditures in the created product * and therefore can easily be coordinated with the index of production also expressed through these expenditures. Because of difficulties in accounting it is practically useless to talk about any universal utilization of this index number form. Thus with all their drawbacks the value characteristics and primarily those of gross output remain the main characteristics of labour productivity. This is so because it is impossible on the scale of the national economy or of separate economic branches and in many cases even on the scale of a separate enterprise to calculate any other summary index number which could characterize the changes taking place in labour productivity as fully as the price index. At the same time the need is evident in calculating a number of corrective coefficients for the index of gross output.

From the algebraic expressions for the index of labour productivity based on gross output $I = \frac{\Sigma p_1 q_1}{\Sigma t_1} ; \frac{\Sigma p_0 q_0}{\Sigma t_0}$ it is evident that all changes in the output structure effect its size. Hence the purpose of correction coefficients for this index number is to eliminate the influence of the structure on the level of labour productivity. This is especially important for construction works in which the dynamics of output themselves are expressed in estimated prices. Thus the dynamics and consequently the level of labour productivty is influenced by regional differences in the prices themselves as well as by differences in the structure and character of the construction work.

One of the other methods of calculating index numbers of labour productivity (which was checked in practice) is the method proposed at one time by academician Strumilin,

* I. e., the formula $I = \frac{\Sigma t_0 q_1}{\Sigma t_1 q_1}$ where t is the expenditure per unit of roduct in the reference and current years.

According to his proposal, the general index number for an economic branch was calculated by weighting the indices of enterprises on the basis of their labour input or the number of workers. This method does not eliminate the influence of structural changes inside the enterprises themselves, but it eliminates the influence of changes in the structure of the entire economic branch.

Of the recent works devoted to the investigation of index forms the book written by prof. Lukomsky should be noted. The essense of his investigations is as follows. The weighting of particular index numbers according to the number of workers does not always properly characterize the dynamics of the level of labour productivity because of random fluctuations in the number of workers can effect the general index number. In order to eliminate these random fluctuations Lukomsky offers to weight particular indices by the average harmonic number of workers during the base and current periods *. Although the problem of eliminating the influence of random fluctuations on the level of the economic index numbers deserves serious attention, the method of solving it proposed by prof. Lukomsky evokes serious objections because the index number calculated in this way is allienated from other economic characteristics (first of all from the change in the volume of production). The problem deserves further specification and development.

Even a very brief survey of the methods of constructing some index numbers shows convincingly the importance of the problem of interdependence between index numbers for indexology and, on the whole, for economic statistics. Any attempt to analyse a totality of social phenomena or even a separate phenomenon more profoundly will bring the investigator to the conclusion that the application of quantitative characteristics is very difficult. The extreme complexity of social and economic phenomena, the diverse connections and relations between the phenomena means that a separately taken index number cannot give any complete characteristics of the whole rich contents of these phenomena. Thus from the very beginning the idea of finding a universal index number which could be suitable at all times and places must

* J. Lukomsky. "The application of the theory of large numbers to the calculation of index numbers". Uchenye zapiski po statistike, v. 1, M., 1955.

be abandoned. Each separate characteristics reflects only one aspect of the phenomena or its interrelations. Only a system of index numbers and characteristics makes it possible to study the development of a phenomena. Let us illustrate this statement taking as an example the index numbers of labour productivity. On the initial basis of the annual or monthly output per worker engaged in a given economic branch, we can obtain only a very general and rough idea of the change in labour productivity to say nothing of the fact that these general characteristics do not allow us to make any conclusions concerning the factors determining the change in productivity. Only a series of index numbers showing the dynamics of monthly, daily and hourly output as well as the output of different categories of the personnel engaged, etc. will give a certain idea of the influence exerted on labour productivity by the structure of working power and by the utilization of the working day. At the same time the price index numbers must be corrected by taking into account the output of the most important manufactured goods, etc.

On the scale of an economic branch or of the national economy as a whole the interdependence of index numbers is of still greater significance. The economic processes and the intensity of their development probably can be shown only in a thoroughly thought over system of interdependent index numbers. This does not mean that each index should meet the same formal requirements similar to the famous I Fisher tests. The interdependence of indices must express the existing economic relation between the phenomena and between economic branches. This interdependence makes it possible to measure the factors which determine the development of this or that phenomenon. Indeed the volume of industrial production is determined as a function of labour productivity and the input of working time (or, in the first rough approximation to the latter, by the number of workers). Hence it is natural that the methods of constructing index numbers of output and index numbers of labour productivity must be eligible for mutual coordination. In this case the changes in the input of working time plays the role of a link in the system of indices. The changes are also charaterized by economic indices but more simple ones in their structure since they deal with a comparison of two homogeneous magnitudes: the sums of working time. An analogous role is played

by the dynamics of retail turnover in the interdependence between the price index and the index of the physical volume of goods circulation. Although algebraically all these interdependencies are characterized by the fact that the multiplication of two indices gives the third one, their essence is, of course, different—the construction of the index numbers is based on a single methodological economic principle. Moreover this single economic principle is expressed in the diversity of the methods of calculation and in the algebraic index forms. Hence it is not difficult to understand the negative attitude existing in Soviet statistics towards the concept of index numbers as a formal mathematical entity which has no economic foundation.

In conclusion we shall briefly describe how Soviet statistics study the influence of various factors with the aid of index numbers. This implies the measurement of the influence exerted by each of the interdependent factors on the aggregate economic characteristics. Essentially this is one of the aspects of the problem of index interdependence. When all the characteristics of a system of index numbers are expressed in the same units of measurement (as in the calculation of labour productivity with the aid of labour expenditure per product unit), the problem can be solved easily. But considerable difficulties arise when we analyze a system of heterogeneous indices. The task is to give to practical workers the most simple means of calculating the influence of separate factors on the final result of productions or other economic activities. A typical example of this task is the determination of output increment, taking place on the one hand because of the growth of labour productivity and on the other because of the working time input. Practically hitherto the respective values are calculated by means of multipling the increment of the one factor by the other, e.g., the increment in the number of workers by the current characteristics of labour productivity. In this way an increment of output due to the growth in the number of workers is obtained, the rest of the increment is ascribed to the second factor: productivity of labour. But it was pointed out that this method is too rough and gives different results depending on the factor from which the calculation is to begin. Moreover it does not take into account the results of the joint influence of both factors. Various methods of

specifying the character of output distribution between both factors were offered. Some of them are analogous to the methods described in foreign literature. Thus, for example, some economists and statisticians consider that sufficiently accurate is the method of multiplying the increment of one factor by the average of the other within periods of time under study *.

But in essence this method is a purely formal solution of the problem based on a number of conditions. Therefore prof. Pisariev considers that generally we should abstain from disintegrating the absolute total of the increment into factors and confine ourselves only to expressing the interdependence by multiplying the appropriate indices**. All these questions were recently discussed at various statistical and methodological conferences and in press columns. The results of the discussion show that despite certain conditionalities of the method used in practical work, it remains more satisfactory than all kinds of correction methods, because it is based on definite economic considerations. The problem consists only in finding an economically correct index numbers. Thus, in the above mentioned example of labour productivity the initial characteristic is certainly the number of workers in the current period. This characteristic is independent of the others. On the other hand in determining the level of labour productivity in a given period it is necessary to take into consideration this number of workers. An ascribtion of the additional interdependent increment of production to the total number of workers is economically correct because the new level of productivity is attained by the whole mass of workers but not by any conditional "old" part of it. The truth of this consideration becomes clear when distant periods are compared.

Analogous reasoning can be cited for disintegrating the increment of real wages expressed in comparable prices.

* To this is devoted, for example, the article by S. Yugenburg "Disintegration of Absolute Increments according to Factors". Uchenye zapisky po statistike, t. I if $Z = xy$, then $\Delta Z = \Delta x y_0 + \Delta y x_0 + \Delta x \Delta y$. The advocates of the first method mentioned in the text add the last items expressing a joint and simultaneous effect of two factors to the influence of one of the two factors. The advocates of the second method distribute this additional item equally between the two factors.

** His consideration were published in the journal "Voprosy Ekonomiki", No6, 1956.

This increment can be considered as a function of nominal wages and of the purchasing power of the rouble. In this case the index of nominal wages is initial, for it is independent of other components and is the actual sum of money in the possesion of the workers and employees. In contradistinction to this the index of purchasing power always contains element of certain conditionality.

The problem of interdependence of index numbers is also connected with the question of measuring the influence of the structure of the total on the index number. This influence cannot be determined directly. The majority of economists and statisticians think that this can be done by means of comparing the results of the calculation of two above mentioned indices with variable and fixed composition. Thus, for example, the index of labour productivity of fixed composition calculated according to the norms of time is expressed by the formula $I = \frac{\Sigma t_0 q_1}{\Sigma t_1 q_1}$, while the index of variable composition is $\frac{\Sigma t_0 q_0}{Q_0} : \frac{\Sigma t_1 q_1}{Q_1}$. In order to make the comparison of these two indices more evident, the first one can be represented in the following form: $\Sigma \frac{t_0 q_1}{Q_1} : \frac{\Sigma t_1 q_1}{Q_1}$. From a comparison of these two forms it is evident that in the first case a change in the structure of the output does not exert any influence on the index number, and in the second case it directly influences it. A ratio between these two indices shows the magnitude of the influence of structural changes on the dynamics of labour productivity.

A detailed study of this question carried out by V. Peregudov shows however that such a general coefficient is not enough for the analysis of the influence exerted by the structure *.

The structural factors themselves may be of different orders. A change in the composition of gross output even independently of price factors affects the productivity of labour. The dynamics of labour productivity is also influenced by the redistribution of the volume of production between enterprises and economic branches as well as by the distribution of labour between separate enterprises and branches with different levels of labour productivity and by the fluctuations in this distribution. As for the changes in output composition, or the list of items ptoduced prof. Savinsky an outstanding specialist in the field of industrial statistics, thinks that the most correct method of characterizing them is the comparison of indices which were weighted firstly according to the weights of the current period and secondly according to the weight of the base period *.

Thus it becomes evident that only a series of various indices can properly reflect the mutual interlacing effects of various factors. Peregudov, for example, asserts that the index of labour productivity with fixed composition weighted according to the gross output of the base period will be more fitting than the usual index in characterising labour redistribution between economic branches. He also tried to prove that the index of structural changes is an independent type of indices, thus rejecting its interpretation as a ratio of two indices. A further study of this question seems necessary to us.

Summary

The present paper deals with the general questions of index theory and their treatment by Soviet statistics as well as with the main features of the practical application of index numbers in the U. S. S. R. Soviet statistics considers the problem of index numbers as one of measuring correctly the corresponding economic processes. The choice of mathematical form of index numbers, of their weights, etc., is determined by the character of these processes. The diversity of economic phenomena naturally must lead to different methods of measurement. In many cases it is impossible to express

* The result of this study can be found in his article "To the Question of the Theory of Index Method". Uchenye Zapisky po Statistike, t. I. The criticism of his statements is given by I. Malyim in the journal "Vlestnik Statistiki", 1956, No6.

* See in particular his article "The Influence of Assortment Changes on the Cost Price Index". Vlestnic Statistiki», No3, 1956.
Conformably to the aggregative index of labour productivity the requirements mentioned in the text mean a comparison of the following two indices $\frac{\Sigma t_0 q_1}{\Sigma t_1 q_1}$ and $\frac{\Sigma t_0 q_0}{\Sigma t_1 q_0}$. Their respective average indices are $\frac{\Sigma IT}{\Sigma T}$ and $\frac{\Sigma T_0}{\Sigma \frac{1}{I} T_0}$ where $T_0 = t_0 q_0$, while $T_1 = t_1 q_1$.

all the distinguishing features of a given economic process through an index number, then it is necessary to create a system of index numbers which would allow, to a certain degree, to avoid a narrow and over-simplified study of these distinguishing features. The interdependence of index numbers within such a system reflects the existing mutual dependence between the economic phenomena they measure.

The paper sets forth some of the principal distinctions in the approach to the problem of index numbers in the U. S. S. R. on the one hand and in the U. S. A. and some Western European countries on the other. As is shown by several index numbers the task of determining the economic effect of this or that economic process determines the selection of a suitable set of index numbers. It is not accidental that Soviet statistics prefers aggregate index number which make possible a direct economic grounding of the methods of measurement.

The paper gives brief characteristics of the methods of calculating index numbers of retail prices, real wages, volume of production, cost prices, and labour productivity.

The author tried to elucidate the most important actual problems which everyday life puts before index number statistics. The most difficult problems arise in connection with the creation of index numbers of cost prices and labour productivity. Many years of calculating index numbers have shown that cost price aggregative index numbers determined by comparing actual expenditures on output with normative expenditures (according to the norms of the base period) although they answer the general theoretical requirements still are of small effect in conditions of rapid and essential changes in the list of items produced (this change taking place first and foremost in mechanical engineering). At present Soviet statisticians are discussing the possibility of using other index numbers in such cases, for example, those of expenditure per one rouble of commodity output.

In measuring labour productivity the most rational index number form is the comparison between normative and current expenditure per given output volume. But in this case difficulties in comprehensive accounting of labour expenditure in each kind and variety of products rather than the change in the list of items necessitate the calculation of index numbers on the basis of price characteristics. The specific

structure of these index numbers as well as the characteristic features of price formation leave a deep impression on the movement of the characteristics of labour productivity. In the author's opinion, however, the problem can be solved not by searching for a universal and „ideal" index number but by creating a system of index numbers, and specifically, by using separate index numbers to correct the conclusions drown from the general price characteristics of labour productivity.

The paper also touches upon some controversial problems, for instance, the taking into account of past embodied labour and the use of added value characteristics when measuring the dynamics of labour productivity.

As to the problem of determining the influence of different factors on the increment of a given economic characteristic, the author also prefers to proceed from economic criteria rather than search for a formal mathematical way of solving this problem.

The paper is concluded by a consideration of the question of measuring the influence of the structure of the total on th level of the index number. In this case also the conclusion can be drawn, this influence can be correctly reflected only by series of different characteristics since these latter can be disintegrated into a number of components which correspond to the effect of different factors. In this case the use of different weighting systems may be recognized rational.

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POPULATION CENSUS METHODS IN THE U.S.S.R.

by *M. V. Ptukha*

Historic documents show that local enumerations of the population were carried out in Russia already in the 11th — 12th centuries. In 1255—1257 and 1273 the Tatars organized crude per capita enumerations of the population, excluding the clergy. In 1646, 1678 and 1710 cadastral censustaking was carried out throughout the country. In 1710 all men and women (including the nobility) were taken into account and this census may be considered as the first attempt of registering the entire population of the country. With the introduction of capitation, tax the tax-paying population of the country was enumerated ten times, in accordance with the decrees of 1718, 1742, 1761, 1781, 1794, 1811, 1815, 1833, 1850 and 1856. Capitation tax was not paid by the privileged groups of the population who were therefore exempt from the census. The tax was levied only on men, regardless of age. Women belonging to the tax-paying groups were not registered in the first, second and sixth census-takings. Age was recorded in every census.

In the middle of the 19th century the movement in favour of a general census of the population gained momentum in Russia. In 1874 the Director of the Central Statistical Committee P. P. Semyonov who later became honorary member of the International Statistical Institute, drew up the draft for the census. Before the revolution the only general census to be carried out was the census of February 9 (new style), 1897. It was prepared under the guidance of P. P. Semyonov who sought to plan and organize the census so as to take into account the experience accumulated in other

countries, as well as the specific conditions in Russia. Oral questioning of the population was introduced, and the secondary occupations were also registered. The processing of the obtained data was not satisfactory and this affected unfavourably the quality of the materials which were later published. Before the war of 1914 preparations for a second census were started, and draft-schedule was worked out. The program of this census was more detailed than that of 1897.

Population censuses reflect the general as well as the specific conditions of the country in which they are taken. Under Socialism the law of planned balanced development of the national economy necessitates the introduction of economic planning. The law of Socialist society consists in the maxium satisfaction of the constantly rising requirements of its members. Therefore the establishment of the number and composition of population in the U. S. S. R., and of its distribution is of particular interest in planning the national economy and culture, in controlling the implementation of plans, in determining the reserves of productive forces, in studying the requirements of various population groups, etc. Labour statistics, data on villagers obtainable from village Soviets, elector's lists, etc., are sufficient to satisfy the current requirements for statistical data concerning the number and composition of different groups of the population. Yet they cannot give any precise information on the size of the country total population and its distribution according to social, economic and other characteristics. The needs of planning require detailed information of the number and composition of the future population according to sex, age, etc. A deep study of the processes of the reproduction of the population requires a large amount of data on the number and composition of the population. These requirements can only be satisfied by means of a general census.

In the U. S. S. R. there were three general censuses and two more censuses of urban population (in 1923 and in 1931). During the first years of the Soviet State the tasks facing the Goverment called for information on the condition of the national economy considerably shattered by the war. The planning of the national economy and culture of the young Soviet Republic also required initial statistical data. On the initiative of V. I. Lenin a census of the population, an

agricultural census and a registration of industrial plants were conducted on August 28, 1920.

The data of the census of December 17, 1926 worked out on the basis of a comprehensive schedule, were used in devising a number of steps for the planning of national economy and culture and in the deep study of processes involved in the reproduction of the population.

The census taken on January 17, 1939 showed the changes in the number, distribution and composition of the population which had occured as a result of the first two five-year plans. Its data served as a basis for the further planning of national economy and culture in the U. S. S. R. as well as in the individual Republics and regions. In 1957 preparatory work was started for a general census to be taken in January 1959.

The establishment of the total number of the population and its distribution according to various characteristics is most accurately carried out by computing the actual (de facto) population. Under "actual population" we understand people who were present in a given inhabited locality at the critical moment of the census. The establishment of the number and composition of the permanent resident population is important for administrative requirements and for the rendering of special services to various categories of people. By "permanent residents" we usually mean people habitually living in the given locality, even if they should be absent from it at the critical moment of the census. The enumeration of registered or "de jure" residents is of limited importance in the U. S. S. R. Various categories of legal residents in the U. S. S. R. are listed and registered by different institutions in the process of their current work.

The general task of census-taking is to register all citizens without any omissions. Therefore the time when the census is taken is of considerable interest. Under the conditions prevailing in the U. S. S. R. the time most convenient for census-taking is that around January1, when no important migration is taking place. A census is not be taken on a holiday because on such days the population moves around more than on week days. The holidays of schoolchildren and studients must also be taken into account. In the U. S. S. R. the term "critical moment of a population census" indicates the exact hour of the census: in 1920 it was taken at 9 a. m.,

in 1926 and 1939 at midnight. In the schedule of the new census, the critical moment for the registration of the actual population has been fixed at zero hour January 15, 1959 (Thursday).

In the various instances of census-taking in our country the concepts of the population to be registered did not fully coincide. The shedule of the 1897 census included an attempt to collect data not only on the actual population, but also on permanent and registered residents, which led to a confusion of the two categories of residents. In the census of 1920 the actual population was enumerated and the permanent or temporary nature of residence was marked, the definition being made at the discretion of the person questioned. Data on temporary absentees were entered into "apartment cards" and "domicile house list". In the census of 1926 the temporary residents were marked in a "personal list". Permanently domiciled residents were enumerated only in towns and inhabited localities of the township type where "family cards" were used. The actual population proved to exceed the permanent one by two per cent. The main distinguishing feature of the 1939 census was that both actual and permanent resident population fell within its scope. The detailed instructions that had been worked out and the successful carrying out of the census determined the insignificance of the divergence in the registered types of population (0.06 per cent). The draft for the 1959 census provides for the registration of both actual and permanent resident population.

In the U. S. S. R. great attention is given to the organization of census-taking on which the degree of its accuracy depends. State statistics are concentrated in the Central Statistical Office and its branches. In 1939 offices were created for the preparation, enumeration and processing of the census. One office was on a national-wide scale, while the others were Republican, territorial, regional and some offices were created in the big cities. The preparation for the census and the actual census-taking in regions and cities of regional, territorial and Republican significance were entrusted to district and city inspectors for national economic registration and their assistants. Apart from them heads of census departments, their assistants, control inspectors and tellers (enumeraters) were appointed. The number of the entire personnel including the reserves amounted

to 592,000 people; 26.5 per cent of the census personnel were accountants, 22.3 per cent teachers and 11.9 per cent students. The leading census workers frequented special courses in Moscow or in Republican, territorial and regional centres, the rest of the workers also recieved special training and instructions.

Preparatory work for the organization of the census in 1959 was started in 1957. A central office has been organized at the Central Statistical Office of the U. S. S. R. Special department have been set up by the Statistical Administration of the Union Republics, while the territories and regions have sectors for preparatory work and actual census-taking.

To ensure a successful census-taking it is necessary to draw up complete and accurate lists of inhabited localities in advance. Before the census of 1939 inhabited locality was defined as a number of buildings forming an uninterrupted group. The vast territory of the U. S. S. R. makes the compilation of lists of inhabited localities difficult in view of the varied types of inhabited localities in national Republics, territories and regions. Soviet collective farms notably have buildings, which are sometimes located at a considerable distance from their centre. An inhabited locality is of interest for statistics from the standpoint of the social, economic, cultural and other characteristics on the other hand it plays a big role in the preparatory work of a census. The collection of all statistical data pertaining to each inhabited locality is not included in the tasks of census-taking. The lists of inhabited localities are necessary to safeguard the complete coverage of the population in order to avoid omissions and for the correct distribution of the census-taking personnel. In the census of 1939 not only were all the inhabited localities listed, but also individually situated buildings which could not be considered as independent inhabited localities. The form used consisted of 11 columns. The left side of the form contained data on the inhabited locality as a whole: 1) Nos., 2) name, 3) type of locality, 4—6) the number of inhabited houses, households and population number according to the data of the village Soviet registration by January 1, 1938. The right side of the form deals with the separately situated inhabited houses of the locality in question. It contained the following columns: 7) Nos., 8) type of building, 9—10) number of households and population number according to the data of the village Soviet by January 1, 1938, 11) distance from the outskirts of the basic inhabited locality (in kilometres). In 1939 the number of inhabited localities of the village type amounted to 573,000, with 600,000 separately located buildings and with a population of 2,500,000. At present the number of such buildings has considerably grown.

The rapid development of industry in the Soviet Union is manifested in the growth of population in old towns, in the transformation of inhabited localities of the village type into industrial and commercial centres, in the establishment of new inhabited localities of the township type, etc. Therefore in each new census the question of singling out the urban population presents certain difficulties. Before the census of 1939 there were two lists of urban population: 1) the list approved by legislative bodies and 2) the census list which was twice bigger than the first. The administrative borders of townships often did not correspond to the actual size of the town at the moment of census-taking. According to the instruction of the urban census of 1923 a town included all its adjacent suburbs economically closely linked with it. In the census of 1926 the urban population included all the areas connected with the town by forming one uninterrupted mass of buildings.

Such divergances developed because statistical data were being collected to characterize towns which came into being only by the moment of census-taking. This data did not have any practical meaning for administration or planning bodies as the administrative territory and that of the census did not coincide. In connection with the census of 1939 steps were taken to draw up a unified list of townships, which would correspond with the actual situation at the moment of census-taking. During this census the list of townships was compiled for the first time to contain only inhabited localities legislatively recognized and in all of them the census was taken according to their administrative boundaries.

In towns and villages lists were drawn up beforehand for all households and the number of the population according to the available data. Such lists were necessary to avoid omission and to break up the territory into census-taking sections. The lists of inhabited localities and households

were drawn up in advance; before the census they are checked once more and are then distributed among the census personnel.

Apart from this, the personnel was equipped with geographical maps and city plans. This helped in setting up of the boundaries of the census sections and in achieving accuracy during the census-taking.

The territory was broken up into census districts, instruction and counting sections according to the available approximate data on the number of the population and other information forming the object of the census. This data forms a basis for determing the necessary number of census-taking personnel and questionairs in each territorial division.

In the process of census-taking great importance was attached to census documents. In 1939 basic documents approved by the Government were as follows: 1) census schedule, 2) instruction on its filling in, 3) control form, 4) report on the census work. The latter two documents were of great importance as a check-up. There were also additional documents such as 1) compound schedule on private house ownership in towns, 2) cadastral list for rural districts, 3—6) compound report-sheets from the census distrists, instruction and counting sections, notebooks for teller, controllers and instructors. The notebooks were filled in with preliminary information on the district, observations and notes as well as the results of audits, etc.

On certain importance is the preparation of the population for the forthcoming census by the publication of booklets and newspaper articles, lectures and talks. Special local commissions facilitating census-taking are set up in various spots, etc.

In the U. S. S. R. there is a practice of carrying out preliminary pilot or trial censuses in a number of towns and in the countryside, in order to check the effectiveness of the census schedule, the instruction and the other documents. After this the documents are approved, printed in the necessary number of copies in Russian and the other national languages of the U. S. S. R. and circulated throughout the country.

Unification in the interpretation of questions pertaining to census documents can best be achieved by the oral questioning of the population. Explanations given by trained

tellers on various questions connected with the census are apt to improve the quality of the information. This oral questioning is of special importance in the registration of answers to complicated questions of the schedule, notably pertaining to occupation and the nature of the resident's stay at the given place. In Soviet census-taking the forms were filled in on the basis of replies given to oral questions; in 1926 exception was made for the urban population.

In 1939 omissions and double registration were avoided by means of census certificates, control forms and control inspections. Certificates were issued to people entered as temporary residents and to these for whom control forms had been drawn up, such as people travelling in trains at the time of the census, etc. At their permanent domicile the residents who had received certificates were included into the list of temporary absentees. Control forms introduced in 1939 contained the same questions as the census schedule and were destined for people who at the critical moment of the census were absent from their permanent place of residence and had no certificate of having passed the census in the place where they were of the critical moment. Later the control forms were sent to the persons place of permanent residence. At the place where the control forms had been filled in these people were not included into the general census schedule showing the actual population.

Apart from information on the address, the schedule of 1939 contained 16 questions. The first six of them were of a general demographic nature.

Registration of relation to the head of household (question 1) made it possible to establish the composition of a household at the moment of the census-taking. Questions 2—4 covered information necessary for the establishment of actual and permanent residence. Among the data registered were the temporary or permanent nature of residence, the place and duration of temporary stay and temporary absence. The questions on sex (question 5) and age (in years, or months for infants under one year of age) were included in every census. Question No. 9 referred to the marital status. The family status was registered on the basis of the answers given by the persons questioned.

Questions 7, 8 and 10 registered the nationality, mother tongue and citizenship of the person questioned. The variega-

ted composition of the population and the solution of both national problems in the U.S.S.R., make the registration of nationality and mother tongue necessary, on the basis of the self-determination of the persons in questioned. These data are not only important for population studies but also for various administrative purposes, and for the development of culture in the national Republics. The data of the 1939 census mentioned 100 nationalities. Sixty of them formed national Republics, autonomous regions and national areas. The census material made it possible to judge the economic and cultural development of various nationalities in the U. S. S. R.

Questions 11—13 dealt with the registration of literacy and education. In 1939 there was a general question of literacy: "a) able to read and write or only to read in some language? b) or completely illiterate?" Such a question was due to the fact that at the time there were many people inclined to call themselves "illiterate" although they could read and write. Question 12 refered to shoolchildren and students, and question 13 to people who had finished school or graduated from higher educational institutions. The tremendous strides in the cultural development of our country will be reflected in the nature of these questions in the 1959 census. Particular attention will be given to the registration of the educational status of the economically active population with secondary and special education.

Great importance is attached in the U. S. S. R. to questions pertaining to the occupation and social grouping of the population. The questions of 1939 were: "14) Occupation (employment) at the present moment or other means of livelihood", "15) Place of employment (name of enterprise, collective farm or institution)". "16) Social group— worker, employee, collective farmer, member of craftsmen's cooperative, individual farmer, craftsmen non-member of cooperative, professional, clergy or non-working citizen. If pensioners, people receiving scholarships, etc., were employed at the same time, only this employment was mentioned in column 14. Persons supported by others were marked as "dependant" and their census schedule contained the number of the census schedule of the person supporting them. Pensioners and people receiving scholarships were mentioned as members of the social group to which they had previously belonged. The composition of

the population of the U. S. S. R. according to occupation, sources of income, and the distribution of the population according to branches of labour, types of production and social groups was established on the basis of the data contained in the replies to the last three questions of the 1939 census schedule. Certain social groups included in the 1926 schedule (such as unemployed and proprietors using employed labour) are not mentioned in the schedule of 1939. Neither does it include questions on physical and mental defects.

The draft of the program of 1959 census-taking is closely connected with that of 1939. Special attention will be paid to the precise determining of actual and permanent population of the educational status and composition of the working people as well as the place and character of their employment. The census-taking will last 8 days. The processing of the results of the census will be fully completed before May 1960.

Summary

1. Population censuse in the U. S. S. R. are an important link in the statistic system of the country. The data obtained forms the basis for the planning of national economy and culture; they are also used in studying the reproduction of the population.

2. The census is taken orally by special tellers — a method safeguarding more reliable data.

3. The completeness of the census and the division into actual and permanent population are saferguarded by the introduction of additional documents.

4. The fixing of the critical moment of the census at zero on a week day around January 1 st favours the success of census-taking. This is the time, when the migration of the population from one inhibited locality to another is lower than ever.

5. The preliminary drawing up of a list of basic inhabited localities and adjacent separate buildings in rural districts, as well as lists of townships and the boundaries of each town by the time of a new census, insures the success of the census and helps to obtain data of scientific and practical importance.

6. In the U. S. S. R. it is necessary to put to the citizens simultaneous questions on their nationality and their mother tongue in accordance with their own determination.

7. In the forthcoming census of 1959 particular attention will be paid to questions pertaining to the education of economically active citizens.

8. The data obtained from the census are used to establish the composition of the population of the U. S. S. R. according to occupation, sources of income, distribution of workers in various branches of labour, types of production, and social groups.

Appendix I

Model of the balance-sheet table of national economy of the USSR (relative numbers)

Reproduction phases / Subdivisions of the national economy	Funds and reserves at the beginning of the year		Reproduction outlays: Past labour		Reproduction outlays: Live labour V_1+V_0		Production of the national product P				Circulation of P		Redistribution balance	Consumption of the national product: Provisions for depreciation (C_1+C_2)	National income (V + M): At plant	National income (V + M): At consumer: Total (including losses)	At consumer: including: Consumption fund	At consumer: including: Fund of accumulations and reserves[1]: Fixed	Fund of accumulations and reserves[1]: Turnover	Fund of accumulations and reserves[1]: Total	Funds and reserves by the end of the year	
	Fixed F_1	Turnover F_2	Depreciation of means of production C_1	Expenditure of the means of labour C_2	For own account V_1	For the society V_0	Means of labour	Objects of labour	Means of consumption	Subtotal	Purchased	Realized									Fixed F_1	Turnover F_2
A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
I. Productive sphere	2000	200	65	535	230	170	120,8	556,7	322,5	1000	625,2	890	−324,8	600	400	75,2	—	52,1	22,6	74,7	2052,1	222,6
1. Industry	1050	100	48	352	110	81,3	50,8	316,7	212,5	580	445,1	580	− 146,2	400	191,3	45,1	—	35	10	45,0	1095	110
2. Agriculture	350	50	12	138	80	59,1	15	225	60	300	115	190	−124,1	150	139,1	15,0	—	9	5,7	14,7	350	55,7
3. Construction	225	25	3	32	30	22,2	45	—	35	80	45	80	− 42,2	35	52,2	10,0	—	4,1	5,9	10,0	229,1	30,9
4. Transport and communication	290	10	2	13	10	7,4	10	15	15	40	20,1	40	− 12,3	15	17,4	5,1	—	4	1	5,0	379	26
5. Provision with capital goods and materials, and trade	85	15																				
Including																						
A. Means of production	1400	100	45	332,5	180	133	120,8	556,7	—	677,5	402,5	627,5	−263	377,5	313	50,0	—	30,1	10,6	49,7	1439,1	110,6
A_1 for the first subdivision	860	40	30	205,0	140	103,5	100,8	354,2	—	455	255,2	430	−213,3	235	243,5	30,2	—	25	5	30	885	45
A_2 for the second subdivision	540	60	15	127,5	40	29,5	20	202,5	—	222,5	147,3	197,5	− 49,7	142,5	69,5	19,8	—	14,1	5,6	19,7	554,1	65,6
B. Means of consumption	600	100	20	202,5	50	37,0	—	—	322,5	322,5	222,7	262,5	− 61,8	222,5	87	25,2	—	13	12	25	613	112
B_1 for the personal consumption	510	90	15	187,5	47	34,8	—	—	296,5	296,5	190,7	236,5	− 59,6	202,5	81,8	22,2	—	12	10	22	521	99
B_2 for the social consumption	90	10	5	15	3	2,2	—	—	26	26	23	26	− 2,2	20,0	5,2	3,0	—	1	2	3	92	13
II. The sphere of service and consumption	1000	100	18,5	281,5	64,5	−64,5	—	—	—	—	264,8	—	+324,8	—	—	324,8	300	15	9,8	24,8	1015	109,8
1. In public institutions	910	90	14,0	6,0	64,5		—	—	—	—	40	—	40	—	—	40	20	11	9	20	921	99
a) Public administration and defence	50	50	2,0	6,0	9,0	—	—	—	—	—	13	—	13	—	—	13	8	1	4	5	51	54
b) Science, culture, etc.	860	40	12,0	—	55,5	—	—	—	—	—	27	—	27	—	—	27	12	10	5	15	870	45
2. Population in household	90	10	4,5	275,5	—	—	—	—	—	—	224,8	—	284,8	—	—	284,8	280	4	0,8	4,8	94	10,8
a) workers and employees	14	1	0,7	153,8	—	—	—	—	—	—	145	—	147,1	—	—	155,0	154,5	0,5	—	0,5	14,5	1
b) collective farmers and cooperatives members	72	8	3,6	116,9	—	—	—	—	—	—	75,8	—	135,9	—	—	124,8	120,5	3,5	0,8	4,3	75,5	8,8
c) individual peasants	4	1	0,2	4,8	—	—	—	—	—	—	4	—	1,8	—	—	5	5	—	—	—	4	1
III. Total in the national economy	3000	300	83,5	816,5	294,5	105,5	120,8	556,7	322,5	1000	890	890	0	600	400	400	300	67,1	32,4	99,5	3067,1	332,4

[1]) Less the losses of −0.5

Source: „Statistika" (Statistics), Moscow, 1956, p. 452

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Appendix 2

Interindustry transactions, 1947 in the USA ($ millions)

A concise alternative of the table „Interindustry flow of goods and services by the industry of origin and destination"

Purchases by / Sales by	Consumption for production purposes						Other industries			Total the productive sphere	Final buyers							Grand total
	Investment goods			Means of existence														
	Metals, engineering and vehicles (18, 20—28)	Construction (45)	Subtotal	Agriculture and fishery (1)	Industry excluding metals, engineering etc. (2—17, 19, 29, 30, 42, 43)	Subtotal	Transport and communication (31—33, 35)	Trade and public catering (34, 44)	Subtotal		Services, finances and banking (36—41)	Public authorities (48)	Household (50)	Total the non-productive sphere	Investment (49)	Change in stocks (46)	Foreign trade (exports) (47)	
A	1	2		3	4		5	6			7	8	9		10	11	12	
I. Productive sphere																		
A. Investment goods																		
1. Metals, engineering and vehicles (18, 20—28)	10121	2796	12917	180	6000	6180	555	38	593	19690	1608	1826	6431	9865	12169	1126	3798	46648
2. Construction (45)	154	7	161	199	789	988	1431	255	1686	2835	4542	5464	154	10160	15709	0	0	28704
Subtotal	10275	2803	13078	379	6789	7168	1986	293	2279	22525	6150	7290	6585	20025	27878	1126	3798	75352
B. Means of existence																		
3. Agriculture and fishery (1)	4	92	96	10856	19655	30511	16	865	881	31488	116	569	9785	10470	21	1008	1276	44263
4. Industry excluding metals, engineering, etc. (2—17, 19, 29, 30, 42, 43)	15307	8582	23889	4264	78915	83179	2560	8954	11514	118582	13329	2081	48979	64389	1401	2334	7011	193717
Subtotal	15311	8674	23985	15120	98570	113690	2576	9819	12395	150070	13445	2650	58764	74859	1422	3342	8287	237980
C. Other industries																		
5. Transport and communication (31—33, 35)	802	1322	2124	1638	7174	8242	1308	1073	2381	12747	1678	792	7292	9762	369	112	2282	25272
6. Trade and public catering (34, 44)	614	2506	3120	1360	4246	5606	477	1263	1740	10466	1762	45	39182	40989	2336	149	987	54927
Subtotal	1416	3828	5244	2428	11420	13848	1785	2336	4121	23213	3440	837	46474	50751	2705	261	3269	80199
Total productive sphere	27002	15305	42307	17927	116779	134706	6347	12448	18795	195808	23035	10777	111823	145635	32005	4729	15354	393531
II. Nonproductive sphere																		
7. Services, finances and banking (36—41)	601	1437	2038	3007	6288	9295	1116	6825	7941	19274	6274	5454	45053	56781	1075	0	266	77396
8. Public authorities (48)	2190	470	2660	813	10414	11227	2441	5160	7601	21488	6311	3458	31308	41077	216	73	831	63685
9. Household (50)	16650	11492	28142	19166	52806	71972	14959	30494	45453	145567	41668	30058	2116	73842	218	0	847	220474
Total non-productive sphere	19441	13399	32840	22986	69508	92494	18516	42479	60995	186329	54253	38970	78477	171700	1509	73	1944	361555
10. Changes in stocks (46)	68	0	68	2660	2137	4797	0	0	0	4865	0	0	0	0	0	0	22	4887
11. Foreign trade (imports) (47)	137	0	137	690	5293	5983	409	0	409	6529	108	1313	1325	2746	0	0	0	9275
Grand total	46648	28704	75352	44263	193717	237980	25272	54927	80199	393531	77396	51060	191625	320081	33514	4802	17320	769248

1. Source: D. Evance and M. Hoffenberg, „An interindustry relations study for 1947", „The review of economics and statistics", May 1952.

2. The columns and rows of Evans'and Hoffenberg's tables were grouped by me into broader subdivisions. In brackets the numbers of the rows and columns which were summen up are shown. The row 9 includes depreciation allowances which Evans and Hoffenberg do not take into account. Services rendered to business are shown not in item 6 but are added to item 7.

Interindustry transactions 1950 (United Kingdom) (£millions)

Purchases by (Distribution) / Sales by (Input)	Agriculture, forestry and fishing	Mining and quarrying	Metals, engineering and vehicles	Textiles, leather and clothing	Food, drink and tobacco	Other manufacturing	Building and contracting	Gas, electricity, water	Transport, communication and trade	Public administration, educational and medicine services household etc	Total intermediate output	Final Buyers: Persons	Final Buyers: Public authorities	Final Buyers: Gross domestic capital formation: Fixed	Final Buyers: Gross domestic capital formation: Stocks	Export	Total final output	Stock appreciation	Total output
	1	2	3	4	5	6	7	8	9	10	11 (1–10)	12	13	14	15	16	17 (12–16)	18	19 (11 + 17 + 18)
1. Agriculture, forestry and fishing	—	—	—	28	563	17	—	—	1	—	609	451	8	—	4	9	472	37	1118
2. Mining and quarrying	6	—	42	19	14	133	27	127	56	—	424	99	4	6	−15	48	142	5	571
3. Metals, engineering and vehicles	55	50	—	48	33	70	160	50	248	—	714	285	205	866	−40	1070	2386	90	3190
4. Textiles, clothing and leatner	10	5	41	—	13	107	3	1	27	—	207	810	23	—	−27	477	1283	160	1650
5. Food, drink and tobacco	116	—	—	1	—	—	—	—	15	—	132	2166	16	—	40	129	2351	25	2508
6. Other manufacturing	118	30	395	80	130	—	209	21	200	—	1192	249	180	—	−29	323	723	118	2033
7. Building and contracting	30	21	22	15	8	12	—	2	121	—	231	220	155	637	—	2	1014	30	1275
8. Gas, electricity, and water	4	9	60	13	14	45	8	—	88	—	241	230	28	41	−2	4	301	—	542
9. Transport, communication, and trade	105	30	400	130	145	185	80	65	—	—	1140	2980	390	81	−5	536	3991	95	5226
10. Public administration, educational and medicine services, household	—	—	—	—	—	—	—	—	—	—	—	472	1071	—	—	—	1543	—	1543
11. Import	53	11	218	468	396	393	39	1	210	—	1798	747	80	42	−130	115	854	140	2792
12. Sales by final buyers	—	—	12	12	—	17	—	—	26	—	67	35	−103	−20	−6	27	−67	—	—
13. Goods and services	497	156	1190	823	1316	979	526	267	1001	—	6755	8753	2057	1653	−210	2740	14993	700	22448
14. Income of employees (wages)	256	359	1384	480	246	611	610	146	2133	1227	7452	—	—	—	—	—	—	—	7452
15. Gross profits, other trading income and rent	409	53	605	336	268	362	132	106	1808	316	4395	—	—	—	—	—	—	—	4395
16. Taxes on expenditures (less subsidies)	−44	3	11	11	678	81	7	23	284	—	1054	499	11	21	—	—	531	—	1585
17. Total input	1118	571	3190	1650	2508	2033	1275	542	5226	1543	19656	9252	2068	1674	−210	2740	15524	700	35880

Source: National income and expenditure 1946–52, London, August, 1953, p.p. 22–23

Tableau économique d'ensemble de l'année 1954 (en milliards de francs courants)

	Emplois										Ressources									
	1. Entreprises			2. Ménages			3. Administrations		Extérieur	Total général	1. Entreprises			2. Ménages			3. Administrations		Extérieur	Total général
	Exploitation	Affectation	Capital	Exploitation	Affectation	Capital	Affectation	Capital			Exploitation	Affectation	Capital	Exploitation	Affectation	Capital	Affectation	Capital		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
5 a Production intérieure brute	—	—	—	—	—	—	—	—	—	—	13394	—	—	357	—	—	—	—	—	13751
5 b Amortissement	—	—	1233	—	—	242	—	26	—	1501	—	—	—	—	—	—	—	—	—	—
5 c Consommation intérieure	—	—	—	—	9962	—	808	—	—	10770	—	—	—	—	—	—	—	—	—	—
5 d Formation nette de capital	—	—	461	—	—	335	—	274	—	1070	—	—	—	—	—	—	—	—	—	—
5 e Exportations	—	—	—	—	—	—	—	—	1688	1688	—	—	—	—	—	—	—	—	—	—
5 f Utilisation de services	—	—	—	—	—	—	—	—	147	147	—	—	—	—	—	—	—	—	—	—
5 g Formations de stocks	—	—	150	—	—	—	—	—	—	150	—	—	—	—	—	—	—	—	—	—
5 h Plus value de stocks	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5 i Importations	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1575	1575
Total 5 Biens et services	—	—	1844	—	9962	577	808	300	1835	15326	13394	—	—	357	—	—	—	—	1565	15326
6—1 Dividendes et parts	—	470	—	—	—	—	—	—	74	544	—	58	—	—	422	—	40	—	24	544
6—2 Intérêt	300	—	—	9	11	—	212	—	13	545	318	—	—	—	129	—	63	—	35	545
6—3 Salaires et traitements	4270	—	—	—	170	—	896	—	—	5336	—	—	—	—	5061	—	275	—	—	5336
6—4 Cotisations sociales	1006	—	—	—	85	—	50	—	—	1141	—	—	—	—	—	—	1141	—	—	1141
6—5 Prestations sociales	64	—	—	—	—	—	1717	—	—	1781	—	—	—	—	1775	—	—	—	6	1781
6—6 Impots et taxes directs	—	473	—	—	318	—	—	—	—	791	—	—	—	—	—	—	791	—	—	791
6—7 Taxes sur le chiffre d'affaires	1516	—	—	—	—	—	—	—	—	1516	—	—	—	—	—	—	1516	—	—	1516
6—8 Autres impots et taxes indirects	1114	—	—	57	—	—	11	—	—	1182	23	—	—	—	—	—	1159	—	—	1182
7—1 Assistance	—	—	—	—	—	—	391	—	—	398	—	—	—	—	398	—	—	—	—	398
7—2 Dommages de guerre	—	—	—	—	—	—	293	—	—	293	—	120	—	—	164	—	9	—	—	293
7—3 Subventions d'exploitation	—	—	—	—	—	—	227	—	—	227	227	—	—	—	—	—	—	—	—	227
7—4 Subventions d'équilibre	—	—	—	—	—	—	487	—	—	467	—	117	—	—	—	—	350	—	—	467
7—5 Subventions d'équipement	—	—	—	—	—	—	87	—	—	87	—	87	—	—	—	—	—	—	—	87
7—6 Coopération internationale	—	—	—	—	—	—	9	—	283	292	—	—	—	—	—	—	287	—	5	292
7—7 Dépenses et recettes publiques extérieures	—	—	—	—	—	—	554	—	65	619	—	—	—	—	—	—	65	—	554	619
7—8 Dépenses et recettes privées extérieures	—	—	—	—	136	—	—	—	235	371	—	—	—	—	235	—	—	—	136	371
7—9 Transferts divers	32	—	—	21	162	—	33	—	55	303	109	—	—	—	37	—	120	—	37	303
Total 6 et 7 Transferts	8802	943	—	87	882	—	4954	—	725	15893	677	382	—	—	8221	—	5816	—	797	15893
Total 8: Créances et dettes	—	—	—	—	—	519	—	—	—	519	—	—	85	—	—	—	—	246	188	519
9—1 Revenus bruts d'exploitation	5769	—	—	270	—	—	—	—	—	6039	—	5769	—	270	270	—	—	—	—	6039
9—2 Revenus bruts des entrepreneurs individuels	—	3769	—	—	—	—	—	—	—	3769	—	—	—	3769	—	—	—	—	—	3769
9—3 Revenus bruts non distribués des sociétés	—	1439	—	—	—	—	—	—	—	1439	—	—	1439	—	—	—	—	—	—	1439
9—4 Financement des investissements par les entrepreneurs individuels	—	—	—	—	320	—	—	—	—	320	—	—	320	—	—	—	—	—	—	320
9—5 Epargne brute des ménages	—	—	—	—	1096	—	—	—	—	1096	—	—	—	—	—	1096	—	—	—	1096
9—6 Deficit des administrations	—	—	—	—	—	—	—	—54	—	—54	—	—	—	—	—	—	—	—54	—	—54
Total 9: Revenus et épargnes	5769	5208	—	270	1416	—	—	—54	—	—	—	5769	1759	—	4039	1096	—54	—	—	—
Total général	14071	6151	1844	357	12260	1096	5762	246	2560	—	14071	6151	1844	357	12260	1096	5762	246	2560	—

Source: „Statistiques et études financières" № 100, avril 1957, Paris, p.p. 424—425.

UTILISATION DE LA NOTION DE POPULATION STABLE POUR MESURER LA MORTALITÉ ET LA FÉCONDITÉ DES POPULATIONS DES PAYS SOUS-DÉVELOPPÉS

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Dans les pays sous-développés, les statistiques du mouvement de la population sont très défectueuses. Souvent elles ne donnent même pas un ordre de grandeur des niveaux de fécondité et de mortalité. Les recensements sont en général d'une qualité bien supérieure. Or la population saisie à l'occasion d'un recensement est le résultat de l'évolution passée de la fécondité et de la mortalité. On peut donc espérer tirer des recensements des renseignements sur cette fécondité et cette mortalité. C'est là une espérance qui a déjà suscité de nombreux travaux. Les méthodes que nous nous proposons d'exposer ici ont trouvé leur principe dans l'étude des effets des variations de la mortalité et de la fécondité sur la composition par âge des populations et c'est la nécessité de mesurer la fécondité et la mortalité des pays sous-développés pour calculer des perspectives de population pour ces pays qui a conduit le Service de la Population des Nations Unies à les imaginer.

Mortalité et structure par âge

L'ensemble des taux de mortalité par âge constitue un bon indice pour mesurer un niveau de mortalité. Quand la mortalité varie dans une population, on rencontre une succession d'ensembles de taux de mortalité par âge qui sont toujours à peu près les mêmes. Par exemple, on observe qu'à une valeur donnée du taux de mortalité de 5 à 9 ans, correspond une valeur du taux de mortalité de 40 à 44 ans qui est plus élevée et qui est toujours à peu près la même. Autrement dit, on peut établir une série d'ensembles de taux de mortalité par âge qui matérialisent les états successifs par où passe la mortalité au fur et à mesure que l'état sanitaire se modifie. L'étude démographique No. 22 publiée par l'Organisation des Nations Unies sur les tables de mortalité modèles a eu pour objet d'établir cette série d'ensembles de taux de mortalité par âge[2].

[1] L'auteur de ce document est membre du Secrétariat de l'Organisation des Nations Unies. Il expose ses vues personnelles qui ne sont pas nécessairement celles du Secrétariat.

[2] *Schémas de variation de la mortalité selon l'âge et le sexe*, Document des Nations Unies, No. ST/SOA/Ser. A/22, No. de vente : 1955.XIII.9.

Les tables de mortalité modèles permettent d'étudier l'effet de la baisse de la mortalité sur la composition par âge des populations. Considérons à l'instant t une population où le taux brut de reproduction est égal à R et l'espérance de vie à la naissance E_1. Supposons qu'à partir de l'instant t la mortalité décroisse de telle sorte que les taux de mortalité par âge parcourent la série des tables de mortalité modèles, l'espérance de vie à la naissance passant en x années de E_1 à E_2. Supposons en outre qu'après l'instant $t+x$ la mortalité se stabilise au niveau E_2. Supposons enfin que la fécondité demeure constante pendant toute cette évolution, le taux brut de reproduction restant au niveau R. Calculons dans ces hypothèses une perspective de population. Soit P cette perspective.

Dans la perspective P la structure par âge varie et ces variations ne dépendent pas seulement des variations de la mortalité et de la fécondité à partir de l'instant t, mais aussi des variations subies par ces facteurs démographiques avant l'instant t. Autrement dit, pour isoler, dans les variations de la structure par âge observées dans la perspective P, ce qui est dû à la baisse de la mortalité *après* l'instant t, il faut évaluer ce qui est dû, dans ces variations, aux modifications de la fécondité et de la mortalité *avant* l'instant t. Dans ce but, on calcule une seconde perspective P' où, à partir de l'instant t, la mortalité et la fécondité restent constantes respectivement au niveau E_1 et R. La comparaison des évolutions de la composition par âge dans les deux perspectives P et P' permet de mesurer l'effet de la baisse de la mortalité considérée.

Si l'on choisit comme population de départ à l'instant t une population stable correspondant à la fécondité R et à la mortalité E_1, la perspective P' se réduit à cette population stable. Il suffit alors de comparer l'évolution de la structure par âge de la perspective P à la structure par âge de la population stable de départ. Notons enfin que dans la perspective P, on se trouve après l'instant $t+x$ dans une population où la mortalité reste constante au niveau E_2 et où la fécondité reste constante au niveau R. Par conséquent, dans cette perspective la population tendra vers une population stable correspondant à la fécondité R et à la mortalité E_2.

Le tableau 1 donne les résultats d'un tel calcul effectué dans les conditions que voici. $R = 3{,}00$; $E_1 = 40$ ans; $x = 40$ ans; $E_2 = 60$ ans. En d'autres termes, on imagine, dans une population de fécondité relativement élevée et constante, une baisse de la mortalité permettant de faire passer l'espérance de vie à la naissance de 40 à 60 ans et cela au cours d'une période de 40 années de calendrier. Le tableau 1 met en évidence les faits suivants :

(*a*) L'effet de la baisse de la mortalité considéré sur la composition par âge n'est pas très important. Cette baisse produit un rajeunissement par la base de la pyramide des âges et peu de changement au sommet.

(*b*) La composition par âge varie peu au cours du temps et au moment où se stabilise la mortalité, elle est très voisine de la composition par âge de la population stable d'arrivée.

(*c*) Il résulte de (*b*) que les taux de natalité et de mortalité ainsi que le taux d'accroissement naturel observés au moment où la mortalité se stabilise sont pratiquement

TABLEAU 1. *Variations des diverses caractéristiques démographiques dans le passage d'une population stable (a) à une autre population stable, (b) dans le cas où la mortalité décroît et où la fécondité reste constante.*

Epoques	Taux brut de mortalité (pour mille)	Taux brut de natalité (pour mille)	Taux d'accroissement naturel (pour mille)	Composition, pour 100, par grands groupes d'âges (en années)		
				0–14	15–59	60 et plus
Population stable de départ[a]	23,3	40,0	22,7	43,1	52,5	4,4
Au moment où la mortalité cesse de diminuer[c]	9,8	43,6	33,8	44,0	50,2	4,9
Population stable d'arrivée[b]	9,6	43,8	33,2	46,0	49,6	4,4

[a] Population stable correspondant à un taux brut de reproduction de 3,0 et une espérance de vie à la naissance de 40 ans.

[b] Population stable correspondant à un taux brut de reproduction de 3,0 et une espérance de vie à la naissance de 60 ans.

[c] On a supposé que le passage de la 1re à la 2e mortalité se faisait en 40 ans.

égaux aux taux correspondants observés dans la population stable vers laquelle tend la perspective.

Le calcul précédent n'est évidemment qu'un cas particulier. Pour généraliser les résultats, il faudrait multiplier des calculs analogues et imaginer toutes les baisses possibles de la mortalité. Le travail est en cours au Service de la Population des Nations Unies. On s'est contenté ici de comparer de nombreuses populations stables, c'est-à-dire de comparer les points de départ et les points d'arrivée de perspectives analogues à celles qui font l'objet du tableau 1. Le tableau 2 donne les éléments permettant de faire cette comparaison en utilisant les populations stables calculées en associant deux à deux, d'une part, six niveaux de fécondité correspondant respectivement aux six valeurs suivantes du taux brut de reproduction : 1,0– 1,5– 2,0– 2,5– 3,0– 4,0, et d'autre part, six niveaux de mortalité correspondant respectivement aux six valeurs suivantes de l'espérance de vie à la naissance : 20 ans– 30 ans– 40 ans– 50 ans– 60 ans– et 70 ans. Ce tableau montre que les conclusions précédentes ont vraisemblablement une portée générale[1].

On peut présenter les résultats de la manière que voici. Considérons une population où la fécondité reste constante et où la mortalité baisse. Notons en passant que

[1] En toute rigueur, le tableau 2 ne permet pas de connaître ce qui se passe entre le point d'arrivée et le point de départ. Toutefois comme les compositions par âge d'arrivée et de départ sont voisines, il est peu probable que la composition par âge varie beaucoup dans l'intervalle; sauf peut-être dans le cas d'une baisse très rapide de la mortalité. Ce point sera éclairci bientôt grâce aux travaux en cours du Service de la Population de l'Organisation des Nations Unies.

TABLEAU 2. *Caractéristiques de populations stables modèles correspondant à divers niveaux de fécondité et de mortalité.*

Taux brut de reproduction	Espérance de vie à la naissance (en années)	Répartition de la population par groupes d'âges (en années)				Taux brut pour 1000			Répartition des décès de 5 ans et plus par groupes d'âges (en années)		
		Moins de 15	15-59	60 ou plus	Tous âges	Natalité	Mortalité	Accroissement naturel	5-14	15-59	60 et plus
4	20	45,2	52,4	2,4	100,0	63,8	53,0	10,8	19,6	68,3	12,1
3		38,5	57,6	3,9	100,0	50,5	50,2	0,3	14,7	68,4	16,9
2,5		34,1	60,7	5,2	100,0	42,0	40,1	- 0,3	11,8	66,5	21,7
2		28,0	64,0	7,1	100,0	34,2	48,6	- 14,4	9,1	65,4	25,5
1,5		22,6	66,9	10,5	100,0	24,8	49,7	- 24,9	6,2	61,3	32,5
1		14,8	68,3	16,9	100,0	14,6	54,4	- 39,8	3,3	53,6	43,1
4	30	48,2	49,2	2,6	100,0	59,8	35,3	24,5	19,5	64,7	15,8
3		41,3	54,5	4,1	100,0	47,7	33,7	14,0	14,5	63,4	22,1
2,5		36,9	57,6	5,5	100,0	40,6	33,2	7,4	11,6	61,6	26,8
2		31,4	60,9	7,7	100,0	32,7	33,6	- 0,9	8,7	58,4	32,9
1,5		24,7	63,8	11,5	100,0	23,8	35,0	- 11,2	5,7	53,0	41,3
1		16,3	65,0	18,7	100,0	14,0	39,0	- 25,0	2,9	44,0	53,1
4	40	50,0	47,3	2,7	100,0	57,3	24,1	33,2	18,8	60,8	20,4
3		43,1	52,5	4,4	100,0	46,0	23,3	22,7	13,6	58,1	28,3
2,5		38,5	55,6	5,9	100,0	39,3	23,2	16,1	10,8	55,4	33,8
2		32,9	58,8	8,3	100,0	31,7	23,7	8,0	7,9	51,1	41,0
1,5		25,9	61,6	12,5	100,0	23,1	25,6	- 2,5	5,0	44,6	50,4
1		17,0	62,5	20,4	100,0	13,6	30,9	- 17,3	2,4	35,0	62,6
4	50	51,5	45,8	2,7	100,0	55,7	16,2	39,5	17,5	56,5	26,0
3		44,6	50,9	4,5	100,0	44,0	15,8	29,1	12,3	52,3	35,4
2,5		40,0	53,9	6,1	100,0	38,4	16,0	22,4	9,5	48,8	41,7
2		34,2	57,2	8,6	100,0	31,1	16,8	14,3	6,7	43,7	49,6
1,5		27,0	60,0	13,0	100,0	22,7	18,8	3,9	4,1	36,7	59,2
1		17,8	60,7	21,5	100,0	13,4	24,3	- 10,9	1,9	27,3	70,8
4	60,4	52,9	44,4	2,7	100,0	54,1	9,4	44,7	14,8	51,1	34,1
3		46,0	49,6	4,4	100,0	43,8	9,6	34,2	9,9	45,5	44,6
2,5		41,4	52,6	6,0	100,0	37,7	10,1	27,6	7,4	41,3	51,3
2		35,6	55,8	8,6	100,0	30,6	11,1	19,5	5,0	35,9	59,1
1,5		28,2	58,7	13,1	100,0	22,5	13,5	9,0	2,9	29,0	68,1
1		18,7	59,4	21,9	100,0	13,3	19,0	- 5,7	1,3	20,6	78,1
4	70,2	54,1	43,3	2,6	100,0	52,7	4,1	48,6	9,2	42,8	48,0
3		47,3	48,4	4,3	100,0	42,9	4,8	38,1	5,7	36,1	58,2
2,5		42,7	51,4	5,9	100,0	37,0	5,5	31,5	4,0	31,9	64,1
2		36,8	54,7	8,5	100,0	30,1	6,8	23,3	7,6	26,8	70,6
1,5		29,3	57,7	13,0	100,0	22,3	9,4	12,9	1,4	21,1	77,5
1		19,5	58,6	21,9	100,0	13,3	15,1	- 1,8	0,6	14,5	84,9

c'est le cas de la majorité des populations des pays sous-développés à l'heure actuelle[1]. Supposons qu'à un instant donné, la mortalité cesse de baisser et reste constante au niveau atteint à cet instant. Au bout d'un certain temps, la population atteint un état stable.

Les indications précédentes montrent qu'au moment où l'on imagine la stabilisation de la mortalité, la population est déjà très voisine de cet état stable. Il en résulte qu'une population où la fécondité reste constante et où la mortalité baisse peut être assimilée, à chaque instant, à une population stable. En d'autres termes, dans ces populations, il y a à chaque instant entre la composition par âge, le taux de natalité, le taux de mortalité et le taux d'accroissement, approximativement les mêmes relations que dans une population stable.

La population à structure par âge invariable

On peut encore justifier l'assimilation des populations des pays sous-développés à des populations stables de la manière suivante. Dans ces pays on constate en effet que la composition par âge de la population reste pratiquement invariable au cours du temps[2]. Considérons donc une population de composition par âge constante. Soit a l'âge des individus et $c(a)$ la composition par âge. Remarquons d'abord que dans une telle population, le taux brut de natalité est constant. Il est en effet égal à $c(0)$[3].

Désignons à l'instant t par P_t l'effectif de la population, r_t le taux annuel d'accroissement naturel et $l_t(a)$ la fonction de survie.

L'effectif des personnes d'âge a est égal à $P_t c(a)$. Un an après, elles ont l'âge $a+1$ et leur effectif est

$$P_t c(a) \frac{l_t(a+1)}{l_t(a)}$$

[1] La fécondité des populations des pays sous-développés ne peut être considérée comme constante qu'en première approximation. Dans la réalité, cette fécondité varie d'une année l'autre. Mais, jusqu'ici, ces fluctuations n'ont jamais été très grandes. Elles ont été en particulier très inférieures aux variations de la mortalité. Nous n'en tiendrons pas compte étant donné que nous cherchons à déterminer un niveau moyen de fécondité.

[2] Cette constatation peut paraître contradictoire avec ce que nous avons dit plus haut sur l'effet des mouvements de la mortalité sur la structure par âge des populations. La mortalité a baissé et continue à baisser dans les pays sous-développés. On devrait donc observer un rajeunissement par la base de la pyramide des âges. En fait, le tableau 2 montre que l'effet de rajeunissement est très faible. Il faut que la mortalité baisse beaucoup pour que cet effet soit sensible. Dans les populations stables correspondant au taux brut de reproduction de 3,0, le pourcentage des personnes de 0 à 14 ans varie de la manière suivante avec le niveau de mortalité :

Espérance de vie à la naissance en années . . .	30	40	50	60,4	70,2
Pourcentage des personnes de 0 à 14 ans . . .	41,3	43,1	44,6	46,0	47,3.

[3] Dans la pratique cela revient à dire que les taux de fécondité par âge sont constants. Si l'un variait, il faudrait en effet que les autres varient en sens inverse et dans des proportions telles que les conséquences de ces variations sur le taux brut de natalité soient finalement nuls. Des variations de cette nature ne se rencontrent jamais pratiquement.

qui est aussi égal à $P_{t+1}\, c(a+1) = P_t (1+r_t)\, c(a+1)$,

On a donc $$\frac{l_t(a+1)}{l_t(a)} = (1+r_t)\frac{c(a+1)}{c(a)}.$$

On tire facilement de cette relation l'égalité suivante :

$$\frac{l_t(a)}{l_t(0)} = (1+r_t)^a \frac{c(a)}{c(0)}.$$

Si l'on introduit la notation continue on peut aussi écrire

$$\frac{c(a)}{c(0)} = e^{-r_t a}\frac{l_t(a)}{l_t(0)}.$$

Ce qui montre que la composition par âge considérée est identique à la composition par âge d'une population stable calculée avec la mortalité et le taux annuel d'accroissement naturel observé à l'instant t. En d'autres termes, dans une population de composition par âge invariable, il y a à chaque instant les mêmes relations que dans une population stable entre la structure par âge, la fécondité, la mortalité et le taux d'accroissement naturel.

C'est cette possibilité d'assimiler les populations des pays sous-développés à des populations stables qui est à la base des méthodes que nous allons maintenant exposer. Les possibilités d'application sont très variées. Elles dépendent des données dont on dispose et l'on pourrait presque dire que chaque cas particulier a sa propre méthode d'analyse. On se limite ici au cas où l'on dispose au moins de deux recensements par trop éloignés l'un de l'autre[1] et l'on se propose d'obtenir une estimation des niveaux moyens de natalité et de mortalité pour la période entre les deux recensements. Ces estimations se rapportent par conséquent à des époques souvent assez éloignées du temps présent. Pour connaître la situation démographique actuelle, il faut donc à partir des estimations passées, calculer de nouvelles estimations pour les années récentes. C'est là une opération qui a ses propres méthodes. Elle sera ici laissée de côté.

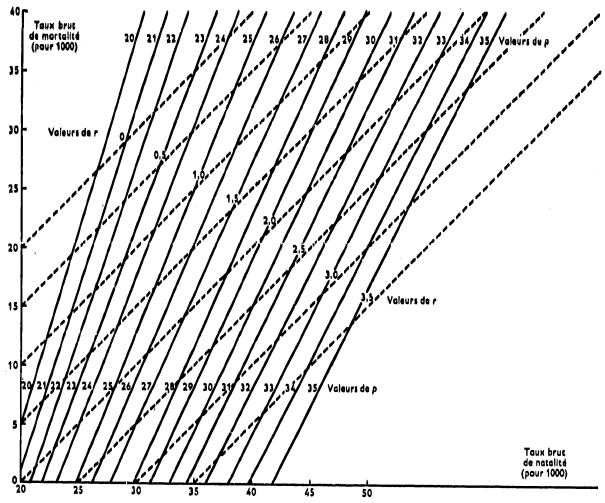
L'utilisation des populations stables modèles

Cette première méthode[2] repose sur les hypothèses suivantes :

(*a*) La fécondité dans les populations considérées est peu variable, et peut être considérée comme pratiquement constante.

[1] C'est un cas qui se rencontre très souvent dans la pratique.

[2] D'après les chiffres du tableau 2, il est possible de montrer qu'à chaque population stable, c'est-à-dire à chaque couple de valeur de l'espérance de vie à la naissance et du taux brut de reproduction correspond *une* structure par âge et *une seule*. Par conséquent, inversement, à chaque structure par âge correspond *un seul* couple de valeurs de l'espérance de vie à la naissance et du taux brut de reproduction. En assimilant la structure par âge d'une population réelle avec la structure par âge d'une population stable du tableau 2 (ou d'une population stable interpolée entre deux populations stables du tableau 2), on peut donc en déduire les niveaux de fécondité et de mortalité de la population réelle. Mais ce n'est là qu'une possibilité théorique. En effet, comme nous l'avons déjà dit, la structure par âge est très peu sensible aux mouvements de la mortalité si bien qu'une imprécision relativement faible de la structure par âge de la population réelle, entraîne une grande imprécision dans la détermination du niveau de la mortalité. Autrement dit, la connaissance de la seule structure par âge, théoriquement suffisante pour obtenir les niveaux de mortalité et de fécondité se révèle pratiquement impuissante. Si l'on veut obtenir des évaluations convenables il faut avoir d'autres informations en plus des renseignements que l'on possède déjà sur la structure par âge. On s'est placé ici dans le cas où l'on connaît la structure par âge et le taux d'accroissement naturel.



GRAPHIQUE 1. Lignes à p constant et lignes à r constant dans l'ensemble des populations stables du tableau 2.

(*b*) La mortalité varie en suivant le schéma des tables de mortalité modèles.

(*c*) Les recensements de population donnent une évaluation assez précise de la structure par âge. Toutefois, pour tenir compte du fait que les recensements sousestiment généralement le nombre des enfants en bas-âge, on considère seulement la composition par âge de la population de 5 ans et plus et l'on fait choix comme indice de la composition par âge du rapport p des personnes de 5 à 14 ans au nombre total des personnes de 5 ans et plus[1]. Dans les pays où les migrations internationales sont

[1] On a évidemment le choix entre une infinité d'indices de composition par âge. On a choisi le groupe 5–14 ans parce qu'il comprend des personnes qui sont généralement bien recensées et qui ne sont pas beaucoup affectées par les mouvements migratoires.

importantes, une correction est apportée à la structure par âge pour tenir compte de ces migrations.

(*d*) Les recensements successifs corrigés au besoin pour tenir compte des migrations donnent une bonne mesure du taux d'accroissement naturel. (Ceci suppose donc qu'on dispose d'au moins deux recensements.)

On a construit un diagramme (graphique 1) illustrant comment varient dans les populations stables précédemment définies les valeurs de p et de r en fonction des taux bruts de mortalité et de natalité. Le procédé est alors très simple. Supposons par exemple qu'on dispose pour un pays donné de deux recensements successifs respectivement exécutés en 1940 et 1950. On calcule la valeur de p au recensement de 1940 et au recensement de 1950 et on prend la valeur moyenne p_m. La comparaison des deux recensements, compte tenu si besoin est des mouvements migratoires, nous donne le taux d'accroissement naturel r. On lit sur le diagramme au point d'intersection des lignes p_m et r les valeurs des taux de mortalité et de natalité. On admet que ces taux sont les taux moyens de la période entre les deux recensements.

Les applications pratiques

Dans la zone où se situent les applications pratiques[1] le diagramme No. 1 se présente sous la forme de deux réseaux de droites parallèles. Il est donc possible de le transformer en un graphique du type nomogramme à points alignés (graphique 2). Sur l'échelle de droite on repère le taux d'accroissement naturel, évalué comme on l'a dit à l'aide de la comparaison des deux recensements. Sur l'échelle du milieu on repère l'indice de la composition par âge p (indice moyen des deux recensements). On joint par une droite les deux points obtenus. Cette droite coupe l'échelle de gauche en un point où l'on lit le taux brut de natalité. Le taux brut de mortalité s'obtient évidemment en soustrayant le taux d'accroissement naturel du taux brut de natalité ainsi obtenu.

Si l'on préfère, on peut aussi utiliser la formule numérique suivante, équivalente au nomogramme 1, où p est exprimé en % et r en ‰

$$b = \frac{3{,}76\,p - 44{,}68 - r}{1{,}076}.$$

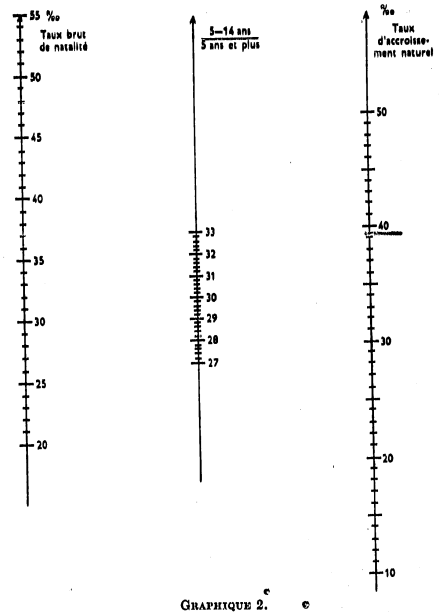
Prenons un exemple. Celui de la Colombie pour laquelle on dispose de recensements en 1938 et 1951. Les statistiques sur la nationalité des habitants montrent que les migrations internationales sont négligeables au cours de cette période.

En 1938 on a $p = 0{,}314$.
En 1951 on a $p = 0{,}313$.

La valeur moyenne $p_m = 0{,}3135$.

Le taux d'accroissement calculé en comparant les deux recensements est pris comme une estimation du taux d'accroissement naturel. On trouve

[1] Rappelons que la méthode ne s'applique que dans des populations à fécondité constante, c'est-à-dire pratiquement les pays à forte fécondité.



Graphique 2.

$r = 22{,}3‰$.

La droite joignant les deux points correspondant respectivement à ces valeurs de r et de p coupe l'échelle des taux de natalité en un point correspondant à un taux brut de natalité.

$$b = 47{,}3‰.$$

Le taux brut de mortalité est donc

$$m = 47{,}3‰ - 22{,}3‰ = 25{,}0‰.$$

Il lui correspond[1] une espérance de vie à la naissance de 38,5 ans. Les taux bruts moyens de natalité et de mortalité enregistrés en Colombie de 1939 à 1950 sont indiqués dans le tableau 3. La comparaison de ces valeurs avec les estimations

[1] L'espérance de vie à la naissance correspondant au taux de mortalité se calcule par interpolation des chiffres du tableau 2.

TABLEAU 3. *Mouvement naturel de la population enregistrée en Colombie entre les deux derniers recensements.*

Population recensée le 5-VIII-1938	8.701.816	Décès annuels moyens enregistrés de 1939 à 1950	154.961
Population recensée le 9-V-1951	11.548.177	Naissances annuelles moyennes enregistrées de 1939 à 1950	335.496
Taux brut annuel moyen de mortalité (pour 1000)			15,1
Taux brut annuel moyen de natalité (pour 1000)			33,1

précédentes fait apparaître pour la période considérée un sous-enregistrement des naissances de 30,0 % et un sous-enregistrement des décès de 38,6 %.

Le sous-enregistrement des naissances et des décès qu'on vient de mettre en évidence en Colombie est loin d'être particulier à ce pays. On trouve un résultat analogue dans la plupart des pays sous-développés. Devant un sous-enregistrement d'une telle ampleur, on est en doit de s'interroger sur la validité de la méthode et il apparaît indispensable de chercher par d'autres moyens une confirmation des résultats.

Méthode basée sur l'invariance de la structure par âge

La validité de l'hypothèse suivant laquelle la mortalité varie dans les populations considérées conformément au schéma des tables de mortalité modèles peut prêter à discussion. On a vu tout-à-l'heure qu'on pouvait assimiler à des populations stables

TABLEAU 4. *Composition de la population de la Colombie par grands groupes d'âges aux trois derniers recensements.*

Groupes d'âges (en années)	Date des recensements 14-X-1918	5-VII-1938	9-V-1951
Moins de 1	4,0	3,3	3,7
1– 4	11,3	12,0	13,1
5– 9	13,1	14,3	14,0
10–14	11,6	12,3	12,0
15–19	9,7	10,3	10,2
20–29	17,6	17,5	17,0
30–39	13,2	12,2	11,7
40–49	8,7	8,1	7,9
50–59	5,2	5,0	5,2
60–69	3,3	3,1	3,2
70–79	1,4	1,3	1,4
80–89	0,7	0,5	0,5
90 ans plus	0,2	0,2	0,1
Tous âges	100,0	100,0	100,0

TABLEAU 5. *Calcul de la table de survie de la Colombie au-dessus de 7,5 ans pour la période 1938–1951.*

Composition par âge — Moyenne — 1938–1951 $c(a)$	Age moyen a (en année)	Produit ra ($r = 22{,}3$ ‰)	(ra) $(\mathrm{Log}_{10}\, e)$	e^{ra}	$e^{ra}c(a)$	$l(a)$ (fonction de survie)
14,15	7,5	0,1673	0,072636	1,182	16,725	1000
12,15	12,5	0,2788	0,121060	1,321	16,056	960
10,25	17,5	0,3902	0,169483	1,477	15,142	905
17,25	25,0	0,5575	0,242119	1,746	30,124	901
11,95	35,0	0,7805	0,338907	2,183	26,082	779
8,00	45,0	1,0035	0,438815	2,728	21,822	652
5,10	55,0	1,2265	0,532662	3,409	17,387	519
3,15	65,0	1,4495	0,629510	4,261	13,422	401
1,35	75,0	1,6725	0,726358	5,326	7,189	215
0,50	85,0	1,8955	0,823205	6,656	3,328	100
0,15	95,0	2,1185	0,920053	8,319	1,248	37

les populations de structure par âge invariable sans faire appel, pour justifier cette assimilation, aux tables de mortalité modèles. Or la stabilité de structure par âge d'une population est un fait d'observation indiscutable. Le tableau 4 montre qu'en Colombie la structure par âge a très peu varié au cours des trois derniers recensements. En multipliant cette structure par âge, pratiquement invariable, par la fonction $\exp(r_t a)$ où r_t est le taux d'accroissement naturel à l'instant t, on obtient, à un facteur constant près, la fonction de survie $l_t(a)$ à l'instant t.

Pour tenir compte du fait que les enfants sont en général mal recensés, on a limité le calcul aux personnes de 5 ans et plus et la table de survie obtenue commence à 7,5 ans. On a pris pour r le taux annuel d'accroissement donné par la comparaison des deux derniers recensements (22,3‰). Le tableau 5 donne le détail du calcul. Dans la table de survie ainsi calculée, l'espérance de vie à $7\frac{1}{2}$ ans est de 47,9 années. Dans les tables de mortalité modèles, la correspondance entre l'espérance de vie à la naissance et l'espérance de vie à $7\frac{1}{2}$ est la suivante (Tableau 6).

TABLEAU 6. *Correspondance entre l'espérance de vie à la naissance et l'espérance de vie à 7,5 ans dans les tables de mortalité modèles.*

Espérance vie à la naissance (en années)	Espérance de vie à $7\frac{1}{2}$ ans (en années)
20,0	33,2
30,0	40,6
40,0	47,3
50,0	54,4
60,0	60,4

On est ainsi conduit à admettre pour la Colombie, de 1938 à 1951, une mortalité tous âges donnant une espérance de vie à la naissance de 40 ans. Le tableau 2 permet de calculer les taux bruts de natalité et de mortalité correspondants. On trouve

$$b = 45{,}6‰, \qquad m = 23{,}3‰.$$

La nouvelle évaluation est relativement indépendante des tables de mortalité modèles. Celles-ci ne sont en effet utilisées que pour passer de la mortalité au-dessus de 7½ ans à la mortalité tous âges. L'accord entre les deux estimations montre donc que dans le cas de la Colombie, l'utilisation des tables de mortalité modèles est parfaitement valable. Par contre, dans les deux méthodes, l'hypothèse sur l'exactitude des recensements est la même et l'accord des résultats ne permet pas de tirer une conclusion sur la validité de cette hypothèse.

La structure par âge des décès

La structure par âge des décès est une source de renseignements indépendante des recensements. Il arrive qu'on la connaisse même quand l'enregistrement des décès est incomplet. Il suffit en effet que le sous-enregistrement soit à peu près le même à chaque âge. Le tableau 2 montre que pour un niveau de fécondité donné, cette répartition par âge varie avec la mortalité et le tableau 7 donne une vue un peu plus détaillée du phénomène[1]. On voit que pour un niveau de fécondité donné, la baisse de la mortalité accroît la proportion des décès de personnes âgées et diminue la proportion des décès des personnes jeunes. On observe une sorte de pivotement de la structure par âge autour du groupe d'âges 50-69 ans. L'étude de la structure par âge des décès nous renseigne donc sur les niveaux de fécondité et de mortalité. Si l'un de ces niveaux est donné, l'autre est déterminé. D'une façon plus précise, on peut, pour une composition par âge des décès donnée, déterminer une série de couples de valeurs des taux bruts de natalité et de mortalité tels que dans les populations stables modèles correspondantes les décès aient la composition par âge considérée. Le graphique 3 a été tracé de cette façon pour diverses répartitions par âge des décès, ces répartitions étant repérées par les pourcentages des décès, ces répartitions étant repérées par les pourcentages des décès de 60 ans et plus dans l'ensemble des décès de 5 ans et plus.

Parmi les décès de 5 ans et plus enregistrés en Colombie de 1939 à 1950, il y a eu 35,5 % de décès de 60 ans et plus. La courbe marquée 35 sur le graphique 3 correspond donc assez bien au cas de la Colombie. On voit que le point *A* correspondant aux couples de valeurs des taux bruts de mortalité et de natalité observés est assez loin de cette courbe aussi bien d'ailleurs que le point *B* correspondant aux couples de valeurs des taux estimés d'après les deux méthodes précédentes.

Si l'on admet que la répartition enregistrée des décès par âge est exacte, et que les taux de natalité et de mortalité enregistrés sont des limites inférieures des vrais

[1] Pour tenir compte du fait que les décès des jeunes enfants sont souvent mal déclarés, on s'est limité dans ces deux tableaux aux décès de 5 ans et plus.

TABLEAU 7.

(A) *Répartition par groupes d'âges des décès de 5 ans et plus dans quatre populations stables correspondant à un taux brut de reproduction de 3,0 et à quatre niveaux de mortalité donnant des espérances de vie à la naissance respectivement égales à 30, 40, 50 et 60 ans.*

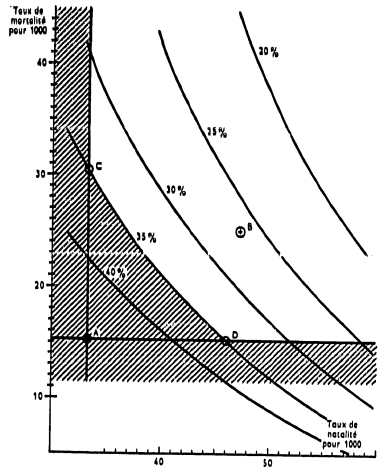
(B) *Répartition par groupes d'âge des décès de 5 ans et plus enregistrés en Colombie de 1939 à 1950.*

Groupes d'âges	A — Taux brut de reproduction = 3,0 — Espérance de vie à la naissance (en années) 30	40	50	60	B — Décès enregistrés en Colombie de 1939 à 1950
5-9	905	852	766	614	820
10-14	541	511	462	377	393
15-19	667	650	601	502	486
20-24	775	770	713	587	640
25-29	761	712	632	509	609
30-34	734	650	559	456	539
35-39	712	606	512	418	604
40-49	1.380	1.180	1.028	908	1.202
50-59	1.316	1.243	1.190	1.177	1.071
60-69	1.181	1.315	1.429	1.573	1.283
70 et plus	1.033	1.511	2.108	2.884	2.263
Tous âges	10.000	10.000	10.000	10.000	10.000
Taux brut de mortalité (pour 1000)	33,7	23,3	15,8	9,6	15,6
Taux brut de natalité (pour 1000)	47,7	46,0	44,9	43,8	

taux de natalité et de mortalité, tous les couples de valeurs lues sur le segment *C D* de la courbe marquée 35 % sont compatibles avec la répartition des décès enregistrés. En *C* l'enregistrement des naissances est complet et il y a 40 % de sous-enregistrement des décès. En D l'enregistrement des décès est complet et il y a 11,4 % de sous-enregistrement des naissances. Dans l'intervalle, il y a à la fois sous-enregistrement des naissances et des décès.

Mais tout ceci suppose que l'âge au décès est convenablement déclaré. Or on sait que très souvent l'âge au décès est exagéré. Une telle exagération produit le même effet qu'une baisse de la mortalité : elle accroît la proportion des décès aux âges élevés et diminue la proportion des décès aux âges jeunes. Si l'on tient compte de ce phénomène de l'exagération de l'âge au décès, ce sont tous les couples de valeurs lues dans l'aire non hachurée du graphique 3 qui sont compatibles[1] avec la composition par âge observé. Autant dire que cette composition par âge n'apporte aucun renseigne-

[1] En pratique les taux bruts de natalité et de mortalité sont aussi limités supérieurement. On peut admettre que les taux de natalité sont inférieurs à 50 ‰ les taux de mortalité à 40‰.



GRAPHIQUE 3. Courbes de variation du taux brut de mortalité en fonction du taux brut de natalité dans des populations stables modèles, pour divers pourcentages des décès de 60 ans et plus parmi les décès de 5 ans et plus.

ment supplémentaire sur le niveau de la mortalité tant qu'on ne connaît rien du degré d'exagération de l'âge au décès. Il est donc permis d'interpréter la répartition des décès enregistrés en Colombie de 1939 à 1950 comme résultant d'une exagération de l'âge au décès, la vraie répartition étant la répartition stable correspondant à la combinaison des taux de natalité et de mortalité estimés respectivement à 47,3 pour 1000 et 25,0 pour 1000.

On peut même par ce moyen évaluer les effets de l'exagération de l'âge au décès sur la composition par âge des décès. Le tableau 8 présente un essai d'une semblable évaluation. L'exagération de l'âge paraît exister à tous les âges. Chaque groupe d'âges reçoit des décès qui normalement appartiennent aux groupes d'âges inférieurs et déverse des décès dans le groupe d'âges supérieur[1]. De 35 à 69 ans, les deux mouvements se compensent à peu près et finalement tout se passe comme si environ 30 pour 100 des décès de 5 à 34 ans passaient dans le groupe de 70 ans et plus[1].

En résumé, là où l'on a des raisons de croire à l'inexactitude de la déclaration d'âge des décès, on peut interpréter de façons très diverses les répartitions des décès par âge observées et l'on peut en tirer à peu près n'importe quelle conclusion sur le niveau de la mortalité tant qu'on ne sait rien sur le degré d'exagération de l'âge au décès.

[1] Pour rendre compte de la répartition par âge des décès enregistrés en Colombie, le mécanisme d'exagération de l'âge au décès devrait jouer de la manière suivante :

Pourcentage des décès d'un groupe d'âges de 5 ans passant dans le groupe d'âges de 5 ans supérieur, par suite de l'exagération de l'âge au décès.

Groupe d'âge en année . . .	5-9	10-14	15-19	20-24	25-29	30-34	35-39	etc.
Pourcentage	5	30	50	60	80	100	100	etc.

TABLEAU 8. *Essai d'évaluation de l'exagération de l'âge au décès en Colombie de 1939 à 1950.*

Groupes d'âges	Décès dans la population stable[a]	Décès enregistrés en Colombie de 1939 à 1950	Différences en valeurs absolues	Différences en % de la répartition par âge des décès enregistrés
5-9	861	820	041	5,0
10-14	516	393	123	31,3
15-19	652	486	166	34,2
20-24	771	640	131	20,3
25-29	720	609	111	18,2
30-34	664	539	125	23,2
35-39	623	604	19	
40-49	1.213	1.292	− 79	3,1
50-59	1.255	1.071	184	
60-69	1.293	1.283	10	
70 et plus	1.432	2.263	− 830	− 36,7
5 ans et plus	10.000	10.000		
Taux brut de mortalité (pour 1000)	25,0			
Taux brut de natalité (pour 1000)	46,3			

[a] Obtenue par interpolation des populations stables du tableau 2 de telle façon que le taux brut de mortalité soit égal à 25 ‰.

La comparaison des recensements par groupe d'âges

La comparaison de deux recensements successifs par groupe d'âges est un moyen très commode d'évaluer la mortalité quand on ne dispose pas de statistiques du mouvement de la population. Dans un pays où le sous-enregistrement des décès est

Au-dessus de 30 ans, il faudrait donc que la totalité des décès de chaque groupe d'âges de 5 ans passent dans le groupe d'âges supérieur. C'est ce qu'on observerait si, à partir de cet âge, l'exagération de l'âge au décès consistait à donner au décédé un âge égal au multiple de 5 immédiatement supérieur à l'âge réel. C'est là un comportement qui n'est pas impensable surtout si l'on tient compte de l'attraction qu'exercent les multiples de 5 dans les déclarations d'âge.

[1] Tout ce qui précède suppose que le sous-enregistrement des décès est proportionnellement le même à chaque âge. En réalité, on mesure ici l'effet global de l'exagération de l'âge au décès et des variations du pourcentage d'enregistrement avec l'âge.

de l'ordre de 50 pour 100, une telle comparaison doit permettre de mettre en évidence ce sous-enregistrement.

Le tableau 9 donne les éléments d'un calcul de ce genre pour la Colombie entre les deux recensements de 1938 et 1951. Partant du recensement de 1938, on a soustrait les décès observés entre les deux recensements par groupe de génération. On a calculé ainsi la population qu'on aurait observée au second recensement en l'absence de toute migration et si les décès avaient été convenablement enregistrés.

Dans un premier calcul, on a utilisé les décès tels qu'ils ont été enregistrés (partie supérieure du tableau 9). Dans un second calcul on a utilisé les décès enregistrés, corrigés de l'exagération de l'âge au décès (partie inférieure du tableau 9). Pour cette correction, on s'est servi des résultats obtenus précédemment (voir tableau 8). On a admis que l'exagération de l'âge au décès se ramenait à faire passer dans le cinquième groupe de génération (65 ans et plus en 1938), 30 % des décès des deux premiers groupes de générations (5-19 ans et 20-34 ans en 1938). Le tableau 9 met en évidence des différences importantes entre la population calculée et la population recensée.

A priori ces différences peuvent être dues à trois causes : (*a*) des mouvements migratoires, (*b*) des erreurs au recensements, (*c*) des erreurs dans l'enregistrement des décès.

Les migrations ont été négligeables entre la Colombie et l'étranger au cours de la période considérée et l'on peut écarter cette cause. Pour étudier les deux autres, il est utile de commencer par quelques considérations théoriques.

Soit k et h respectivement les proportions de sous-enregistrement aux 1er et 2e recensements et soit q la proportion de sous-enregistrement des décès. Pour un groupe de générations donné, la population calculée à la date du 2e recensement sera :

$$P'_2 = P_1(1-k) - D(1-q)$$

et la différence entre la population recensée au 2e recensement et la population calculée sera :

$$E = P_1(1-k) - D(1-q) - P_2(1-h).$$

Ce qui s'écrit :

$$E = P_1(h-k) + D(q-h). \qquad (1)$$

Introduisons la population recensée au 1er recensement $P'_1 = P(1-k)$ et les décès enregistrés $D' = D(1-q)$. L'équation (1) s'écrit :

$$E = P'_1\frac{h-k}{1-k} + D'\frac{q-h}{1-q}. \qquad (2)$$

Admettons, à titre d'hypothèse de travail, que h, k et q soient les mêmes pour tous les groupes de générations, c'est-à-dire que le sous-enregistrement soit indépendant de l'âge. Pour chaque groupe de générations, on écrira une équation du type (2) et on obtiendra, si n est le nombre de groupes de générations, un système de n équations à 2 inconnues.

TABLEAU 9. *Colombie. Comparaison par groupes d'âges de la population recensée en 1951 avec la population calculée en soustrayant de la population recensée en 1938 les décès enregistrés entre les deux recensements (chiffres en milliers).*

1	2	3	4	5	6	7	9
Age au recensement du 5-VII-1938	Effectif au recensement de 1938 des groupes de générations ayant au recensement de 1938 l'âge indiqué dans la première colonne	Décès enregistrés entre les deux recensements dans les groupes de générations	Population calculée à la date du recensement	Population recensée le 9-V-1951	Différence	Différence en % de la population recensée en 1938	Différence en % des décès enregistrés entre les deux recensements
5-19 ans	3.200	167	3.042	2.884	158	4,9	95,2
20-34 ans	2.043	176	1.867	1.690	177	8,8	100,6
35-49 ans	1.238	174	1.064	950	114	9,2	65,5
50-64 ans[a]	635	185	450	350	100	15,7	54,1
65 ans et +	234	215	19	44	− 24		
5 ans et +	7.350	917	6.442	5.918	524	7,1	57,1
		Décès enregistrés entre les deux recensements, corrigés de l'exagération de l'âge au décès			Différences corrigées de l'exagération de l'âge au décès	Différences corrigées en % de la population recensée en 1938	Différences corrigées en % des décès enregistrés entre les deux recensements
5-19 ans		217			108	3,4	49,8
20-34 ans		229			124	6,1	54,1
35-49 ans		174			114	9,2	65,5
50-64 ans		185			100	15,7	54,1
65 ans et +		112			78	33,3	69,6
5 ans et +		917			524	7,1	57,1

[a] Au-dessus de 50 ans les chiffres des recensements ont été ajustés pour tenir compte de l'attraction de l'âge 60 ans et de l'exagération de l'âge aux âges élevés. On a pris comme répartition par âge ajustée, la répartition par âge d'une population stable correspondant à un taux brut de reproduction de 3,0 et une espérance de vie à la naissance de 40 ans.

$$X = \frac{h-k}{1-k} \quad \text{et} \quad Y = \frac{q-h}{1-q}.$$

Si notre hypothèse est exacte, dans un système de coordonnées OX et OY, les droites d'équation (2) seront concourrantes en un point d'ordonnée $(q-h)/(1-q)$ et d'abscisse $(h-k)/(1-k)$.

En fait, on ne peut pas s'attendre à obtenir des droites passant absolument par le même point, ne serait-ce que parce que l'hypothèse adoptée de l'invariance du sous-enregistrement avec l'âge n'est sans doute qu'une approximation. On peut du moins s'attendre à ce que les diverses droites circonscrivent un polygone par trop étendu dans lequel on puisse déterminer sans trop d'ambiguïté un centre dont les coordonnées pourront être prises comme une solution convenable du système d'équation à résoudre.

Voyons comment se présente pratiquement le problème pour la Colombie. En utilisant les résultats du second calcul, c'est-à-dire le calcul portant sur les décès corrigés de l'exagération de l'âge au décès, le système d'équation à résoudre s'écrit :

$$\begin{aligned} 108 &= 3.200\,X + 217\,Y \\ 124 &= 2.043\,X + 220\,Y \\ 114 &= 1.238\,X + 174\,Y \\ 100 &= 635\,X + 185\,Y \\ 100 &= 635\,X + 185\,Y \\ 78 &= 234\,X + 112\,Y \end{aligned}$$

Les pourcentages calculés dans les deux dernières colonnes du tableau 9 sont les ordonnées et les abcisses à l'origine des droites du système I. Le graphique 4 montre comment se présente la résolution graphique de ce système. Les cinq droites du système I circonscrivent un polygone de faible étendue. Le point M d'abscisse nulle et d'ordonnée 60 % fournit une assez bonne solution du système I. On a donc

$$\frac{h-k}{1-k} = 0, \qquad \frac{q-h}{1-2} = 0{,}6.$$

Ce qui s'écrit

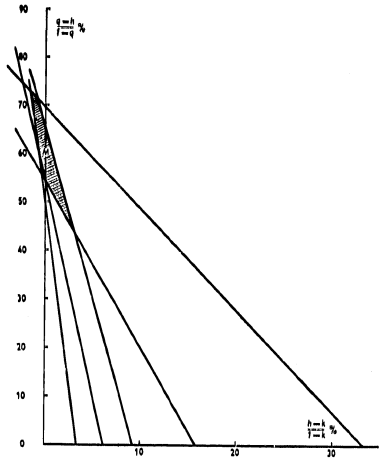
$$\left.\begin{aligned} h &= k, \\ q &= 0{,}375 + \frac{h}{1{,}6}. \end{aligned}\right\}$$

Nous pouvons en tirer deux conclusions :

(*a*) Les deux recensements peuvent donc être considérés comme étant de même précision $(h-k)$

(*b*) Le pourcentage de sous-enregistrement de décès de 5 ans et plus est au moins de l'ordre de 37,5 %.

Les deux méthodes précédentes nous avaient conduits à un sous-enregistrement de 40 % pour les décès de tous âges. On peut donc penser que $h/1{,}6$ est petit. C'est là un renseignement supplémentaire sur la validité des recensements de la Colombie



GRAPHIQUE 4. Résolution graphique du système d'équations N° I — Colombie.

en 1938 et 1951. Nous avons eu raison de les considérer comme assez exacts. Pour continuer le calcul, on a tenu h et k pour négligeables et admis qu'on obtenait les décès réels de 5 ans et plus en majorant de 60 % les décès enregistrés.

Passage du taux de 5 ans et plus au taux brut de mortalité

Nous sommes maintenant en mesure de calculer le taux vrai de mortalité de 5 ans et plus. Le tableau 10 donne les éléments d'un tel calcul.

A l'aide de la série des populations stables modèles considérées au début de cet exposé, on peut tracer sur un diagramme où l'on porte en abscisse le taux brut de natalité et en ordonnée le taux brut de mortalité, les courbes à taux d'accroissement naturel constant et les courbes à taux de mortalité de 5 ans et plus constant. A l'intersection de la courbe correspondant au taux d'accroissement naturel donné par la comparaison des deux recensements successifs et de la courbe du taux de mortalité de 5 ans et plus corrigé du sous-enregistrement des décès de la façon indiquée dans le tableau 10, on lit le taux brut de mortalité et le taux brut de natalité cherchés.

Dans la zone où le diagramme s'applique en pratique, celui-ci se présente sous la forme de deux réseaux de droites parallèles. On peut donc le transformer en un graphique du type nomogramme à points alignés. C'est un tel nomogramme qui est

TABLEAU 10. *Colombie. Calcul du taux réel de mortalité de 5 ans et plus pour la période 1939–1950.*

Population de 5 ans et plus au recensement de 1938	7.960.306
Population de 5 ans et plus au recensement de 1951	9.608.079
Population moyenne	8.485.970
Moyenne des décès annuels de 5 ans et plus enregistrés de 1939 à 1950	78.733
Taux annuel moyen de mortalité de 5 ans et plus, enregistré de 1939 à 1950	9,27 ‰
Taux annuel moyen de mortalité de 5 ans et plus, corrigé du sous-enregistrement des décès	14,8 ‰

reproduit sur le graphique 5. Sur l'échelle de droite, on repère le taux d'accroissement naturel. Sur l'échelle de gauche on repère le taux de mortalité de 5 ans et plus. La droite qui joint les deux points ainsi obtenus coupe l'échelle du milieu en un point qui donne le taux brut de mortalité cherché. Le taux brut de natalité s'obtient évidemment en ajoutant au taux brut de mortalité le taux d'accroissement naturel. Si l'on préfère, on peut utiliser aussi la formule numérique suivante équivalente au nomogramme 5.

$$m = \frac{1{,}55\,\lambda - 14{,}6 + 0{,}3774\,r}{0{,}6226}.$$

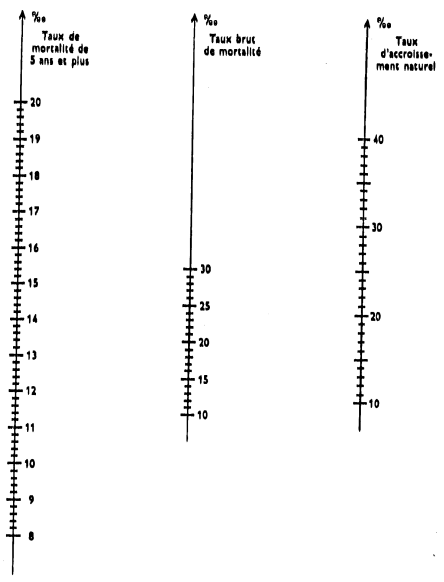
Dans cette formule λ est le taux de mortalité de 5 ans et plus, r est le taux d'accroissement naturel, m est le taux brut de natalité. Tous ces taux étant exprimés pour 1000 habitants.

Dans le cas de la Colombie λ égale 14,7 pour 1000 et r égale 22,3 pour 1000. Le nomogramme donne $m = 26{,}7$ pour 1000 et $b = 49{,}0$ pour 1000.

En résumé nous disposons maintenant des trois estimations suivantes pour les taux bruts de natalité et de mortalité de la Colombie pour la période 1938–1951.

	Taux brut de natalité (pour 1000)	Taux brut de mortalité (pour 1000)
Méthode des populations stables modèles	47,3	25,0
Méthode de l'invariance de la structure par âge	45,6	23,3
Méthode de la comparison des recensements successifs par groupe de générations	49,0	26,7
Taux moyens enregistrés de 1939 à 1950	33,1	15,1

On ne peut guère espérer un meilleur accord entre ces trois estimations.



GRAPHIQUE 5.

Un autre exemple, la population du Chili

Le cas du Chili va nous donner un aperçu de la variété des problèmes posés par l'application des méthodes précédentes. On trouvera dans le tableau suivant les données brutes permettant d'appliquer la méthode des populations stables modèles.

Date des recensements	Population recensée	Rapport des personnes de 5 à 14 ans aux personnes de 5 ans et plus
28-XI-40	5.023.539	0,2827
24-IV-52	5.932.995	0,2785
Valeur moyenne	5.478.267	0,2806

Taux d'accroissement entre les deux recensements . . . . . $r = 14{,}8$ pour 1000

Les mouvements migratoires ayant eu un effet négligeable sur la population du Chili au cours de la période considérée, on peut prendre comme estimation du taux

d'accroissement naturel la valeur du taux d'accroissement entre les deux recensements. Le nomogramme 2 donne alors pour 1940–1952 un taux brut moyen de natalité $b = 43{,}0‰$ et un taux brut moyen de mortalité $m = 28{,}3‰$. Les statistiques du mouvement naturel de la population au Chili fournissent les chiffres suivants de 1940 à 1952.

	Nombres absolus	Taux brut moyen (pour 1000)
Moyenne annuelle des nés vivants enregistrés dans les deux ans qui suivent la naissance de 1940 à 1951	180.141	32,0
Moyenne annuelle des décès enregistrés de 1940 à 1951	98.939	18,1

Le taux de natalité de 32,0 est certainement inférieur à la réalité puisqu'il est calculé sur les nés vivants enregistrés dans les deux ans qui suivant leur naissance. Il est donc normal que l'estimation précédente fasse apparaître un sous-enregistrement des naissances. Le sous-enregistrement des décès est plus surprenant, les autorités chiliennes considérant en effet que les statistiques des décès sont complètes. Examinons ce que donnent les autres méthodes. Nous laisserons provisoirement de côté la méthode basée sur l'invariance de la structure par âge et nous passerons tout de suite à la comparaison des recensements de 1940 et de 1952 par groupes de générations.

Le tableau 11 donne les éléments de cette comparaison.

TABLEAU 11. *Chili. Comparaison par groupe d'âges de la population recensée en 1952 avec la population calculée en soustrayant de la population recensée en 1940 les décès enregistrés entre les deux recensements (en milliers).*

Age au recensement 28-XI-1940	Effectif au recensement de 1940 des groupes de générations ayant au recensement de 1940 l'âge indiqué dans la première colonne	Décès enregistrés entre les deux recensements dans les groupes de générations	Population calculée à la date du deuxième recensement	Population recensée en 1952 24-IV-1952	Différence	Différence en % de la population recensée en 1940	Différence en % des décès enregistrés entre les deux recensements
5–14 ans	1.244	53	1.191	1.130	61	4,9	115,1
15–29 ans	1.397	115	1.282	1.178	104	7,4	90,4
30–44 ans	942	118	824	755	69	7,3	58,5
45–59 ans[a]	548	136	412	387	25	4,6	18,4
60–74 ans	233	134	99	86	13	5,6	9,7
75 ans et + [a]	38	74	[b]	3	[b]	[b]	[b]
5 ans et +	4.402	630	3.772	3.539	233	5,3	37,0

[a] Les chiffres des recensements ont été ajustés au-dessus de 60 ans.
[b] Le calcul conduit à une population négative qui n'a aucun sens.

Le dernier groupe de générations figurant au tableau 11 conduit à une population négative. L'exagération de l'âge au décès peut sans doute expliquer ce résultat, étant donné le grand âge de ce groupe de générations. Dans ce qui va suivre, on ne tiendra pas compte de ce dernier groupe. Avec les notations utilisées précédemment pour la Colombie, le système d'équations linéaires s'écrit :

$$\begin{aligned} 1.244\ Y + 53\ X &= 61 \\ 1.397\ Y + 115\ X &= 104 \\ 942\ Y + 118\ X &= 69 \\ 548\ Y + 136\ X &= 25 \\ 233\ Y + 134\ X &= 13 \end{aligned} \qquad \text{(II)}$$

Le graphique 6 montre comment se présente la résolution de ce système. Le point N d'abscisse 0,07 et d'ordonnée $-0{,}06$ fournit une solution approché convenable. On a donc les relations approchées suivantes

$$\left.\begin{aligned} \frac{h-k}{1-k} &\# 0{,}07, \\ \frac{q-h}{1-q} &\# -0{,}06 \end{aligned}\right\}$$

qui peuvent s'écrire

$$\left.\begin{aligned} h &\# 0{,}06 + 0{,}94\ q, \\ h &\# 0{,}07 + 0{,}93\ k, \end{aligned}\right\}$$

ou enfin avec une nouvelle approximation

$$\left.\begin{aligned} h &\# 0{,}06 + q, \\ q &\# k. \end{aligned}\right\}$$

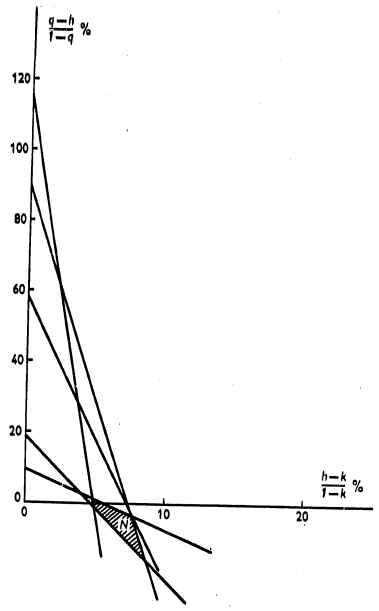
La première relation montre que h est au moins égal à 0,06. Il y a donc eu en 1952, dans le recensement des personnes de 5 ans et plus, un sous-enregistrement d'au moins 6 %. Cette même relation montre également que q n'est pas très grand. Sinon, h et k seraient grands aussi et de grandes erreurs sur le recensement sont improbables.

Mais que faut-il entendre exactement par q petit et par des statistiques d'enregistrement complètes? Il semble que q ne puisse guère dépasser un pourcentage de quelques unités. Si q égale 4 % par exemple, h sera égal à 10 %, ce qui représente déjà une erreur importante sur le recensement de 1952. Pour continuer le calcul, on a donc supposé que la complétude d'enregistrement des décès était comprise entre 96 % et 100 % et on a mené les calculs pour les deux limites. On va voir que les résultats dépendent assez peu de la valeur adoptée pour q.

Reprenons avec le recensement de 1952 ainsi corrigé les trois méthodes d'estimation de la natalité et de la mortalité.

Le tableau 11 donne les détails d'application de la méthode des populations stables modèles (nomogramme 2).

On voit que les résultats sont à peu près les mêmes pour les deux complétudes d'enregistrement des décès adoptées pour le calcul. Pour les deux autres méthodes on s'est contenté d'un seul calcul.



GRAPHIQUE 6. Résolution graphique du système d'équations N° II — Chili.

Le tableau 14 se réfère à la méthode basée sur l'invariance de la composition par âge. Le tableau 13 montre que depuis 1907 la structure par âge de la population du Chili a subi peu de changement, ce qui justifie l'emploi de la méthode. La table de survie qu'on obtient présente quelques irrégularités qu'il serait facile de corriger par une méthode d'ajustement quelconque. Cette table de survie donne une espérance de vie à l'âge de 7,5 ans égale à 52,8 ans. Dans les tables de mortalité modèles, l'espérance de vie à la naissance correspondante est de 47,5 ans. Ce qui correspond à un taux brut de mortalité de $m = 17{,}7‰$. Le taux brut de natalité s'obtient en ajoutant à ce taux le taux d'accroissement naturel $r' = 20‰$, on a donc $b = 37{,}7‰$.

Dans le tableau 15 enfin, on utilise la méthode de comparaison des recensements par groupe de génération (nomogramme 5) en supposant que l'enregistrement des décès est complet ($q = 0$).

TABLEAU 12. *Chili. Estimation du taux brut annuel moyen de la natalité et de la mortalité pour la période 1940–1952 en utilisant la méthode des populations stables modèles.*

Date des recensements	Rapport des personnes de 5 à 14 ans aux personnes de 5 ans et plus	Populations recensées	Populations corrigées en admettant pour la complétude de l'enregistrement des décès les pourcentages suivants	
			100 %	90 %
28-XI-1940	0,2827	5.023.539	5.023.539	5.224.481
24-IV-1952	0,2785	5.932.995	6.288.975	6.526.295
Valeur moyenne	0,2806		5.656.257	5.875.388
Taux d'accroissement entre les deux recensements calculé sur les populations corrigées (pour mille)			19,9	19,6
Nombre annuel moyen de nés vivants enrigistrés dans les deux ans suivant leur naissance, de 1940 à 1951			180,141	
Taux brut annuel moyen de natalité enregistré (pour mille)			31,9	30,6
Nombre annuel moyen de décès enregistrés de 1940 à 1951			98.959	
Taux brut annuel moyen de mortalité enregistré (pour mille)			17,5	16,8
Taux brut annuel moyen de natalité lu sur le nomogramme 2 (pour mille)			38,0	38,3
Taux brut annuel moyen de mortalité correspondant[a] (pour mille)			18,1	18,7

[a] Différence entre le taux de natalité lu sur le nomogramme 2 et le taux d'accroissement calculé sur les populations corrigées.

TABLEAU 13. *Composition par grands groupes d'âges de la population du Chili aux cinq derniers recensements.*

Groupe d'âges (en année)	Année des recensements				
	1907	1920	1930	1940	1952
0–9	25,9	26,2	26,2	25,0	26,4
10–19	22,2	22,4	21,9	22,3	20,7
20–29	17,9	17,9	18,2	17,6	17,2
30–39	12,4	13,0	13,0	13,4	12,8
40–49	9,1	9,1	9,2	9,6	9,9
50–59	6,1	5,6	5,8	6,2	6,6
60–69	3,8	3,5	3,5	3,7	4,0
70–79	1,7	1,5	1,5	1,6	1,7
80 et plus	0,9	0,8	0,7	0,6	0,7
Tous âges	100,0	100,0	100,0	100,0	100,0

TABLEAU 14. *Chili. Fonction de survie au-dessus de 7,5 ans pour la période 1940–1952 calculée sur la structure par âge moyenne des recensements de 1940 et 1952 en utilisant un taux d'accroissement naturel de 20 ‰.*

Groupes d'âges (année)	Age moyen (année) (a)	Composition par âge aux recensements 28-XI-1940	24-IV-1952	Valeur moyenne $c(a)$	$(1+0{,}02)^a c(a)$	$(1+0{,}02^a)$	Fonction de survie
0–4		12,4	13,2				
5–9	7,5	12,6	13,2	12,9	1,16	1.407	1.000
10–14	12,5	12,1	11,0	11,5	1,28	1.473	984
15–19	17,5	10,2	9,7	10,0	1,41	1.414	945
20–24	22,5	9,1	9,5	9,3	1,56	1.451	969
25–29	27,5	8,5	7,6	8,0	1,72	1.379	921
30–34	32,5	7,0	6,4	6,7	1,90	1.275	852
35–39	37,5	6,4	6,4	6,3	2,10	1.323	883
40–44	42,5	5,3	5,4	5,3	2,32	1.230	822
45–49	47,5	4,3	4,4	4,4	2,56	1.127	753
50–54	52,2	3,5	3,9	3,7	2,83	1.046	699
55–59	57,5	2,8	2,8	2,7	3,12	843	563
60–64	62,5	2,4	2,5	2,5	3,45	892	576
65–69	67,5	1,3	1,6	1,4	3,81	533	356
70–74	72,5	1,0	1,2	1,1	4,20	462	309
75–79	77,5	0,5	0,6	0,5	4,64	232	155
80–84	82,5	0,4	0,4	0,4	5,12	205	137
85 et plus	87,5	0,3	0,3	0,3	5,66	170	114
Tous âges		100,0	100,0				

TABLEAU 15. *Chili. Estimation du taux brut annuel moyen de mortalité et de natalité pour la période 1940–1952 en utilisant la méthode de comparaison par groupe de génération des recensements de 1940 et 1952.*

Date des recensements	Population de 5 ans et plus recensée	Population de 5 ans et plus corrigée
28-XI-40	4.401.536	4.401.536
24-IV-52	5.153.856	5.463.087
Valeur moyenne		4.932.311
Nombre annuel moyen de décès de 5 ans et plus enregistrés de 1940 à 1951 . .	56.411	
Taux annuel moyen de mortalité de 5 ans et plus enregistré de 1940 à 1951 . . .	11,4 ‰	
Taux annuel moyen d'accroissement de la population totale de 1940 à 1951 calculé sur les populations corrigées	$r' = 20$ ‰	
Taux brut moyen de mortalité lu sur le nomogramme 2	$m = 17{,}0$ ‰	
Taux brut moyen de natalité correspondant	$b = 37{,}0$ ‰	

Finalement on a les trois évaluations suivantes :

	Taux brut de natalité (pour 100)	Taux brut de mortalité (pour 1000)
Méthode de populations stables modèles	38,0	18,1
Méthode de l'invariance de la structure par âge	37,7	17,7
Méthode de la comparaison des recensements par groupe de génération . .	37,0	17,0
Taux enregistrés comme il est indiqué au tableau 12 (dans le cas où $q = 0$) .	31,0	17,5

L'accord entre les résultats donnés par les trois méthodes est excellent. La comparaison des estimations avec les taux enregistrés montre que l'enregistrement des décès est pratiquement complet et qu'il existe un sous-enregistrement des naissances de l'ordre de 20 %[1].

Conclusions

Le deux exemples que nous venons d'étudier un peu en détail montrent bien la complexité des problèmes qui se posent quand on veut tirer des recensements de population des renseignements sur la natalité et la mortalité. Les méthodes dont nous venons d'exposer le principe ne doivent jamais être appliquées mécaniquement. Chaque cas doit être soigneusement étudié en fonction de toutes les données possibles. L'effet des mouvements migratoires que nous avons pu laisser de côté dans les deux cas envisagés parce qu'il était faible, peut devenir très important dans d'autres populations.

Enfin nous nous sommes placés dans le cas où l'on disposait pour un même pays de deux recensements pas trop éloignés l'un de l'autre parce que c'est un cas qu'on rencontre souvent dans la pratique. Mais on peut développer, à partir des populations stables, bien d'autres méthodes adaptées aux données dont on dispose. Un seul recensement, un échantillon de décès, un échantillon de femmes classées suivant le nombre des enfants nés et le nombre des enfants survivants, etc. sont des données suffisantes pour obtenir des résultats intéressants.

Une application systématique de ces diverses méthodes est en cours au Service de la Population des Nations Unies. On peut déjà dire que le principe d'assimilation des populations des pays sous-développés à des populations stables fournit un puissant outil d'analyse de la situation démographique de ces pays.

[1] Pour interpréter ce résultat, il convient de se souvenir que le taux de natalité enregistré ne porte que sur les nés vivants enregistrés moins de deux ans après leur naissance.

SUMMARY

This article illustrates with two concrete examples—Colombia and Chile—some of the methods devised by the Population Branch of the Bureau of Social Affairs of the United Nations for measuring the level of fertility and mortality for countries where vital statistics are deficient.

In the first part of the paper, the possibility of associating the population of most under-developed countries with stable populations is demonstrated. In this context, a set of model stable populations calculated by associating six levels of mortality (expectation of life at birth, ranging from 20 to 70 years) with six levels of fertility (gross reproduction rate ranging from 1 to 4) is presented. Three estimating methods are then discussed.

In the first method, it is assumed that the annual rate of increase and the age composition of the population are available from censuses. By identifying the stable population whose characteristics most nearly coincide with those of the observed population, estimates of the levels of fertility and mortality of the actual population can be derived.

The second method rests on the assumption that, as in a stable population, the age composition at a given moment results from the rate of natural increase observed at that moment as applied to the stationary population corresponding to the mortality of the same moment. In other words, in multiplying the age composition by the function $\exp(r_t a)$ where r_t is the rate of natural increase and a the age, one obtains the stationary population.

The third method consists of comparing cohorts at two censuses and by applying registered deaths. By this means, an evaluation of the under-registration of deaths of individuals 5 years and over is obtained. Deaths under age 5 are then estimated in relation to deaths at ages 5 and over, and a total crude death rate is obtained.

The principle of associating the population of an under-developed country with a stable population has a wide-range of applications. The methods studied here represent only some examples of what can be done. More extensive work is now in process in the Population Branch of the United Nations.

Uppsala 1957. Almqvist & Wiksells Boktryckeri AB

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INTERNATIONELLA STATISTISKA INSTITUTET
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BERECHNUNG DER HEIRATSWAHRSCHEINLICHKEITEN DER LEDIGEN, DER VERWITWETEN, DER GESCHIEDENEN UND BERECHNUNG DER EHESCHEIDUNGSWAHRSCHEINLICHKEITEN AUS DEN ERGEBNISSEN DER VOLKSZÄHLUNGEN

von

Ivo Lah
Belgrad

Mit L_x, S_x, M_x, W_x, D_x bezeichnen wir die Zahlen aller, lediger, verheirateter, verwitweter, geschiedener Personen, die am Zähltage $(x - 0.5)$ oder mehr, jedoch weniger als $(x + 0.5)$ Jahre alt sind. Es ist

$$S_x + M_x + W_x + D_x = L_x \qquad /1/$$

Die Verhältniszahlen der ledigen, verheirateten, verwitweten, geschiedenen Personen bezeichnen wir mit einem Apostroph, nämlich

$$\begin{aligned} S'_x &= S_x : L_x \\ M'_x &= M_x : L_x \\ W'_x &= W_x : L_x \\ D'_x &= D_x : L_x \end{aligned} \qquad /2/$$

Es ist

$$S'_x + M'_x + W'_x + D'_x = 1 \qquad /3/$$

Mit $p_x, p_x^s, p_x^m, p_x^w, p_x^d$ bezeichnen wir die einjährigen Erlebenswahrscheinlichkeiten aller, lediger, verheirateter, verwitweter, geschiedener Personen.

Schliesslich bezeichnen wir mit $\mu_x^s, \mu_x^w, \mu_x^d$ die einjährigen Heiratswahrscheinlichkeiten der ledigen, verwitweten, geschiedenen Personen und mit δ_x die einjährigen Ehescheidungswahrscheinlichkeiten der Verheirateten.

Die Aufgabe, die wir uns stellen, ist, die Werte von $\mu_x^s, \mu_x^m, \mu_x^w, \delta_x$ aus S'_x, M'_x, W'_x, D'_x zu berechnen.

\+ \+ \+

Für eine stationäre Bevölkerung, d.i. für eine Bevölkerung konstanter Natalität, Nuptialität, Divortialität, Mortalität und ohne Migration gelten folgende Gleichungen:

$$L_{x+1} = L_x p_x \qquad /4/$$

$$S_{x+1} = S_x p_x^s (1 - \mu_x^s) \qquad /5/$$

$$M_{x+1} = M_x p_x^m p_y^m (1 - \delta_x) + (S_x p_x^s \mu_x^s + W_x p_x^w \mu_x^w + D_x p_x^d \mu_x^d)(1 - \tfrac{1}{2}\delta_x) \cdot (1 - \tfrac{1}{2} q_y^m) \qquad /6/$$

$$W_{x+1} = W_x p_x^w (1 - \mu_x^w) + M_x p_x^m q_y^m (1 - \tfrac{1}{2}\delta_x)(1 - \tfrac{1}{2}\mu_x^w) + (S_x p_x^s \mu_x^s + W_x p_x^w \mu_x^w + D_x p_x^d \mu_x^d)(1 - \tfrac{1}{2}\delta_x)\tfrac{1}{2} q_y^m \qquad /7/$$

$$D_{x+1} = D_x p_x^d (1 - \mu_x^d) + M_x p_x^m \delta_x (1 - \tfrac{1}{2}\mu_x^d) + (S_x p_x^s \mu_x^s + W_x p_x^w \mu_x^w + D_x p_x^d \mu_x^d) \tfrac{1}{2}\delta_x \qquad /8/$$

Vorstehende Formeln sind leicht verständlich. So z. B. ist die Zahl der Ledigen S_{x+1}/5/ gleich der Zahl S_x multipliziert mit der Erlebenswahrscheinlichkeit der x-jährigen Ledigen p_x^s und mit der Wahrscheinlichkeit, dass die Ledigen im Laufe des Jahres nicht heiraten $(1 - \mu_x^s)$. Desgleichen ist die Zahl der Verheirateten M_{x+1}/6/ gleich der Zahl M_x, multipliziert mit der Erlebenswahrscheinlichkeit der Gatten p_x^m, mit der Erlebenswahrscheinlichkeit der im Durchschnitt y Jahre alten Gattinen p_y^m und mit der Wahrscheinlichkeit, dass die Gatten im Laufe des Jahres nicht scheiden $(1 - \delta_x)$ vergrössert um den Zuwachs der im Laufe des Jahres Neuverheirateten. Dieser Zuwachs ist gleich den Zahlen der Ledigen, der Witwer, der Geschiedenen, jede Zahl multipliziert mit der entsprechenden Erlebens- und Heiratswahrscheinlichkeit, und die Summe der Produkte multipliziert mit der Wahrscheinlichkeit, dass die Gatten nach der Heirat jedoch vor Ablauf des Jahres nicht scheiden $(1 - \frac{1}{2}\delta_x)$ und mit der Wahrscheinlichkeit, dass die Gattinen vor Ablauf des Jahres nicht sterben $(1 - \frac{1}{2}q_y^m)$, wobei wir annehmen, dass die Ehen im Durchschnitt in der Mitte des Jahres geschlossen werden. Usw. Usw.

Eine derartige stationäre Bevölkerung existiert in Wirklichkeit so gut wie nicht. Infolgedessen müssen die Formeln /4/ bis /8/ geschrieben werden, wie folgt:

$$L_{x+1} = k_x L_x p_x \qquad /4^*/$$

$$S_{x+1} = k_x^s S_x p_x^s (1 - \mu_x^s) \qquad /5^*/$$

$$M_{x+1} = k_x^m [M_x p_x^m p_y^m (1 - \delta_x) + (S_x p_x^s \mu_x^s + W_x p_x^w \mu_x^w + D_x p_x^d \mu_x^d)(1 - \tfrac{1}{2}\delta_x)(1 - \tfrac{1}{2}q_y^m)] \qquad /6^*/$$

$$W_{x+1} = k_x^w [W_x p_x^w (1 - \mu_x^w) + M_x p_x^m q_y^m (1 - \tfrac{1}{2}\delta_x)(1 - \tfrac{1}{2}\mu_x^w) + (S_x p_x^s \mu_x^s + W_x p_x^w \mu_x^w + D_x p_x^d \mu_x^d)(1 - \tfrac{1}{2}\delta_x) \tfrac{1}{2}q_y^m] \qquad /7^*/$$

$$D_{x+1} = k_x^d [D_x p_x^d (1 - \mu_x^d) + M_x p_x^m \delta_x (1 - \tfrac{1}{2}\mu_x^d) + (S_x p_x^s \mu_x^s + W_x p_x^w \mu_x^w + D_x p_x^d \mu_x^d) \tfrac{1}{2}\delta_x] \qquad /8^*/$$

Die Grössen $k_x, k_x^s, k_x^m, k_x^w, k_x^d$ nennen wir Störfaktoren des stationären Zustandes der gesamten, ledigen, verheirateten, verwitweten, geschiedenen Bevölkerung. Dieselben hängen von den Änderungen der Natalität, Nuptialität, Divortialität, Mortalität, als auch von der Migration ab.

Für die weitere Rechnung nehmen wir zwei Hypothesen an und zwar:

1/ Wir nehmen an dass die Sterblichkeit von Zivilstande unabhängig ist, d.i.

$$p_x = p_x^s = p_x^m = p_x^w = p_x^d \qquad /9/$$

Dies entspricht selbstverständlich nicht ganz und gar der Wirklichkeit, jedoch diesbezüglicher Fehler ist erfahrungsgemäss so klein, dass er ohne weiteres vernachlässigt werden kann.

2/ Wir nehmen weiter an, dass auch die Störfaktoren des stationären

Zustandes vom Zivilstande unabhängig sind, d.i.

$$k_x = k_x^s = k_x^m = k_x^w = k_x^d \qquad /10/$$

Auch dies entspricht nicht ganz und gar der Wirklichkeit, jedoch der Fehler kann im Grossen und Ganzen nicht gross sein. Je grösser die Natalität und die Immigration ist und je kleiner die Sterblichkeit ist, desto grösser ist nicht nur L_x sondern auch S_x, M_x, W_x, D_x und umgekehrt.

Mittels Division von /5*/, /6*/, /7*/, /8*/, durch /4*/ und unter Beachtung von /2/, /9/, /10/ bekommen wir folgende vier für die Berechnung der Unbekannten μ_x^s, μ_x^w, μ_x^d, δ_x notwendige und ausreichende Gleichungen:

$$S'_{x+1} = S'_x (1 - \mu_x^s) \qquad /11/$$

$$M'_{x+1} = M'_x p_y (1 - \delta_x) + (S'_x \mu_x^s + W'_x \mu_x^w + D'_x \mu_x^d)(1 - \tfrac{1}{2}\delta_x)(1 - \tfrac{1}{2}q_y) \qquad /12/$$

$$W'_{x+1} = W'_x (1 - \mu_x^w) + M'_x q_y (1 - \tfrac{1}{2}\delta_x)(1 - \tfrac{1}{2}\mu_x^w) + (S'_x \mu_x^s + W'_x \mu_x^w + D'_x \mu_x^d)(1 - \tfrac{1}{2}\delta_x)\tfrac{1}{2}q_y \qquad /13/$$

$$D'_{x+1} = D'_x (1 - \mu_x^d) + M'_x \delta_x (1 - \tfrac{1}{2}\mu_x^d) + (S'_x \mu_x^s + W'_x \mu_x^w + D'_x \mu_x^d)\tfrac{1}{2}\delta_x \qquad /14/$$

Sofern unsere Hypothesen über die Unabhängigkeit der Sterblichkeit und der Störfaktoren vom Zivilstande der Wirklichkeit entsprechen, sind die Formeln /11/ bis /14/ exakt, sonst sind sie aber Näherungsformeln, deren Präzision davon abhängt, wie weit unsere Hypothesen von der Wirklichkeit abweichen.

Die Berechnung von μ_x^s aus /11/ ist sehr einfach, wogegen die Bestimmung von μ_x^w, μ_x^d, δ_x aus /12/, /13/, /14/ mit rechnerischen Schwierigkeiten verbunden ist, da die Elimination je zweier Unbekannten zu einer Gleichung vierten Grades der dritten Unbekannten führt. Wir haben also für jedes Alter x eine biquadratische Gleichung aufzulösen um μ_x^w, μ_x^d, δ_x zu bestimmen.

Gegen vorstehende Methode der Berechnung von μ_x^w, μ_x^d, δ_x aus /12/, /13/, /14/ kann man einwenden, dass die Ehescheidungswahrscheinlichkeiten δ_x und die Sterbenswahrscheinlichkeiten der Frauen q_y für die im letzten Jahre die Ehe Schliessenden nicht dieselben sind, wie für die übrigen Verheirateten, welche die Ehe schon vor einem oder mehreren Jahren geschlossen haben. Das gleiche gilt auch für μ_x^w /13/ und μ_x^d /14/ für diejenigen Verheirateten, die im letzten Jahre Witwer oder Geschiedene geworden sind. Aus diesem Grunde sind nach Möglichkeit im Gleichungssystem /12/, /13/, /14/ passende Korrekturen anzubringen.

\+ \+ \+

Vor Auflösung des Gleichungssystems /11/ bis /14/ müssen die empirischen Werte S'_x M'_x W_x D_x fein ausgeglichen werden, weil schon recht kleine Fehler der empirischen Werte sehr grosse Diskontinuitäten in der Folge der Zahlen μ_x^s, μ_x^w, μ_x^d, δ_x verursachen. Die graphischen und mechanischen Ausgleichsmethoden haben nicht die notwendige Feinheit. Es kommt daher nur analytische Ausgleichung in Betracht. In die Einzelheiten der analytischen Ausgleichung von S'_x, M'_x, W'_x, D'_x, welche wir im nachstehenden zahlenmässigen Beispiel angewendet haben, können wir an dieser Stelle leider nicht eingehen. Wir bemerken nur, dass es am besten ist, analog der Gompertz-Makeham-schen Idee vorzugehen, nämlich die Nuptialität und Divortialität

mittels "force of nuptiality" bzw. "force of divorciality" zu erklären, welche mit der Intensität $I(x)$ gemessen wird. Unter der Intensität einer Funktion $f(x)$ versteht man die Änderung der Funktion in der unendlich kleinen Zeit dx, berechnet auf Funktions- und Zeiteinheit.

$$I(x) = \frac{df(x)}{f(x)dx} \qquad /15/$$

Die Funktion $f(x)$ ist so zu wählen, dass sie im niedrigsten heiratsfähigen Alter und im Alter, mit welchem die analytische Ausgleichung abgeschlossen wird, gegebenen Anfangsbedingungen nicht nur in Bezug auf den Wert sondern auch in Bezug auf die erste Ableitung genügt. Ausserdem muss die Funktion $f(x)$ eine entsprechende Zahl von Parametern enthalten, die nach der Methode der kleinsten Quadrate so zu bestimmen sind, dass sich die ausgeglichenen Werte möglichst an die empirischen Werte anschmiegen. Zu beachten ist, dass die ausgeglichenen Werte wenigstens auf fünf oder sechs Dezimalen berechnet werden müssen.

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Wir haben unsere theoretischen Ausführungen an der Alters- und Zivilstandgruppierung der jugoslawischen männlichen Bevölkerung am Zähltage 15.III.1948 zahlenmässig überprüft.[1] Die empirischen Verhältniszahlen S'_x, M'_x, W'_x, D'_x sind auf vier Dezimalen abgerundet in der Tabelle 1 gegeben. Die eingeklammerten Geburtsjahre von /1915/ bis /1895/ bzw. die eingeklammerten Altersjahre von /33/ bis /53/ bedeuten Quinquennien, da die empirischen Zahlen für einzelne Altersjahre nur von $x = 15$ bis $x = 30$ vorliegen. Die empirischen Zahlen für $x \geq$ /53/ haben wir bei der Ausgleichung nicht berücksichtigt, weil dieselben unzuverlässig sind. Die Grössen μ'_x, μ^w_x, μ^d_x, s_x für $x \geq 53$ können übrigens am besten mittels geeigneter Extrapolation bestimmt werden.

1/ Von der Überprüfung der Methode an der jugoslawischen weiblichen Bevölkerung mussten wir absehen, da die Zahlen der Witwen W_y durch die beiden Weltkriege stark perturbiert sind, so dass wir die daraus sich ergebenden Schwierigkeiten der analytischen Ausgleichung von W'_y bisher nicht bewältigen konnten.

Empirische Verhältniszahlen der jugoslawischen männlichen Bevölkerung nach Zivilstand und Alter am Zähltage 15.III.1948.

Geburtsjahr	Alter	Ledige	Verheiratete	Verwitwete	Geschiedene
	x	100 S'_x	100 M'_x	100 W'_x	100 D'_x
1	2	3	4	5	6
1933	15	100.00	0.00	0.00	0.00
1932	16	99.37	0.62	0.01	0.00
1931	17	97.96	2.00	0.03	0.01
1930	18	94.67	5.27	0.04	0.02
1929	19	88.45	11.42	0.07	0.06
1928	20	79.83	19.93	0.14	0.10
1927	21	77.86	21.86	0.15	0.13
1926	22	70.61	29.04	0.19	0.16
1925	23	63.45	36.09	0.24	0.22
1924	24	55.76	43.64	0.31	0.29
1923	25	49.02	50.22	0.40	0.36
1922	26	42.08	57.02	0.50	0.40
1921	27	36.27	62.73	0.56	0.44
1920	28	30.43	68.30	0.75	0.52
1919	29	23.04	75.85	0.61	0.50
1918	30	21.03	77.65	0.73	0.59
/1915/	/33/	14.42	83.91	1.01	0.66
/1910/	/38/	9.10	88.48	1.71	0.71
/1905/	/43/	6.38	90.02	2.89	0.71
/1900/	/48/	4.99	89.71	4.63	0.67
/1895/	/53/	4.60	88.10	6.59	0.71

Tabelle 1.

Die analytisch ausgeglichenen Verhältniszahlen sind mit S''_x, M''_x, W''_x, D''_x bezeichnet und in der Tabelle 2 gegeben. Dieselben sind aus den Zahlen der Tabelle 1 nach folgenden Formeln auf sechs Dezimalen genau berechnet:

$$\left.\begin{aligned} S''_x &= 1 - 0.9537e^{0.014\xi + 0.19263\eta - 1.46424\eta^2 - 0.31630\eta^3} \\ \xi &= \ln \frac{x - 16}{38} \\ \eta &= \frac{53 - x}{38} + \ln \frac{x - 15}{38} \end{aligned}\right\} \quad /16/$$

$$W''_x = 0.0659\left(\frac{x - 15}{38}\right)^{2.037 + 0.00092(x - 15)^2} \quad /17/$$

$$\left.\begin{aligned} D''_x &= 0.007e^{2.7436\eta} \\ \eta &= \frac{38 - x}{23} + \ln \frac{x - 15}{23} \end{aligned}\right\} \text{ für } x = 15, 16, \ldots 38$$

$$D''_x = 0.007 \text{ für } x = 38, 39, \ldots 53 \quad /18/$$

$$M''_x = 1 - S''_x - W''_x - D''_x \quad /19/$$

Da Jugoslawien keine für das ganze Staatsgebiet giltige Sterbetafel hat, haben wir die Sterbenswahrscheinlichkeiten der Frauen q_y durch eine lineare Kombination der beiden slowenischen Volkssterbetafeln aus der Beobachtungsperiode 1931/33[2] bzw. 1948/52[3] ermittelt. Aus verschiedenen Erfahrungen haben wir festgestellt, dass folgende lineare Kombination

$$q_y = 0.8q_y^{31/33} + 0.2q_y^{48/52} \quad /20/$$

am besten der Frauensterblichkeit in ganz Jugoslawien entspricht. Die nach /20/ berechneten Sterbenswahrscheinlichkeiten der Frauen q_y sind in der Spalte /6/ der Tabelle 2 gegeben.

2/ Lah Ivo: "Bases techniques pour les assurances sur la vie", Državni zavod za socijalno osiguranje, Zagreb, 1947.

3/ Dr. Blejec Marijan: "Tablice umrljivosti prebivalstva LR Slovenije", Zavod za statistiko LR Slovenije, Ljubljana, 1955.

Analytisch ausgeglichene Verhältniszahlen der jugoslawischen männlichen Bevölkerung nach Zivilstand und Alter am Zähltage 15.III.1948. und ausgeglichene Sterbenswahrscheinlichkeiten jugoslawischer Frauen.

Alter	Ledige	Verheiratete	Verwitwete	Geschiedene	Sterbenswahrscheinlichkeiten der Frauen
x, y	1000 S''_x	1000 M''_x	1000 W''_x	1000 D''_x	1000 q_y
1	2	3	4	5	6
15	1000.000	0.000	0.000	0.000	
16	993.414	6.528	0.040	0.018	
17	977.490	22.243	0.162	0.105	
18	944.307	55.042	0.366	0.285	
19	894.090	104.704	0.650	0.556	
20	830.546	167.533	1.010	0.911	3.22
21	758.746	238.478	1.443	1.333	3.45
22	683.553	312.696	1.946	1.805	3.63
23	608.897	386.277	2.515	2.311	3.77
24	537.586	456.432	3.148	2.834	3.84
25	471.399	521.401	3.842	3.358	3.88
26	411.299	580.234	4.595	3.872	3.92
27	357.644	632.587	5.406	4.363	3.97
28	310.380	678.523	6.274	4.823	4.05
29	269.192	718.362	7.200	5.246	4.18
30	233.614	752.575	8.185	5.626	4.35
31	203.100	781.709	9.230	5.961	4.54
32	177.090	806.325	10.337	6.248	4.73
33	155.035	826.967	11.511	6.487	4.91
34	136.413	844.153	12.756	6.678	5.08
35	120.755	858.346	14.076	6.823	5.24
36	107.632	869.967	15.478	6.923	5.41
37	96.668	879.381	16.970	6.981	5.61
38	87.528	886.912	18.560	7.000	5.82
39	79.929	892.813	20.258	7.000	6.06
40	73.624	897.301	22.075	7.000	6.29
41	68.399	900.576	24.025	7.000	6.50
42	64.070	902.808	26.122	7.000	6.67
43	60.496	904.120	28.384	7.000	6.80
44	57.537	904.635	30.828	7.000	6.91
45	55.096	904.426	33.478	7.000	7.01
46	53.078	903.564	36.358	7.000	7.16
47	51.418	902.087	39.495	7.000	7.36
48	50.048	900.029	42.923	7.000	7.66
49	48.927	897.395	46.678	7.000	8.08
50	48.017	894.181	50.802	7.000	8.60
51	47.287	890.371	55.342	7.000	9.23
52	46.722	885.924	60.354	7.000	9.93
53	46.300	880.800	65.900	7.000	

Tabelle 2.

Wir haben weiter angenommen, dass das Alter des Gatten durchweg dem Alter der Gattin gleich ist, d.h. wir haben angenommen $x = y$ was selbstverständlich durchaus nicht der Fall ist. Es müsste vielmehr für jedes Alter der Gatten x das durchschnittliche Alter der Gattinen y berechnet werden. Die so berechneten empirischen Durchschnittsalter der Gattinen müssten nachher fein analytisch ausgeglichen werden. Schliesslich müssten die Sterbenswahrscheinlichkeiten q_y für nicht ganzzahlige y nach Parabeln interpoliert werden. Wir haben jedoch von diesen Berechnungen Abstand genommen, weil die nach /20/ berechneten q_y nur annähernd der Wirklichkeit entsprechen.

Um die Berechnung von μ_x^w, μ_x^d, δ_x aus /12/, /13/, /14/ zu vereinfachen, haben wir angenommen, dass die Sterblichkeit der Gattinen im ersten Jahre nach der Hochzeit - im Durchschnitt handelt es sich nur um ein halbes Jahr - praktisch gleich Null sei. Weiter haben wir das Produkt $q_y \delta_x$ in /13/, welches eine Grösse der zweiten Ordnung der Kleinheit darstellt, gleich Null gesetzt. Ausserdem haben wir in /14/ das letzte Glied vernachlässigt. Dadurch vereinfacht sich das Formelsystem /11/ bis /14/ wie folgt:

$$\mu_x^s = \frac{S''_x - S''_{x+1}}{S''_x} \qquad /21/$$

$$\mu_x^w = \frac{W''_x + M''_x q_y - W''_{x+1}}{W''_x + \frac{1}{2} M''_x q_y} \qquad /22/$$

$$\mu_x^d = \frac{D''_x + M''_x \delta_x - D''_{x+1}}{D''_x + \frac{1}{2} M''_x \delta_x} \qquad /23/$$

$$\delta_x = \frac{M''_x p_y + (S''_x \mu_x^s + W''_x \mu_x^w + D''_x \mu_x^d) - M''_{x+1}}{M''_x p_y + \frac{1}{2}(S''_x \mu_x^s + W''_x \mu_x^w + D''_x \mu_x^d)} \qquad /24/$$

Zunächst haben wir die Werte von μ_x^s und μ_x^w nach /21/ und /22/ berechnet. Nachher haben wir δ_x aus /24/ unter der Annahme berechnet, dass die Heiratswahrscheinlichkeiten der Geschiedenen diegleichen sind wie die der Witwer. Schliesslich haben wir noch μ_x^d aus /23/ berechnet. Die so ermittelten Werte μ_x^s, μ_x^w, μ_x^d, δ_x sind in der Tabelle 3 gegeben.

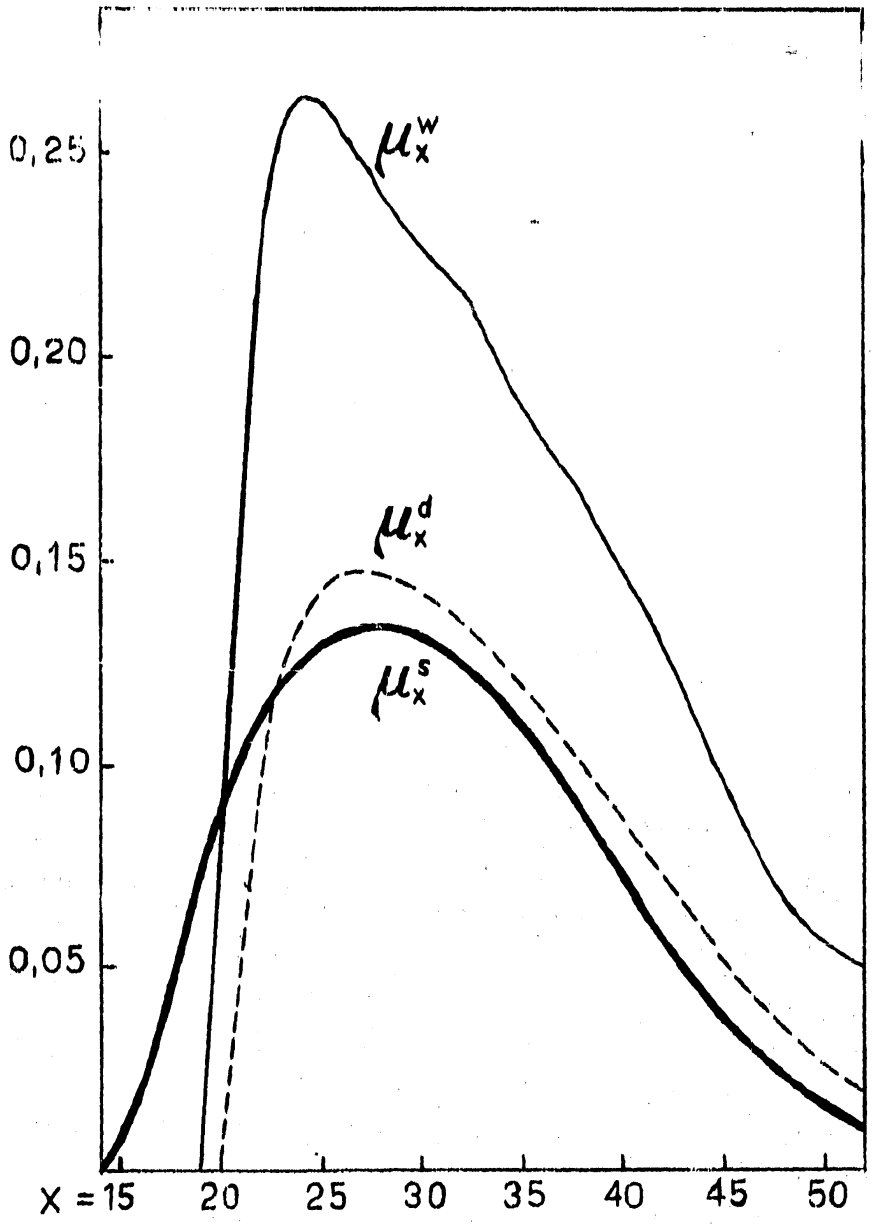
Einjährige Heiratswahrscheinlichkeiten der ledigen, verwitweten geschiedenen Männer und einjährige Ehescheidungswahrscheinlichkeiten der verheirateten Männer, berechnet aus den Ergebnissen der jugoslawischen Volkszählung vom 15.III.1948.

Alter	Heiratswahrscheinlichkeiten der			Ehescheidungswahrscheinlichkeiten
	Ledigen	Verwitweten	Geschiedenen	
x	$100\ \mu_x^s$	$100\ \mu_x^w$	$100\ \mu_x^d$	$100\ \delta_x$
1	2	3	4	5
15	0.66			
16	1.60			
17	3.40			
18	5.32			
19	7.11			
20	8.65	8.32	0.00	0.23
21	9.91	17.24	4.47	0.23
22	10.92	22.52	9.16	0.23
23	11.71	25.39	11.95	0.22
24	12.31	26.31	13.50	0.21
25	12.75	26.17	14.26	0.21
26	13.05	25.53	14.55	0.20
27	13.22	24.67	14.59	0.19
28	13.27	23.82	14.46	0.18
29	13.22	23.19	14.36	0.17
30	13.06	22.69	14.18	0.16
31	12.81	22.19	13.86	0.15
32	12.45	21.56	13.50	0.14
33	12.01	20.79	13.03	0.13
34	11.48	19.92	12.41	0.12
35	10.87	18.96	11.79	0.11
36	10.19	18.04	11.07	0.10
37	9.46	17.20	10.47	0.09
38	8.68	16.38	9.88	0.08
39	7.89	15.65	9.13	0.08
40	7.10	14.84	8.47	0.07
41	6.33	13.94	7.79	0.06
42	5.58	12.91	7.09	0.06
43	4.89	11.77	6.39	0.05
44	4.24	10.61	5.77	0.05
45	3.66	9.44	5.04	0.04
46	3.13	8.42	4.42	0.04
47	2.66	7.50	3.92	0.03
48	2.24	6.77	3.41	0.03
49	1.86	6.22	3.03	0.02
50	1.52	5.76	2.52	0.02
51	1.20	5.39	2.26	0.02
52	0.90	5.02	1.88	0.01

Tabelle 3

Die Grössen $\mu_x^s, \mu_x^w, \mu_x^d$ sind übersichtshalber in der Figur 1 graphisch dargestellt. Trotz allen Unzulänglichkeiten unserer Rechnung zeigen die Kurven von $\mu_x^s, \mu_x^w, \mu_x^d$ den typischen Verlauf der Heiratswahrscheinlichkeiten der ledigen, verwitweten, geschiedenen Bevölkerung, wie die Heiratswahrscheinlichkeiten, welche einige Länder mit der klassischen Methode, d.i. mit den Elementargesamtheiten der Eheschliessenden bisher berechnet haben.

EINJÄHRIGE HEIRATSWAHRSCHEINLICHKEITEN DER LEDIGEN, VERWITWETEN UND GESCHIEDENEN MÄNNER, BERECHNET AUS DEN ERGEBNISSEN DER JUGOSLAVISCHEN VOLKSZÄHLUNG VOM 15.III.1948.



Figur 1

+ + +

Der vorstehend skizzierten neuen Methode der Berechnung der Heirats- und Ehescheidungswahrscheinlichkeiten kommt unseres Erachtens nicht nur eine theoretische sondern auch eine praktische Bedeutung zu.

In theoretischer Hinsicht erwähnen wir, dass verschiedene demographische Massenerscheinungen durch "Kräfte" gedeutet und analytisch ausgeglichen werden können, genau so und mit demselben Erfolg wie Gompertz /1825/ und Makeham /1860/ die Sterblichkeit mit "force of mortality" geklärt und analytisch ausgeglichen haben. Diese Art der Ausgleichung kann die mathematische Statistik fördern.

In praktischer Hinsicht bemerken wir, dass aus den Ergebnissen jeder soliden Volkszählung Fertilitäts, Nuptialitäts und Divortialitätstafeln rasch und leicht konstruiert werden können, ganz abgesehen davon, ob die Statistik der natürlichen Bewegung der Bevölkerung funktioniert oder nicht. Die klassische Konstruktion von demographischen Tafeln mittels Elementargesamtheiten ist bekanntlich sehr kostspielig und zeitraubend. Aus diesem Grunde haben bisher nur recht wenige Länder Fertilitäts-, Nuptialitäts- und Divortialitätstafeln konstruiert. Mit der neuen Methode kann dieser Nachteil behoben werden, was das Studium der demographischen Vorgänge in allen Ländern fördern wird.

CALCULATION OF MARRIAGE RATES FOR SINGLES, WIDOWED AND DIVORCED PERSONS AS WELL AS OF DIVORCE RATES FROM CENSUS STATISTICS

Summary

The author puts himself the task to calculate the marriage and divorce rates from the population structure by age and marital status.

The formulas /4/ to /8/ do hold for the stationary population and the formulas /4*/ to /8*/ for the non-stationary one.

The formulas /11/ to /14/ from which the marriage and divorce rates might be computed, have been deduced from /4*/ to /8*/ on the assumption that the mortality /9/ and the perturbation factors of the stationary status /10/ do not depend on marital status.

The method is numerically examined by the male population structure of Yugoslavia obtained from the Population Census as of March 15, 1948 /Table 1/.

The analytically graduated structure of the male population of Yugoslavia is presented in Table 2.

The formulas /21/ to /24/ which served for computation of marriage and divorce rates and which are numerically exposed in table 3 and graphically in figure 1, have been obtained by simplification of the formulas /11/ to /14/.

Finally, the author stresses the possibility of a rapid and easy construction of fertility, nuptiality and divorce tables from census statistics i.e. without recurring to vital ones, what might well promote the population studies of single countries.

LE CALCUL DU TAUX DE MARIAGE POUR LES CELIBATAIRES, VEUFS ET DIVORCES AUSSI BIEN QUE DU TAUX DE DIVORTIALITE A PARTIR DES DONNEES DE RECENSEMENT

Résumé

L'auteur s'est chargé de présenter une solution du problème du calcul du taux de mariage et de divortialité à partir de la structure de la population selon l'âge et l'état matrimonial.

Quant à la population stationnaire, les formules /4/ à /8/ seront à appliquer et celles de /4*/ à /8*/ au cas d'une population non-stationnaire.

Les formules /11/ à /14/ à l'aide desquelles on peut calculer les taux des mariages et des divorces sont déduites de /4*/ à /8*/ sous l'hypothèse que ni la mortalité /9/ ni les facteurs perturbateurs de l'état stationnaire /10/ ne se trouvent en dépendance de l'état matrimonial.

La méthode était examinée numériquement à l'aide de la structure de la population masculine de la Yougoslavie obtenue à la base du Recensement de la population du 15 mars 1948 /Tableau 1/.

La structure de la population masculine de la Yougoslavie ajustée analytiquement se trouve au Tableau 2.

Les formules /21/ à /24/, à l'aide desquelles les taux de mariage et de divortialité sont calculés et présentés numériquement au Tableau 3 et graphiquement au Figure 1, sont obtenues par la simplification des formules /11/ à /14/.

A la fin, l'auteur souligne l'importance du fait que les tables de fécondité, de nuptialité et de divortialité peuvent être calculées très facilement à partir des données provenant des recensements de la population et sans recourir à celles des statistiques de l'état civil, ce qui représente incontestablement une facilité assez considérable pour l'avancement des recherches démographiques des pays individuels.

ISI

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DIE ORGANISATION DES STATISTISCHEN DIENSTES IN DEN EUROPÄISCHEN GROSSTÄDTEN

/85/

von
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Die amtliche Statistik der Länder und Gemeinden ist ein Teil der staatlichen bzw. der regionalen Verwaltungsorganisation. Sie dient in erster Linie Zwecken der Regierung und Verwaltung und empfängt von diesen ihre Aufgaben. Die Organisation des statistischen Dienstes in den Grosstädten hängt daher entscheidend von dem in den einzelnen Staaten herrschenden staatsrechtlichen Zustand, von dem Verhältnis der regionalen Körperschaften zur staatlichen Gewalt und nicht zuletzt von der Städteverfassung ab. Straffe staatliche Zentralverwaltung muss eine andere Organisation der Städtestatistik zur Folge haben als Städtefreiheit mit grösserer Selbstverwaltung. Auch die Grösse der Gemeinde kann eine Rolle spielen, da selbständige Ämter in Städten unterhalb der Grossstadtgrenze selten sind.

Die statistischen Ämter sind entstanden aus dem Bedürfnis der Stadtverwaltungen, sich über Zahl, Struktur und Entwicklung der Bevölkerung zu unterrichten, Einblicke in die wirtschaftliche Struktur der Stadt zu erhalten oder auch Unterlagen für steuerliche Massnahmen zu gewinnen. Ausserdem mussten die einmal beschlossenen und durchgeführten Massnahmen überprüft werden. In einer Zeit sich stark entwickelnder Industrie und der damit zusammenhängenden Ballung der Menschen in den grossen Städten war eine solche zahlenmässige Gesamtschau besonders notwendig. In den einzelnen Dienststellen der städtischen Verwaltung war bereits vorher statistisches Material vorhanden. Es fiel im Laufe der Verwaltungstätigkeit z.T. ohne besondere Arbeit an und konnte Auskunft über die Leistung der Dienststellen geben. Eine systematische Sammlung dieser statistischen Zahlen und ihre Auswertung nach einheitlichen methodischen Grundsätzen wurde aber erst betrieben, als die statistischen Ämter in Funktion traten.

Ihnen wurden im Laufe der Jahre zwei grosse Aufgabengebiete übertragen. Sie haben primärstatistische Erhebungen für die Zentralstellen durchzuführen. Die örtlichen Ergebnisse derartiger Zählungen sind für die eigene Verwaltung auszuwerten. Sie haben aber auch das sekundärstatistische Material, das in den Dienststellen der Verwaltung anfällt, zu sammeln und für Zwecke der Verwaltungsführung nutzbar zu machen. Diese letzte Aufgabe ist als

besonders wichtig anzusehen, war sie doch der Anlass zur Errichtung der städtestatistischen Ämter, verschaffte ihnen im Rahmen der gesamten amtlichen Statistik die Selbständigkeit und prägte ihnen ein eigenes Gesicht. Die zentrale Statistik könnte zwar einen grossen Zensus mit Hilfe eines eigenen dafür aufgebauten Verwaltungsapparates durchführen. Es wird ihr aber trotz der modernen Hilfsmittel nicht möglich sein, "eine so genaue und vollständige Beschreibung der grosstädtischen Zustände und Vorgänge mit den für die städtische Verwaltung erforderlichen, bis in Einzelheiten reich gegliederten Unterlagen zu liefern". [1] Wie weit diese beiden Aufgabengebiete für die Arbeit der modernen Städtestatistik massgebend sind, soll im Laufe der folgenden Untersuchung dargestellt werden.

Nachdem zu Beginn des 19. Jahrhunderts verschiedene Staaten statistische Ämter gegründet hatten, folgten einige Grosstädte in der zweiten Hälfte des Jahrhunderts. Im Jahre 1862 errichteten derartige Ämter Berlin, Wien und Rom, 1865 Frankfurt a.M., 1866 Hamburg, New York und Riga, 1867 Leipzig, 1868 Stockholm, 1869 Budapest, 1871 Altona und Lübeck, 1873 Breslau und Chemnitz, 1874 Dresden, 1875 München, 1879 Paris und 1883 Kopenhagen, um die ersten Anfänge der städtestatistischen Ämter zu nennen. Damit beginnt keineswegs erst die statistische Bestätigung der Städte. Sogenannte Volkszählungen der Städte reichen bis ins 14. und 15. Jahrhundert zurück.[2] Aus der Stadt Florenz liegen Volkszählungsergebnisse für das Jahr 1380 vor, aus Treviso für 1384 und 1396, aus Padua für 1411 und 1420. In Ypern fanden Volkszählungen in den Jahren 1412, 1431, 1437, 1491 und 1506 statt, in Freiburg im Üchtland 1444, in Nördlingen 1459, in Nürnberg 1449, in Strassburg 1473/77. Damit soll keine erschöpfende Darstellung gegeben werden, es soll nur an einigen Beispielen auf die Anfänge der Städtestatistik und der städtestatistischen Ämter hingewiesen werden. Darüber hinaus lagen in den Städten Listen über die Wehrfähigen, die Steuerpflichtigen, die Feuerstellen, die Bodenverhältnisse, sowie Bürger-, Handwerker-, Zunftlisten und dgl. vor, die noch nicht statistische Arbeiten in unserem Sinne darstellen. Auf weitere Einzelheiten kann hier jedoch nicht eingegangen werden, es sollte in diesem Zusammenhang nur die Stellung der Städtestatistik innerhalb der gesamten Statistik und in der historischen Entwicklung gekennzeichnet werden. Daraus erhellen gleichzeitig Notwendigkeit und bis zu einem gewissen Grade Bedeutung der städtestatistischen Arbeit.

Im Laufe des Bestehens dieser Einrichtungen haben sich Aufgabenkreis und Organisation gewandelt, je nach den Aufgaben, die die Stadtverwaltungen übernehmen mussten, und nach der Stellung, die ihnen die staatlichen Organe übertragen haben. Um den neusten Stand darstellen zu können, hat das Internationale Statistische Institut eine Rundfrage zu Beginn des Jahres 1957 in den europäischen Ländern veranstaltet. Dazu bestand umso mehr Veranlassung, als im Institut ein Ausschuss für Grosstadtstatistik gebildet ist und von ihm das Internationale Jahrbuch der Grosstädte herausgegeben wird. Ausserdem ist eine Sektion "Städtestatistik" gebildet worden, die erstmalig auf dem 30. Internationalen Kongress in Stockholm zu-

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1 Vgl. Wilhelm Morgenroth, "Städtische Statistische Ämter", im Handwörterbuch der Staatswissenschaften, 7. Band 4. Aufl. Jena 1926, S. 945 ff.

2 Vgl. Richard Korherr, "Geschichte der Städtestatistik", in Die deutsche Kommunalstatistik, Stuttgart und Berlin 1938, S.36 ff.

sammentritt. Es war daher notwendig, einen Überblick über die Organisation des städtestatistischen Dienstes zu erhalten, der für den Erfahrungsaustausch zwischen den Ländern wichtig ist und für die Auswertung der Zahlenangaben aus den einzelnen Ländern von Bedeutung sein kann.

Die Fragebogen sind von 20 europäischen Ländern beantwortet worden. Es fehlen die Angaben von Belgien, Rumänien, UdSSR und der Türkei sowie evtl. von Ägypten, wenn die Länder berücksichtigt werden sollen, die am Internationalen Jahrbuch der Grosstädte mitarbeiten. Die vorliegenden Antworten geben bereits einen so gut Überblick, dass eine Darstellung lohnend und interessant ist und den genannten Zweck erreicht.

Als Kriterium für das Vorhandensein eines statistischen Amtes wurde es angesehen, wenn die statistischen Arbeiten aus dem Bereich der einzelnen Fachdienststellen herausgelöst und in einer zentralen Dienststelle, der die Bearbeitung sämtlicher statistischen Angelegenheiten der Verwaltung obliegt, zusammengefasst sind. Nur im Falle einer Zentralisation der Statistik kann von einem statistischen Amt gesprochen werden. Es kam also darauf an zu erfahren, ob in den Grosstädten noch die frühere Form der unausgelösten, dezentralisierten Statistik Gültigkeit hat oder ob besondere statistische Dienststellen bestehen.

Aus dem Aufgabenbereich der statistischen Ämter konnten nur wenige Angaben erfragt werden. Wesentlich ist für die Organisation des Amtes, ob statistische Erhebungen laufender oder einmaliger Art, wie etwa eine Volkszählung, im Auftrage der statistischen Zentralstellen durchgeführt werden. Dabei wird es sich meist um das Verteilen und Einsammeln der Zählpapiere handeln sowie um die Prüfung auf Vollzähligkeit der Papiere und Vollständigkeit der Antworten. Schliesslich ist nicht unwichtig für die Arbeit des statistischen Amtes, ob es die Auswertung der örtlichen Ergebnisse dieser zentralen Erhebungen vornimmt. Dies setzt bereits eine gewisse Selbständigkeit des regionalen Amtes voraus und eine gefestigte Stellung innerhalb der örtlichen Verwaltungsorganisation.

In der gleichen Richtung läuft die Frage, ob die grosstädtischen Ämter statistische Erhebungen für eigene Zwecke durchführen, ob sie ferner von der eigenen Verwaltung mit besonderen Untersuchungen und Gutachten beauftragt sind. Dies würde eine gute Organisation des Amtes voraussetzen, vor allem einen Amtsleiter, der über methodische Kenntnisse der Statistik und praktische Erfahrung in der Auswertung statistischer Zahlen und in der Verwaltungstätigkeit verfügt. Aus diesem Grunde wurde auch die Frage aufgenommen, ob der Leiter des Amtes eine wissenschaftliche akademische Ausbildung besitzt. Diese Frage wird nicht immer einheitlich beantwortet sein, weil die Ausbildung auf den Hochschulen in den einzelnen Ländern verschiedenartig ist. In Deutschland wird z. B. Wert gelegt auf eine abgeschlossene Hochschulbildung mit dem Diplom-Examen, evtl. der Doktor-Promotion. Das ist aber nicht in allen Ländern der Fall. In Italien wird gesetzlich ein besonderer Fähigkeitsnachweis verlangt, der nicht unbedingt der Hochschulausbildung in anderen Ländern zu entsprechen braucht. Dies muss also bei Vergleichen beachtet werden. Es kam in der vorliegenden Untersuchung nicht darauf an, die Vorbildung der Amtsleiter zu analysieren, sondern ein weiteres Kriterium für die Organisation der Städtestatistik

zu gewinnen.

Schliesslich wurde als Anhaltspunkt für eine intensive Arbeit der Ämter das Veröffentlichungswesen angesehen. So wurde nicht nur die Herausgabe laufender Monats-, Vierteljahres- und Jahresberichte erfragt, sondern auch die Publikation von Sonderuntersuchungen, die auf eine besonders intensive wissenschaftliche Arbeit des Amtes schliessen lässt. Dadurch wird das Zahlenmaterial mit einer wissenschaftlichen Auswertung nicht nur der eigenen Verwaltung zugängig gemacht, sondern auch einer breiteren Öffentlichkeit, vor allem anderen statistischen Ämtern, wie überhaupt der Wissenschaft, übergeben. In den letzteren Fällen würde es sich also um ein besonders gut organisiertes und ausgebautes Amt handeln.

Damit hat sich die Fragestellung in der Rundfrage des Internationalen Statistischen Instituts erschöpft. Weitere Fragen etwa nach der Art der wissenschaftlichen Vorbildung des Amtsleiters, nach der Zahl der wissenschaftlichen Mitarbeiter und des sonstigen Personals, nach dem Vorhandensein technischer Hilfsmittel oder einer Bücherei, nach der Übertragung anderer Verwaltungsarbeiten auf das statistische Amt sind nicht gestellt worden, um die Rundfrage nicht zu umfangreich zu gestalten und damit die Beantwortung und die Auswertung zu erschweren. So ist nur ein erster grober Überlick über die Organisation des städtestatistischen Dienstes möglich. Es wurden auch nur die Verhältnisse in den Grosstädten berücksichtigt, um die Antworten nicht zu komplizieren. Erfahrungsgemäss besteht in den kleineren Städten nicht so sehr die Neigung, stätistische Arbeiten in einer besonderen Diensstelle zu konzentrieren, wenn auch die Grosstadtgrenze von 100.000 Einwohnern für die Schaffung eines statistischen Amtes nicht überall massgebend ist.

Um einen möglichst vollständigen Überblick geben zu können, wird im folgenden auf jedes einzelne Land eingegangen und die dort vorhandene Organisation dargestellt. Dabei sei wegen der Verhältnisse in früheren Jahren auf die bereits zitierte Untersuchung von Morgenroth verwiesen, die einen Anhaltspunkt für die Veränderung in den letzten 30 Jahren geben kann. Den Gepflogenheiten des Internationalen Statistischen Instituts entsprechend soll die Beschreibung der Länder in der alphabetischen Reihenfolge nach der französischen Schreibweise erfolgen, zumal in der gleichen Weise in den Veröffentlichungen des Internationalen Statistischen Instituts, insbesondere im Internationalen Jahrbuch der Grosstädte, verfahren wird.

1. DEUTSCHLAND[3]

In den 54 Grosstädten sind statistische Ämter eingerichtet worden. Mit Ausnahme von 6 Städten sind sie selbständige Dienststellen, in denen die statistische Arbeit der Verwaltung zentra-

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[1] Ausführlich behandelt in Bernhard Mewes, "Die Kommunalstatistik", in Handbuch der kommunalen Wissenschaft und Praxis, Bd. I, Berlin, Heidelberg, Göttingen 1956, S. 612. - Vgl. auch vom gleichen Verfasser, "Städtestatistik", im Handwörterbuch der Sozialwissenschaften, 15. Lieferung, Stuttgart, Tübingen, Göttingen 1957, S.63.

lisiert ist. Gewöhnlich ist ihnen auch die Aufsicht über die Geschäftsstatistiken der übrigen Fachdienststellen übertragen. In den 6 Ausnahmefällen handelt es sich zwar um zentralisierte Statistik, aber um unselbständige Stellen, die mit anderen Dienststellen zusammengefasst sind. Sie haben sämtliche Auftragsstatistiken des Statistischen Bundesamtes bzw. der Statistischen Landesämter, soweit sie gesetzlich übertragen werden, für den örtlichen Bereich durchzuführen. Bei den grossen Zählungen, also dem Zensus, erhalten sie für diese Arbeiten einen Zuschuss zu den entstandenen Kosten für die eigentliche Erhebung und die Überprüfung der Zählpapiere. Sofern bei laufenden statistischen Ermittlungen die Ergebnisse bereits bei den städtestatistischen Ämtern anfallen bzw. zusammengestellt werden, besitzen die Städte die Ergebnisse für ihre Verwaltungsarbeiten. Bei dem Zensus oder einer grossen Wohnungszählung werden den Städten die Ergebnisse für den örtlichen Bereich von den Zentralstellen geliefert, so dass die städtestatistischen Ämter die Auswertung übernehmen. Dazu kommen die zahlreichen Aufträge der eigenen Verwaltung, die erst eigentlich zur Zentralisation der Statistik in besonderen Ämtern geführt haben Eigene statistische Erhebungen sind nur verhältnismässig selten, da meist die zentralen Erhebungen für die örtlichen Zwecke ausgewertet werden. Ausserdem sind die Ämter mit der Sammlung und Auswertung des in der Verwaltung anfallenden und sonstigen für die Verwaltung wichtigen statistischen Zahlenmaterials sowie mit der Anfertigung von Denkschriften und Gutachten beauftragt, die kommunalpolitische Massnahmen vorbereiten und die durchgeführten Massnahmen beobachten und überprüfen sollen. Um diese Arbeiten mit der erforderlichen Sachkenntnis ausführen zu können, sind die leitenden Stellen mit akademisch vorgebildeten Statistikern besetzt, in den meisten Fällen handelt es sich um Nationalökonomen. Von akademisch ausgebildeten Wissenschaftlern werden 40 statistische Ämter geleitet. Mit Ausnahme von zwei Grosstädten werden in den übrigen statistische Publikationen herausgegeben, und zwar in 24 Fällen Monatsberichte, in 20 Fällen Vierteljahresberichte. In 27 Grossstädten werden Statistische Jahrbücher publiziert und in 28 Städten die Ergebnisse statistischer Untersuchungen in Sonderveröffentlichungen herausgebracht. Die Bearbeitung des Verwaltungsberichts ist in 15 Grosstädten den statistischen Ämtern übertragen, sie enthalten ebenfalls umfangreiches Zahlenmaterial über die Verwaltungstätigkeit. Ergänzend sei bemerkt, dass in weiteren 17 Städten kleinerer Grössenordnung ebenfalls selbständige statistische Ämter bestehen, von denen 6 einem akademisch vorgebildeten Leiter unterstehen. Im Statistischen Jahrbuch Deutscher Gemeinden werden für 517 Städte über 10.000 Einwohner vergleichbare Einzelangaben für fast sämtliche Verwaltungsgebiete zusammengestellt. Die Zahlen sind ausserdem für die Grössengruppen und für die Länder zusammengefasst. Bisher liegen 44 Jahrgänge vor, die vom Deutschen Städtetag herausgegeben und vom Verband Deutscher Städtestatistiker bearbeitet werden.

In Mittel- und Ostdeutschland bestanden vor dem Kriege 1939 7 statistische Ämter unter akademischer Leitung, die auf eine alte Tradition zurückblicken können, und 7 statistische Stellen in kleineren Städten. So besteht das Leipziger Amt seit 1867, das von Breslau und Chemnitz seit 1873, das von Dresden seit 1874, von Plauen seit 1876, von Görlitz seit 1878, von Magdeburg seit 1885 sowie von Königsberg seit 1893.

Nach dem Kriege waren nur noch in Halle, Magdeburg, Leipzig und Erfurt statistische Ämter vorhanden. Durch Verordnung über die Reorganisation des statistischen Dienstes in der sowjetischen Zone vom 16. Februar 1950 wurden die kommunalstatistischen Ämter zu Kreisstellen, die bisherigen Statistischen Landesämter zu Bezirksstellen der Staatlichen Zentralverwaltung für Statistik. Sie sind ausschliesslich deren Weisungen unterworfen, werden finanziell von der Zentralstelle betreut, die auch die Leiter der Ämter anstellt bzw. entlässt. Eigene statistische Arbeiten werden von ihnen also nicht für den örtlichen Bereich durchgeführt, ebenso wie sie keine statistischen Veröffentlichungen herausgeben. Erstmalig lag Anfang 1957 ein statistischer Vierteljahresbericht von Leipzig vor, der aber nur wenige Verhältniszíffern enthält.

2. ÖSTERREICH

In Österreich arbeiten 5 Grosstädte am Internationalen Statistischen Jahrbuch mit: Graz, Innsbruck, Linz, Salzburg und Wien. In ihnen sind selbständige statistische Ämter vorhanden, die in der gleichen Weise organisiert sind und arbeiten wie die deutschen Ämter. In Linz und Wien sind Akademiker mit der Leitung der Ämter betraut. Sie geben statistische Veröffentlichungen heraus. Die zusammenfassende Veröffentlichung über die wichtigsten Sachgebiete in 45 Städten erfolgt im "Statistischen Jahrbuch österreichischer Städte", das bisher in 6 Ausgaben erschien und vom Österreichischen Statistischen Zentralamt zusammengestellt wird.

3. BULGARIEN

Die Statistik ist in den Grosstädten in der gleichen Weise zentralisiert, wie sie für das Land im Statistischen Zentralamt zusammengefasst ist. Die regionalen statistischen Ämter sind diesem unterstellt, sie haben die statistischen Aufträge (Zählungen) in seinem Auftrage durchzuführen, werten aber weder die Ergebnisse der zentralstatistischen Erhebungen aus, noch bearbeiten sie eigene Zählungen oder Gutachten udgl., noch geben sie Veröffentlichungen heraus. Sie werden jedoch von akademisch ausgebildeten Fachkräften geleitet. In der Zeit nach dem ersten Weltkrieg waren in Bulgarien keine städtestatistischen Ämter vorhanden.

4. DÄNEMARK

Kopenhagen und Aarhus haben statistische Ämter, in denen die statistischen Arbeiten der Kommunalverwaltung zentralisiert sind. Einige Dienststellen, vor allem die technischen, sammeln und werten ihre eigenen Geschäftsstatistiken, meist in Zusammenarbeit mit dem Statistischen Amt, aus. Es ist beauftragt mit der Durchführung des Zensus udgl. für den örtlichen Bereich und wertet dessen Ergebnisse aus. Die Ämter führen auch eigene Ermittlungen durch, vor allem auf dem Gebiet der Bevölkerungsstatistik, der Wohnungsstatistik und der

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4 Vergl. Hans Heidenwag, "Wiederaufbau der österreichischen Städtestatistik", in Allgemeines Statistisches Archiv, 34. Bd. 150, S. 176 ff.

Steuerstatistik sowie auf besonderen kommunalen Sachgebieten und fertigen Gutachten und Denkschriften für die Verwaltung an. Sie sind mit akademisch ausgebildeten Leitern besetzt und geben statistische Veröffentlichungen heraus: Kopenhagen Monatsberichte, Jahrbücher, einen Kommunalkalender und Einzelveröffentlichungen, Aarhus Vierteljahresberichte, Jahrbücher und Sonderveröffentlichungen.

5. SPANIEN

In den Grosstädten sind eigene statistische Ämter eingerichtet worden. Von den 22 Grosstädten werden insbesondere Madrid, Barcelona, Valenzia, Bilbao, Saragossa usw. genannt. Sie führen die grossen Zählungen durch, werten aber die Ergebnisse für örtliche Zwecke nicht aus. Alle 5 Jahre veranstalten sie eine städt. Zählung, ferner verschiedene Erhebungen für die Kommunalverwaltung, vor allem über die Lebensmittelversorgung und das Verkehrswesen. Ausserdem sind sie mit Gutachten und Denkschriften für die Verwaltung beauftragt. In Barcelona und Saragossa werden die Ämter von Akademikern geleitet. Monatsberichte geben Palma de Mallorca, Madrid und Barcelona heraus, Vierteljahresberichte Barcelona, Bilbao und Burgos.

6. FINNLAND

In Helsinki, Tampere und Turku gibt es statistische Ämter, sie führen zentrale Erhebungen im allgemeinen nicht durch, mit Ausnahme des Zensus 1950, werten aber auch deren Ergebnisse nicht aus. Das wird durch das Statistische Zentralamt bewerkstelligt. Helsinki hat jedoch über das allgemeine Tabellenprogramm hinaus Sonderauszählungen für das Stadtgebiet vorgenommen. Die Statistischen Ämter übernehmen eigene statistische Arbeiten, so hat Helsinki eine Repräsentativstatistik über die Wohnverhältnisse und über die Freizeitgestaltung der Jugend durchgeführt. Die Leitung der Ämter liegt in den Händen von akademisch ausgebildeten Statistikern. Sie geben statistische Veröffentlichungen heraus: Monatsberichte in Helsinki und Jahrbücher in Helsinki, Tampere und Turku, ausserdem veröffentlicht Helsinki einen Kommunalkalender.

7. FRANKREICH

Von den 24 französischen Grosstädten sind in Paris (Bureau de Statistique de la Préfecture de la Seine) und Strassburg die statistischen Arbeiten in besonderen Ämtern zentralisiert, in St.Etienne und Reims in Gesundheitsamt die Bevölkerungs- und Gesundheitsstatistik. Diese Ämter und in den Städten, in denen keine zentralen Ämter bestehen, die städt. Dienststellen besorgen bei Volkszählungen das Einsammeln und Abliefern der Zählpapiere an das Nationale Statistische Institut. Ausserdem sichern sie die laufende Erstellung der verschiedenen Nachweise für die Statistik der Bevölkerungsbewegung. Diese Unterlagen werden im Nationalen Statistischen Institut bearbeitet und ausgewertet. Die Statistischen Ämter von Paris, Strassburg und St. Etienne führen auch eigene statistische Erhebungen durch und fertigen ebenso wie die von Nizza und Reims eigene statistische Untersuchungen und Gutachten für die Kommunalverwaltung an. Nur in Paris hat die Leitung ein akademisch ausgebildeter Sta-

tistiker. Paris, Strassburg und St. Etienne geben eigene statistische Veröffentlichungen heraus: Paris Monatsberichte und jährl. Einzeluntersuchungen, Strassburg alle 10 Jahre einen Verwaltungsbericht, jährl. ein Statistisches Jahrbuch, sowie laufend Untersuchungen über Preise und Löhne sowie andere Untersuchungen in grösseren Abständen. In St. Etienne und Reims werden monatliche Berichte des Gesundheitsamtes, sowie jährl. Tätigkeitsberichte des Gesundheitsamtes veröffentlicht. Auch von anderen Städten wie Lyon, Toulouse, Bordeaux, Nantes, Lille, Rennes, Grenoble, Dijon werden von Fall zu Fall Berichte mit statistischen Angaben angefertigt, meist handelt es sich um Bevölkerungs- und Gesundheitsstatistiken.

8. GRIECHENLAND

Die Hauptstadt Athen besitzt ein eigenes statistisches Amt. Da die beiden anderen Grosstädte Piräus und Saloniki nicht genannt werden, muss angenommen werden, dass hier die statistischen Arbeiten nicht in einem besonderen Amt zentralisiert sind. Das Athener Statistische Amt führt jedoch weder zentral angeordnete Erhebungen noch eigene Zählungen für die Verwaltung durch, noch wird es von einem Akademiker geleitet, noch gibt es Veröffentlichungen heraus. Es scheint sich daher nicht um ein besonders ausgebautes Amt zu handeln.

9. UNGARN

Für jeden Verwaltungsbezirk gibt es eine dem Statistischen Zentralamt unterstehende Statistische Direktion; davon befinden sich 19 an den Hauptplätzen der Verwaltungsbezirke und 2 in den Städten, die den Status eines Verwaltungsbezirks haben, die aber leider nicht genannt sind. Sie führen zentrale Erhebungen durch und werten sie für regionale Zwecke aus, sie können aber auch eigene Erhebungen durchführen, es handelt sich um Industrie-, Binnenhandel- und Gesundheitsstatistiken. Budapest hat 1955 ein statistisches Handbuch herausgegeben. Es ist beabsichtigt, dass die einzelnen Statistischen Direktionen ab 1957 Jahrbücher veröffentlichen. Vor dem zweiten Weltkriege war ein Statistisches Amt in Budapest vorhanden, das durch seine zahlreichen guten Veröffentlichungen bekannt war.

10. IRLAND

In der Hauptstadt Dublin ist kein statistisches Amt vorhanden.

11. ITALIEN

Durch Gesetz vom 16.11.1939 ist für die italienischen Grossstädte über 100.000 Einwohner die Einrichtung eines städtischen statistischen Büro vorgeschrieben. Sie führen zwar zentral angeordnete Zählungen durch, werten aber die Ergebnisse nicht für eigene Zwecke der Städte aus. Sie können eigene statistische Erhebungen veranstalten, bedürfen dazu aber der Genehmigung des Sta-

tistischen Zentralinstituts. Die offiziellen Veröffentlichungen geben im allgemeinen die Ergebnisse der statistischen Erhebungen wieder. Für die Amtsleiter ist nach dem Gesetz vom 24.3.1930 eine Spezialausbildung erforderlich. Von den 28 Grosstädten geben 20 statistische Monatsberichte, Ferrara Vierteljahresberichte heraus. 15 Städte veröffentlichen Statistische Jahrbücher, wenn auch nicht in allen Jahren,wie Mailand 1939 und Modena 1949. Florenz hat ausserdem eine besondere Monographie herausgebracht.

12. NORWEGEN

Statistische Ämter sind in Oslo und Bergen errichtet. Sie führen Erhebungen für das Norwegische Statistische Zentralamt durch, werten teilweise die Ergebnisse für örtliche Zwecke aus. Als eigene Erhebungen sind Krankenhausstatistik, Schulstatistik, Wohnungsstatistik, Verkehrsstatistik genannt. Auch werden sie mit Gutachten für die Verwaltung beauftragt und werden von wissenschaftlich ausgebildeten Statistikern geleitet. Neben Monatsberichten, Vierteljahresberichten und Jahrbüchern ist von Oslo eine Fülle von Einzelschriften verzeichnet. Bergen gibt nur Vierteljahresberichte und ein Jahrbuch heraus, seltener Sonderveröffentlichungen.

13. NIEDERLANDE

Von den Grosstädten haben nur Amsterdam, Rotterdam, Haag, Utrecht, Eindhoven und Tilburg ein eigentliches statistisches Amt, von denen Amsterdam und Haag den grössten Wirkungskreis haben. Ihre Selbständigkeit ist verschieden. In Utrecht und Eindhoven sind ihnen auch andere als rein statistische Angelegenheiten übertragen. Daneben gibt es in Arnheim, Nimwegen, Enschede, Almelo, Hilversum, Maastricht, Zaandam sogenannte Soziographische Ämter, meist als Dienststellen der Städtischen Bauämter, bisweilen als Teil der Gemeindekanzlei. Sie sind verschieden in Grösse und Bedeutung und beschäftigen sich neben der Statistik mit der Stadtplanung. Die städt. statistischen Ämter führen teilweise zentral angeordnete Erhebungen durch und bearbeiten meist für die Stadtviertel die Ergebnisse zentraler Erhebungen. Die kleineren statistischen oder die soziographischen Ämter machen diese Auswertungen nicht. Eigene statistische Erhebungen werden in den grösseren Städten durchgeführt, z.B. die von Haushaltsrechnungen, in Amsterdam zuletzt eine Stichprobenerhebung über den Theater- und Konzertbesuch sowie über die Studentenunterkünfte. Ebenso werden Gutachten für die Verwaltungen angefertigt. In Amsterdam, Utrecht und Eindhoven sind die Leiter wissenschaftlich ausgebildet, den kleineren soziografischen Ämtern ist meist ein Akademiker, der Sozigrafie studierte, vorgesetzt. Die meisten Ämter geben Publikationen heraus, und zwar Monatsberichte. Vierteljahresberichte, Jahrbücher, Taschenbücher. Einmalige Sonderveröffentlichungen werden nur in Amsterdam herausgebracht, in deren "Statistischen Mitteilungen" seit 1894 137 Hefte erschienen sind.

14. POLEN

In den Grosstädten sind die statistischen Dienststellen innerhalb der örtlichen Verwaltungen unabhängige Abteilungen. Aufgaben

und Arbeitsplan werden vom Statistischen Zentralamt im Einverständnis mit den Nationalräten ausgearbeitet. Das Zentralamt hat ferner die Aufgabe, die örtlichen Dienststellen zu instruieren und zu kontrollieren. Die Leiter der statistischen Ämter werden vom Zentralamt ausgewählt. Infolge der in der letzten Zeit eingeführten Dezentralisierung der Wirtschaftsverwaltung und im Zuge des Anwachsens der Aufgaben der Nationalräte nimmt auch der Aufgabenbereich der statistischen Ämter zu, was zu einer Personalvermehrung führt. Bei der Ausführung der Aufgaben sind die Belange des Zentralamts neben denen der örtlichen Nationalräte zu beachten. Die städtestatistischen Ämter beteiligen sich daher auch aktiv an den allgemeinen Zählungen, darüber hinaus können sie örtliche Erhebungen durchführen, bedürfen dazu jedoch grundsätzlich der Zustimmung des Zentralamts.

15. PORTUGAL

In Lissabon und Porto sind die statistischen Arbeiten nicht in einem besonderen Amt zentralisiert. Sie werden in den einzelnen statistischen Dienststellen der Verwaltung durchgeführt. Es gibt auch keine statistischen Veröffentlichungen. Die Dienststellen liefern jedoch statistische Tabellen für den städtischen Verwaltungsbericht.

16. GROSSBRITANNIEN

Mit Ausnahme von Birmingham, wo ein besonderes Statistisches Amt eingerichtet ist, sind in den übrigen Grosstädten die statistischen Arbeiten nicht zentralisiert. Die kommunalen Fachdienststellen befassen sich mit routinemässigen Untersuchungen für Verwaltungszwecke. Einige Ämter, wie z.B. die Gesundheitsämter, führen gelegentlich örtlich begrenzte Erhebungen mittels Interviewer durch, um Angaben über die Lebensbedingungen bestimmter Bevölkerungsgruppen zu erhalten. Von den zentralen Regierungsstellen werden bei den örtlichen Gemeindeverwaltungen zahlreiche Statistiken angefordert. Nur wenige Städte bringen statistische Veröffentlichungen heraus. Gewöhnlich enthalten die jährlichen Verwaltungsberichte auch statistische Angaben. Ein Statistisches Jahrbuch veröffentlicht Birmingham.

17. SCHWEDEN

In Stockholm und Göteborg bestehen selbständige statistische Ämter, die allerdings nicht mit zentralen Erhebungen beauftragt sind, auch keine regionale Auswertung dieses Materials vornehmen. Sie führen aber eigene Erhebungen durch, fertigen Denkschriften und Gutachten an und werden von wissenschaftlichen Fachkräften geleitet. Stockholm gibt wöchentliche Berichte, Monatsberichte, Jahrbücher heraus und hat eine grosse Zahl von Sonderuntersuchungen statistischer Art veröffentlicht.

18. SCHWEIZ

Bern und Zürich haben kommunale statistische Ämter, Basel und Genf dagegen kantonale Ämter. In Lausanne besteht kein Statistisches Amt, die Statistik ist dort noch dezentralisiert. Die genannten Statistischen Ämter führen zentrale Erhebungen durch und werten das Material für die örtlichen Stellen aus. Sie veranstalten auch örtliche Erhebungen, fertigen Denkschriften und Gutachten für die eigene Verwaltung an. Mit Ausnahme von Genf sind die leitenden Stellen mit wissenschaftlich ausgebildeten Statistikern besetzt. Sie geben mit Ausnahme von Genf statistische Publikationen heraus, und zwar monatliche Pressemitteilungen, Vierteljahresberichte sowie Jahrbücher, ausserdem auch Einzeluntersuchungen in grösserem Umfange. Die Zusammenfassung der Zahlen von 24 Städten über die verschiedenen Sachgebiete erfolgt im "Statistischen Jahrbuch des Schweizerischen Städteverbandes", das 1955 in der 23 Ausgabe vorlag.

19. TSCHECHOSLOWAKEI

Der statistische Dienst ist in den einzelnen städtischen Dienststellen dezentralisiert. Nur Prag ist eine Ausnahme, seine statistischen Arbeiten sind teilweise in der regionalen Abteilung des Statistischen Amtes der Tschechoslowakei zentralisiert, und zwar so weit Prag als Hauptstadt in Frage kommt. In Zukunft sind Verbesserungen hinsichtlich der Organisation der Städtestatistik beabsichtigt. Danach sollen die besonderen örtlichen Statistiken von den einzelnen Abteilungen der Comités Nationaux Municipaux erstellt werden, es handelt sich vor allem um Wohnungs- und Verkehrsstatistiken. Die Leitung in methodischer Hinsicht soll beim Statistischen Zentralamt liegen, das gleichzeitig die Herausgabe statistischer Veröffentlichungen, die einige ausgewählte Städte betreffen, vornimmt. Nach dem 1. Weltkrieg waren in Prag, Brünn und Pilsen statistische Ämter vorhanden.

20. JUGOSLAWIEN

In den 5 Grosstädten sind die statistischen Arbeiten in besonderen statistischen Ämtern zentralisiert, die die zentral angeordneten Zählungen durchführen und für regionale Zwecke auswerten. Eigene Erhebungen sind nur mit Genehmigung des Statistischen Zentralamts möglich. In Belgrad und Agram obliegt die Leitung akademisch ausgebildeten Personen. Monatsberichte veröffentlicht Skoplje, Vierteljahresberichte Belgrad und Sarajewo, Jahrbücher sind in Belgrad und Agram in Vorbereitung.

Als Ergebnis dieser Darstellung der Organisation in den verschiedenen europäischen Ländern soll eine Gruppierung der Typen der städtestatistischen Ämter versucht werden. Dabei gibt es Übergänge, so dass eine klare Abgrenzung der einzelnen Gruppen voneinander nur schwer möglich ist. Je nach dem Grad der Konzentration der statistischen Arbeiten in einem besonderen Amt sind 3 Gruppen von Ländern zu unterscheiden, wobei von dem augenblicklichen Stand ausge-

gangen wird:

I. Die erste Gruppe bilden die Länder, in denen es keine oder nur wenige statistische Ämter gibt, in denen die Statistik nicht zentralisiert, sondern unausgelöst bei den einzelnen Fachdienststellen der Verwaltung bearbeitet wird, wie es in sämtlichen Ländern vor der Gründung der statistischen Ämter üblich war. Hier ist Grossbritannien mit Ausnahme von Birmingham zu nennen, Frankreich mit Ausnahme von Paris und Strassburg, Portugal und die Tschechoslowakei. Hierher würde auch Irland behören, das kein städtestatistisches Amt besitzt. Damit ist jedoch nicht gesagt, dass in diesen Ländern keine städtestatistische Arbeit geleistet wird. Sie ist den einzelnen Fachdienststellen überlassen, die die bei ihnen anfallenden Zahlen sammeln und verwerten. Sie kann daher für die Gemeinden nicht so wirkungsvoll arbeiten wie die zentralisierte Statistik, was bereits in dem Fehlen von statistischen Publikationen zum Ausdruck kommt. Auch diese Form ist auf die dort herrschende Staatsauffassung und auf die Städteverfassung zurückzuführen.

II. In den meisten Ländern Europas, nämlich 11, sind in den Grosstädten eigene statistische Ämter eingerichtet worden, eine Organisationsform, die sich fast 100 Jahre erhalten hat, wenn sich auch Organisation und Aufgabenkreis seit dieser Zeit gewandelt haben, wie auch die Zuständigkeiten der örtlichen Verwaltungen einem Wechsel unterlagen. Von diesen Ämtern werden in den meisten Fällen die grossen Zählungen der Zentralstellen durchgeführt und die Ergebnisse dieser Erhebungen für den örtlichen Bereich ausgewertet, so dass die Stadtverwaltungen die benötigten Zahlen erhälten. Ausserdem werden eigene statistische Erhebungen und Untersuchungen veranlasst sowie Gutachten für die Verwaltung gefertigt. Die meisten dieser statistischen Ämter haben einen akademisch ausgebildeten Leiter angestellt. Sie veröffentlichen das gesammelte Zahlenmaterial in Monatsberichten, Vierteljahresberichten und Jahrbüchern, ausserdem werden in einigen Städten auch einmalige Sonderveröffentlichungen herausgegeben, um die Ergebnisse besonderer statistischer Untersuchungen einem weiteren Kreise zugängig zu machen. Durch diese Organisationsform, also durch Zentralisation der statistischen Arbeiten an einer Stelle, soll eine möglichst grosse Wirkung für den Bereich der Kommunalverwaltung erzielt werden. Die Ämter sind selbständige Dienststellen im Rahmen der örtlichen Kommunalverwaltung. Sie haben durch ihre aus der örtlichen Sicht unternommenen wissenschaftlichen Untersuchungen methodisch und soziologisch wertvolle Erkenntnisse zur gesamten Statistik beigetragen. In Deutschland wurden z.B. durch die Arbeiten der städtestatistischen Ämter wichtige Vorarbeiten für die Bundes- und Landesstatistik geleistet. Viele Erhebungen, die zunächst nur von der Städtestatistik als zum eigenen Aufgabenbereich gehörend, durchgeführt wurden, wurden später von der Reichs- bzw. Bundesstatistik übernommen, als das Sachgebiet sich mehr und mehr in die Gesetzgebungskompetenz des Bundes verlagerte. Solche wissenschaftlichen Leistungen sind nur bei der Konzentration sämtlicher statistischen Arbeiten in einem besonderen Amt möglich, da nur in diesem Falle ein Überblick über das gesamte vorhandene Material gegeben ist. Im übrigen existieren nicht in allen Grosstädten der hier in Frage kom-

menden Länder derartige Ämter. Einen Übergang zur dritten Organisationsform bieten die Verhältnisse in Italien, wo die Arbeit der zwar gesetzlich vorgeschriebenen statistischen Ämter eingeschränkt wird durch die Genehmigung des Zentralamtes für örtlich beabsichtigte Erhebungen und Untersuchungen, die die freie Entfaltung der Städtestatistik etwas einschränkt.

III. Schliesslich ist noch eine weitere Organisationsform erkennbar, die sich in den zentralistisch organisierten Staaten des Ostens findet. Es handelt sich um Mitteldeutschland, Polen, Ungarn, Bulgarien und Jugoslawien. Dort ist die Zentralisation der statistischen Organisation bis zur letzten Konsequenz getrieben. Es sind zwar statistische Ämter in den Grosstädten vorhanden, in denen die statistischen Arbeiten im örtlichen Bereich zentralisiert sind, sie sind aber direkt den statistischen Zentralstellen untergeordnet, die Aufgabenbereich und Arbeitsmethode vorschreiben und die Leiter der Ämter anstellen und entlassen. Infolge der zentralisierten Verwaltungsorganisation kann nicht mehr von selbständigen statistischen Ämtern gesprochen werden, es sind der Zentralgewalt nachgeordnete Dienststellen. Infolgedessen können sie eigene Erhebungen nicht oder nur mit Genehmigung der Zentralstellen veranlassen und üben keine Publikationstätigkeit aus. Es gibt dort keine Städtestatistik als Selbstverwaltungsstatistik, sondern Landesstatistik mit örtlichen Nebenstellen. In Polen und Jugoslawien ist im Zuge der Bestrebungen zur Dezentralisation beabsichtigt, die statistischen Arbeiten in Zukunft wieder etwas mehr zu dezentralisieren.

Nach diesen ersten zusammenfassenden Untersuchungen sollten in der nächsten Zeit die gewonnenen Ergebnisse durch weitere Rundfragen ergänzt und erweitert werden, um das erlangte Bild zu vervollständigen und die Vielfalt der Organisationsformen der Städtestatistik deutlich sichtbar zu machen.

R E S U M E

C´est déjà au moyen âge que l´on trouve, dans l´une ou l´autre municipalité, des recensements de statistique municipaux, c´est-à-dire, une organisation de statistique dans divers pays, pourtant, ce n´est guère qu´à la première moitié du XIX^{e} siècle que remontent les bureaux de recensements de statistique, municipaux, soit une organisation de statistique dans les divers pays. Cette dernière doit son origine au développement industriel et à la concentration de la population qu´elle entraîna dans les villes. Il s´ensuit que les administrations municipales eurent des difficultés à embrasser d´un coup la population, son accroissement et sa structure, de sorte qu´il fallut de plus en plus recourir à l´aide d´exposés de statistiques. On récolta donc les chiffres de statistique dispersés dans les différents bureaux d´administration à un bureau central, où ils allaient se trouver à la disposition de toute l´administration et surtout de la direction administrative.

L´Institut International de Statistique a fait une enquête afin de réaliser la situation actuelle de l´organisation de statistique des grandes villes européennes. Les réponses de vingt pays que

nous avons sous les yeux, divergent les unes des autres. La dite organisation dépend essentiellement de la constitution fondée sur le droit public de chaque pays. Dans la plupart des pays, des bureaux de statistique ont été institués, propres à chaque grande ville. La statistique la moins centralisée est celle des grandes villes de France, de la Grande-Bretagne, de l'Irlande, du Portugal et de la Tchécoslovaquie. Outre Paris, Strasbourg et Birmingham, les autres grandes villes de ce pays ne possèdent point de bureaux de statistique. Les travaux de statistique y sont exécutés par des bureaux détachés.

En Pologne, Bulgarie et Yougoslavie, de même qu'en Allemagne centrale, des bureaux de statistique ont bien été établis dans les grandes villes, toutefois, ils dépendent des bureaux d'arrondissements des bureaux centraux de statistique, et n'ont à effectuer aucun travail d'eux-mêmes, à moins qu'ils n'en aient l'autorisation de la part des bureaux centraux. De ce fait, leur mission est-elle, en leur qualité de bureaux de statistique, fort restreinte et obtient ainsi un caractère différent de celui des autres pays.

Le réseau le plus dense de bureaux municipaux est bien celui de la Fédération républicaine de l'Allemagne, où se trouvent des bureaux de statistique dans chacune de ses 54 grandes villes. La direction de 40 de ces bureaux se trouve en main de statisticiens de formation académique. L'organisation des pays scandinaves, des Pays-Bas, de l'Autriche, de la Suisse et de l'Italie sont du même genre. En Italie, elle est même prescrite pour toute ville comptant plus de 100 000 âmes, tandis que dans les autres pays, ce ne soit pas chaque ville qui possède un bureau de statistique.

L'enquête de l'Institut International de Statistique regarde de plus les questions suivantes: les bureaux municipaux de statistique poursuivent-ils des enquêtes en faveur des bureaux centraux et surtout, exploitent-ils les résultats de recensements de ce genre en faveur des bureaux régionaux? On aura alors, un aperçu général des publications de statistiques périodiques et uniques, qui seront publiées par les bureaux de statistique des grandes villes.

S U M M A R Y

Statistical censuses were undertaken by various municities in individual cases already in the Middle Ages; the establishment of municipal statistical offices, however, i.e. an organization of statistical services in various countries, can be registered only in the second half of the 19th century as a result of growing industrialization and subsequent concentration of people in large towns. Owing to this concentration it became more difficult for municities, to survey the population, its growth and structure. Therefore, they had more and more to make use of statistical activities. The statistical figures, previously filed in various scattered administration-offices, were now compiled at one central office and consequently at the disposal of the entire administration, in particular of that of the management of administration.

At the beginning of 1957, the International Statistical Institute

started an inquiry by circular, to ascertain the present state of organization of statistical services in the large towns of Europe. The answers received from 20 countries reflect a different situation. The organization depends decisively on the public law constitution of the country. Large towns of most of the countries have established special statistical offices. Less centralized are statistical services of large towns in France, Great Britain, Ireland, Portugal, and Czecho-Slovakia. The other large towns of these countries, expected Paris, Strasbourg, and Birmingham, do not keep up central statistical offices. There the statistical services are executed in various offices.

In Poland, Hungaria, Bulgaria, and Yugo-Slavia, as well as in Central Germany statistical offices were established, but they represent dependant regional sub-offices of statistical central offices and don't have to execute any activities of their own, or with approval of central offices only. Consequently their scope of duties as independant municipal statistical offices has been limited largely, and they are, compared with other countries, of specific character.

The tightest net of municipal statistical offices is that of the Federal Republic of Germany, where statistical offices are located in all of the 54 large towns, among them 40 under the direction of university-trained leaders. The organization has been centralized in a similar way in the Scandinavian countries, the Netherlands, Austria, Switzerland, and Italy. In Italy it is even provided by law for municities with a total population of more than 100.000; in the other countries don't have all of the large towns their own statistical offices.

The investigation of the International Statistical Institute dealt additionally with the questions, whether municipal statistical offices have to undertake inquiries for central services, and primarily, whether they have to analyse the results of such censuses for the regional offices. Moreover, it comprises a survey on the periodical and occasional statistical publications, issued by the statistical offices of the large towns.

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QUELQUES REMARQUES SUR LA DISTRIBUTION DE L'INTERVALLE ENTRE LE MARIAGE ET LA PREMIERE NAISSANCE PAR AGE DE LA MERE ET SON DOMICILE (URBAIN - RURAL)

/43/

par

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I

Sources et type de population étudiée

Nous présentons dans cette communication les résultats partiels d'une plus vaste enquête que nous avons menée au sein du Séminaire statistique de la Faculté des sciences économiques de Ljubljana sur l'espacement des naissances en Slovenie. La population yougoslave est au point de vue démographique très différente et les diverses caractéristiques calculées pour la population entière sont peu représentatives. C'est pourquoi la limitation de l'enquête à une partie bien déterminiée et hautement homogène peut revêtir, croyons nous, quelque intérêt plus général, tout particulièrement parce que nous avons essayé à étudier l'espacement des naissances comme fonction de l'âge de la mère et de son domicile urbain ou rural.

La population de Slovénie - une des républiques populaires de la Yougoslavie - représente une population relativement évoluée au point de vue démographique et économique. Voilà quelques paramètres caractéristiques de cette population (en parenthèse nous donnons à titre de comparaison les valeurs moyennes pour toute la population yougoslave; d'après les résultats du recensement de la population de 1953 et des statistiques de l'état civil en 1953):

population: 1,5 millions (17,0);
population active agricole: 43 % (62 %);
population illettrée âgée de dix ans et plus: 1,9% (24,4%);
taux brut de natalité: 22 ‰ (28 ‰);
taux brut de mortalité: 10 ‰ (12 ‰);
mortalité infantile: (pour 1000 né-vivants): 59 (116);
reproduction brute: 1,42
espérance de vie à la naissance: (femmes): 64, 76 ans.

L'enquête a été basée sur l'élaboration détaillée des fiches statistiques originales des naissances de la population entière de la Slovénie des années 1948 à 1955 d'après la date de naissance, date du mariage, âge de la mère, dimension de la naissance et lieu de naissance. Les fiches des années de 1951 et subs. contenaient la date complète du mariage (jour, mois, année), tandis que les fiches des années précédentes n'indiquaient que la durée du mariage en années.

Dans cette communication nous ne donnons que les résultats sur la distribution de l'intervalle entre le mariage et la première naissance, par âge de la mère et son domicile(urbain-rural).

II

Méthode

Les données - nous n'avons considéré que les nés-vivants - ont subi le double classement d'après la date de naissance et la date du mariage. Ce double classement a permis d'attribuer les naissances aux cohortes bien déterminées des mariages des années 1948 à 1954.

Pour éliminer le plus possible l'influence des facteurs secondaires on a cherché à arriver aux distributions typiques en calculant les valeurs moyennes pour la période observée.

Pour la distribution typique de l'intervalle de la première année p a r m o i s les moyennes ont été calculées à la base des données mensuelles des années 1951 à 1954.

Dans le calcul des moyennes des intervalles p a r a n n é e s on a dû recourir à un procédé spécial pour pouvoir tirer le plus d'information des dates disponibles. Les fréquences les plus complètes n'existaient que pour la cohorte de 1948 pour laquelle on a pû obtenir le classement de l'intervalle de 0 à 6 ans (1). Pour chaque cohorte suivante l'intervalle se reduit d'un an ainsi que pour la cohorte de 1954 on ne dispose que des naissances de la première année (voir les fréquences brutes du Tableau 1).

(1) Nous étions obligéesà nous arrêter à la septième année du mariage comme la limite supérieure de nos recherches de l'espacement des premières naissances. L'omission des naissances survenues dans les années subséquentes tout de même n'introduit pas; d'après notre opinion, des alterations sensibles dans la distribution de l'intervalle, étant donné que l'intervalle observé de 0 à 6 ans embrasse environ 99 p.c. de toutes les premières naissances.

TABLEAU 1. DISTRIBUTION DE L'INTERVALLE ENTRE LE MARIAGE ET LA PREMIÈRE NAISSANCE. FRÉQUENCES ABSOLUES

Intervalle	Cohortes						
	1948	1949	1950	1951	1952	1953	1954
Moins de 1 an	6671	6203	6299	5428	5558	5852	6454
1 an	2389	2546	2482	2104	1920	1955	
2 ans	726	762	695	592	611		
3 -	312	292	317	272			
4 -	132	156	149				
5 -	105	94					
6 -	68						

La proportion de la fréquence (pour 1000 premières naissances) de l'intervalle "6 ans" n'a donc pû être basée que sur la distribution de la cohorte de 1948. En désignant les fréquences de la cohorte de 1948 par $n_{0,48}, \ldots, n_{6,48}$, le premier souscrit se référant à l'intervalle, on a eu pour la proportion des fréquences de l'intervalle "6 ans":

$$p_6 = \frac{n_{6,48}}{\sum_0^6 n_{i,48}}$$

Pour la proportion des fréquences de l'intervalle "5 ans" nous nous sommes basés sur les cohortes de 1948 et 1949, en calculation cette proportion de l'équation:

$$\frac{p_5}{\sum_0^5 p_i} = \frac{n_{5,48}}{\sum_0^5 n_{i,48}} \quad \frac{n_{5,49}}{+ \sum_0^5 n_{i,49}}$$

$$\sum_0^5 p_i = 1 - p_6 .$$

Pour la proportion p_4 on a eu :

$$\frac{p_4}{\sum_0^4 p_1} = \frac{n_{4,48} + n_{4,49} + n_{4,50}}{\sum_0^4 n_{1,48} + \sum_0^4 n_{1,49} + \sum_0^4 n_{1,50}}$$

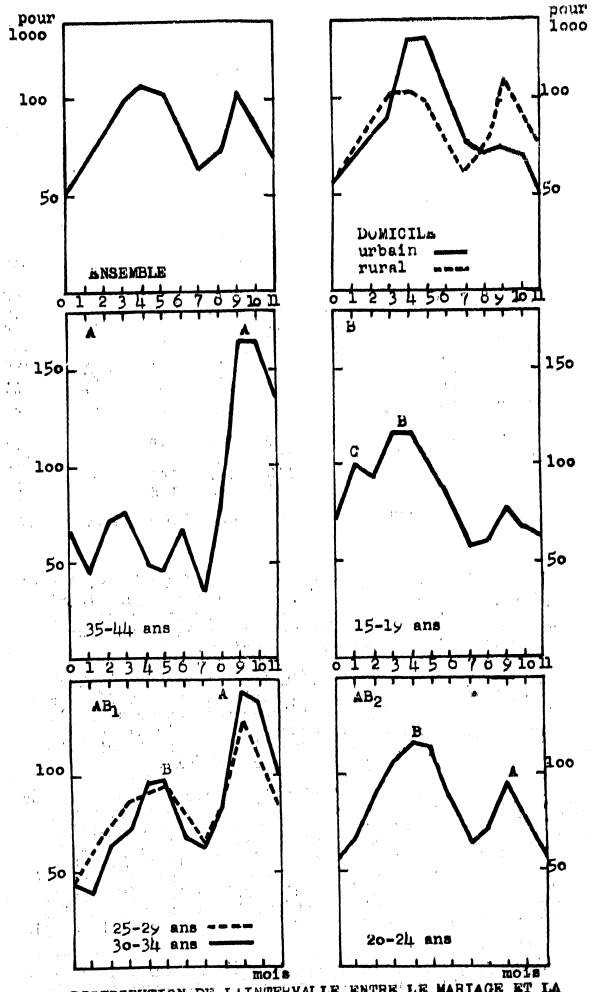
$$\sum_0^4 p_1 = 1 - (p_6 + p_5)$$

et ainsi de suite pour le calcul des proportions p_3, p_2, p_1, p_0. Les proportions p_0 et p_1, les proportions les plus importantes, couvrant environ 87 p.c. de toutes les premières naissances, sont basées sur les cohortes de 1948 à 1953 et sont donc bien représentatives.

III

Intervalles par mois de la première année du mariage

En se rattachant tout d'abord à la distribution totale (voir le Tableau II et le Graphique) nous constatons qu'elle est caractérisée par une courbe bimodale à deux sommets, l'un dans le 10e et l'autre dans le 5e mois après le mariage. Comme l'a démontré M.L. Henry dans son Etude statistique sur l'espacement des naissances (Population, 1951, No. 3), les naissances survenues après le 8e mois du mariage doivent être considérées comme des naissances surgies des conceptions n u p t i a l e s, tandis que les naissances des premiers 8 mois du mariage doivent être considérées comme des naissances surgies des conceptions a n t é - n u p t i a l e s.



DISTRIBUTION DE L'INTERVALLE ENTRE LE MARIAGE ET LA NAISSANCE D'UN PREMIER ENFANT - par mois de la première année.

TABLEAU II. NAISSANCES PAR MOIS DANS LES 12 PREMIERS MOIS DU MARIAGE
(pour 1000 naissances dans ces 12 mois)

Intervalle	Ensemble	Groupes d'âge de la femme					Domicile de la femme	
		15-19	20-24	25-29	30-34	35-44	urbain	rural
Moins de 1 mois	55	68	54	41	42	68	54	53
1 mois	70	100	69	61	59	44	68	70
2 "	85	93	91	73	64	70	78	86
3 "	100	113	107	86	71	75	91	103
4 "	107	113	113	90	96	49	128	103
5 "	104	101	114	93	97	47	131	99
6 "	82	83	85	81	68	68	107	76
7 "	74	58	61	67	83	35	78	60
8 "	75	60	72	80	85	70	72	76
9 "	104	77	94	126	143	165	73	110
10 "	88	87	76	110	137	165	70	92
11 "	58	62	56	81	95	135	50	72
Ensemble	1000	1000	1000	1000	1000	1000	1000	1000

La bimodalité nous fait penser qu'il s'agit, à vrai dire, d'une courbe composée, provenant de deux distributions élémentaires diverses correspondant chacune à des comportements bien différents des couples dans leurs rapports intimes vis-à-vis du mariage.

En analysant la distribution totale d'après les groupes d'âge de la femme au mariage, on peut déceler dans les distributions de l'intervalle du groupe d'âge de 35 à 44 (type A de la courbe du graphique) et du groupe d'âge de 15 à 19 (type B) ces deux distributions élémentaires quasi dans leur forme idéale.

Le type A de la distribution - caractéristique pour les couples qui se sont mariés à un âge relativement tardif - correspond au comportement des gens pour lesquels le mariage représente la forme assez rigide, moralement et socialement donnée et acceptée pour le règlement de leurs descendance. La forme s'approche assez de près à une forme imaginée idéale qui refléterait l'état où il n'y a pas de conceptions anténuptiales et où le maximum unique des conceptions s'effectue dans les premiers mois du mariage.

Le type B de la distribution reflète un comportement bien différent. Le maximum des naissances s'est déplacé à gauche ce que montre que la plus grande partie des naissances de la première année du mariage provient des conceptions anténuptiales. Ce sont le 4e, 5e et 6e mois du mariage qui font apparaître les plus fortes naissances correspondantes aux conceptions qui se sont

effectuées de 4 à 6 mois avant le mariage. Il s'agit des couples qui ont eu des rapports anténuptiaux mais qui se sont mariés sans hésitation dès qu'ils se sont aperçus que leurs rapports anténuptiaux ont abouti à la conception d'un enfant.

Le comportement du type B est absolument prépondérant chez les femmes jeunes d'âge de 15 à 19 qui ont le privilège de ne pas se soucier pas beaucoup dans leurs rapports des conventions sociales et morales au moins jusqu'au moment où leurs rapports ne se matérialisent dans l'événement de la conception et dans l'arrivée de l'enfant.

Cette catégorie comprend aussi les cas où les couples utilisent, dans la période anténuptiale, des moyens anticonceptionnels (y compris l'avortement voulu) mais qui, à un moment donné, au lieu de continuer leurs pratiques anticonceptionnelles, se décident pour l'enfant et pour le mariage.

Enfin y sont inclus aussi les cas (autrefois dans certaines régions de la Slovénie assez nombreux, spécialement dans la population agricole) où le mariage n'a pas été conclu avant que la femme n'ait pas démontré d'une manière sure sa fécondité, c'est-à-dire sa capacité de donner au propriétaire agricole un héritier.

En regardant de plus près la distribution du groupe d'âge de 14 à 19 on s'aperçoit d'un troisième sommet situé dans le 2e mois du mariage, avec des fréquences tout à fait remarquables dans le premier et le 3e mois du mariage. Nous croyons qu'on en peut déceler un troisième type de distribution correspondant au troisième type (C) de comportement des couples. Il s'agit des couples qui se sont aperçus que leurs rapports anténuptiaux vont aboutir à la naissance d'un enfant qui, cependant, pour diverses raisons, ne pouvaient pas se décider à temps pour le mariage. C'est le cas probablement caractéristique des jeunes filles qui ont peut-être réussi à cacher devant les parents (et peut-être aussi devant le futur père) jusqu'à un moment assez avancé le fait de la grossesse et qui sont enfin, au dernier moment, poussées au mariage pour éviter le reproche social (et paternel parfois plus forte encore), toujours existant d'une naissance illégitime.

Les distributions des groupes d'âge de 20 à 34 représentent les cas intermédiaires dont les différences dans l'allure (voir les distributions AB_1 et AB_2 du Graphique) résultent des poids différents des distributions élémentaires dont elles sont composées. On en peut discerner facilement deux variétés intermédiaires, représentées dans notre graphique par les courbes AB_1 et AB_2. Aux groupes d'âge de 25 à 29 et de 30 à 34 le groupe des femmes du type A reste toujours prépondérant bien que le groupe des femmes du comportement type B et provoquant le second sommet des conceptions anténuptiales se fasse déjà sentir. A l'âge de 20-24 ans les conceptions anténuptiales deviennent

prépondérantes, ce qui pousse le maximum vers les conceptions anténuptiales, le second sommet des conceptions postnuptiales ne jouent qu'un rôle inférieur.

Revenant à la distribution totale on voit que du point de vue numérique la plus grande partie des conceptions proviennent du temps avant la célébration du mariage, c'est-à-dire appartiennet au comportement type B et C. C'est donc le cas le plus fréquent, le cas socialement normal. Cela prouve d'une part que l'acte formel du mariage ne représente, pour la plus grande partie des couples, une barrière sensible pour leurs rapports anténuptieux, et d'autre part que l'arrivée prochaine de l'enfant pousse ces couples à sanctionner leurs relations par le mariage.

Le graphique montre aussi les distributions de l'intervalle des naissances pour la population urbaine et rurale. Tandis que la distribution pour la population rurale - numériquement prépondérante - suit assez de près la distribution totale, la distribution pour la population urbaine est essentiellement une distribution du type B. Ce n'est d'ailleurs qu'un des aspects du fait bien connu que la vie dans la ville est beaucoup moins dominée par les conventions morales et sociales vis-à-vis de la vie à la campagne.

IV

Intervalles par années

Dans le Tableau 3 figurent les distributions par années pour les premières sept années du mariage couvrant environ 99 p.c. du total des premières naissances. Pour les naissances survenues dans la première année du mariage nous avons donné la subdivision de l'intervalle de 0 à 7 mois (conceptions anténuptiales) et de 8 à 11 mois (conceptions postnuptiales).

TABLEAU III. DISTRIBUTION DE L'INTERVALLE ENTRE LE MARIAGE ET LA PREMIÈRE NAISSANCE.

Valeurs moyennes 1948-1953

Intervalle	Ensemble	Groupes d'âge de la femme 15-19	20-24	25-29	30-34	35-44	Domicile de la femme urbain	rural
0-7 mois	422	504	454	363	317	245	453	413
8-11 mois	212	183	194	250	270	293	164	223
Moins de 1 an	634	687	648	613	587	538	617	636
1 an	235	195	228	247	265	318	212	241
2 ans	70	66	68	75	76	89	76	70
3 -	30	29	29	32	37	33	50	26
4 -	15	12	11	14	17	10	25	12
5 -	10	8	10	10	11	5	13	9
6 -	6	3	6	9	7	7	7	6
Ensemble	1000	1000	1000	1000	1000	1000	1000	1000

On voit tout d'abord que les naissances conçues avant le mariage représentent environ 42,2 p.c. de toutes les premières naissances, un chiffre beaucoup plus élevé du chiffre que M. Henry a constaté pour la Bohème d'avant guerre. Ce pourcentage varie assez considérablement d'après l'âge de la femme, tandis que la différence entre le chiffres pour la population urbaine et rurale sont moins prononcées.

Nous avons cherché à expliquer ces différences dans la partie III de notre communication. Le nombre élevé des conceptions anténuptiales des jeunes femmes a pour conséquence que la proportion totale des naissances de la première année du mariage est aussi plus forte chez les jeunes femmes et qu'elle diminue avec l'âge, ce qui aboutit d'autre part nécessairement à ce que l'ordre des proportions des naissances de la deuxième année du mariage soit inverse. Environ 87 p.c. de toutes les naissances surviennent dans les deux premières années du mariage. Les années suivantes du mariage ne montrent qu'un nombre très faible des premières naissances. Les fréquences très faibles des naissances des intervalles de plus de trois ans doivent en outre être regardées avec réserve vu le nombre relativement faible des données brutes.

SUMMARY

Some observations on the distribution of the interval between the marriage and the first birth, analysed by age and domicile of mother.

In analysing the distribution of the intervals by months between the marriage and the first birth of the Slovenian population by age and domicile of mother for the cohorts of marriages of the years 1948 to 1954 the author discloses three types of distributions corresponding to three types of behaviour of the couples vis-à-vis the marriage:

1. Type A, caracteristic for elder couples: no births before the eighth month following the marriage (i.e. no antemarital conception), maximum of births in and around the ninth month of marriage.

2. Type B, caracteristic for the major part of the population and especially significant for the urban population: maximum of births in the fifth month of marriage (i.e. most of births in the first year of marriage come from antemarital conceptions).

3. Type C, caracteristic for the very young mothers (age groupe 14 to 19): maximum of births in and around the second month of marriage.

The author tries to explain the sociological background for these three caracteristic types of behaviour.

C. Taeuber

ISI

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L'INSTITUT INTERNATIONAL DE STATISTIQUE
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Hungary

SOME PROBLEMS OF THE STATISTICAL MEASURING OF PLAN-FULFILMENT IN HUNGARY.

The problems of the statistical measuring of plan-fulfilment cannot be appraised but on strength of some knowledge of planning; therefore it is necessary to give a brief outline of this operation.

In the course of recent years planning has been constantly changing, developing in Hungary. It began with the Three Year Plan in 1947. This Plan, then not for all fields of economy, included only the most important indicators. The plan relating to the next phase, the Five Year Plan could, as a result of changes meanwhile having taken place in ownership, cover a wider scope of economic and social life but contained, and with right, too, only general data and prescriptions concerning the main ratios. Besides also more detailed annual plans were drawn up, with yearly changing methods. On one hand, more and more numerical data were available, thus ensuring a firmer basis for planning, on the other, plans were becoming ever more detailed - not without having its drawbacks. The view that the more detailed an economic plan, the better it is, gained ground. It is obvious that realistic and correct planning requires a very wide scope of numerical data. Thus, for instance, to be able to take a decision in the most important problem, how much may be used for consumption and accumulation respectively, obviously the national income must be appraised. To do so, computations have to be made to cover all fields of economy, of social and cultural life and a number of important indicators are needed for all these fields. Not all such computations can, however, be made binding directives in the form of a "Plan Law"; a part thereof are simple figures required for the correct determination of the plans. In the course of the development this essential difference between the computations needed for detailed planning and the plan itself, became, to a certain extent, obliterated. Thus tasks in the Plan were prescribed too meticulously and planning assumed some bureaucratic features imposing heavy administrative burdens. Beyond a certain point, it hampered local initiatives, the implementation of actual intentions. While planning was becoming on one hand most detailed, at the same time it was also one-sided to some extent - despite most elaborate detailed figures the Plan System did not include any computations prescribing as to how far production and distribution was economical.

The shortcomings of this practice had become obvious and the system and method of planning have undergone a marked improvement in recent years. Plans are being based on an ampler material of computation than in the beginning and, at the same time, contrary to the too detailed methods of the interim years, the principle to indicate only the direction and main internal proportions of the economy, is making headway. The number of indicators compulsorily prescribed in the various fields has undergone a radical diminuation. The 1957 plans lay down directives concerning production of socialist industry and construction, marketing of agricultural products by the state sector, the most significant forecasts of forestry, forecasts as to purchasing, the 1957 goods-supply of domestic trade by the Ministries concerned, foreign trade and the respective tasks of delivery of the competent Ministries, prescriptions concerning education, the development of the health and social services, the tasks of housing, the extent and the division of investments and renewals, supply of material funds and technical help by ministries, and finally the Wages Fund, similarly by Ministries. Besides, as basis for computation the most diverse material balances, the main aggregate data of agricultural production /crop, cultivation, live-stock/, the development of stocks, manpower balance, the development of costs of production, the production and consumption of the National Income, the data of purchasing power and of consumer goods available as well as the Financial Balance are being drawn up.

As the State Plan thus contains fixed, concrete numeric prescriptions covering a wide scope of economic, cultural and social life in a uniform system, it looks reasonable that it should suffice to measure the fulfilment of each numeric prescription and the drawing up of the well-known "Plan Fulfilment Percentage" indices. The Hungarian Statistical Office had actually followed this practice for a long time and only as a result of an appreciable development did it recognize the fact that while thus implementing its task formally, it fails to cope with the essence of the problem.

In order to get near to the core of the task, a distinct line has to be drawn between the actual main intentions of the State Plan and the concrete Plan directives aimed at reaching such intentions. The general and constant aim of the Plan in our country is, of course, the possible raising of the living standard of the working people as far as circumstances permit. In this wording, however, the aim is so vague that it cannot be called a plan. That it should develop into a Plan, the main objectives of the Plan have to be fixed which determine, how the above general aim can and shall be attained, how and by how much the living standard shall be increased, to what extent and in what composition the goods available shall be placed at the disposal of the public and to what extent they shall be accumulated for raising future consumption, moreover, to what extent all this must be covered from internal or external resources. These main objectives of the Plan being still rather of a general character, further detailed plans have to prescribe, how to implement the above

main objectives in the various fields of life. These detailed, concrete, numerical prescriptions are commonly indentified with the Plan itself.

The measuring of these latter plan prescriptions began to prove obviously inadequate when we could account on one hand about the fulfilment of the detailed plans about the increase of industrial output, about the growth of trade, about the spending of the funds forecast for investment and, on the other hand, studying economic development as a whole, its interconnections, we had to see that the main objectives, or an appreciable part of them, were at the same time left unfulfilled. This recognition meant, of course, to a certain extent a criticism of our planning, but it also throws light on the inadequateness of the system developed for the measuring of plan-fulfilment. This has led us to ask: what is to be actually regarded the Plan and how it is to be measured. The answer was that the notion of Plan must be interpreted more amply and the methods of its measurement must be developed accordingly. All this has led the Hungarian Statistical Office to adopt the view that as the part-prescriptions of the Plan being, for one, of different importance and, for another, correlated to each other, and since a series of plan-fulfilment percentages or any other numeric means do not give a right order of importance or express the connections and mutual effects, the measuring of plan-fulfilment is not a mere statistical task but rather a work of economic valuation, analysis, fulfilled with statistical methods. /Beside testing the performance of these tasks in the way described here-above, the Statistical Office measures, of course, also the fulfilment of the detailed numeric plans in the usual manner./

About the methods and problems of a more broadly interpreted measuring of the plan-fulfilment.

As the main tasks of the Plan relate to big general connections, it naturally follows that in order to give a correct appraisal of the fulfilment of these plans, the statistical methods reserved for big general processes must be applied. In Hungary this is done with the aid of the Economic Balance System, parts of which are:

1. The balance of man-power and of labour force,
2. The balance of gross material product [1], consisting of two parts:

1/ Similarly to the concept of the gross national product, the value of the gross material product includes the value of the final product and that of provisions for consumption of fixed capital but differs from it inasmuch as it includes the value of the intermediatory product.

a/ aggregation by economic sectors and by use,

b/ Interconnections of gross production and consumption between economic sectors /the so-called chessboard balance of the gross material product, which has some similarities with the input-output tables/,

3. The balance of net material product [2], showing the production and the distribution of the net material product,

4. The financial balances, i.e. the balances of the State Budget, the balance of International Payments and the balance of the money-incomes and outlays of the population.

Though this System of Balances gives, of course, only in its complexity a comprehensive picture of the most important process, in the following we shall deal solely with the problems of the national income and with those of the computations attached. They are mostly the ones containing the data which, from some points of view as final results, should give the nearest information regarding the main tasks of the plan.

The fulfilment of the plans can be properly valued only against a long run development, if possible even more so, than that covering numeric part prescriptions. Thus the first task is to draw up the Balance of the National Income at unchanged prices.

To draw up the National Income Balance at unchanged prices, in a way allowing for the equilibrium of production and consumption in spite of the application of the naturally not quite correct different price indices and volume prices, is a most elaborate statistical task. Experience has taught us that however great difficultios this way involves, the methods of computation must be developed until the balance of the production and consumption sides can be ensured at unchanged prices. Not until the final figures of the production and consumption sides tally, can we be sure about the correctness of the final result. Since the question cannot be put even in such a way that before the two sides agree we cannot know which of the two values of the production and consumption sides is correct /as it can turn out and it occur frequently in practice that a third, interim value proves correct/, it is clear that not until the two sides of the National Income computed at unchanged prices tally, can we find means to establish correctly the dynamics of the National Income.

Having mentioned the most general problem of analysing development in time and comparability, going over to the underlying issues proper, it

2/ The concept of the net material product /i.e. national income/ differs from the concept of the net national product in the estimation of the value of services as we do not measure the value of rendered services, but its material consumption only.

is obvious that the analysis has to be performed broken down into two main groups:

1. to what extent and how the living conditions of the workers changed in the given period,

2. what has been done for a future change in the living conditions of the workers.

In other words: what has happened in the field of consumption and accumulation. In the following I wish to deal only with the first group of questions because one single group gives also a picture of the character of problems generally arising and about the ways of their solution.

/1/ National Income and computations of Real Income in measuring plan-fulfilment.

In the analysis of the changes in the living conditions of the population, the computation of the consumption side of the National Income offers a good starting point, but let us emphasize: a starting point only. To be able to feature the living conditions of the population properly, we have to abandon the circle of National Income computations; this purpose is best served by computations of real wages - real incomes.

How can we sum up the difference between the approach through the National Income on one hand and through real wages - real incomes on the other?

With us the calculation of the National Income starts from the side of material production, it uses a grouping and valuation corresponding to the realisation of production; accordingly it covers big fields, actually giving comprehensive results embracing the population as a whole. Real income, on the other hand, starts from the individual income resp. individual consumption of the population, uses a classification by the main groups of the population thus being apt to give detailed results as to various classes, strata, groups. Besides consumption as per the National Income covers only the consumption of goods, whereas the computations of Real Income include also that of services. This, however, does not mean that when judging the living conditions of the population, the national income computations can be dispensed with. It partly gives a picture of the ratio between consumption and accumulation, partly a number of data required for establishing the real income of the peasantry are based on this balance, and mainly because the annual dynamics of the population's consumption

as shown on the consumption side of the national income offer control for the average real income index of the various groups of the population. If the real income indices of the various groups of people are correct, their weighted averages must agree with the index of the consumption of the total population as resulting from the National Income, with due regard to the intrinsic difference between the two methods.

The computations covering the living conditions of the population cover separately the development of the real wages and real incomes of workers belonging to certain main strata of the population. These calculations show the development of the real incomes of workers, employees and peasants and moreover, that of workers engaged in certain physical and intellectual professions. The statistical returns help to analyse the changes the nominal incomes and the price level undergo and how, on one side, the changes in the earnings themselves, on the other, those of wage-earners and their proportions act. They also display the difference to be found behind the changes of the living condition averages. Also how deviations from the average affect certain layers and how the incomes of various family types develop, etc.

Whereas in the case of workers and employees real wages and real incomes together with the development of social allocations give a more or less satisfactory picture of their living conditions resp. changes of these, in case of the peasantry it is far from satisfactory. The personal existence of the peasantry is closely interlinked with the agricultural unit serving its maintenance: the same goods which serve their personal consumption can be used also for the maintenance and enlargement of its enterprise. Owing to the interchangeability of consumer goods and factors of production, the peasantry actually uses the goods available whether for its enterprise or its personal needs. So the examination of his consumption alone does not give a true picture of the development of his full economic resources, living conditions. Thus e.g. if we had wanted to judge the living standard of the peasantry alone by its consumption, we ought to have reported about the very poor year of 1952 /when the peasantry slaughtered quite a considerable part of the livestock in lack of fodder, consumed its stocks and was forced to a relatively high consumption/ that the standard of living of the peasantry increased. On the other hand, about 1953, when the good crop allowed the peasants to renew their farms, when they could increase livestock, stocks and consumed relatively less, we should have said that its standard of living was stagnating or at least decreased.

This duality of the living conditions of the peasantry, its most complex character as a consumer and producer, makes it imperative that its living conditions be made subject to double analysis; for one: similar to workers and employees, the changes in the volume of consumption of the peasantry must be expressed; for another: taking into consideration changes in stocks, the development of the real value of

the peasantry's income must be established.

In the present stage of our economy it is of special importance to know from what sources the peasantry draws its income: what is its income from agricultural production and what is its revenue from wages for non-agricultural, industrial, building, etc. work. Such analysis has shown that in recent years, due to the relative backwardness of agriculture, the ratio of peasantry's income from agriculture has greatly decreased and that from industry increased. Similarly it is most important to examine the proportion between income in money and in kind. The development of income in kind should give an idea about the supply of the overwhelming majority of the fundamental consumer goods, income in money shows the extent of the relations with town, industry, culture. It is further most timely to clear up the problem, to what extent the peasantry covers its needs of consumption from own production and how far from the central stock. We submit also the question of price movements to thorough scrutiny. Prices, through the money- and goods-connections between peasantry and State on the one hand, and the peasantry and the rest of the population on the other hand, can appreciably influence its participation in the National Income.

It is therefore that we examine most thoroughly the movement of prices in respect of articles sold and purchased by the peasants and their correlation. In view of the town-dwellers, special attention is paid to the changes of the free market prices as reflected in the sales of the peasantry. Taking into account the fact that in recent years the increase of the agricultural output has lagged behind the development of the economy as a whole, and consequently, the demand for agricultural products has, on the whole, exceeded supply, the peasantry has fetched relatively high prices for its products. In years with inferior crops, as a result of relatively high free market prices, the peasants found almost full compensation for the smaller volume of products, and in years with better crops, when demand was still greater than supply, with prices not proportionally lower, the relatively bigger volume of products ensured relatively favourable conditions as compared to those of the workers and employees.

The task of statistically comparing the living conditions of workers, employees and peasants raises an apparently simple but really most complex statistical problem viz. that of delimiting these main groups as properly as possible. Such delimitation did not represent any special problem in olden days, because the agricultural and non-agricultural population could be relatively easily separated. The situation is different to-day when, due to the big and rapid growth of our industry, building and construction, the agricultural producer of the village of yesterday changes gradually into an industrial worker. Between 1949 and 1956 the number of employees in industry and building increased by over 500.000 i.e. by about 65 per cent. This rise comes to a great extent from agriculture. The major part of the new masses of workers streaming from agriculture into industry takes part at the time of the harvest and other peaks in the work of

the country-family and draws the main part of his food supply from the village base. In view of this multifariousness of transitory forms, it is difficult to delimit properly these two layers from each other, especially if we consider that not the earners themselves must be grouped but the peasant households have to be delimited according to their character, though some members of the same peasant households have incomes as peasants, others as workers or employees. Under such circumstances a perfect delimitation is, of course, impossible. In principle this delimitation takes place on ground of the dominating part of income in case of incomes from several sources. It is based on the consideration that sooner or later it will determine the corresponding character of the living conditions, of the way of living. A most careful statistical survey and thorough computations are required to obtain an approximation as to how the part resulting from agricultural production and that from wages resp. salaries develops.

The computations mentioned hitherto make possible the analysis of the development in accordance with the main intentions of the plan. These computations show, among others

1) the real joint effect of the planned wage and price policy,

2) the influence of changes in employment on household incomes, in connection with the relative plans,

3) the effect of the fulfilment of plans relating to the development of agricultural cooperatives on basis of the detailed analysis of the incomes of peasants working in cooperatives or individually,

4) and, comparing the incomes of workers and peasants, the actual share of these most essential strata of the population in the national income.

5) Though the said methods serve a far-reaching analysis of plan-fulfilment, they do not exhaust the task; the examination of other fields is also required.

/// Statistical testing of the population's outlays for measuring plan-fulfilment; examination of the living conditions of some groups and of the whole population.

If we wish to examine the living conditions of the population, it is obvious that though it is of decisive importance, we cannot be satisfied with the statistical analysis of only the incomes of the various classes, layers, groups. In complementation of it, it is absolutely imperative to analyse statistically also the utilisation of the incomes, the movement of expenditures, the pattern of consumption. To this end we partly study carefully trade and the catering industry, its division

among the various forms of trade /State, cooperative, private, products directly marketed by village producers, etc./. On the other hand, we endeavour to obtain information also from the population itself in this important question. At present, 1700 town workers and 2800 country workers /collective and individual farmers/ render household statistical data which give us partly valuable information as to the actual composition of income, on the other hand about the changes in consumption. Thus e.g. data are obtained about the aggregate incomes of families of various types, /the per capita income within the family is of the most determinative importance/, further about the factors underlying this income per head /size of family, proportion between earning members and dependants, the average earnings in case of different numbers of earners, etc./. Apart from the composition of incomes, we gain ample data of the way of using the incomes. Such data make possible the comparison between the living conditions of workers and employees and of the peasantry, as well as the comparative analysis of the various layers, the establishment of the structure of consumption, and how it is interconnected with incomes. These data show also the material and cultural level of the various strata, their alimentation, clothing etc. Such relatively abundant data give rich material for testing the living conditions of the population partly to judge the main tasks set in the plan, partly to make further plans.

The various computations of real wages, real income as well as the tests of household statistics are to give general features of the members of different classes, layers, groups, but in themselves do not throw light on changes in the living conditions of the population as a whole. It is therefore that we examine changes exercising an influence on the population as a whole, too. E.g. as referred to above, many workers were peasants some years ago. At the same time the consumption level of the peasants, even though to a lesser extent than before, is still lagging behind that of the workers. Considering that the real income indices both of peasants and of workers reflect the changes only within any one group, it is clear that stepping over from the group of peasants into the circle of workers means such a sudden rise which does not find due expression either in the real income index of one or of the other strata.

In recent years our society has been featured by great changes, thus a peasant becoming a worker is but one instance of changing over "from one circle into another". Similarly powerful migrations have taken place also within the peasantry and within the circles of workers and employees.

Masses of unskilled workers have become trained and skilled workers; the ever increasing number of inferior technical cadres has been mainly drawn from among the skilled workers and from the best workers and employees there became a number of first class experts leading economic and cultural life. At the same time, entrepreneurs and the like, who uses to live on a higher level of consumption, have become

workers. The change "from one circle into another" - a grandiose change in the structure of professions - partly illustrates and explains the change in the average conditions of the main groups of the population, partly makes possible the completion of valuing the Main Averages, in fact a better valuation.

The former computations make it primarily possible that beside measuring the fulfilment of the plans of distribution, their impact on everyday life of the population can also be measured. The coordination and implementation of the plans relating to the shaping of incomes and their use are made possible by these figures. Summing up, these calculations show the joint effect of carrying out the various intentions concerning the living conditions of the different strata.

/3/ Analysis of certain questions of timely interest for judging the implementation of the Plan.

The analyses hitherto mentioned are so to say always valid. In addition, the concrete circumstances prevailing determine when and in which fields further tests for the meritory valuation of plan-fulfilment are required. Let some examples be quoted:

Foreign trade plays an important part in the life of our country and thus in the development of the living standard of the population. Imports and exports account for about 20 per cent. each in the National Income. Foreign trade having developed in recent years in a manner considerably different from our plans, and, at the same time, the standard of living of the population not having developed by the Plan, it was found necessary to submit foreign trade to a statistical analysis paying due regard to its broader connections. Against such background we have partly been dealing with the interconnection between production and foreign trade plans, partly with the actual relations between our foreign trade and production. We have further dealt with the interconnection of our industrialisation, agricultural production and our trade. We have statistically proved the connection between the production of the national income as well as its use for consumption and accumulation and the development of the balance of foreign trade. The purpose of these computations was to render account, in what form the fulfilment of various plans referring to different fields is realised, how it influences the other connected fields, how it ultimately affects the consumption of the population.

In consequence of the events of Autumn 1956, the problem of the equilibrium between goods available and purchasing power gained special impetus. To make the importence of the problem evident, it will do well to refer to the fact that according to preliminary estimates, the national income in 1957 per capita will be 7 to 10 per cent. lower than in 1955, at the same time the consumption of the population per

head will exceed, on account of the readjustment of wages and prices and of the change in the marketing conditions of the peasantry, that of 1955 by 15 per cent. /As well-known, a number of countries, first of all the Soviet Union have contributed a great deal to the solution of the problem arising herefrom in the form of substantial aid and loans. It stands, of course, to reason that it is only a contribution to the solution of the problem but cannot be regarded as the solution itself./

In order to throw light upon the problem, we tried to sum up the situation at the beginning of this year on basis of the development of note circulation, of the velocity of circulation of money, the stocks, the volume of consumer goods coming from home production and foreign credits or aid. We also forecast the incomes and expenditures of the population duly considering the purchasing and taxation forecasts and the wage rises decided upon. This work had also been based on National Income computations in view of the fact that it represents the upper limit for covering all requirements from inland resources. Figures showed that in 1957 the national income will cover the consumption requirements and it even permits investments of a more modest nature than hitherto.

Calculations have also proved how much bigger a volume of goods must be provided for than last year in order to ensure the equilibrium between money and goods, how much of it must be covered partly from an increased quantity of consumer goods produced within our total output and partly through foreign trade.

This computation served, exceptionally, less the purpose of accounting for plan-fulfilment than to offer a ground for adequate plans, measures.

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The aforementioned examples should give an approximate picture as to how the work of the Hungarian Statistical Office supports the measuring of plans and that of planning itself. It is evident that a number of cases when the Statistical Office does not measure the prescribed tasks but values the realisation of the main tasks of planning, it has often to interpret the plan itself. Thus e.g. the interpretation of how far the readjustment of wages performed in Summer 1956, when workers in low wage-categories got a rise - is open to interpretation from the point of view of the main objectives of the Plan. This readjustment, while raising the standard of living in a very justified field at a rate of more than average, is diminishing at the same time the relatively small differences between the earnings of lowly and highly qualified workers, which did not exercise a beneficial effect on wages proportionate with output, with the quality of work, on the reproduction of qualified workers and through all this, on developing production and on raising the standard

of living of the whole community.

The above statistical work serves simultaneously the measuring of the actual plan-fulfilment and further planning. The statistical data and valuations offer a vast array of knowledge for planning and for Government measures.

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Although our work has seen a significant development in the course of recent years, in my opinion we are far from being satisfied. As far as the statistical data themselves are concerned:

the relatively wide scope of the uniform statistical accounting system ensured by the State Laws, its more or less uniform character and its roughly acceptable support of documentation yields us great benefit.

At the same time, the steady development of our work has led us by now to realize also the limitations of this system. Under the statistical system, the bulk of the data reaches the Statistical Office through the lower /local/ statistic bodies or the operative directive bodies in pyramid-like form /the higher the level, the more summarized the result/, finally summed up by Ministries or Administrative Units. Thus the Statistical Office, except its direct collection which represents a considerably smaller part of all data available, does not possess individual data. This fact greatly hampers the use of one of the most particular methods of Statistics, i.e. that by summarizing the statistical multitude in different groupings, different processes can be analysed.

Our work is also limited by the fact that, partly as a result of our planning and controlling work practised hitherto, we are inclined to follow up every process in its complexity. Consequently our accounts are almost full-scope and thus involve great material efforts and, from the point of view of them who are rendering the data, they represent a disproportionate burden. If, however, in justified cases we content ourselves with characterising processes without aiming at the precise value of such processes, we could observe some problems in a more detailed manner, quicker and at smaller expenses. On ground of this perception, we now are endeavouring to develop our work. While retaining the global and wide possibilities secured by the system of state accounting, at the same time we wish to apply more frequently than hitherto the methods of single or rarely effected detailed collections within a narrow field.

Of course, it is not only the field of statistical data themselves that

could offer a scope for constant improvement but also their use. At present, in our analyses and informatory work the possibilities offered by the accounting system are often only partly exploited. Though it may often be due to financial reasons, it is obvious that, taking economy as a whole, the not full utilization of data collected with great material sacrifices cannot be deemed economical.

We are facing a number of difficulties not only as far as the right valuation of the main intentions of the plan, but also when establishing the numerical targets. The method of planning, as referred to in my introductory remarks, is changing. Accordingly the notions, groupings, detailedness used in the plan change to a certain extent. Since statistics do not tolerate frequent changes, the tasks of steadily representing development and measuring plan-fulfilment often conflict. The frequent alteration of plans also aggravates the numerical measuring of plan-fulfilment.

Summing up, we think to be approaching the core of our task. For statisticians the main problem of measuring plan-fulfilment both in our country and in all other is that beside informing about the numbers of plan-fulfilment they should <u>value</u> plan-fulfilment, analyse its effect also in connection with some part-fields, primarily however the effect of plan-fulfilment of the main connections of economic and social life.

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Balance of man-power

I. Sources of man-power	II. Utilization of man-power
Population in age of working capacity	Wage-earners
Wage-earners out of age of working capacity	1./ By branches
	In productive branches
	Of which: industry
	building and construction
	agriculture
	transport
	trade
	Non-productive branches
	2./ By social sectors
	Workers and employees
	Of which: socialist sector
	private sector
	Members of co-operatives
	Small-scale producers
	Capitalists
	All wage-earners:
	Not having a gainfully occupation
	Students, apprentices and school-children
	Mothers with 3 and more children
	Man-power reserve
	Unemployed not having a gainfully occupation, total:
All-together:	Utilization of man-power, total:

Chessboard Balance of Gross Material Product

	Total	Of which		Branches of material production							
		I. subdivision	II. subdivision	Industry	Building and construction	Agriculture	Transport of goods	Trade	Other	Together	Imports

I. Sources

II. Distribution

1. Productive consumption
   - Industry
   - Building and construction
   - Agriculture
   - Transport of goods
   - Trade
   - Other

2. Non-productive consumption

   a/ Consumption of population
      - Purchases and in institutions
      - Consumption of own-production
      - Depreciation allowances of dwellings

   b/ Material consumption of public institutions

   c/ Material consumption of enterprises rendering services

3. Accumulation

   a/ Increase in stock of fixed capital
      - Productive
      - Non-productive

   b/ Increase in circulating capital
      - Changes in stocks
      - Work in proces

4. Exports

Balance of Gross material product

I. Production

1./ By economic branches
- Industry
- Building and construction
- Agriculture
- Transport of goods
- Trade
- Other

2./ By social sector
- State
- Co-operative
- Socialist together:
- Small-scale Capitalist
- Private, together:

3./ By destination of products
- I. subdivision
- II. "

Total production:

II. Imports

All sources:

I. Consumption
- 1./ Productive
- 2./ Non-productive
  - Of which: population
  - public institutions
  - services

Total consumption:

II. Accumulation
- 1./ Increase in stock of fixed capital
  - a/ productive
  - b/ non-productive
- 2./ Increase in circulating capital
  - a/ changes in stocks
  - b/ work in process

Accumulation, total:

Domestic utilization

III. Exports, transfers, etc.

Total consumption:

National income /net material product/

Production	Consuming
Industry	I. Consumption
Building and construction	1/ Consumption of the population
Agriculture	a/ food
Transport of goods	b/ industrial products
Home-trade	c/ fuel and illuminant
Foreign-trade	d/ depreciation allowances of dwellings
Trade, total	Together:
Other branches of material production	2/ Other non-productive consumption /institutions and services/
Total national income	Total consumption:
	II. Accumulation
	1/ Increase in stock of fixed capital
	2/ Increase in stock of circulating capital
	Total accumulation:
	III. Use abroad
	Surplus of imports /-/ of export /+/
	Together:
	Total consuming:

Balance of the money-incomes and expenses of the population

INCOMES

	Total income	Socialist sector	Private
Wage-earners			
Wages			
Pensions, scholarships and sickpays			
Other personal incomes			
Credits and savings			
Premiums on State Loan			
Other incomes			
Total:			
Peasantry			
Hoarding			
Free-market sales			
wages			
Unit of labour and rent in co-operatives			
Freight incomes			
Credits and savings			
Premiums on State-Loan			
Other incomes			
Total:			
Others population			
Private small-scale industry			
Private retail trade			
Carriers			
Professionals			
Credits and savings			
Premium on State-Loan			
Other incomes			
Total:			
Total incomes:			
All-together:			

EXPENSE:

	Total expenses	Socialist sector	Private
Turnover of goods			
I. Personal purchases for consumption			
In commerce			
In catering trade			
In industrial co-operatives			
In private small-scale industry			
From peasants			
From other producers			
Together:			
II. Personal purchases for re-sale or for further processing			
Turnover, total:			
Services			
Rent			
Communications			
Other services			
Total:			
Financial expenses			
Takses			
State-Loan			
Other			
Total :			
Wages paid by privates			
All expenses:			
Increase of cash in hand			
All-together:			

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Distribution of National Income

	National income	Wages	Incomes	Out of the income		
				taxes and social insurance	other costs	net result
	million forints					
Socialist sector						
State sector						
Industry						
Building and construction						
Agriculture						
Transport of goods						
Home trade						
Foreign trade						
Total:						
Co-operative sector						
Industry						
Building and construction						
Agricultural producer's co-operatives						
Agricultural co-operatives						
Total:						
Socialist sector, total:						
Private sector						
Small-scale						
Small scale and handicraft						
Working peasantry						
Freight performed by peasants						
Own-account construction						
Other branches of the material production						
Total:						
Capitalist sector						
Capitalists, craftsmen with employees, merchants, kulakhs						
Total						
Private sector, total:						
All-together:						

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THE INTERNATIONAL STATISTICAL INSTITUTE

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NOTE DE LA DIRECTION CENTRALE DE STATISTIQUE DE LA REPUBLIQUE POPULAIRE ROUMAINE SUR LE PROJET DE PROGRAMME PREPARÉ PAR LA F.A.O. POUR LE RECENSEMENT MONDIAL DE L'AGRICULTURE DE 1960

par

/96/

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Comme suite à une analyse approfondie du projet de programme préparé par la FAO et du rapport de la réunion de Rome du Groupe de Travail des recensements et enquêtes agricoles (recensement mondial de l'agriculture de 1960), nous jugeons opportun de porter à votre connaissance certaines considérations sur les problèmes d'ordre général que pose l'exécution d'un tel recensement à l'échelon mondial, ainsi que sur les problèmes particuliers que cela soulève dans notre pays.

I. Considérations générales sur le recensement mondial de l'agriculture de 1960

1. Unité d'observation

En ce qui concerne le concept de l'exploitation agricole, proposé dans le projet de programme comme unité d'observation (défini dans la section O du projet de programme), on estime que l'exploitation agricole, étant considérée principalement comme une unité technique agricole située entre les limites d'une ou plusieurs circonscriptions de recensement, voisines ou contigues une telle unité ne se prête pas au but poursuivi par l'exécution du recensement.

A notre avis ceci est dû à ce que le terme "exploitation" pourrait en pratique être appliqué à l'entreprise ou au ménage (quoique la définition proposée pour ce dernier dans le projet de programme soit différente de celle de l'exploitation), mais il pourrait tout aussi bien ne pas s'y appliquer. En fait, l'exploitation est une sous-unité d'entreprise à caractère technique (de production), sous-unité spécialisée dans une certaine subdivision de la branche agricole (par exemple porcherie, vigne, prairie, etc.), ou bien, desservant l'entreprise agricole (par exemple forêt, pâturage, etc.), dépendant donc de l'entreprise, tant au point de vue économique que

technique (direction).

D'ailleurs, on se rappellera qu'au cours des discussions qui ont eu lieu à la FAO, il est ressorti clairement que le choix de l'exploitation comme unité d'observation n'assure pas le recensement complet de l'entreprise agricole. Ainsi certaines exploitations spécialisées (par exemple dans la production du bois), qui sont en relations étroites de coopération avec d'autres exploitations d'une même entreprise agricole, seraient considérées à tort comme appartenant à une autre branche économique(dans le cas cité: la branche forestière).

Aussi, estime-t-on qu'en adoptant l'exploitation comme unité d'observation pour le recensement il ne sera pas possible de recueillir des données complètes sur la production et le potentiel économique des entreprises agricoles.

On signalera également que l'observation de l'exploitation, au lieu d'observer l'entreprise agricole, empêcherait le recueil de données sur les propriétaires des terres et des moyens matériels et par conséquent ferait obstacle à l'étude de certains problèmes sociaux, comme ceux des rentes, de la concentration du capital dans l'agriculture, de la nécessité des réformes agraires, etc., dont la solution conditionne principalement le développement de la production agricole et le relèvement de vie de la masse des travailleurs agricoles.

En conclusion, on estime qu'il serait plus efficace, pour atteindre le but du recensement, de substituer à "l'exploitation" comme unité d'observation, "l'entreprise agricole", définie comme unité indépendante, du point de vue technique et économique, ayant direction et bilan uniques (pour l'agriculture paysanne: le ménage).

L'acceptation de cette proposition impliquerait le dénombrement des terres, des moyens matériels et de la production agricole, par entreprise, exploitant et propriétaire, indépendamment du fait que les exploitations dont est composée l'entreprise se trouvent réunies dans une seule circonscription de recensement ou au contraire dans des plusieurs, voisines ou éloignées. Quant à la main-d'oeuvre, elle devra être dénombrée par entreprise.

La proposition ci-dessus n'exclue pas la possibilité de faire simultanément des relevés pour les sous-unités de l'entreprise agricole, les exploitations.

Bien entendu, cette proposition suppose que l'on prenne des mesures propres à éviter les relevés doubles, mesures d'ailleurs bien connues par les statisticiens de tous pays.

2. Période de référence

Vu que dans le projet de programme la période de référence n'est pas indiquée d'une manière précise, nous jugeons opportun qu'elle soit définie et établie aussi judicieusement que possible pour assurer la comparabilité des données, tant à l'échelon mondial, qu'au niveau régional.

Ainsi, par exemple, il est bien connu que pour la plupart des espèces d'animaux de ferme, on peut distinguer au courant de l'année deux moments où l'effectif de l'espèce présente des variations importantes. La différence entre les effectifs maximum et minimum annuels peut être appréciable et dépend de la prolificité des différentes espèces et aussi de certaines coutumes propres à chaque pays (ou région), comme la vente et l'abattage des animaux à tel ou tel âge, la consommation de la viande de préférence pendant certaines périodes de l'année, etc.

Aussi, estime-t-on que la période de référence devrait être établie pour les pays d'Europe immédiatement après la fin des travaux agricoles de l'année civile 1959, c'est-à-dire en hiver 1959-1960.

3. Recensement de la population

Nous estimons qu'il y a lieu de faire les remarques suivantes sur la méthodologie du recensement de la population, proposée dans le projet de programme:

a) Etant donné que le dénombrement de la population des exploitations tel qu'il est proposé dans le projet de programme, ne pourra pas renseigner sur la population agricole (puisque la population des exploitations comprend également les personnes travaillant dans d'autres secteurs, ainsi que les personnes qui sont à la charge de l'exploitant), ni sur la population rurale (les exploitations agricoles étant situées aussi bien dans des régions rurales que dans des régions urbaines), - nous proposons de dénombrer la population active de l'agriculture en indiquant toutefois distinctement les personnes qui sont à la charge de l'exploitant (aptes et inaptes pour le travail, spécifiées séparément).

b) Dans ce même problème du recensement de la population agricole, nous proposons de dénombrer séparément ceux qui effectuent un travail manuel productif (travailleurs agricoles) et ceux qui sont chargés de diriger ou d'administrer, l'un et l'autre de ces groupes étant divisés en personnel permanent et en personnel temporaire, en salariés et en personnes appartenant au ménage de l'exploitant.

c) Pour obtenir des renseignements plus complets sur le nombre et la structure des travailleurs agricoles, nous sommes d'avis qu'il serait opportun de recenser également les conducteurs de tracteurs et autre personnel employé dans le secteur mécanisé de l'agriculture, même si les machines et les installations dont ce personnel a la charge - n'appartiennent pas à l'unité recensée (mais ont été, per exemple, louées).

4. Recensement de la superficie et la production agricole

En ce qui concerne les superficies soumises au recensement agricole:

a) nous jugeons opportun de recueillir des données non seule-

ment sur la "superficie récoltée" mais aussi sur la "superficie portant des cultures au moment de la clôture de la période des semailles". Nous estimons, en effet que si l'on procédait selon la méthode proposée dans le projet de programme, la production de l'année du recensement pourrait ne pas refléter un niveau normal, ce qui n'assurerait pas un degré satisfaisant de comparabilité des données, ni à l'échelon mondial, ni en ce qui concerne l'évolution par année, en raison de la diversité des conditions locales, dépendant du climat et, pour certains pays, des prix non-rémunérateurs pratiqués sur le marché;

b) nous estimons de même que les superficies ensemencées successivement, durant la campagne agricole, devraient être indiquées séparément et que les superficies cultivées qui fournissent plusieurs récoltes, sans même qu'aient été nécessaires un ou plusieurs ensemencements, devraient être comptées une seule fois, en indiquant toutefois le nombre de récoltes, afin de pouvoir en estimer le rendement.

La proposition ci-dessus présente un certain inconvénient. Elle exige que l'on recueille des données supplémentaires sur les superficies donnant plusieurs récoltes annuelles. Malgré cet inconvénient elle aura l'avantage d'obtenir des données plus complètes, utiles pour les analyses ultérieures.

Comme il est nécessaire de connaître les données de la production agricole à l'échelon international, afin de prendre des mesures en vue d'une répartition plus équitable de cette production, il serait opportun à notre avis de rassembler des renseignements sur toute la production récoltée et, en ce qui concerne les superficies non-récoltées pour des raisons d'ordre économique, d'en évaluer la production non-récoltée, en faisant explicitement mention du rendement à l'hectare obtenu sur les superficies récoltées pour la même culture et dans des conditions similaires.

c) Pour ce qui est des "investissements liés au sol" (bâtiments, digues, dispositifs d'irrigation et de drainage, rideaux de protection forestiers, chemins de fer à voie étroite dans le secteur de l'élevage, etc.), il serait opportun à notre avis, de recueillir des données complètes, simultanément avec les données concernant les superficies agricoles.

On estime que si l'on procède au recensement uniquement des surfaces effectivement irriguées pendant l'année précédente, comme il a été proposé dans le projet de programme, on n'obtiendrait pas une image claire des possibilités de l'agriculture mondiale.

5. Recensement des tracteurs et des machines agricoles

En ce qui concerne la méthode indiquée dans le projet de programme pour le recensement des tracteurs et des machines agricoles, on estime qu'il serait bon de les dénombrer au moins en unités naturelles (par entreprise, exploitant et propriétaire), au cas d'impossibilité d'en estimer la valeur vu la diversité des systèmes monétaires et des niveaux différents de prix.

Nous estimons qu'il serait opportun de recueillir également

des données sur le nombre total de tracteurs et de machines agricoles usuelles appartenant à l'inventaire des entreprises agricoles au moment de l'exécution du recensement (même si, à ce moment, le matériel ne se trouve pas sur la superficie de l'entreprise agricole recensée).

De même il serait utile, à notre avis, de dénombrer, - séparément, bien entendu, - le matériel des stations de machines et tracteurs, des centres, coopératives ou entreprises du secteur privé, qui fournissent en location des tracteurs ou des machines agricoles.

En ce qui regarde la fréquence d'utilisation de tracteurs et de machines agricoles par les entreprises agricoles, le plus indiqué serait le calcul du "nombre moyen enregistré de machines", ou du "nombre de journées-machines présentes dans l'entreprise", etc.

II. Considérations sur les problèmes posés par l'exécution du recensement mondial de l'agriculture de 1960, dans notre pays

1. Recensement des exploitations agricoles du type socialiste

Dans le but d'assurer un recensement en accord avec les traits caractéristiques de l'agriculture de notre pays, - on estime, et cela est valable également pour les autres pays européens du camp socialiste, que le projet de programme doit être élargi, afin de pouvoir ajouter aux questionnaires et aux tableaux de résultats, certaines données particulières, propre à l'économie socialiste.

Ainsi, dans l'agriculture de notre pays, en dehors des exploitations agricoles individuelles, il existe des exploitations agricoles du type socialiste, à savoir: exploitations agricoles d'Etat, stations de machines et de tracteurs, enfin les exploitations agricoles coopératives (exploitations agricoles collectives, coopératives agricole de production avec rente, associations agricoles et associations simples).

Par conséquent, si l'on soumettait ces exploitations à un mode de recensement non-approprié à leur caractères fondamentaux, on ne parviendrait pas à réunir des données statistiques reflétant fidèlement la réalité, ce qui ferait que les objectifs du recensement mondial de l'agriculture ne seraient pas atteints et que les informations nécessitées par les statistiques des pays en question, ne pourront être obtenues.

En ce qui concerne les sections et les fermes des exploitations agricoles d'Etat, qui sont des sous-unités agricoles correspondant aux "exploitations agricoles" définies dans le projet de programme il sera mentionné que, puisque ces sous-unités ont une activité qui dérive du plan unique de l'entreprise, elles ne peuvent être considérées comme des unités économiquement indépendantes et par suite ni être recensées en dehors de l'entreprise. Cela d'autant plus que le personnel est partiellement commun à toutes

les sous-unités, par exemple le personnel chargé de diriger et d'administrer l'entreprise, certains spécialistes, une partie du personnel chargé du matériel, etc.

Ainsi qu'il a déjà été dit: le recensement mondial de l'agriculture doit également fournir des données statistiques sur certaines unités économiquement indépendantes, comme les stations de machines et tracteurs.

En ce qui concerne les exploitations agricoles du type coopératistes, on doit tenir compte du fait que la méthodologie du recensement de la main-d'oeuvre doit refléter le caractère de cette forme de production. Les membres des coopératives agricoles de production ne peuvent être considérés comme salariés agricoles. Travaillant dans la coopérative en leur qualité de coopérateurs, les membres des exploitations agricoles du type coopératiste ne reçoivent pas de salaire pour leur travail, mais participent, en rapport de la quantité et de la qualité de leur travail, à la répartition du revenu, en espèces et en produits agricoles, obtenu par la coopérative durant une certaine période. (Dans les coopératives de production avec rente une partie du revenu est réparti en rapport de la valeur de l'outillage mis en commun par chaque coopérateur.)

On devrait également tenir compte pour le rassemblement des données et la présentation des résultats, du fait que, d'après ce qui a été dit ci-dessus, les membres des exploitations agricoles collectives qui ont en usage personnel une superficie de 20-30 ares et en propriété personnelle un nombre variable d'animaux de ferme, ne peuvent être récensés dans la même groupe que les membres des exploitations agricoles individuelles.

2. Sur la nécessité d'effectuer en 1960, un recensement de l'agriculture de notre pays

A l'occasion de l'examen du projet de programme de la FAO pour le recensement mondial de l'agriculture, il n'est pas sans intérêt d'examiner également l'opportunité d'un recensement de l'agriculture de notre pays, en tenant compte que les techniques statistiques actuellement utilisées dans notre pays - relevés techniques locaux et comptes rendus - permettent de rassembler annuellement les principales données sur notre agriculture.

Tout d'abord on remarquera que, dans le secteur socialiste de notre agriculture, - qui, estime-t-on sera prépondérant en 1960, - n'est guère nécessaire d'organiser un recensement séparé. En effet, par la technique des comptes-rendus courants et annuels, on rassemble actuellement des renseignements complets, permettant de répondre à des questions plus nombreuses que celles proposées dans le projet de programme.

La modalité utilisée pour compléter les comptes-rendus annuels, les relevés techniques locaux d'ordre contable aussi bien que statistique constituant la source des données, la possibilité de traiter par la méthode de correlation les problèmes, tout cela assure l'obtention de données exactes à la fin de chaque année

civile, donc également à la fin de l'année 1959, année proposée pour le recensement mondial de l'agriculture.

Il s'en suit que, pour notre pays, le problème d'un recensement de l'agriculture ne se pose que pour les exploitations agricoles individuelles et les exploitations agricoles propriété personnelle des membres des différentes coopératives.

Le projet de programme prévoit - et la réunion régionale de Rome, s'est déclaré d'accord, - l'utilisation combinée de l'observation complète, exhaustive, et des sondages.

Au niveau actuel de l'organisation de nos relevés statistiques, les données prévues dans le programme de recensement peuvent être réunies en utilisant les travaux statistiques annuels habituels. Seules les questions qui n'y figurent pas devront être retenues pour être traitées à l'occasion du recensement mondial.

Si l'on analyse, en parallèle, le projet de programme du recensement mondial et les possibilités actuelles qu'offrent les relevés locaux et les données recueillies annuellement, on aura la situation suivante:

En ce qui concerne le ménage, le nombre de personne y appartenant, la classification des terres d'après l'utilisation, le nombre de parcelles, les superficies cultivées, le nombre d'arbres, de machines et d'outils, l'effectif de bétail, etc. (donc pour la majeure partie des questions incluses dans le projet de programme), les données qui s'y rapportent sont contenues dans le registre agricole, comprenant les relevés exécutés par les agents administratifs des villes et des communes rurales.

Vu l'ampleur des travaux nécessaires pour compléter annuellement le registre agricole, vu le mode d'exécution des opérations complémentaires (inspections et visites aux ménages) - cela équivaut en grandes lignes à un recensement complet. D'habitude ces données ne sont centralisées qu'au niveau des unités administratives, et, en particulier, elles ne sont pas dépouillées par ménage, étant utilisées par les autorités administratives locales, pour l'application de la politique agraire dans le cadre des unités administratives, de même que pour la communication de certaines données particulières aux échelons supérieurs.

Toutefois certaines données ne figurent pas, à savoir la production obtenue, les engrais utilisés et les amendements appliqués, la main-d'oeuvre étrangère au ménage employée pendant l'année, etc. Ces questions font néanmoins l'objet de dépouillements annuels basés sur d'autres observations statistiques et sur des relevés particuliers exécutés par les agents des autorités administratives locales (par total unités administratives), mais ces renseignements ne sont pas actuellement réunis par ménages.

Ainsi on étudie couramment, par années, l'évolution de la production totale des différentes cultures par unités administratives, les quantités d'engrais utilisées, etc. De plus, on procède à des enquêtes sur les budgets de famille paysans par la méthode des sondages (enquêtes complexes et continue sur un échantillon choisi d'après les critères du sondage typique proportionnel) permettant

de recueillir des données qui ne figurent pas dans les relevés effectués par les unités administratives locales, sur les exploitations individuelles des paysans et les exploitations propriétés personnelles des membres des coopératives agricoles.

Dans le cas où l'on effectuerait un recensement de l'agriculture dans notre pays, nous estimons qu'on devra soumettre à une observation complète les faits figurant dans le registre agricole, les données principales concernant les exploitations agricoles paysannes, les exploitations auxiliaires et les propriétés personnelles.

L'exécution proprement dite du recensement consisterait à extraire du registre agricole les données par exploitation, sur formulaires spécialement établis, opération qui serait effectuée par les agents chargés de compléter et de tenir à jour ces données. L'utilisation de tels formulaires pour les questions prévues dans le projet de programme rendrait possible de rassembler les données d'une manière correlative et d'effectuer les groupements nécessaires.

Comme il a été indiqué ci-dessus, certaines questions ne figurent pas dans le registre agricole, tandis que d'autres ne sont traitées que par total unités administratives seulement. Pour faire rentrer aussi ces questions dans le champ de l'observation et pour assurer leur présentation correlative (en premier lieu par rapport à la superficie des exploitations) on pourrait envisager deux possibilités alternatives, en admettant, par avance, que ces questions soient traitées par la seule méthode des sondages:

a) l'utilisation des enquêtes par sondages sur les budgets de famille paysans et d'autres enquêtes effectuées dans le but de ventiler par groupes d'exploitations les données globales disponibles,

b) en même temps que le rassemblement des données, c'est-à-dire lorsqu'on fera leur transcription du registre agricole dans les formulaires appropriés, par exploitations, on pourrait effectuer un sondage dans le but d'obtenir des données supplémentaires par groupes d'exploitations sur un échantillon de grandeur convenable, choisi à l'échelon des communes.

Ayant en vue l'importance exceptionnelle d'un tel recensement et la nécessité de telles données, même sur les plus petites unités administratives, nous estimons que la seconde méthode correspondrait mieux aux objectifs fixés.

En faveur de cette dernière méthode plaide aussi le fait suivant: l'échantillon des budgets de famille paysans sera choisi d'une manière représentative par régions seulement et non par communes. L'opération combinée de la transcription des données du registre agricole d'un sondage effectué dans chaque commune, permettrait de réunir d'une façon complète les données prévues dans le projet de programme, pour les exploitations paysannes individuelles et pour les exploitations propriétés personnelles des membres des coopératives agricoles.

On notera toutefois que cette question exigerait un travail d'organisation d'une certaine envergure, dépassant le cadre habituel des travaux statistiques annuels; cela entraînerait aussi des dépenses en conséquence.

SOME COMMENTS AND PROPOSALS CONCERNING

THE DRAFT PROGRAM OF THE 1960 WORLD CENSUS OF AGRICULTURE

(Abriged text)

I. General Consideration on the 1960 World Census of Agriculture

1. Reporting unit

Taking into account that the "agricultural holding" is not always an independent economical unit, but a technical or deserving unit of an enterprise or of an agricultural household, we consider more useful the adoption of the term "agricultural enterprise" /and "household" - for individual agriculture respectively/ as a reporting unit for the 1960 census of agriculture.

From the point of view of the arm of the census, registering of the characteristics by enterprise, enterpriser as well and by owner imposes itself. This does not exclude the registration of the holdings considered as subunits.

2. Time reference

We consider that for European countries, time reference should be established in the period immediately following the agricultural of the 1959 year, that is in winter 1959-1960 respectively, /and in a corresponding manner for other regions of the world/ bearing in mind especially the problem of comparability of data on a regional level.

3. Enumeration of farm population

The enumeration of "population of holdings" - as proposed by the F.A.O. draft program - allows neither the determination of the farm population nor that of rural population. Therefore we recommend for enumeration the adoption of the category "economically active population" in agriculture, pointing out distinctly persons who perform productive work and those in charge of technical and administrative activities; persons performing full-time and part-time works; wageearners, members and non members of households; and also persons who are in charge of others /distinguishing between working persons and unapt ones/.

In opposition with the draft program, we consider necessary the inclusion of tractor drivers, as well as of other persons employed in the mechanical sector of agriculture, in the farm population.

4. Registration of agricultural area and crops

In addition to "harvested area" we also recommend the registration of the "area under crops at the end of sowing period".

Land sown successively during the same agricultural year are to be shown separately, and areas yielding more than one crop, without another sowing or more being necessary, are to be recorded only once, specifying however the number of harvests.

5. Registration of tractors and agricultural machinery

All tractors and agricultural machinery are to be registered in physical units, by enterprises, enterprisers and also by owners.

The degree of utilization of tractors and agricultural machinery can be reflected by the "redorded average number" or by "the number of days-machines actually present".

II. Some Comments about the Execution of the 1960 World Census of Agriculture in our Country

1. The registration of socialist agricultural household

In order to obtain a registration in accordance with our specific agriculture, it is necessary that draft program should be extended to include in questionnaires and in reporting tables data characterising individual agricultural households as well as socialists agricultural farms /State Agricultural Farms, Machine and Tractor Stations and Agricultural Cooperative Farms/.

2. The necessity to carry out an agricultural census in our country in 1960

Annual and current reporting system provides yearly a comprehensive documentation on the socialists sector of agriculture, exceeding even the number of items included in the draft program. We consider that the organization of an agricultural census in our country will present a problem only for individual agricultural households as well as for those which are the personal propriety of members of agricultural cooperatives.

The current record of the local administrative bodies offers in the case of such households most of the data required by the draft program, while other items are to be collected either by current sample survey now in use, or by special sample survey in accordance with aim of the 1960 world census of agriculture.

ISI

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SOME CONTRIBUTIONS TO THE THEORY OF PROBABILITY SAMPLING.

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By Jaroslav Hájek, Prague.

1. Confidence interval for the ratio of two means.

There are two methods in use, one based on Fieller's device /1/ and one based on the usual theory of large-sample approximations. The large-sample method, however, can be justified on the grounds of a "small-sample" theorem, and, moreover, it may be shown that under the very conditions of probability sampling which are often met with in practice, the large-sample "approximation" is superior to Fieller's "exact" method.

In the most simple case when we deal with n independent and indentically distributed pairs of observations (x_i, y_i), Fieller's and the large-sample confidence intervals for $\varphi = E\,y / E\,x$ are solutions of the following inequalities in φ, respectively:

$$(1.1)\qquad (\textstyle\sum y_i - \varphi \sum x_i)^2 \le t^2 \frac{n}{n-1} \sum (y_i - \varphi x_i - \bar{y} + \varphi \bar{x})^2,$$

$$(1.2)\qquad (\textstyle\sum y_i - \varphi \sum x)^2 \le t^2 \frac{n}{n-1} \sum (y_i - f x_i)^2, \qquad f = \frac{\sum y_i}{\sum x_i}.$$

Now, the following assertions are valid:

(i) From algebraica considerations, Fieller's confidence interval given by (1.1) is always longer than the large-sample interval given by (1.2).

(ii) Despite this fact, the large-sample confidence interval may contain the true value of φ with a greator probability than Fieller's, namely in the case, when the pairs (x_i, y_i) are normally distributed and the regression line of y on x passes through the origin.

(iii) In the latter case the probability that the interval given by (1.2), i. e. interval

$$(1.3)\qquad f \pm t \frac{\sqrt{\frac{n}{n-1} \sum (y_i - f x_i)^2}}{\sum x_i}$$

contains the true value of φ is greater than the probability which correspond to the used t (with $n-1$ d.f.).

Remark 1.1. If the regression line of y on x passes through the origin, then φ equals the regression coefficient $b = \sigma_{xy} / \sigma_x^2$, and, consequently, it would be possible to construct a better confidence interval than (1.3). But this interval would not be sufficiently "robust" to the possible violation of the supposition that $\varphi = b$. On the other hand, the assertions (i) - (iii) remain true even in cases when $\varphi \simeq b$ only approximately.

2. Upper estimate of sampling error in multistage sampling.

Let us denote by y_i and Q_i the y-value and the probability of being included in the sample, respectively, corresponding to the i-th element (elementary unit). The unbiassed estimate of the total $Y = \sum_{i=1}^{N} y_i$ is known to be

$$\hat{Y} = S\left(\frac{y_i}{Q_i}\right), \tag{2.1}$$

where S stands for summation over the sample. The variance of $\hat{Y}$ equals

$$V\hat{Y} = \sum y_i^2 \left(\frac{1}{Q_i} - 1\right) + \sum_{i \neq j} \sum y_i y_j \left(\frac{Q_{ij}}{Q_i Q_j} - 1\right), \tag{2.2}$$

where Q_{ij} denotes the probability of the simultaneous inclusion of both elements i and j in the sample. In many cases, especially in multistage sampling the unbiassed estimation of $V\hat{Y}$ is unduly complicated. We may, however, find a much simpler upper estimate $v(\hat{Y})$ satisfying the condition $E\{v(\hat{Y})\} \geq V\hat{Y}$.

Now, let us denote by Y_j and P_j the total of the y-value and the probability of being included in sample, respectively, for j-th (primary) sampling unit. In addition, let $\hat{Y}_j$ be the unbiassed estimate of Y_j obtained from the subsampling (further sampling stages). Then $\hat{Y}$ may be written in an equivalent form

$$\hat{Y} = S\left(\frac{\hat{Y}_j}{P_j}\right),$$

where S stands for summation over the sample of primary sampling units. If the subsampling in each of the primary sampling units is conducted independently, then, irrespective of the further properties of the subsampling, there is the following upper estimate of variance of Y

$$v(\hat{Y}) = S\left(\frac{\hat{Y}_j}{P_j}\right)^2 + S_{j \neq k} S \hat{Y}_j \hat{Y}_k \left(\frac{1}{P_j P_k} - \frac{1 + C_{jk}}{P_{jk}}\right), \tag{2.3}$$

where the C_{jk} may be any constant such that for any λ_j's the relation

$$\sum_{j=1}^{M} \lambda_j^2 - \sum_j \sum_{k \neq j} \lambda_j \lambda_k C_{jk} \geq 0$$

holds; for example, $C_{jk} = 0$ or $C_{jk} = \frac{1}{M-1}$, where M is the number of primary sampling units.

Example 2.1. If the first stage of sampling is random with sampling rate $\frac{m}{M}$ then one of the upper estimates of variance of $\hat{Y} - \varphi\hat{X}$ equals

$$v\left(\hat{Y} - \varphi\hat{X}\right) = \left(\frac{M}{m}\right)^2 \frac{m}{m-1} S\left(\hat{Y}_j - f\hat{X}_j\right)^2 \tag{2.4}$$

where

$$f = \frac{S(\hat{Y}_j)}{S(\hat{X}_j)}.$$

3. Poisson's sampling.

If the ratio estimate is used, there is no necessity to keep fixed the number of elements or even of sampling units in the sample. On the other hand, if the size of sample may vary, it gives no trouble to find such a sampling procedure which (i) is without replacement, (ii) guarantees to elements (or primary sampling units) varying probabilities of being included in the sample and (iii) has easily calculable and estimable variance. One of the simplest procedures of this kind I call Poisson's sampling owing to the apparent connection with Poisson's process. Poisson's sampling simply consists of N independent experiments, the i-th of which decides with probabilities Q_i and $1 - Q_i$ if or if not the i-th element will be included in sample. Then, obviously, $Q_{ij} = Q_i Q_j$, and the variances (2.2) of $\hat{Y}$ and $\hat{Y} - \varphi\hat{X}$ have these simple forms:

$$V\hat{Y} = \sum_{i=1}^{N} y_i^2 \left(\frac{1}{Q_i} - 1\right) \tag{3.1}$$

$$V\left\{\hat{Y} - \varphi\hat{X}\right\} = \sum_{i=1}^{N} (y_i - \varphi x_i)^2 \left(\frac{1}{Q_i} - 1\right) \tag{3.2}$$

Example 3.1. Let the first stage of sampling be Poisson's sampling with probabilities P_j and the second stage let be random with sampling rates $\frac{n_j}{N_j} = \frac{Q}{P_j}$, so that every element has the same probability Q of being included in sample. Under these conditions, we have for the ratio estimate of $\varphi = Y / X$, the variance of $\hat{Y} - \varphi\hat{X}$ and the confidence interval for φ (based on the upper estimate of $V\left\{\hat{Y} - \varphi\hat{X}\right\}$) the following formulae:

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$$f = \frac{S(y)}{S(x)}$$

$$(3.3)\quad V\left\{\hat{\bar{Y}} - f\hat{\bar{X}}\right\} = \sum_{j=1}^{M}\left[(Y_j - fX_j)^2\left(\frac{1}{P_j} - 1\right) + N_j\sigma_j^2\left(\frac{1}{Q} - \frac{1}{P_j}\right)\right]$$

$$f \pm t\,\frac{\sqrt{\sum_S [S_j(y) - f\,S_j(x)]^2}}{S(x)}$$

where M is the number of sampling units, Y_j and X_j are totals over j-th sampling unit, σ_j^2 is the variance of the $(y_i - fx_i)$'s within j-th sampling unit and S_j stands for summation over the subsample within the j-th primary sampling unit.

Remark 3.1. There are many useful modifications of Poisson's sampling. For example, we may, in the first phase, select randomly r elements and then, from this "wide" sample conduct Poisson's sampling with probabilities NQ_i/r (supposition that $NQ_i \leq r$). This device makes the sampling procedure easy. The variance remains almost the same.

$$(3.3)\quad V(\hat{\bar{Y}} - f\hat{\bar{X}}) \sum_{i=1}^{N}(y_i - fx_i)^2\left(\frac{1}{Q_i} - \frac{N(r-1)}{r(N-1)}\right).$$

Remark 3.2. The sampling of only one or a few elements with probabilities propartionate to the numbers $a_1, \ldots, a_N$ may be conveniently carried out in the following manner: we choose an arbitrary number $a \geq a_i$ $(i = 1, \ldots, N)$ and then select one element randomly and accept it definitely (with probability a_i/a, if $a_i \geq \xi$, where ξ is a random number chosen between 1 and a; if $a_i < \xi$, the selected element is not accepted and the procedure is repeated until one of the randomly selected elements is accepted. The average number of steps needed equals $a/\bar{a}$, where $\bar{a} = \sum_{i=1}^{N} a_i / N$.

One of the possible applications of this method is sampling which makes the ratio estimate $S(y)/S(x)$ unbiassed: it consists of the sampling of one element with probabilities proportionate to $x_1, \ldots, x_N$ to which are added $n-1$ further elements selected from the remaining $N-1$ elements at random.

4. Optimum sampling strategie.

Sometimes, the method of sampling and estimating is predetermined with the exception of parameters $\nu_1, \ldots, \nu_h$ whose value should be chosen so that either

(a) the variance V is minimum for given costs C; or,

(b) the costs C are minimum for given variance V.

If V and C can be - as is usually the case - expressed in the following "canonical" forms

$$(4.1)\quad V = V_1/\nu_1 + \ldots + V_h/\nu_h + V_o\,,\quad V_i > 0,\ i = 1, \ldots, h$$

$$(4.2)\quad C = C_1\nu_1 + \ldots + C_h\nu_h + C_o,\quad C_i > 0\,,$$

then both problems (a) and (b) can be solved simultaneously by minimizing the product $(V - V_o)(C - C_o)$. According to Schwatz's inequality

$$(V - V_o)(C - C_o) \geq \left(\Sigma\sqrt{C_i V_i}\right)^2$$

and the minimum value is reached when

$$(4.3)\quad \nu_i = \lambda\sqrt{\frac{V_i}{C_i}}\,.$$

Example 4.1. Using the above mentioned method, one can easily solve the optimum allocation in stratified sampling, the optimum arrangement of multistage sampling and so on. As a less trivial example, let us consider the "without replacement" analogue of the problem solved by Hansen and Hurwitz in [2]. Suppose we have a sampling design described in Ex. 3.1 and let us rewrite the variance (3.3) in the form

$$(4.4)\quad V = \sum_{j=1}^{M}\frac{(Y_j - fX_j)^2 - N_j\sigma_j^2}{P_j} + \frac{1}{Q}\sum_{j=1}^{N} N_j\sigma_j^2 - \sum_{j=1}^{M}(Y_j - fX_j)^2\,.$$

If, in addition, the cost function C has the Hansen Hurwitz's form

$$(4.5)\quad C = \sum_{j=1}^{M}(C_1 + C_2 N_j)P_j + C_3 QN$$

we can see that both V and C are "canonical" in P_j's and Q. Consequently, according to (4.3), the optimum probabilities are

$$(4.6)\quad P_j = \lambda\sqrt{\frac{(Y_j - fX_j)^2 - N_j\sigma_j^2}{C_1 + C_2 N_j}}\,,\quad Q = \lambda\sqrt{\frac{\sum_{i=1}^{N} N_i\sigma_i^2}{C_3 N}}$$

where λ is determined from either of the equations (4.4) or (4.5).

Remark 4.1. If $V_i < 0$ then the optimum ν_i assumes its minimum possible value. For example, if $(Y_j - fX_j)^2 - N_j\sigma_j^2 < 0$ in (4.4), then optimum $P_j = Q$, (i.e. $n_j = N_j$).

In some papers an attempt has been made to give an optimum solution of sampling strategy (i.e. sampling design + estimating method) with respect to some "a priori" distribution of parameters $Y_1, \ldots, Y_N$. This "Bayes solution" is quite justified, since we usually have some a priori knowledge about the sampled population and, moreover, the accepted assumptions about a priori distribution of $Y_1, \ldots, Y_N$ affect only the choice of sampling strategy and have no influence on the validity of probability statements about constructed confidence limits. (We note that the solution (4.6) has no practical value unless some "expected value" is substituted for $(Y_j - fX_j)^2$.) We shall

consider the two simplest cases when $y_1, \ldots, y_N$ (i) are independent or (ii) form a stationary sequence with convex (=concave upward) correlation function (see [3] and [4]).

Now, suppose the y_i's are independent with expected means $E_i = Ey_i$ and variances $D_i = Vy_i$. Let us consider all possible linear unbiassed estimates $\hat{Y}$ of the total $Y = \sum y$

$$\hat{Y} = S(y_i\, w_{is})$$

where S stands for summation over the sample and weights w_{is} may depend on the sample s. In addition, let the cost function be

$$C = C_1 Q_1 + \ldots + C_N Q_N ,$$

where Q_i is the probability that the i-th element is included in sample. Under these conditions, the expected variance of $\hat{Y}$ is minimum at given costs C (or conversely), if

(4.7) $\quad w_{is} = \frac{1}{Q_i}$ for all samples s, $i \in s$,

(4.8) $\quad Q_i = \lambda \sqrt{\frac{D_i}{C_i}}$,

(4.9) $\quad S(\frac{a_i}{Q_i}) = \sum_{i=1}^{N} E_i$ with probability 1.

For example, if the expected means E_i and costs C_i are constant over some strata, then the above conditions are fulfilled by optimum allocation of a stratified sample, or, if the expected means E_i are proportionate to some numbers x_i, then the condition (4.7) is fulfilled approximately and condition (4.9) exactly by the ratio estimate

$$\hat{Y} = \sum x_i \frac{S(\frac{y}{Q_i})}{S(\frac{x}{Q_i})} ,$$

where the Q_i's are calculated from (4.8).

If $y_1, \ldots, y_N$ form a stationary sequence with convex correlation function, and if the probabilities Q_i of including the i-th element in the sample are given, then among all possible sampling designs the systematic design yields the minimum variance of S(y). (This is a generalization of a Cochran's result contained in [3]).

5. The number of degrees of freedom of Student's t for finite population.

Sometimes, it is misleadingly suggested to the effect that, in the case of sampling without replacement from a finite population, Student's t is distributed not with $n-1$ but with $(n-1) / (1 - \frac{n}{N})$ degrees of freedom, approximately. In reality, however, in spite of the fact that the estimate of variance has approximately chi-square distribution with $(n-1)/(1-\frac{n}{N})$ d.f., the number of d.f. of Students t should still remain $n-1$. This apparent paradox is due to the interdependence of the sample mean and sample variance. Indeed, the distribution of Student's t remains unchanged when the condition of independence of observations is replaced by a weaker condition that all pairs of (normal and equidistributed) observations

have the same covariance $\sigma_{ij} = \rho\sigma^2$ (in the case of random sampling from a finite population we have $\sigma_{ij} = -\frac{\sigma^2}{N-1}$).

6. Definitions of fundamental concepts.

The fundamental concepts of the theory of probability sampling may be introduced in the following formal way:

A population (universe) U is a set of couples (i, y_i),

$$U = \left\{ (i, y_i) \right\} .$$

A probability sample is a subset s c U selected by a random technique defining a probability distribution P( ) over all possible s, s c U.

An estimate (statistic) t is any function of the probability sample s, $t = t(s)$.

Thus the characteristic feature of the "sampling from a finite population" is not the finiteness of the population but the real existence and identifiability of its elements. The estimates, consequently, may depend not only on the y-values but also of on which elements they were observed.

It would be possible (and more usual) to define the probability sample as a sequence $\left\{ (i_1, y_{i_1}), \ldots (i_n, y_{i_n}) \right\}$. Such a definition is, however, (a) inconvenient, since the size of the sample n may be itself a random variable, and (b), unnecessary, since each "good" estimate does not depend on the order or on the number of times an element is included in the sample (i.e. "good" estimates are function of the sample s in the sense of the above definition). Each estimate depending on the order or multiplicity of sampled elements may be adjusted by taking its average value over all samples which differ only in order and multiplicity of sampled elements. This adjusted estimate has the same mean value but a smaller variance.

Example 6.1. Let us draw independently n-times one of N elements with probabilities $q_1, \ldots, q_N$. Then the unbiassed estimate of the total $Y = \sum y$ is known to be

$$\hat{Y}_1 = S_1 \left(\frac{y_i}{Q_i} \right),$$

where $Q_i = n\, q_i$ and S_1 stand for summation over the selected sequence (some elements may appear in the sum more times than once). If there are $n-1$ different elements in this sequence (precisely one element was sampled twice), then the average value $\hat{Y}$ of $\hat{Y}_1$ over all sequences formad from those n-1 elements equals

$$\hat{Y} = S(\frac{y_i}{Q_i}) + \frac{S(y_i)}{S(Q_i)} ,$$

where S stand for summation over the sample as defined above.

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Résumé

Contributions à la théorie de l'échantillonnage probabiliste.

L'exposé a pour but de présenter quelques résultats obtenus par l'auteur dans la théorie de l'échantillonnage probabiliste pour le cas d'une population finie.

1) Intervalle de confiance pour le rapport de deux valeurs moyennes.

On emploie le plus souvent la méthode de Fieller ainsi que celle basée sur la théorie des grands échantillons. Dans le cas le plus simple des paires indépendantes d'observations (x_i , y_i) , les deux intervalles de confiance pour $\varphi = E_y / E_x$ sont déterminés par les inégalités (1.1) et (1.2) respectivement. On observe que

(a) l'intervalle de Fieller est toujours plus long que l'intervalle obtenu par l'autre méthode;

(b) ce dernier peut quand même contenir φ avec une probabilité plus grande, surtout lorsque la ligne de régression d'y par rapport à x passe par l'origine. Dans ce cas l'intervalle de confiance (1.3) construit à la base de la théorie des grand échantillons, contient φ avec une probabilité plus grande que celle qui correspond au t employé.

2) Estimation par excès de l'erreur d'échantillonnage dans le cas d'un échantillonnage à plusieurs degrés.

Si le sous-échantillon est choisi indépendamment dans chaque unité primaire, il existe pour la variance de l'estimation linéaire (2.1) une simple estimation par excès (2.3), (la valeur moyenne de (2.3) est toujours plus grande que la variance estimée).

3) Echantillonnage de Poisson

est constitué par N expériences indépendantes dont la i-ième décide avec les probabilités Q_i et $1-Q_i$ respectivement, si l'élément i fera partie de l'échantillon ou non.

4) Les meilleures stratégies d'échantillonnage.

Si la variance V et les frais C ont les formes "canoniques" (4.1) et (4.2),

alors les meilleures valeurs des paramètres $v_1 \dots , v_n$ sont données par (4.3). Ainsi on peut déterminer la meilleure disposition d'un échantillon stratifié, d'un échantillon à plusieurs degrés, les meilleures probabilités pour le choix des unités primaires etc.

Si les valeurs observées $y_1 , \dots , y_N$ sont considérées comme des variables aléatoires indépendantes suivant des lois à priori avec valeurs moyennes E_i et variances D_i , alors la meilleure stratégie d'échantillonnage par rapport à la fonction des frais C est déterminée par les conditions (4.7) - (4.9) . Si les y_i forment une réalisation d'un processus aléatoire stationnaire dont la fonction de corrélation est convexe, alors l'échantillonnage systématique est meilleur que tous les autres méthodes d'échantillonnage.

5) Le nombre de degrés de liberté du critère t de Student dans le cas d'une population finie doit être pris égal à n-1 bien que l'estimation de la variance dépende d'une loi du type χ^2 avec $(n-1)/(1-\frac{n}{N})$ de degrés de liberté.

6) Définitions des notions fondamentales.

Une population U est un ensemble de paires (i , y_i), $U = \{(i ; y_i)\}$. Un échantillon "probabiliste" est un sous-ensemble $s \subset U$ choisi à l'aide d'une technique aléatoire déterminant une certaine répartition de probabilité P(s) sur tous les $s \subset U$. Une estimation (statistique) t est une fonction réelle $t = t(s)$.

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ANALYSE STATISTIQUE DES PLANS ECONOMIQUES DE LA REPUBLIQUE POPULAIRE DE BULGARIE

par

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Dans les conditions de la propriété privée et du capitalisme, où les tendances économiques se développent en général spontanément, on comprend sous la notion de prévision économique l'estimation préable du cours futur des phénomènes économiques, basée sur le dépouillement mathématique d'une série de données et de situations déjà connues ou bien observées supplémentairement. Il s'ensuit que le but des prévisions économiques dans les conditions mentionnés plus-haut consiste à évaluer pour une certaine étappe prochaine l'état d'un phénomène donné, se développant spontanément.

Il en est autrement ce qui concerne les prévisions dans les conditions de la propriété sociale et de la planification à l'échelle de l'économie nationale. Le développement de cette dernière dépend aussi des lois objectives. Mais, ce qui est typique ici, c'est que l'action des lois économiques est le résultat du travail de planification, basé sur celles-ci. Les buts de la planification sont: 1) de fixer les ressources (les possibilités) existant dans la période de départ; 2) de déterminer sur cette base les buts qui peuvent et doivent être atteints; 3) d'établir objectivement la proportion indispensable au développement; en un mot, de fixer ce que la société doit entreprendre prochainement pour ne pas enfreindre les lois objectives. Par conséquent, étant dit que chez nous le développement économique spontané s'effectue exclusivement dans un cercle très restreint, l'objet de la prévision sera non ce développement spontané, mais une planification visant l'obtention des résultats possibles et indispensables, conformément aux lois objectives. Cela ne signifie pas, comme déjà dit, qu'il n'existe pas de moments spontanés dans notre économie. Ainsi par exemple, il est très important pour nous de prévoir en composant le plan, comment changera spontanément la structure de la recherche dans la consommation chez le rythme général d'accroissement du niveau matériel et culturel, dont la planification s'est avérée possible en prenant pour base les ressources découvertes. Dans le procès d'exécution du plan nous dirigeons en meme temps consciemment l'activité de la société pour la coordiner au développement objectif.

La planification annuelle donne la possibilité d'orienter l'économie dans la direction voulue. Ce qui n'a pas pu être prévu dans les plans quinquennaux à cause de l'intervention de ressources supplémentaires ou de difficultés inattendues dans certains cas, se précise consécutivement par les plans annuels. Ces précisions sont indispensables

pour pouvoir maintenir la proportionalité nécessaire, la coordination du développement réalisée consciemment, mais dans un degré bien inférieur chez les procès spontanés. Etant dit que la société possède les moyens de production et dispose d'un système, composé par un nombre énorme d'indicateurs, les prévisions concernent d'abord les conditions qui détermineront dans le futur les relations mutuelles des indicateurs. Autrement, les prévisions comprennent les indicateurs techniques et économiques. Il faut observer ici que meme une partie de ces indicateurs sont déterminés par le plan et strictement pris, ils ne peuvent etre considérés comme étant spontanés: nous avons en vue le plan pour l'introduction d'une technique plus parfaite. Après avoir déterminé les conditions de production futures il incombe encore de résoudre le problème de leur balance, c'est-à-dire d'établir la concordance intérieure de la dimension des indicateurs. Les bilans composés de cette manière représentent un moyen de détermination ("une prévision") de la valeur concrète de la grandeur, exprimée par un indicateur donné.

Cette méthode, désignée chez nous comme méthode de la balance, est essentiellement un moyen d'analyse économique scientifique des proportions de l'économie nationale et de planification de ces proportions et représente en somme la base de l'édification du système des indicateurs du plan.

La méthode de la balance est un moyen de refléter les proportions de l'économie nationale parceque ses deux cotes - d'une part les ressources et d'autre - leur exploitation englobent et mesurent les liens objectifs des phénomènes économiques, représentant l'objet de la planification. D'autre part, la méthode de la balance sert également à effectuer l'analyse économique et l'évaluation objective des rythmes et des proportions, fixés par le plan car nous sommes en état de vérifier à l'aide de la balance jusqu'à quel point ces rythmes et proportions sont possibles et interdépendants et finalement - jusqu'à quel degré ils déterminent le développement optimal de l'économie nationale dans les périodes de planification suivantes.

Après cette préparation préalable, les détails du plan meme sont élaborés dans le système de la balance. On doit remarquer à ce sujet que le système de la balance se constitue dans le début du travail sur le plan qui lui sert de point de départ et après l'achèvement de ce travail, ce système accomplit la fonction de critère de l'exactitude du plan élaboré. Il ne faut pas oublier que le système de la balance est en état de jouer ce role seulement lorsque chaque balance particulière et le système global des balances sont édifiés sur des indicateurs techniques et économiques scientifiques.

La méthode de la balance et son utilisation dans la planification trouvent leur expression synthétique dans l'élaboration du bilan de l'économie nationale englobe dans un système commun les proportions générales les plus essentielles des proportions économiques nationales. En sa qualité de synthèse du système des indicateurs économiques, le bilan de l'économie nationale rend possible l'appréciation du plan dans son total.

Le système de la balance dans les conditions d'une économie nationale

planifiée comprend trois groupes de balances: matérielles, des valeurs et du travail.

Les balances matérielles montrent la coordination de la structure matérielle de l'économie nationale, c'est-à-dire qu'elles reflètent la proportionalité nécessaire de la production, de la consommation et de l'accumulation des produits en nature.

Le système des bilans des valeurs montre le mouvement et la coordination des proportions économiques nationales en indiquant leur valeur. Et finalement, pour englober le procès de la reproduction dans son entité on élabore le système des bilans du travail.

L'unité du procès économique donne la possibilité d'unir dans un système commun ces trois groupes de balances exprimant les trois aspects du procès de la reproduction. De cette façon, le système commun de balances, dans lequel sont inclus et coordinés par des normes techniques et économiques tous les indicateurs fondamentaux du plan, détermine concrètement la grandeur de chacun d'eux. Il représente par conséquent la base de la "prévision" du développement économique dans le sens particulier que revet cette notion dans le système socialiste de la planification à l'échelle de l'économie nationale. Il est suffisant que les données de départ (pour les ressources, le degré de la technique déployée pendant la période précédente) soient déterminées d'une manière juste, que l'interdépendance des indicateurs soit construite sur cette base, pour obtenir une prévision réelle de leur développement.

Voici ce qu'indiquent les données statistiques concernant l'exécution du plan du développement économique de la République Populaire de Bulgarie:

(en pourcentage)

Indices	rythmes moyens annuels du plan quinquennal 1949-57	rythmes moyens annuels réels de 1949-56
1. Production totale de l'industrie:	15.3	16.6
a) Production de moyens de production	15.3	18.1
b) Production d'objets de consommation	15.3	14.7
2. Production d'électroénergie	19.7	20.5
3. Production de combustible	13.9	17.1
4. Construction de machines et fabrication de produits métalliques (à l'exclusion des machines et du matériel de transport)	24.2	27.3
5. Industrie du bois	4.2	2.5
6. Industrie du caoutchouc	16.0	17.3
7. Industrie textile	15.0	15.9
8. Industrie alimentaire	12.5	13.4

Les données statistiques concernant l'exécution du Second plan quinquennal du transport et du commerce sont les suivantes:

Indices	Rythmes moyens annuels du plan quinquennal 1953-57	Rythmes moyens réels annuels de 1953-56
2. Trafic du transport ferroviaire	7.6	9.3
3. Ventes en détail	11.6	16.2

Les données des deux tableaux confirment pleinement notre point de vue au sujet de nos prévisions économiques, c'est-à-dire que nos plans nationaux économiques ont pour but la coordination perspective du développement économique. Là, où il est plus facile pour nous d'établir des normes techniques et économiques, comme c'est le cas pour l'industrie et le transport, les rythmes effectifs du développement sont très proches de ceux du plan. Les écarts des dispositions du plan dans ces domaines de l'économie nationale ne sont pas le résultat d'actes spontanés, mais résultent des plans courants, qui corrigent les plans quinquennaux à partir des ressources advenues supplémentairement.

La prévision dans le domaine de l'agriculture est d'un caractère plus compliqué. Les forces de la nature étant des facteurs jouant un role spécifique dans l'agriculture, les inexactitudes de la planification sont ici plus importantes en dépendance de l'élément d'incertitude qu'ils introduisent. Les rythmes de développement atteints (3.5 % par an) s'écartent chaque année différemment des prévisions du plan dans un degré considérablement supérieur.

Voici sous une forme succinte l'évaluation statistique des plans économiques de la République Populaire de Bulgarie.

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Statistical quality control of production processes using individual sample values.

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1. Introduction:

A useful method of statistical quality control of production processes is based on a control chart for individual sample values /1/, /2/, /3/, /4/. This method has the advantage over the method using sample mean and range that no computation of sampling characteristics is necessary. It also has the advantage over the method using the maximum and minimum sample values as characteristics on the control chart /5/ that all the sample values are recorded straight on to the chart, thus making possible a detailed analysis of the process at any future date. In addition, the chart for individual values offers a more sensitive criterium for detecting changes in the parameters μ and σ of the population being investigated than the (max-min) chart in that it is equipped with at least two pairs of control limits in place of one pair /see Fig.1 a and b/.

The aim of the present paper is to indicate the method of computation of the two sets of control limits for the method of individual values and to present a table of the appropriate coefficients ℓ_1 and ℓ_2. Previously calculated values of ℓ_1 and ℓ_2 /1/, /2/ were only approximate and were accompanied by different and comparatively large risks α for different values of n, the sample size.

2. Basic assumptions:

We assume that the production process under consideration is acted upon mainly by random effects, thus giving rise to a normal distribution of the appropriate quantitative quality characteristic with parameters μ and σ. Further we assume that the process is capable of meeting the specification requirements, i.e. that

$$2 K_{P/2} \sigma = T , \qquad (a)$$

where $T=T_u - T_L$ represents the tolerance and $K_{P/2}$ is the normal deviate corresponding to a permissible small percentage P of defectives lying outwith the tolerance limits T_u and T_L, e.g. for P= 0,27 %, $K_{P/2} = 3$. The latter requirement assumes that the process can be "set" on the value mid-way between the upper and lower tolerance limits. In this case

$$\mu = T_o = \frac{T_u + T_L}{2} \qquad (b)$$

3. Solution

We consider first the case of a normal distribution with zero mean and unit standard deviation. Consider n independent observations x_i, i=1,2,..of a random variable ξ which has the normal distribution function

$$F(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} e^{-t^2/2} \, dt . \qquad (1)$$

Let us define two values $x_{1,u}$ and $x_{2,u}$, where $x_{2,u} < x_{1,u}$ and their corresponding negative values

$$x_{1,L} = -x_{1,u} \quad \text{and} \quad x_{2,L} = -x_{2,u},$$

such that the whole range of variability of the random variable $\xi\ (-\infty, \infty)$ is devided into five intervals as shown in Fig. 2:

$$I_1 = (-\infty,\ x_{1,L}),$$
$$I_2 = (x_{1,L},\ x_{2,L}),$$
$$I_3 = (x_{2,L},\ x_{2,u}),$$
$$I_4 = (x_{2,u},\ x_{1,u}),$$
$$I_5 = (x_{1,u},\ \infty),$$

Then the probability that among the n observations x_i, i=1,2,...n no value will lie in the intervals I_1 and I_5, at most one value will lie in either or both of the intervals I_2 and I_4 and the rest of the values will lie in the interval I_3 is

$$\left[2F(x_{2,u})-1\right]^n + 2n\left[F(x_{1,u})-F(x_{2,u})\right]\left[2F(x_{2,u})-1\right]^{n-1} + n(n-1)\left[F(x_{1,u})-F(x_{2,u})\right]^2\left[2F(x_{2,u})-1\right]^{n-2} = 1-\alpha, \qquad (2)$$

where we have made use of the relation

$$F(-x) = 1 - F(x).$$

Since equation (2) contains for a given value of α two unknowns $x_{1,u}$ and $x_{2,u}$, it is necessary to select one other condition which will enable us to evaluate independently either $x_{2,u}$ or $x_{1,u}$. We select this condition such that the probability that at most one value of the n observed values exceeds the limit $x_{2,u}$ will be equal to an arbitrary value α_1; i.e. such that

$$\binom{n}{n-1}\left[F(x_{2,u})\right]^{n-1}\left[1-F(x_{2,u})\right] + \left[F(x_{2,u})\right]^n = \alpha_1 \qquad (3)$$

Due to symmetry, this condition is equivalent to the condition that the probability of at most one value of the n observed values being smaller than $x_{2,L}=-x_{2,u}$ should equal α_1.

α_1 is thus the probability that the (n-1)-st /or second/ ordered value should exceed /or lie below/ the value $x_{2,u}$ /or $x_{2,L}$/.

The values of $x_{2,u}$ for $\alpha = 0{,}025$ and $\alpha_1 = 0{,}005$ are given in /6/ for n=4, 5, ...,20. It is therefore possible to substitute the appropriate value of $x_{2,u}$ in equation (2) and solve the resulting quadratic equation in $F(x_{1,u})$. In this way the position of the two intervals I_2 and I_4 is completely determined.

We now consider the more general case where the random variable ξ' assumes the values x' of a given quality characteristic and conforms to the normal law $N(\mu,\sigma)$. Then the transformed random variable $\xi = \frac{\xi'-\mu}{\sigma}$ has the normal distribution $N(0,1)$ and assumes the values

$$x = \frac{x'-\mu}{\sigma}. \qquad (4)$$

On the basis of the values $x_{1,u}$ and $x_{2,u}$ derived on the assumption that ξ has the distribution N(0, 1) it is, therefore, possible to compute the values $x'_{1,u}$ and $x'_{2,u}$ which are valid for the normal distribution $N(\mu,\sigma)$.

From equation (4) we have

$$\left.\begin{aligned} x'_{1,u} &= \mu + x_{1,u}\,\sigma, & x'_{1,L} &= \mu - x_{1,u}\,\sigma \\ x'_{2,u} &= \mu + x_{2,u}\,\sigma, & x'_{2,L} &= \mu - x_{2,u}\,\sigma \end{aligned}\right\} \qquad (5)$$

On the basis of assumptions (a) and (b) of § 2, we can substitute into equations (5) the values

$$\mu = \frac{T_u + T_L}{2}, \qquad \sigma = \frac{T}{2K_{p/2}}$$

Hence the four limits are given by

$$x'_{1,u} = \frac{T_u + T_L}{2} + x_{1,u}\cdot\frac{T}{2K_{p/2}} = T_u - \ell_1 T,$$
$$x'_{1,L} = T_L + \ell_1 T,$$
$$x'_{2,u} = \frac{T_u + T_L}{2} + x_{2,u}\cdot\frac{T}{2K_{p/2}} = T_u - \ell_2 T,$$
$$x'_{2,L} = T_L + \ell_2 T,$$

where

$$\ell_1 = \tfrac{1}{2}\left[1 - \frac{x_{1,u}}{K_{p/2}}\right], \qquad \ell_2 = \tfrac{1}{2}\left[1 - \frac{x_{2,u}}{K_{p/2}}\right].$$

The values of ℓ_1 and ℓ_2 for sample sizes of n=3, 4, ...,10, for permissible percentage of defectives P = 2 %, 1 %, 0,5 %, 0,27 % and for risks $\alpha = 0{,}05$ and $\alpha_1 = 0{,}005$ are given in Table 1.

Example:

For n=4, $\alpha_1 = 0{,}005$ we obtain from /6/ the value $x_{2,u} = 1{,}88$, hence $F(x_{2,u}) = 0{,}96995$. Substitution in equation (2) gives

$$0{,}78075 + 6{,}64467\left[F(x_{1,u}) - 0{,}96995\right] + 10{,}6032\left[F(x_{1,u}) - 0{,}96995\right]^2 = 0{,}95,$$

which results in the solution $F(x_{1,u}) = 0{,}99452$, i.e. $x_{1,u} = 2{,}544$. Thus, for P = 0,27 %, $K_{p/2} = 3$ we obtain (see Table 1)

$$\ell_1 = \tfrac{1}{2}\left[1 - \frac{2{,}544}{3}\right] = 0{,}076,$$
$$\ell_2 = \tfrac{1}{2}\left[1 - \frac{1{,}88}{3}\right] = 0{,}186$$

4. Application:

Quality control using the method of individual sample values is governed by the following rules:

a/ The production process is considered satisfactory, if, of the n observed values constituting a sample, none lie outwith the limits $x'_{1,L}$ and $x'_{1,u}$, at most one value lies in each of the control bands $(x'_{1,L}, x'_{2,L})$ and $(x'_{2,u}, x'_{1,u})$ and the rest lie within the inner limits $(x'_{2,L}, x'_{2,u})$.

b/ If the conditions in a/ are not fulfilled, the production process is considered unsatisfactory and instructions are given to investigate the cause and for corrective measures to be taken.

The probability of unwarrantedly investigating the cause of trouble when in fact the process is running satisfactorily (which equals the probability of wrongly classifying a satisfactory production batch as unsatisfactory) is $\alpha = 0{,}05$.

An illustration of the control chart for n=5 is shown in Fig. 3.

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Table 1

Values of λ_1 and λ_2 /expressed as percentage/ for $\alpha = 0{,}05$

n	Average permissible percentage defective P			
	2%	1%	0,5%	0,27%
3	-2,4 12,4	2,7 16,0	6,6 18,8	9,4 20,8
4	-4,7 9,6	0,6 13,5	4,7 16,5	7,6 18,7
5	-6,4 7,4	0,9 11,6	3,3 14,7	6,3 17,0
6	-7,7 5,7	-2,1 10,0	2,2 13,3	5,2 15,7
7	-8,8 4,2	-3,1 8,7	1,3 12,1	4,4 14,5
8	-9,7 2,9	-3,9 7,5	0,6 11,0	3,7 13,5
9	-10,4 1,6	-4,5 6,3	-0,1 9,9	3,2 12,5
10	-11,1 0,6	-5,1 5,4	-0,6 9,0	2,6 11,7

Note: Negative values signify that the control limit lies outside the tolerance limits.

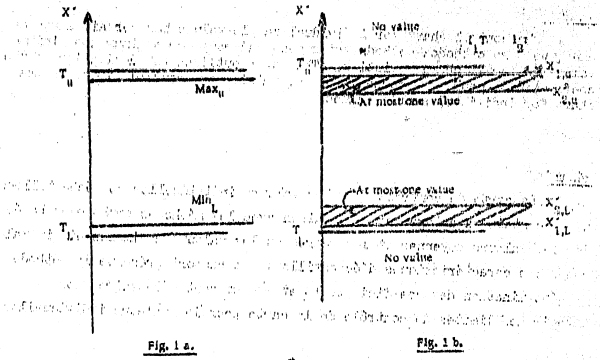

Fig. 1 a. Fig. 1 b.

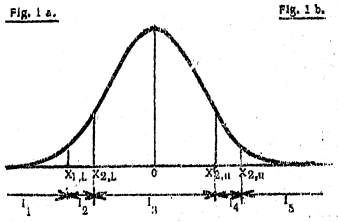

Fig. 2.

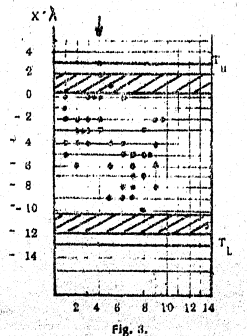

Fig. 3.

Summary:

The control chart for individual sample values has certain advantages over the more orthodox methods using mean and range or maximum and minimum values as sample characteristics. The paper outlines the derivation of the coefficients ℓ_1 and ℓ_2 necessary for determining the control limits on the chart for individual sample values.

Résumé:

La carte de contrôle pour les valeurs individuelles des échantillons a certains avantages en comparaison avec les méthodes orthodoxes basées sur les valeurs moyennes et les rangs ou les valeurs maximales et minimales comme les caractéristiques d'échantillon. Ce rapport présente la méthode de détermination des coefficients ℓ_1 et ℓ_2 qui sont nécessaires pour obtenir les limites de contrôle de la carte pour les valeurs individuelles.

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New China's Population Census of 1953 and its Relations to National Reconstruction and Demographic Research x)

by

Ta Chen, Ph. D.

/119/

A) The Significance of the 1953 Census

New China took her first national census of population in 1953. This census is significant in several respects. With reference to China, this is the first national census under the planning and organization of the Party and Government and by the application of scientific methods. Though China is one of the oldest nations in the world, she has never taken a census extending to the whole nation. During the Tsing Dynasty, through the period of the Peiyang military clique, and later under the Kuomintang reactionary regime, population reports were occasionally published and population surveys were made in several provinces. Owing to the oppressive ruling class which adopted unscientific methods, the results were generally untrustworthy. Before and during the period of China's resistance war against Japan, certain educational institutions such as the Institute of Census Research, Tsing Hua University, were engaged in researches into the methodology of census-taking, and organized field surveys in certain areas. Nevertheless, these small-scale censuses were for experimental purposes only and were carried out during the reactionary periods. Therefore, prior to the 1953 census, there was no reliable account of China's total population. Under the leadership of the Chinese Communist Party, the Chinese people completely won the democratic revolution in 1949, and established the people's republic. Three years later, new China applied scientific methods to take the first national census and ascertained an accurate account of the total population. This is an epoch-making event.

The census of 1953 has also international significance. China is the most populated country in the world. Heretofore, due to the paucity of dependable Chinese population statistics, the demographers of all nations found it impossible to render an accurate report of the world's total population. The 1953 census is a great forward step towards the solution of this difficult problem. Meantime, as the 1953 census reveals, China's population of over 601 million persons constituted about one fourth of the world's total, if the latter were taken to be about

x) For the preparation of this paper, the writer is indebted to Messrs T.Low, F.Yuan, S.Y. Lee, S.T. Wang, K.Li, F.S. Jen.

[illegible] million in 1954. China's immense population implies great strength for the preservation of the world's peace. The Chinese people are peace loving and are eager to co-operate with all the peace loving nations and peoples to struggle for progress and prosperity for all humanity. Hence, the census of 1953 is a great contribution to the peace of the world.

The chief purposes of the census are twofold: First, the census forms the basis for the registration of the voters for the election of the local People's Congresses and later of the national People's Congress, which according to a decision of the Central People's Government was to convene in 1953 through popular election. Persons of 18 years of age and over are qualified to vote in these elections, and the census will furnish reliable population data therefor.

Secondly, the census also yields dependable factual material for national reconstruction in economic and cultural fields. Under the leadership of the Chinese Communist Party, the Chinese people have been engaged in unselfish labor, and by the end of 1952 the country has completely recovered from the effects of the war. The Central People's Government therefore decided to initiate the first Five-Year Plan in 1953. The plan must be based on reliable statistics and especially population statistics. Just as the census results have later revealed, China is a youthful nation in which fully 36,0% are persons of 14 years of age and younger. This rising generation is gradually maturing to provide new strength for socialist reconstruction of their country.

B) The Methods of the 1953 Census

1) The de jure Population The census of 1953 adopted a person's usual abode or his home as the basis of enumeration, thus denoteting the de jure population. When a person leaves his home temporarily and travels either on official duties or for business, he is still enumerated at his home address. When he leaves his usual abode for unknown purposes, and is absent from home not more than 6 months, he is still enumerated at his home. When he joins a government organ, is enlisted in the army, enters a factory or a school, he ordinarily has a new abode and must be enumerated there. In order to diminish errors of repetition and omission, he is enumerated at not more than one abode.

As China's population is pre-eminently agricultural and perhaps more than 86,0% of its inhabitants residing in rural areas, the population is admittedly stable and its movement slight, so the de jure basis reflects the true nature of her population.

2) The Census Hour The census hour is fixed at the 24th hour of June 30, 1953, which corresponds to the 20th day, the 5th moon, of the Snake Year in the lunar calendar. The date is in the midst of the planting season in agriculture. It is chosen to expedite the collection of population data for the election of the people's representatives to the local People's Congresses which is drawing near. June 30 is also advantageous for the estimation of the midyear population.

If the population of a district is enumerated some days before June 30,

births, persons entering the district by marriage or by immigration are added to the total; and deaths, persons leaving the district by marriage or by emigration are subtracted from the total. Likewise, if the enumeration of a district takes place after June 30, births, persons entering the district by marriage or by immigration are not enumerated; and deaths, persons leaving the district by marriage or by emigration are enumerated.

3) Preparatory Work before Census-taking

a) The Training of the Field Staff and Statistical Computers According to the Central Election Committee, the training of the field workers and statisticians should be entrusted to the provinces to suit the local needs. Various types of workers are needed including supervisors, enumerators, recorders, and statistical computers. The training course for general supervision requires three days and that for enumeration, election and statistical computation requires seven days. Data for instruction in the training course are included in the material for publicity as outlined in the following section. The whole working force for the entire country comprises more than 2.5 million persons including supervisors, enumerators, recorders, statistical computers, but without counting the "activists" who serve voluntarily and who are fairly numerous in all communities.

b) Publicity Campaigns The local party organization undertakes the general supervision of census-taking and election as a phase of political activity and starts by organizing publicity campaigns. Under the direction of the party, each election precinct organizes an election committee which conducts publicity campaigns. In the village or in the street of a city, the work is entrusted to the publicity squads. In the factory, mine, or construction camp, publicity work is under the direction of the local party units. Data for publicity include party policy and government regulations on the enumeration and registration of population and election, such as the Election Law, Regulations for the Enumeration and Registration of Population, and Instructions for filling-out the Population Questionnaire. Publicity workers usually are "activists" of the locality who make use of the leisure hours in the factory or on the farm by making calls, holding conversations, informal talks, discussion groups and meetings. In the cities, the display of slogans and placards, the distribution of pamphlets, and the use of the motion picture shows are added features.

4) The Procedure of Census-taking

a) Experimental Work Experimenval work was first initiated in Fang Cheng Hsien, Liaotung Province, and Li Cheng Hsien, Shangtung Province. The former experiment which was started in May 1953 stressed the training of local talents for filling-out the population questionnaire and other technical work in connection with the census by selecting 1 person from every 500 persons in the local population. In June, the Li Cheng experiment demonstrated the practical application of the principle that census-taking and election must proceed hand in hand with farming in the locality. As a result of popular discussion and with the

approval of the local farmers, an irrigation ditch was dug which proved to be the most urgent welfare measure of the whole community. This was in sharp contrast with a similar project in 1952 which was proposed by the local bureaucracy but without the people's consent and was doomed to failure.

b) Direct Enumerations: Report at the Registration Depots

In accordance with the directions of the Central People's Government, the chief method of the enumeration and registration of population consists of the report by the family heads (Form A) at the local registration depots. At each election precinct there is a depot to which each family head goes to report the persons in his family with the particulars of each person specified in the population questionnaire. With regard to public households (Form B), such as government organs, factories, schools and mines, depots are also established to which individuals go to report. The individuals are organized into groups under the leadership of the appropriate department chiefs. Boatmen and workers of water transport who work and live on the boats or waterways report and register at appropriate depots on the boats or ashore.

A special agent visits persons who for various reasons can not go to the registration depots and report themselves, such as old people, patients, persons on leave, those who can not leave their posts when on duty (police men at the government offices or factories), and persons who live in the out-of-way regions too far away from the registration depots.

Out of a total of 601,938,035 persons as returned from the census of 1953, fully 574,205,095 persons were through direct enumeration as briefly discussed above.

c) Indirect Calculations and Estimates The Regulations on the Enumeration and Registration of Population provides (Art. 17) that in outlying regions and in places where the minority peoples live, modifications may be necessary if local conditions require. In these areas, the enumeration and registration of population may, at the discretion of the local government, adopt indirect measures such as through the consultation of the headmen, or through the meetings of old men, women and the general public. By and large, in these places there is no direct election of the people's representatives, hence there is no direct enumeration and registration of population.

Indirect calculations and estimates are also applied in the following cases: the overseas Chinese, Chinese persons in diplomatic and consular services abroad, Chinese students in foreign countries, and the population of Taiwan province.

Out of the total of 601,938,035 persons from the census of 1953, no less than 27,732,095 persons were through indirect means such as calculations and estimates. These include the overseas Chinese and Chinese students abroad (11,743,320 persons), the residents in the

outlying areas including the minority peoples (8,397,477 persons) and Taiwan province (7,591,298 persons) which is not yet liberated.

c) The Principal Items of the Census

1) Sex Ratio Up to the year of the liberation in 1949, the preponderance of males over females in Chinese population was well-known. During the Kuomintang reactionary period, unusually high sex ratios were frequently reported: these were chiefly seen in the population estimates of questionable reliability. Towards the closing days of the Kuomintang regime, experimental censuses of limited areas were taken from time to time by using modern techniques of fairly high dependability. The sex ratios in these hsien censuses are shown in Table 1, in which the highest sex ratio is 129.4 as in Chang Lu of Fukien province.

In Table 2, the sex ratio of the population of new China is compared with that of 15 other nations. New China is reported to have the highest sex ratio, i.e. 107.7, and Democratic Republic of Germany has the lowest, i.e. 74.3. The figure for new China is considerably lower than other figures in the hsien censuses as given in Table 1. Several factors may be mentioned: First, obnoxious social habits such as infanticide and the discrimination against female children by the parents resulting in excessive mortality among young female children are fast disappearing especially since the establishment of the People's Republic in 1949. Secondly, the omissions of children and especially female children which were common in the Hsien censuses were minimized in the national census of 1953. Though in new China, the sex ratio for all ages is still high (107.7) as compared with 15 other nations (Table 2), it is much lower than a number of the hsien censuses in old China (Table 1), especially Chang Lu (129.4) in Fukien, Lan Hsi (125.3) in Chekiang, Chu Yung (116.6) and Kiang Ying (112.1) in Kiangsu.

In Table 2, India (105.6) and Canada (102.5) have relatively high sex ratios. In Australia (100.4) Brazil (99.3), Sweden (99.3), Netherlands (99.3) and the United States (98.7) the ratios for all ages are about even between the sexes. Unlike these nations, England and Wales (92.6) and France (92.2) have shown lower sex ratios. Two extreme cases are noted: in Federal Republic of Germany (88.8) and Democratic Republic of Germany (74.3) the unusually low sex ratios are in a large measure due to the evil effects of the second World War, which in each area killed off an immense number of the males in the prime of their lives.

2) Age Composition In Old China, the age composition of the 8 hsien censuses is shown in Table 3. Infants of the zeroage group all occupy a relatively high percentage in the total population, as 4.94% in the Kunming Lake Region, Yunnan. During the period of China's resistance war against Japan, the Kunming Lake Region attracted a large number of the middle-aged immigrants with their families from other provinces. Besides, the Region included the urban population of a fairly large city. These factors were responsible for the unusually high birth rate of the Region.

In the 1953 census of new China, the infants of the zero-age group constitutes 3.3% of the total population (Table 4). This is considerably lower than the figure for the Kunming Lake Region as shown in Table 3.

In Table 4, it is shown that Brazil (3.7%) China (3.3%) and India(3.2%) have rather similar percentages for the zero-age group: these countries all have high birth rates. In the same table, other nations which have slightly lower percentages of the zero-age group are Yugoslavia (2.8%) and Egypt (2.7%). These two countries also have relatively high birth rates. A group of countries have percentages of the zero-age group still over 2.0%, but their birth rates are not high, such as Australia (2.4%) the United States (2.2%), Czechoslovakia (2.1%) and Japan (2.0%). The age composition for all age groups in Sweden and England and Wales is strikingly similar: both nations have low birth rates, have normal middle-age group, and have relatively large number of the old people. In France, Australia and the United States, the populations are gradually ageing, as in these countries the people of 65 years of age and over now constitute 12.1%, 8.6% and 8.5% respectively.

On the other hand, China's population is rather young, for according to Sundbaerg's age divisions she belongs to the stationary-progressive type as in China the 0-14 year of age group fully occupies 36.0% of the total population. These young people are soon maturing to shoulder the heavy responsibilities of developing industry, commerce, communications and agriculture, which China urgently needs in her expanding program of socialist reconstruction. By contrast, in certain other countries, the 0-14 year of age group occupy quite low percentages in their populations, such as Federal Republic of Germany (22.1%), England and Wales (22.5%), France (23.3%), Sweden (23.7%), and Czechoslovakia (24.6%).

3) Nationality New China's constitution stipules (Art. 3) that all nationalities in her population are equal, and that there shall be no discrimination or oppression of any nationality against any other. Other significant provisions state that in the regions where the minority peoples live, there shall be autonomous areas of various levels and establish self-governing machinery to suit local needs. In these areas where the conditions are appropriate, there shall be people's congresses. A person of 18 years of age may decide his nationality: and with regard to a minor, the question may be decided by his parents.

In new China, as the nationalities are now equal, the minority peoples in a number of regions freely report themselves as members of the minority peoples, such as the Chang in Lung Lin, Kwangsi; the Yi in Wan Hu, Kaichow; or the Wigur in Ah To Shi, Sinkiang. Before the liberation, under the oppression of the Han nationality, certain members of the minority peoples did not disclose their ethnic origins; but during this census, they freely report their true nationalities to the People responsible for census-taking.

In enumerating population, the dejure principle is followed throughout. But among the nomads, they are registered at the last administrative

unit to which they belong.

In certain outlying regions there is no direct election of the people's representatives by the voters, such as certain nationalities in Tibet, Sikang and Sinkiang. Among these nationalities, the total population is ascertained by the local government which summons the headmen of the nationalities under its jurisdiction to make an estimate of their nationals. This is the basis on which the number of the people's representatives to the national People's Congress is apportioned. At the conclusion of the 1953 census, the minority peoples sent 150 representatives to the national People's Congress in Peking. This roughly represents one seventh of the total representatives in that body, but the apportioned number is believed to be much larger than the percentage which the minority peoples actually occupy in the total population of the country.

According to the census of 1953, there were 35,320,360 persons belonging to the minority peoples. This represents 6.06% of the country's total population. The great majority of the minority peoples live among the Han nationality and are enumerated and registered simultaneously with the Han nationality. In addition, there are the inhabitants of the outlying areas, and regions, where no direct election of the people's representatives took place. These areas have 8,397,477 persons, of whom a considerable number belongs to the minority peoples.

The census of 1953 enumerated over 40 nationalities for the whole country, of whom the Han nationality constituting 93.94% of the total. Among the minority peoples, there were 10 nationalities, each numbering over one million persons. They are, in numerical descending order, the Chang, the Wigur, the Mohammedan, the Yi, the Tibetan, the Miao, the Manchu, the Mongolian, the Puyi, and the Chosen.

D) An Appraisal of the 1953 Census

It should be admitted that the results of the 1953 census are quite trustworthy. This is, in the writer's opinion, due to the application of the modern scientific technique and people's eagerness for the undertaking. The combination of these two factors explains, in large measure, the success of the 1953 census. The chief reasons may be briefly discussed as follows:

1) Because the purposes of the census are for the welfare of the people, so the people heartily support the undertaking and happily participate in it. Since the liberation, the position of the people has undergone fundamental changes--rising as it does from servitude to mastership--and they realistically feel that the country now belongs to them. They clearly understand that the census prepares for the subsequent elections, and that by exercising the democratic rights through ballotting, they could bring about socialist reconstruction in economic and cultural aspects. This is radically different from the historical past when the reactionary ruling class for the purpose of imposing taxes, enlisting soldiers, or enforcing the Pao Chia system, collected population data to exploit the people. Under these

circumstances, the people naturally would either abscond themselves or oppose the exploiters. Population figures of old China which were obtained through whatever source must contain considerable information which was concealed in various forms and must have considerable under-reporting. In new China, the census is purely for the benefit of the people, that will basically eliminate concealment and under-reporting; though there may still be omissions, as aspects of the census methodology are yet deficient.

2) Through the promulgation and enforcement of certain land policies, the Chinese Communist Party and the People's Government have exalted the constructive enthusiasm of the common people. At the conclusion of the land reforms, each person in the rural areas is apportioned land. The allotment is on the per capita basis of population. Therefore, every village keeps an accurate record of the inhabitants. The people can neither exaggerate the number of persons in their families nor under-report. Besides, the exemption of the agricultural tax is based on the persons in the family. From these, the people receive practical education on population matters, and increase their confidence in the Government. These efficaciously prepare the people for their participation in census-taking in 1953.

3) To suit the existing conditions at the time of the census, certain scientific procedures were carried out to ensure accuracy and feasibility. Some of these may be mentioned below:

Only 4 items are given in the population questionnaire: name, sex, age, and nationality. The adoption of the de jure principle amply fits the character of the Chinese population which is predominantly agricultural and is therefore immobile. The field working force comprises more than 2.5 million persons who participate in the enumeration and registration of population.

4) From a check-up count subsequently made, it is seen that the field work in census-taking obtains a high degree of accuracy. In order to verify the field work in census-taking, certain areas were selected for a check-up counting of population. These aggregated a total of 52,953,400 persons distributed over 343 hsien and cities in 23 provinces, 5 cities, 1 autonomous area, representing about 9,0% of the total population as shown in the census. This check-up count revealed that repetitions constituted 1,39 per 1,000 population, and omissions constituted 2.55 per 1,000 population of the total in the check-up count. It is clear that there were comparatively more omissions than repetitions in census-taking. The cities had relatively more repetitions and omissions than the villages. In the cities, private families had fewer repetitions and omissions than public households.

But certain short-comings of the census should also be sketched. In the first place, those who were responsible for the census suffered greatly for the lack of previous experience. Besides, prior to census-taking, preparatory work lasted only half a year which was admittedly too short. In addition, actual field work extending to

approximately one year, which naturally gave rise to inaccuracies in data gathering. In enumerating the population, the principal method used was to ask each family head to report the persons under his care to the registration depots. This certainly involves mistakes in reporting.

The tabulation of population statistics through the application of three levels (the hsien as the lowest level, the province as the middle level, and the central government as the top level) entails the great difficulty of detecting errors and the waste of time in statistical computations.

The defects above named were inevitable at the time when the census was being taken. For census work in the future, methodological improvements in regard to field operations and statistical computations must gradually be worked out. In this common endeavour, the writer is most desirous of cooperating with the government agencies concerned and with other demographers to struggle for higher accuracy both with reference to the field work and to statistical computations.

B) The Purposes of the Census

1) The Election and People's Democracy

a) The Election of the People's Representatives Simultaneous with the enumeration and registration of population is the registration of voters. Persons of 18 years of age and over regardless of sex, nationality, religion, education, property, and length of residence are qualified to vote and to be voted on, if they do not belong to any one of the following groups: persons of the landowning class, counter revolutionists, those who are for various reasons deprived of the political rights, and mental defectives. At the registration depot, a subcommittee carefully scrutinizes all the registered persons and registers the qualified voters. After a consultation with the local communist party, democratic parties, and leaders of the community, the local election committee proposes a panel of candidates. Voting takes place at an open election meeting to which all the qualified voters go. The direct election of the people's representatives up to the hsien level is by raising hands.

The qualified voters of the whole country number 323,809,684 persons, constituting 97,18% of those who are 18 years of age and over, and the disfranchised persons amount to only 1,64% of the total population in those areas or 2.82% of those who are 18 years of age and over. In all China, the voters aggregate 278,093,100 persons, constituting 85.88% of the qualified voters who are registered. 84.01% of the females who are qualified to vote actually go to the election meeting to exercise their voting privilege.

Through the direct election, the whole nation elects 5,669,144 people's representatives of whom 17.31% are females.

b) People's Democracy New China's constitution provides that

all power belongs to the people who exercise their political power through the local People's Congresses and the national People's Congress in Peking. The election of the former, up to the hsien level, is directly by those who are 18 years of age and over and who are qualified to vote. From the hsien and upwards, the election of the people's representatives to the People's Congress is by the People's Congress immediately below. The administrative units of direct election number 214,798 in the whole country.

The chief characteristics of the People's Democracy are the universal exercise of the voting privilege by the people and the democratic distribution of the representatives among the social groups, as exemplified in the People's Congress in Peking city. The election commenced in December 1953 and completed in March 1954, in which the voters in the city wards constituted fully 98.2% of those who are registered and qualified to vote; and in the suburbs the percentage is only slightly lower, i.e. 95.2%.

In the city, the 7 wards elected a total of 1,200 representatives distributing among the following social groups: laborers 32.8%, street residents (family members of laborers and employees, independent workmen and pedlers) 20.5%, employees in government offices and State enterprises 15.7%, educationists and members of the medical profession 15.2%, workers in private industrie and businesses 9.8%, workers of the co-operative unions 3.0%, religious workers 1.6%, engineers and technicians 1.4%. Of these people's representatives, females constituted 26.7%, and the representatives from the minority peoples occupied 10.0%.

Generally speaking, the election of the people's representatives is on the basis of population. Thus, starting from the lowest administrative unit which elects people's representatives, the hsiang with varying populations may elect from 15 to 35 representatives, and the national People's Congress, the highest unit, has 1.200 representatives. But there are also limitations and adjustments, such as the maximum number of representatives which a hsiang may elect to a hsien is 3. Also, the population of Ninghsia province is just over 900,000, but is entitled to elect 5 representatives to the national People's Congress. In the rural communities, every 800,000 persons may elect a representative, but in the cities where laborers usually concentrate, a population of 100,000 is sufficient to elect a representative to the national People's Congress.

2) The Census and National Reconstruction

a) Socialist Industrialization, Employment, and Workers' Plane of Living Since 1953, China has begun economic reconstruction on a fairly large scale. This necessitates a big amount of capital investment and a large number of workmen. The census furnishes reliable data on the labor force, and also on production and on consumption.

New China has ever been confronted with considerable unemployment which was handed over from the old regime. On the other hand, a considerable

number of people reaching the working age each year must find employment, thus enabling them to become members of the economically active population.

Unemployment is gradually extending as the program of socialist industrialization expands. At the end of 1949, about 8 million laborers and employees were employed in our national economy. In 1956, their number was increased to more than 24 millions: among these there were about 3 million capitalists and owners of the private enterprises who, after going through the processes of socialist transformation, have joined the State enterprises and joint enterprises as employees, together with the State employees in rural areas. Within 7 years, now China has successfully found employment for 13 million persons, or about 1.8 million persons per year. This rate of expansion is unprecedented in Chinese history. Fundamentally, the army of the unemployed persons of the old days has up to the present found suitable employment.

The tension of unemployment has not only been gradually eased by industrial openings in the cities as above sketched, but also by creating opportunities for employment in the rural regions, especially through the co-operative movement in agriculture. From now on, for a comparatively longer period, increasing opportunities for employment may be found in rural areas. Article 39 of the Draft Regulations on Agricultural Development for China (1955-67) stipulates that aside from finding employment in the cities, the unemployed are encouraged to go to the suburbs, rural areas, forests and hill countries to find work in agriculture, pasture lands, fishing and other subsidiary occupations. Also, they are advised to be engaged in technical, educational, cultural and health activities in the farming regions.

The expansion of employment together with the reduction of unemployment are responsible for the increase in the plane of living among the laborers and employees. Thus, the average annual wages of the workmen and employees have increased from 446 yuan, Chinese people's currency, in 1952 to 610 yuan in 1956, or an increase of about 37.0% in 4 years.

Likewise, the level of consumption for the workmen and employees has also been increasing continuously. Calculated on the basis of the 1952 prices, that the workers and employees consumed amounted to about 130.0 yuan per year per person in 1936. This amount was increased to 167.7 yuan in 1952; to 179.9 yuan in 1955, and to 199.8 yuan in 1956. The level of consumption in 1956 was thus 19.0% higher than in 1952 and 54.0% higher than in 1936.

b) Land Reforms and Co-operation in Agriculture In old China, land ownership and land tenure was unjustly held by a limited number of land aristocrates. Though poor farmers and farm laborers constituted over 90.0% of the total agricultural population, they occupied only 20.0--30.0% of the land. On the other hand, land owners and rich farmers, though numerically less than 10.0%, actually possessed no less than 70.0--80.0% of the total land area in the country. Thus, the tillers of the soil were either landless or occupied insufficient land

which they cultivated. They toiled all their lives, but were generally unable to obtain enough food and clothing to maintain a satisfactory standard of living.

Under the Chinese Communist Party, land reforms were basically carried out in the whole country, which resulted in the liquidation of the land-owning class and in the re-distribution of land among the cultivators. In the countryside, fundamental changes affecting the social classes have taken place as depicted in Table 5. Land reforms were carried out in 21 provinces at various dates, but were completed towards the end of 1953. Between that date and the close of 1954, poor farmers and farm laborers decreased from 57.1% to 29.0%, and middle class farmers increased from 35.6% to 62.2%. For the same period, the decrease of rich farmers was insignificant: a reduction from 3.6% to 2.1% only. Again, the former land lords were also shown in the table, for although they were liquidated but they still retained the stigma of their class, as by regulation it would require 5 years for them to lose their class status.

On the basis of the land reforms, the Chinese Communist Party and the People's Government have launched the co-operative movement among the farmers, which gained great momentum in 1955 and reached its climax in 1956. In June, 1956, among 120 million farming families no less than 110 million families joined the co-operative movement constituting 91.7% of the total farming population. They have thus become collective farmers. This prevents them from differentiating into rich farmers on the one hand and poor farmers on the other, as in the old days. Poverty is decisively diminished.

The level of consumption was 72.8 yuan per farmer in 1952 which was raised to 84.2 yuan in 1956, or an increase of 15.7%.

The land reforms especially the rural co-operative movement have greatly stimulated agricultural production. From 1952 to 1956, a total of 825,000 million kilograms of food grains were produced, but between 1932 and 1936, the period of agricultural prosperity in old China, only 650,000 million kilograms of food grains were produced. In 1956, new China experienced the severest natural calamities since the time of liberation, yet the annual production of food grains amounted to 182,500 million kilograms, or 7,700 million kilograms larger than 1955. The superiority of the co-operative system is thus beyond doubt.

Up to the present time, the production of the food grains is increasing at a faster rate than population. Thus, between 1949 and 1956, population increased only 15.8%, whereas food grains increased 71.0%. However, compared with the size of population, China has a relatively smaller area of the cultivated land averaging about one fifth hectars of the cultivated land per farmer. The food grains available for annual consumption is gradually increasing: from 270 kilograms per capita in 1952 to 294 kilograms per capita in 1956. Compared with a number of foreign nations, the Chinese figure is still considered low.

c) Education and Health As compared with the Kuomintang regime, education and health measures have faster growth in new China. Between 1949 and 1956, about 32 million illiterates gained certain amount of education, which reduced illiteracy considerably (before the liberation, illiteracy was as high as 90.0% of the total population.)

In 1946, the record year under the old regime, there were 50 primary school pupils per 1000 population who were actually attending schools; but in 1952 this figure was raised to 89.2. Between 1952 and 1955, when China's population increased 6.9%, the pupils in the primary schools increased 3.96%.

In 1946, the students attending the secondary schools amounted to 4 per 1,000 population, but this number was increased to 5.5 per 1,000 population, and it was further raised to 7.3 per 1,000 population in 1955.

In 1947, the students in the colleges and universities amounted to 3 per 10,000 population, but this was increased to 3.4 per 10,000 population in 1952 and to 4.8 per 10,000 population in 1955.

With the increase of population there have been corresponding increases of the physicians and hospital beds. In 1954, there was one physician per 1,400 population, and one hospital bed per 2,900 population. In 1955, although more than 10 million persons have been added to the total as compared with 1954, but practically the same ratios as above-mentioned have been maintained.

Regarding the health protection for the people, noteworthy improvements are also discernible. Small pox, cholera and plague have been basically under control. The control is gradually extending to the other infectious and communicable diseases, such as:

i) Schistosomiasis: This was once prevalent in the rice fields in 12 provinces, but is receiving increasing medical attention in recent years. In 1956 alone, more than 400,000 patients were cured, and plans are under way to extinguish the dreadful disease in 7 years.

ii) Malaria: 38 preventive stations have been established not only to cure malaria patients but also to prevent the spread of the disease.

iii) Kala-azar: From 1949 to 1956, a total of 600,000 kala-azar patients have returned to normal health, and the medical profession is confidently looking to the date for the total extinction of the disease in 1960.

iv) Tuberculosis: For the prevention of tuberculosis, all large cities have opened hospitals and sanitoriums. In Peking, the tuberculosis hospital has 6,000 beds which is a sevenfold increase since 1949 resulting the great reduction of the specific death rate from tuberculosis. If the specific death rate from tuberculosis for 1949 were taken at 100, that for 1956 was reduced to 28.

F) The Census and Demographic Research

1) A Preliminary Study of Population Change in Rural Areas(1952-1953)

From 1951 to 1954 there have been a number of sample surveys on population change in different parts of China. Among these, 16 surveys of fairly high accuracy have been hereunder reviewed, which reflected aspects of the demographic situation in 1952-1953, as portrayed in Table 6. These local investigations covered a total of 1,810,107 persons in 16 hsien in 7 provinces. In some cases, the entire hsien is covered which includes the hsien center, the village town, the hsiang and the village. In other cases, only portions of the hsien are included. These surveys essentially deal with the rural populations, but not the city populations.

More specifically, birth rates in these 16 hsien have exhibites rather large variations. Lokiang in Szechuan has the highest rate or 52.8, and Lichuan in Shensi has the lowest rate or 26.1. In 7 hsien, the birth rate is over 40.0. Regarding the death rate, Lokiang in Szechuan has the highest rate or 24.0, and Lichuan in Shensi has the lowest rate or 13.4. In 8 localities the death rate is over 20.0. Natural increase of population also shows variations. Lokiang in Szechuan has the highest natural increase or 28.8, and Lichuan in Shensi has the lowest or 12.7. In 10 hsien, natural increase is over 20.0 per 1,000 population per year.

For 16 hsien the vital rates have been, on the basis of the weighted arithmetic mean, computed as follows: birth rate, 41.6; death rate, 21.0; and natural increase, 20.6 per 1,000 population.

In comparison with the 16 hsien, some rural regions which have richer agricultural lands and better harvests should have higher birth rates; other areas of poorer agriculture including the habitats of the minority peoples should have lower birth rates.

Since the first year of the People's Republic 1949, death rates have generally been declining. New China is laying greater and greater stress on public health and personal hygiene, on the more effective control of epidemic and endemic diseases, and on the substantial reduction of infants' and children's diseases (such as neo-natal tetanus and measles).

As compared with the decade immediately before the time of liberation, new China's birth rate is gradually increasing, her death rate has shown marked decrease, resulting in a substantial natural increase of population every year. This situation roughly indicates the first phase of the "demographic revolution" in which the high birth rate is accompanied by a relatively low death rate which results in a comparatively high natural increase of population.

China to-day faces an appreciably different situation than at the end of the Kuomintang reactionary period. At that time, the vital rates

might be estimated as follows: birth rate, 36; death rate, 29; natural increase 7 per 1,000 population. x) As compared with the vital rates of new China, old China's birth rate was lower, death rate was higher, and natural increase considerably lower. New China's vital rates indicate a vigorous state of affairs purpoting to a growing population helpful for socialist reconstruction of the nation.

2) The Movement of Population

a) The Shift of Workmen between Economic Enterprises and between Economic Sectors China is now in a transitional period where socialist enterprises are flourishing and capitalist enterprises are undergoing socialist transformation. The workmen in the former are showing corresponding increase, whereas that in the latter are relatively decreasing as shown in Table 7. According to this table, the Socialist State enterprises (national and local) are occupying increasing importance in national economy, and their laborers and employees have increased from 2.1 million in 1949 to 9.3 million 1955, or increasing from 40.3% to 67.3%. For the same period, the socialist co-operative enterprises and the joint enterprises (between the State and private individuals) are also demonstrating their economic importance. The three categories of the economic enterprises as above-mentioned illustrate varying degrees of industrialization, and their laborers and employees are likewise showing different degrees of increase. Capitalist enterprises are gradually losing their ground, and their laborers and employees are obviously decreasing: from 2.9 millions in 1949 to 2.1 millions in 1955, or decreasing from 56.0% to 15.6% in the nation's economy.

The development of our national economy is according to plans and proportions. The application of the labor force must also proceed from these principles. The government makes adequate arrangements for the employment of workmen. Thus, the distribution of the working force and its rate of increase in different sectors of the nation's economy assume a new form as shown in Table 8. Industry is quickly expanding and therefore needs a large number of workmen, who increase from 28.7% in 1952 to 31.6 in 1955. The expansion of the Government offices and people's organizations in recent years is much slower, and their relative position in the national economy is decreasing from 15.3% in 1952 to 10.2% in 1955. The distribution of the labor force by planning avoids the blind allocation of labor power in different sectors and also stave off unemployment.

b) The Urban-Rural Movement of Population Urbanization and the development of factors give rise to the cityward drift of population from the hinterland villages to the cities. During the period of the first Five-Year Plan, about 8 million persons have continuously moved into the urban centers. Because in the cities, natural increase of population is faster, urban population is in recent years growing more rapidly than rural population. Thus, in Table 9 it is seen that in 1949, urban population only constituted 10.35%, and rural population occupied fully 89.65% of the total population. But in 1956, urban population increased to 13.84%, and rural population decreased to 86.16%.

x) Another estimate for an earlier period around 1930 was as fellows: birth rate, 38; death rate, 33; natural increase, 5 per 1,000 population. Ta Chen: Population in Modern China, p. 38.

Though the rate of industrial growth is fast, the standard of industrialization is low, so industry is not yet able to draw any large number of workmen every year. In 1953, more than 70.0% of the labor force found employment in the rural areas. During these last two years, priority for employment was given to the workers in the cities. However, henceforward for a rather long period, the principal opportunities for employment must be found in the villages. Thus, hereafter for quite some time, the relative position between the urban and rural populations may undergo only unimportant changes.

c) Internal Migration From 1949 to 1955, the total migrants within the country amounted to more than 520.000 persons, distributing among the following sources: 330,000 persons are engaged in irrigation and construction work; 149,000 persons have emigrated from famine areas and areas of low soil fertility; 47,000 city dependents from Peking, Tientsin, Shenyang have emigrated to the villages for productive work. Among these migrants more than 300,000 persons have settled within the province; over 200,000 persons have settled outside the boundaries of the province.

The waste lands that are suitable for cultivation are widely distributed over all parts of China: such as Kwangtung and Kwangsi in the South, Kansu and Sinkiang in the Northwest; and Liaoning and Heilungkiang in the Northeast. Between 1953 and 1956, the waste lands reclaimed totalled 4,340,000 hectares, chiefly by the State farms and State pastures. In 1956, the reclamation work by the State farms and migrants constituted more than half of all the waste lands reclaimed for the whole period.

3) Birth Control

In new China, marriage and family relations are undergoing significant changes. The traditional joint family system is breaking down, and matrimonial relationships on the basis of the new marriage law are influencing multitudes of young men and women. Facing this fundamental social transformation, the Chinese Communist Party and the People's Government have, in recent years, been considering the adoption of birth control as a new policy for marriage and family relations.

In September 1956, Premier Chou En-lai, in submitting the Party's proposal for the second Five-Year Plan, declared that "for the protection of women and children, for the up-bringing and education of the rising generation, and for the health and prosperity of the nation, we are in favor of the appropriate regulation of reproduction. We entrust the Ministry of Health with the task of working out an effective program of birth control with reference to publicity and practical applications."

Publicity for birth control is being carried on in all parts of China, and is especially successful in the cities of Shantung, Kiangsu, Fukien, Hopei and Hunan. For the rural areas, publicity work is just beginning; and in some provinces, it is barely starting from the administrative center of the hsien.

Plans for 1957 provide that contraceptive devices and medicines be sufficient for the use of 25 million married couples. This supply consists of: sheaths, 80.0%; jelly, 10.0%; suppositories, 5.0%; diaphragms, 3,0%; other, 2,0%. The sales for the first quarter of 1957 by the State Medical and Pharmaceutical Company, Peking, include: sheaths, 4,310,000; diaphragms, 46,500; jelly, 80,000 (tubes); suppositories, 569,504 (boxes).

In a recent study on birth control and related topics, it is revealed that under the proper direction and guidance of the Party and Government, the birth control movement will in due course of time gain in strength and will eventually spread to different sections of the country. Birth control will thus become the determining factor for the reduction of the birth rate.

To slow down the rate of population growth effectively, the birth rate would have to be reduced 50.0% from the present rate. Ostensibly, this would mean a long-term process, and the reduction may take not less than 10 years to complete, or till the end of the ghird Five-Year Plan in 1967. This tentative conclusion is reached after due consideration of a number of factors including the following: time-honored tradition on family and marriage, medical and hospital equipment in urban and rural areas, cultural and socio-economic conditions of the common people, conservatism of the peasants, and means of communication in the outlying regions.

The time interval of 10 years allowed for the reduction of the birth rate by 50.0% as above-stated is a considerably shorter period than what many foreign countries have experienced in adopting birth control successfully. Among other matters there exists this significant difference: in most foreign nations, the people themselves practise birth control voluntarily; whereas in new China the Government on the basis of the people's aspirations takes the initiative and is directing it.

Another social question closely related to the birth rate is the age at marriage of the contracting parties. A passionate debate is now raging as to the proper age at which a young man or young woman may marry. In view of these circumstances, it is suggested that a national system of vital registration be instituted forthwith for the registration of birth, death, marriage and migration with special emphasis on marriage data for the ultimate determination of the proper age at marriage for young men and women based on factual analyses.

To encourage young men and young women to defer their marriages, a further suggestion is put forward that they avail themselves of the increasing opportunities now offered for attending schools, to remain there as long as circumstances would permit, and to take up as far as possible, special studies at the research institutes. Particularly, the young girls are advised to educate themselves as much as their families would allow. In addition, the young men and especially young

women are encouraged to enter trades, occupations and professions to strive for economic independence.

The ultimate aim is, of course, to abandon the objectionable social usage of marrying at young ages, and gradually raise the age at marriage for young men and women. When the young women defer their marriages, they would effectively reduce fertility and thus decrease the birth rate.

4) The Need of new Population Estimates for old China

Chiefly due to the lack of census data and vital statistics, old China's total population, its geographical distribution and its rate of growth have seldom been scientifically analyzed. The 1953 census makes it possible to start researches on the critical re-evaluation of the demographic situation during the last 50 years by paying special attention to the following periods: a) 1909-1911: with some reports on population statistics issued by the Minchengpu; b) 1912-1927: with population statistics records published by the Ministry of the Interior, Peking; c) 1928-1948: with reports on population statistics by the Ministry of the Interior during the Kuomintang regime; and d) the population statistical data compiled by the Ministry of the Interior, the People's Government, for the period of economic recovery. It is hoped that in the near future, a new estimate on population for the period of China's resistance war against Japan may be published.

Table 1: Sex Ratio in 10 Localities in China: Census Data

Locality	Population	Source	Sex Ratio	Source
Kiang Ying	21,864	(1), p. 29	112,1	(1), p. 28, Table 17
Chu Yung	279,455	(2), p. 101	116,6	(2), p. 174
Kiang Ning	562,063	(3), pp. 40-41, Table 1	106,2	(3), pp. 40-41
Ting Hsien	439,259	(4), p. 17	110,49	(4), p. 24, Table 7
Chow P'ing	165,735	(5), p. 620, Table 1	93,1	(5), p. 183, Table 16, or p. 200, Table 18, not specified
Chang Lo	227,801	(6), p. 8	129,4	(6), p. 14
Lan Hsi	276,468	(7), p. 8, Table 1	125,3	(7), p. 121
Cheng Kung	71,223	(8), p. 73, Table 1	90,7	(8), p. 75, Table 2
Szechwan (3 hsien)	619,471	(9), p. 34, Table 12	108,0	(9), p. 34, Table 12
Kungming Lake region	507,216		103,7	
Kungming city	174,024	(10), p. 61, Table 40	121,7	(10), p.61, Table 40 & pp. 268, 331, 372
Kunming hsien, Kunyang Hsien & Chining hsien	333,192		94,0	

The sources in Tables 1 and 3 refer to the original census report of each locality as indicated below. Except report No. 1, which is published in English, all the other reports are published in Chinese.

(1) C.M. Chiao, W.S. Thompson, D.T. Chen, An experiment in the Registration of Vital Statistics in China (Oxford, Ohio, U.S.A.: Scripps Foundation for Research in Population Problems, 1938)

(2) C.C. Chang, W.F. Tao, C.C. Chuang, Experimental Census of Population and Agriculture of Chu Yung Hsien (Commission of National Defense, General Staff, March, 1934)

(3) General Reports of Experiments in Kiang Ning Hsien (Kiang Ning Hsien Government, Kiangsu Province, Nov., 1934.

(4) Franklin C.H. Lee, 'Problems of Technique as Revealed in population Census of Tin Hsien", Social Science Quarterly (Tsing Hua University), Vol. II, No. 3 (April, 1937).

(5) [illegible] Experimental Hsien (Shanghai: [illegible] 1937)

(6) Census of Population and Agriculture of Chang Lo Hsien, Fukien (Foochow: Fukien provincial Government, July, 1937).

(7) Population Statistics and Analysis of Lan Hsi Experimental Hsien (Hangchow: Lan Hsi Hsien Government, September, 1936).

(8) Preliminary Report of Population Census of Cheng Kung, Yunnan (Cheng Kung: Institute of Census Research, Tsing Hua University, August, 1940).

(9) Census of Selected Hsien in Szechwan (Chungking: Directorate of Budgets, Accounts, and Statistics, Chinese National Government, 1943).

(10) Experimental Population Census and Vital Registration in Kunming Lake Region, Yunnan(Kunming: Committee on Experimental Census and Vital Registration for Kunming Lake Region, February, 1944).

Table 2: Sex Ratio in 16 Countries

Country	Date	Sex Ratio for all ages
China	30 VI 1953	107.7
India	1 III 1951	105.6
Canada	1 VII 1955	102.5
Australia	30 VI 1947	100.4
Brazil	1 VII 1950	99.3
Sweden	1953	99.3
Netherlands	1953	99.3
United States	1 VII 1954	98.7
Egypt	26 III 1947	98.1
Japan	1 X 1954	96.6
Yugoslavia	30 VI 1954	94.6
Czechslovakia	22 V 1947	94.5
England and Wales	30 VI 1954	92.6
France	10 V 1954	92.2
Federal Republic of Germany	1954	88.8
Democratic Republic of Germany	29 X 1946	74.3

Source: 1) China: Computed from data given in 1953 Census.

2) 15 Nations: Computed from data given in United Nations: Demographic Yearbook 1955, Table 10.

Table 3: Age compositions in 8 Localities in China: Per Cent.

Age	Kiang Ying	Chu Young	Kiang Ning	Ting hsien	Chang Lu	Lan Hsi	Cheng Kung	Kunming Lake Region
0	3.80	4.17	....	....	......	3.64	4.57	4.94
1	3.60	3.07	2.90	....	......	2.97	3.30	2.72
2	3.30	2.93	3.08	....	......	2.90	2.29	2.06
3	3.30	2.77	2.90	....	......	2.80	1.88	2.07
4	2.60	3.13	2.80	....	......	2.44	1.91	2.07
0-4	16.60	16.08	14.41	13.16	9.40	14.76	13.95	13.86
5-14	23.60	24.56	24.44	20.15	23.3	21.52	20.87	19.79
15-24	16.90	16.78	16.10	15.43	19.3	17.60	13.69	16.92
25-34	14.30	14.35	14.36	14.81	15.4	15.16	14.70	15.37
35-44	11.20	11.91	12.51	12.91	12.5	12.75	14.32	13.62
45-54	8.60	8.70	9.16	10.96	10.5	8.59	10.55	10.09
55-64	6.70	5.72	6.42	6.75	6.2	6.44	8.03	5.28
65-74	1.40	1.51	2.05	4.25	2.7	2.55	3.28	2.56
75 and over	0.70	0.39	0.50	1.56	0.7	0.53	0.55	0.41
unknown	......	....	0.03	....	......	0.08	0.06	0.1
All ages	100.00	100.00	100.00	99.98	100.00	99.98	100.00	100.00
	(1),p.24, Table 12	(2), p.104, Table 4	(3),pp.40-41 Table 3	(4),p. 24, Table 7	(6),p.11	(7),pp. 30-31, Table 16	(8),p.60 Table 24	(10),p.63, Table 43

Source: See Table 1

Table 4: Age Composition in 16 Countries: Per Cent

Age group	China	India	Japan	Egypt	Yugo-slavia	Czecho-Slovakia	Democratic Republic of Germany	Federal Republic of Germ.	England and Wales	France	Nether-lands	Sweden	United States	Canada	Brazil	Austr-alia
	30VI 1953	IIII 1951	IX 1954	26III 1947	30VI 1954	22 V 1947	29 XI 1946	1954	30 VI 1954	10 V 1954	1953	1953	1VII 1954	1VII 1955	1VII 1950	30VI 1947
0	3.3	3.2	2.0	2.7	2.8	2.1	0.9	1.5	1.5	0.7	2.2	1.5	2.2	12.7	3.7	2.4
1-4	12.3	10.1	9.2	11.0	10.0	7.6	6.0	5.9	6.0	7.3	8.6	6.3	8.8		12.4	7.6
5-14	20.3	24.2	22.7	24.3	19.2	14.9	18.1	14.7	15.0	15.3	19.0	15.9	18.0	19.4	25.6	15.0
15-24	17.3	19.0	19.2	17.3	20.1	17.0	13.3	15.5	12.5	13.9	15.2	12.1	13.5	14.4	20.1	15.8
25-34	14.6	15.3	15.1	14.7	15.2	13.5	10.9	14.5	14.7	15.0	14.5	14.7	14.9	14.9	14.2	15.7
35-44	12.0	11.6	11.2	12.9	9.9	16.1	15.4	12.6	14.0	11.1	12.7	15.1	13.9	13.3	10.5	13.8
45-54	9.3	8.1	9.1	9.0	10.3	12.7	14.4	15.0	14.2	13.9	11.2	13.5	11.4	10.1	6.9	11.7
55-64	6.5	4.9	6.3	4.7	6.6	8.4	11.1	10.5	10.7	10.7	8.4	10.3	8.8	7.4	3.9	9.4
65-74	3.4	3.6	3.7	2.2	4.1	5.3	7.3	6.7	7.5	7.7	5.5	7.0	5.7	5.2	1.7	5.4
75 and over	1.0		1.5	0.9	1.8	2.3	2.6	3.1	3.9	4.4	2.7	3.6	2.8	2.6	0.8	2.6
un-known	-	-	-	0.3	0.0	0.1	-	-	-	-0.0	-	-	-	-	0.2	0.6
All ages	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: 1) For China: Computed From data given in 1953 census

2) For 15 nations: Computed from data given in United Nations: Demographic Yearbook 1955, Table 10.

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Table 5: Class Structure in Villages before and after Land Reforms --

Class	At Conclusion of Land Reforms (%)	At end of 1954 (%)
Total	100.0	100.0
Poor farmer and farm laborer	57.1	29.0
Middle class farmer	35.8	62.2
Rich farmer	3.6	2.1
Former Landlord	2.6	2.5
Other	0.9	-
Member of co-operative Farm	-	4.2

Footnote: 1) Member of Co-operative farm does not form a distinct class

2) Source: Statistical work, P31, Vol. 10, 1957, Editorial Committee of statistical work, Journal of statistical planning, Peking.

Table 6: Sample Surveys on Population Change in 16 Hsien (or civil Sub-divisions) in Chine 1951-1954

Hsien	Date	Total Population	Births Number	Birth Rate per 1,000	Deaths Number	Death Rate per 1,000	Natural Increase Number	Rate of Natural increase per 1,000
Grand Total	-	1,810,107	75,296	41.6	38,058	21,0	37,238	20.6
Sub-total (7 Hsien)	-	1,753,389	73,183	41,7	37,010	21,1	36,173	20,6
1) Lokiang, Szechwan	8 months, 1 VII 1953-28II 1954, Converted to one year	185,177	9,786	52,8	4,444	24,0	5,342	28.8
2) Sinfan, Szechwan		134,277	6,436	47.9	2,844	21.2	3,592	26.7
3) Peichwan, Szechwan		80,464	3,441	42.8	1,518	18.9	1,923	23.9
4) Lungchang, Szechwan	1952	425,068	20,224	47.6	10,116	23.8	10,108	23.8
5) Pinyang, Kwangsi	1952	383,503	12,760	33.3	8,144	21.3	4,616	12.0
6) Suiping, Honan	5 months, Jan-May,1952, converted to one year	355,520	15,558	43.8	7,404	20.6	8,184	23.0
7) Lichuan, Shensi	1952	189,380	4,948	26.1	2,540	13.4	2,408	12.7
Sub-total (14 Hsiang, kiangsu)		44,266	1,640	37.0	867	19.6	773	17.4
8) Kianglin, Kiansu (5 Hsiang)	Two years, Jun.1951-Jun. 1953,converted to one year	17,892	651	36.4	345	19.3	306	17.1
9) Tantu, Kiangsu(3 Hsiang)	9 months, sept.1952-jun. 1953, converted to one year	8,198	312	38.1	168	20.5	144	17.6
10) Kaogu, Kiangsu(2 Hsiang)	Two years, Jun.1951-Jun. 1953,converted to one year	5,913	196	33.1	115	19.4	81	13.7
11) Tungtai, Kiangsu (1 Hsiang)	Not specified, probably 1952-1953	3,813	121	31.7	70	18.4	51	13.3
12) Kanyu, Kiangsu/1 Hsiang	1953	3,001	141	47.0	67	22.3	74	24.7
13) Pinghai, Kiangsu(1 Hsiang)	10 months, Jun. 1953-Apr.1954,converted to one year	2,882	110	38.2	47	16.3	63	21.9
14) Hwayin, Kiangsu(1 Hsiang)	One year,Jun.1952-Jun.1953	2,567	109	42.5	55	21.4	54	21.1
15) Yüyao,Chekiang (3 Hsiang)	Two years,1952-1953, converted to one year	9,882	373	37.7	140	14.2	233	23.5
16) Ting hsien, Hopei (1 Hsiang)	1 VII 1952- 30 VI 1953	2,570	100	38.9	41	16.0	59	22.9

Table 8: Average number of workmen & employees in National Economy: Percent, 1952 & 1955

Classification of National Economy	1952 (%)	1955 (%)
Total: of this	100.0	100.0
Industry	28.7	31.5
Agriculture & forestry, Irrigation & Drainage, climatology	2.4	5.1
Basic Construction,	10.3	12.6
Communication, Transportation, Postal & Telegraphic Service	6.7	6.7
Commerce	11.4	15.7
Finance	3.1	2.5
Education & Health	21.6	16.8
Government office, People's organization x)	15.3	10.2

Footnote: 1) Data exclude workmen and employees of private enterprise

2) Data given by National Bureau of Statistics, Peking, 1956.

x) Excluding state employees in rural areas.

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A COMPARATIVE STUDY OF ACTUAL VERSUS STATIONARY POPULATIONS

by

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I. INTRODUCTION

Populations carry with them the imprints of their past, which are characteristically reflected in their sex and age structure as it becomes available in the census returns. Variations in mortality, fertility and migration, as they occurred during the population's life history, are more or less conspicuously recorded in the age-sex pyramids, or better so, in the profiles of the population, when it is stratified by age-groups. Taking as example, the profile of the United States' population as it appeared during the first half of this century, one can notice several interesting features. The center of

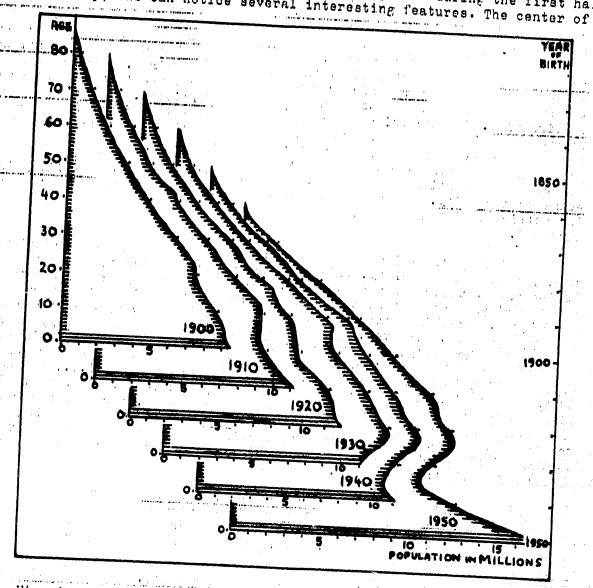

Fig. 1. The Profile of the United States' Population (Both Sexes) 1900-1950, by Age and Year of Birth.

1) Member of the United Nations' Secretariat. The views presented are his own and not necessarily those of the Secretariat.

attraction in this presentation is the hypotenuse (profile of the right triangle whose vertical side represents the age or the year of birth of the corresponding age group, while the horizontal side denotes the population in millions. This profile, in 1900, was almost a straight line with only a small bulge at the ages between 20 and 30 years. Fifty years later, in 1950, the line became a distorted curve with a gaping gulf at the ages of 10 to 20 years, a long tail-line at the ages below ten years and several smaller bulges in the older ages. Other examples may be drawn from almost every modern population, the census data of which are available by sex and age groups.

What is the nature and significance of these deviations from the normally expected smooth profile of human populations? In the case mentioned above, collateral data on vital statistics and migration offer some explanation. An intermittent positive net migration during the period prior to 1920 and a decline of the birth rate in the thirties followed by an accelerated fertility in the post-war years, explain the irregularities observed.

Good as this interpretation may seem, it fails to give a complete answer to the query of how much the given age-structure differs from the expected normal. To answer this, one must first define what is a normal age structure of a population. Among the various types of standard age compositions which have and are being used in this connexion, those of the stable and of the stationary populations seem to best satisfy the conditions required. Both are types of a general demographic norm which describe theoretical age (and sex) structures of a population under the assumption of constant fertility, constant mortality and no migration. The exclusion of the effects of migration from these norms reduces somewhat the immensity of possible variations in the age structure, but the number of profiles that may be constructed under the principle of stable population is still exceedingly large. This number is further reduced to manageable proportion in the stationary population in which fertility is made equal to mortality. Under this principle the variability of population profiles is restricted within the range of possible variation in one of the two factors involved.

Previous publications [2] have made clear that among the variations of fertility and of mortality, which in the absence of migration mould the shape of the age structure of a population, these of mortality are by far the best documented and the most manageable from the point of view of demographic techniques. Mortality statistics are more plentiful and extend to a considerable time in the past. Moreover, the long term variations of mortality, in contrast to those of fertility, seem to take place in a more orderly way. Finally, the maximum range of mortality variations appears to be more or less restricted by physiological limits. For example, a very heavy mortality, i.e., one corresponding to an expectation of life at birth of less than 20 years, seems to be incompatible with the maintenance of the numbers of the population, for it would call for a fertility of seven or more live births to every woman aged 15 to 44 years. On the other end of the range, mortality declines beyond a life expectancy at birth in the neighborhood of 75 years, seem highly improbable under present and all forseeable conditions of life.

This concept of stationary and closed population is proposed here to be used as the standard age composition against which deviations in the profiles of actual populations may be measured and, as far as possible, interpreted within the limitation involved. The idea is not new for demographic literature

2) United Nations: Age and Sex Patterns of Mortality. Model Life-Tables for Underdeveloped Countries. Population Studies, No. 22, New York, December, 1955 and United Nations: Methods of Population Projections by Sex and Age. Population Studies No. 25, New York, August 1956; also: V.G. Valaoras, "Standard Age and Sex Patterns of Mortality" in Trends and Differentials in Mortality, Milbank Memorial Fund, New York, 1956.

has repeatedly hinted at this method in the past. [3] However, an overall picture of normal variations in these "model" populations and the recapitulations of methods for using this information in order to meet some of our dayly demographic problems, may be of some interest to the participants of this meeting.

II. MODEL STATIONARY AND CLOSED POPULATIONS

A series of twelve model life-tables was constructed at about equally spaced levels of general mortality, from a level corresponding to an expectation of life at birth (both sexes), of 20 years to that of 74 years. An interval of five years of expectation of life was used throughout, except for the last one which was reduced to four years. Three sets of corresponding funotions, namely both sexes, males and females, were included in each model. One hundred national life-tables [4] selected from those appearing in the last three volumes of the United Nations Demographic Yearbooks, for the years 1953, 1954 and 1955, were used as the basis for computations. The numbers surviving (l_x) at exact ages 1, 5, 10, 15... 80 and 85 years, were plotted against the corresponding expectations of life at birth (e_0^0) for each sex, and second degree parabolas were fitted to the observations in order to derive the l_x values at the pre-determined levels of e_0^0. In certain cases the theoretical values had to be slightly adjusted to correspond more closely to the observations.

The result appears in the Appendix in the form of six basic tables, giving, at regular intervals of life expectancy, the principal life-table functions. They are: A.- the numbers surviving at exact age (l_x) out of an original cohort of 10,000 live births; B.- the accumulated number of deaths from birth to the specified age group ($\sum d_x$); C.- the probabilities of dying

3) Among the recent and most comprehensive studies in this respect See: George Stolnitz, Life Tables from Limited Data, A Demographic Approach, Princeton University, 1956; also: United Nations: Methods of Using Census Statistics for the Calculation of Life Tables and Other Demographic Measures, by Giorgio Mortara. Population Studies No. 7, New York, Nov. 1949.

4) The following national life-tables were selected in virtue of consistency of results and their representativeness of the various levels of general mortality; Australia: 1901-10, 1920-22, 1932-34, and 1946-48; Austria: 1901-05, 1930-1933, 1949-51; Belgium: 1891-1900, 1928-32 and 1946-49; Canada: 1930-32, 1940-42, 1947 and 1950-52; Czechoslovakia: 1899-1902 and 1929-32; Chile: 1930 and 1940; Denmark: 1901-05, 1911-15, 1931-35, 1941-45 and 1946-50; Egypt: 1936-38; England and Wales: 1901-10, 1910-12, 1920-22, 1930-32 and 1952; Finland: 1901-10; France: 1898-1903, 1908-13, 1928-33, 1946-49 and 1950-51; Germany: 1901-10, 1924-26 and 1949-51 (Fed. Rep.); India: 1891-1901, 1901-11, 1921-31 and 1941-50; Italy: 1901-11, 1921-22 and 1930-32; Jamaica: 1920-22; Japan: 1899-1903, 1909-13, 1921-25, 1926-30, 1935-36, 1949-50 and 1953; Mauritius: 1942-46; Mexico: 1930 and 1940; Netherlands: 1900-09, 1910-20, 1921-30, 1931-40 and 1947-49; New Zealand: 1901-05, 1911-15, 1934-38 and 1950-52; Norway: 1901-10, 1911-20, 1921-30, 1931-40 and 1946-50; Portugal: 1939-42 and 1949-52; Scotland: 1920-22 and 1930-32; Spain: 1900, 1910, 1920 and 1930; Sweden: 1901-10, 1911-20, 1921-30, 1931-40, 1941-45 and 1946-50; Switzerland: 1910-11, 1920-21, 1929-32, 1933-37, 1939-44; Taiwan: 1936-40; Union South Africa: 1920-22, 1925-27, 1935-37 and 1945-47; United States of America: 1900-02, 1909-11, 1929-31, 1939-41, 1949-51 and (whites) 1950.

These data were arranged at ascending order or male life expectancy at birth and the averages of groups, consisting of 10 life tables each, were used for the computation of the theoretical curves. Periods of unusually high mortality were excluded from this series as much as it was possible.

within the age interval ($_5a_x$); D.- the complete expectation of life at exact age (e_x^o); E.- the total size and the distribution of the stationary population by sex and age groups, expressed as a percentage of the total population (both sexes) and, finally, F.- the survival ratios from birth to the specified age group.

A number of generalizations were used in the computation of the basic tables, the most important of which are as follows: A life-table for both sexes was constructed for each model on the basis of those for each sex, at an assumed birth-ratio of 105 males per 100 female births. The mean population in all quinquennial age-groups, with the exception of the first, was taken to equal the average of the two marginal $_1l_x$ values multiplied by five. Those for the age-groups beyond the age of 85 were based on extrapolated $_1l_x$ values on the assumption of a certainty of dying within the next quinquennial age-group, for all those surviving beyond their 100th birthday. The mean population for the first year of life (L_o) was assumed to equal the number surviving at age one, plus one-fourth of the deaths occuring during the first year. Finally the mean population of the age-group 1-4 was taken to equal $1.9\ _1l_1 + 2.1\ _1l_5$.

With these generalizations and certain rounding of the probability of dying at the high mortality levels, these models were taken to approximate successive steps of general mortality improvements, from the heavy toll at which a population can barely sustain its numbers (e_o^o=20 yrs) to a little beyond the best mortality experience so far attained (e_o^o=74 yrs). It is not intended to duplicate the condition of any individual populations, for the simple reason that individual peculiarities in the patterns of dying, as they occur in the various populations, have been glossed out by the use of the average rates and the application of relatively simple mathematical formulas. Nevertheless, these models fit sufficiently well the observations of average patterns of mortality conditions and, consequently, they may be used as theoretical standards for assessing deviations in the status and the dynamics of actual populations.

A few limitations of this scheme must, however, be brought up at the outset. In the first place there is little structural resemblance between actual populations and the models presented here. Even if the population of a country approaches or has reached the stationary and closed condition described by the models, its age structure will still differ perceptibly, until this condition had lasted unchanged long enough to influence all age groups.

A second limitation arises from the scarcity of observations at the lower and the upper limits of the range, within which mortality conditions were presumed to move. For example, mortality levels below a life expectancy at birth of 30 years are not adequately substantiated by actual observations, and experience beyond a life expectancy of 70 years is still very limited. Only between these two levels, the present models may be taken to describe more or less satisfactorily the average mortality - fertility conditions, and their effects upon the structure of a population.

Finally, the reader should keep in mind the fact that these models are based on the experience of some two dozen countries during the period of the last fifty years. Although this experience is believed to offer a good generalization for the approximation of average demographic conditions of any country or period, atypical changes in mortality patterns should be given careful consideration as to their applicability to the present general scheme.

III. THE CHARACTERISTICS OF THE MODEL POPULATIONS

From the basic characteristics of the stationary and closed population, which these models describe, the following postulates emerge:

1. - General fertility and mortality rates: Since the annual numbers of

births and those of deaths are equal in all models, namely 20500 for both sexes, or 10500 for males and 10000 for females, and the resulting total population increases in size, as the mortality intensity decreases, the corresponding crude birth and crude death-rates, as well as those equivalent to the more refined fertility-rates, in the twelve models, decline steadily as shown in Table I.

Thus, at the heavy toll of about 50 deaths per 1000 population (model 1) the aggregated fertility rate, i.e: the number of live births per woman at the reproductive age of 15 - 44 years, amounts to almost seven children. This is a very high fertility for a population which can barely retain its modest size and seldom if ever is it duplicated in actual populations. 5) It is known, for example, that even when fertility is not voluntarily controlled, social and physiological barriers curtail more or less the "maximum" reproductive capacity of the human female, for the simple reason that not all women at the reproductive age are permanently exposed to the chance of childbirth. Even if all women in a population were married and living with their husbands, the proportion of temporary or permanent sterility seems to be of a substantial order of magnitude and in direct relation with the severity of prevailing mortality conditions. On the other extreme (model XII), only a little over two live births per woman in the reproductive age, suffice to sustain a population almost four times as large as the former.

TABLE 1. TOTAL POPULATION, DEATH AND BIRTH-RATES AND SPECIFIC FERTILITY-RATES, IN TWELVE MODELS OF STATIONARY POPULATION (Both Sexes), WITH 20500 DEATHS AND AN EQUAL NUMBER OF BIRTHS ANNUALLY.

Model No.	e_o^o (BS)	Total Population	Per 1000 Population		Women 15 - 44 Years	Fertility Rates per 1000 Women 15-44 yrs.	Births per Woman in the Age Group 15-44 yrs.
			Deaths	Births			
I	20	411,596	49.8	49.8	92,607	221.4	6.64
II	25	513,344	39.9	39.9	117,462	174.5	5.24
III	30	614,389	33.4	33.4	138,910	147.6	4.43
IV	35	715,460	28.6	28.6	158,880	129.0	3.87
V	40	816,878	25.1	25.1	178,877	114.6	3.44
VI	45	918,524	22.3	22.3	198,950	103.0	3.09
VII	50	1,021,943	20.0	20.0	219,085	93.6	2.81
VIII	55	1,124,915	18.2	18.2	228,187	89.8	2.70
IX	60	1,225,791	16.7	16.7	255,340	80.3	2.41
X	65	1,329,964	15.4	15.4	270,860	75.7	2.27
XI	70	1,430,966	14.3	14.3	284,180	72.1	2.16
XII	74	1,517,114	13.5	13.5	293,155	69.9	2.10

2.- Size and age structure. Because mortality declines faster at the younger than the older ages, more people survive to later ages and, therefore, the size and the age distribution of the stationary populations change conspicuously from one model to the other. The combined effect of a parallel decline in the general birth- and death-rates is demonstrated in a series of population pyramids (figure 2), in which each square of shaded area represents 10.000 people. In the absence of migration, the age structure is standard for each model and the population in each quinquennial age-group equals the product of a fixed number of births (in this case 5 x 10500 for males and 5 x 10000 for females) multiplied by a survival ratio, the magnitude

5) See: Unesco.- Culture and Human Fertility, by Frank Lorimer, 1954, pp. 26-27.

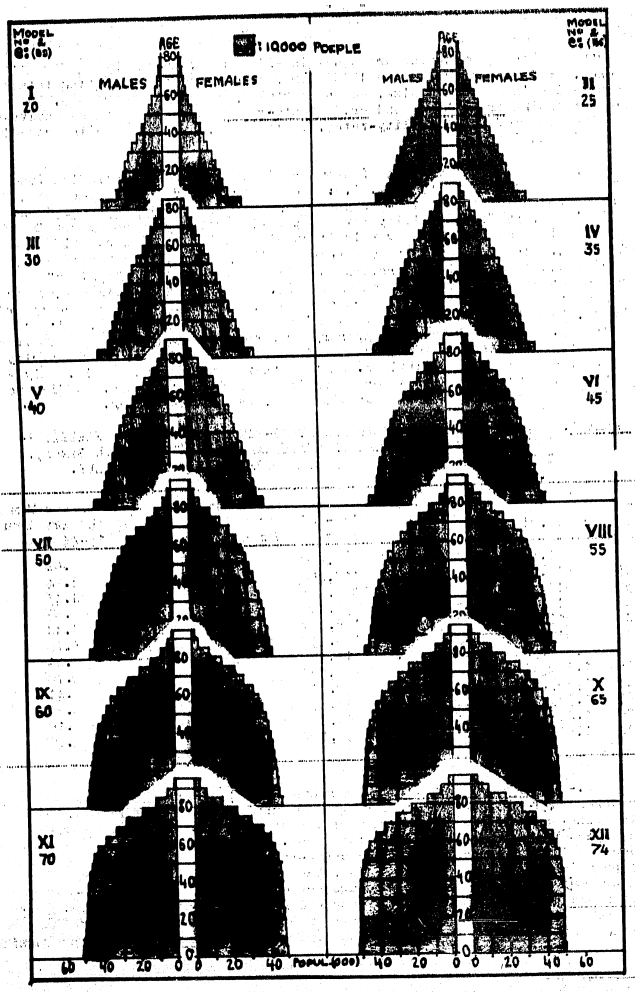

Fig. 2. The Pyramids of the Stationary Populations in the 12 Models (e8 = 20-74 yrs.)

of which is determined by the level of general mortality as well as by the age of the group. A series of such ratios is given in Appendix table E.

This characteristic is shared by actual populations which are also made up mainly of the survivors of a certain number of births annually. For the younger age groups at which the factor of migration may be taken as negligible, the survival ratios, as derived by the models, may safely be applied to actual populations. If the population in a given age group and

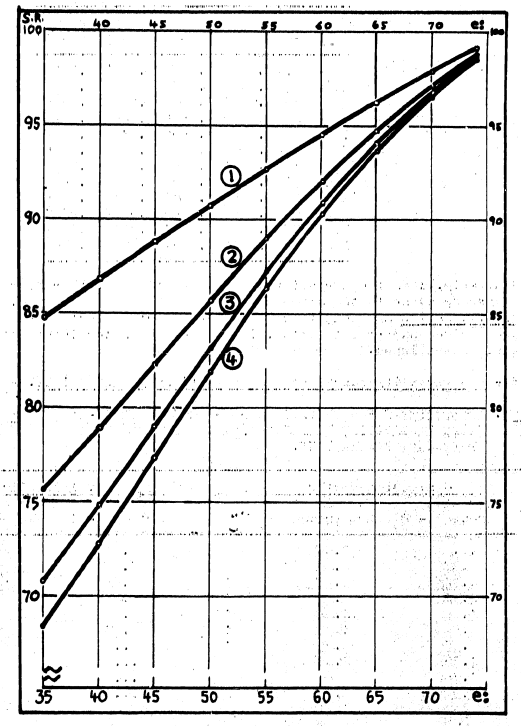

Fig. 3. Survival Ratios from Birth to the Specified Age Groups at Various Levels of Life Expectancy at Birth (both sexes). 1: under 1 year, 2: under 5 years, 3: under 10 years, 4: under 15 years.

the number of births registered during the corresponding period are known, the survival ratio that may be computed from these numbers would approximate closely the general mortality level, to which this population group was exposed.

TABLE 2. SURVIVAL RATIOS FOR THE POPULATION (Both Sexes) AT THE YOUNGER AGE GROUPS IN THE TWELVE MODELS.

Model	e_0^0	Age Groups 0 - 1	0 - 4	0 - 9	0 - 14
I	20	.7718	.6370	.5648	.5262
II	25	.8024	.6832	.6194	.5859
III	30	.8271	.7222	.6666	.6376
IV	35	.8479	.7556	.7072	.6826
V	40	.8682	.7890	.7480	.7274
VI	45	.8880	.8226	.7893	.7726
VII	50	.9071	.8565	.8316	.8187
VIII	55	.9264	.8897	.8723	.8629
IX	60	.9454	.9204	.9090	.9026
X	65	.9625	.9469	.9404	.9364
XI	70	.9786	.9704	.9672	.9652
XII	74	.9920	.9888	.9874	.9864

Similarly, when the mortality level is known from other sources, the number of births corresponding to the given population may also be derived. At later ages, the survival ratios may help to retrace the effect of past migration, or even to correct given numbers of births, if the remaining pertinent data are accurately established.

3.- The mortality functions of the stationary populations. Among the various functions which measure mortality forces in the stationary populations, those of probability of dying within an age interval ($_nq_x$) and the number of deaths within this interval ($_nd_x$), acquire special significance. As it is known, the first of these functions is closely related with the age-specific death-rate ($_nm_x$) derived from census and registration returns. When the interval is uniformly given in five-year age-groups [7] the relationship between $_5m_x$ and $_5q_x$ may be expressed by the coefficients given in Table 3. The age interval of five years is large enough to minimize random errors, but small enough not to be unduly influenced by the atypical age-structure which as a rule is found in actual populations. In the light of this relationship, actual populations may be directly converted into the stationary populations of corresponding mortality, by means of these coefficients.

TABLE 3. COEFFICIENTS FOR CONVERTING AGE-SPECIFIC DEATH-RATES ($_5m_x$) TO LIFE-TABLE PROBABILITY OF DYING ($_5q_x$). COMPUTED ON THE DATA OF THE STATIONARY POPULATIONS.

$_5m_x$	Conversion factor for age-group 1 - 4	Conversion factor for all other age groups	$_5m_x$	Conversion factor for age-group 1 - 4	Conversion factor for all other age groups
1	...	5.00	60	4.08	4.35
2	4.97	4.98	80	3.86	4.16
3	4.94	4.97	100	3.65	3.99
4	4.91	4.95	120	3.43	3.85
5	4.89	4.94	140	3.27	3.71
6	4.87	4.93	160	3.10	3.57
8	4.83	4.90	180	...	3.45
10	4.79	4.88	200	...	3.34
12	4.75	4.86	220	...	3.23
14	4.72	4.83	240	...	3.12
16	4.69	4.81	260	...	3.02
18	4.65	4.78	280	...	2.93
20	4.62	4.76	300	...	2.84
25	4.54	4.70	320	...	2.76
30	4.47	4.65	340	...	2.69
40	4.33	4.54	360	...	2.62
50	4.20	4.45	380	...	2.55

The second function i.e.: the distribution of deaths by five-year age-groups ($_5d_x$) may be used as a test of reliability of the above conversion. Since the annual numbers of births and deaths in the stationary population are equal, and the age structure is standard for each level of general mortality, the distribution of deaths, by age, is also standard for each level of mortality-fertility, assumed to mould the various models. This distribution in a life table with its radix in a multiple of ten, is in fact a percentage distribution of deaths by age, which may be accumulated from birth until the last of the survivors of the cohort dies. From this presentation the median age and the two quadrille ages, that is the ages at which 25 %, 50 % and 75 % of all deaths have occured, were derived, as shown in Table 4.

TABLE 4. AGE AT WHICH 25 %, 50 %, AND 75 % OF ALL DEATHS HAVE OCCURED IN THE 12 MODEL POPULATIONS.

Model No.	e_0^0 (B.S.)	Median and Quadrille Ages at Death in Years 25 %	50 %	75 %
I	20	0.82	6.81	38.12
II	25	0.95	15.66	47.09
III	30	1.56	25.14	55.49
IV	35	2.56	33.93	63.12
V	40	3.84	43.62	68.28
VI	45	9.00	53.10	71.76
VII	50	24.30	60.28	74.11
VIII	55	37.58	65.02	76.54
IX	60	49.56	68.52	78.50
X	65	57.86	71.82	80.57
XI	70	63.76	74.80	82.55
XII	74	67.87	77.25	84.36

These values, in turn, indicate a certain level of life expectancy at birth and the two results i.e.: the one obtained from the conversion of the age-specific death-rates and the other from the median age at death, should correspond, if the given age-specific mortality was accurately recorded.

In the stationary populations the median and the quadrille ages at death constitute a most sensitive indicator in measuring general levels of health

7) Experience has shown that a combined death-rate covering the entire group under the age of five years, yields better results than if infant and early childhood mortality are taken separately.

of the actual population, as expressed by the corresponding expectation of life at birth. Figure 4 shows diagramatically the great amplitude of this set of curves in defining the approximate life expectancy at birth from the age by which a certain percentage of deaths occurs in the stationary population. In actual populations the median and the quadrille ages at death are more or less disturbed by the effect of unbalanced fertility and migration of the past and can only be used when the population is converted into the corresponding stationary type. The various steps of this process are explained in the following chapter.

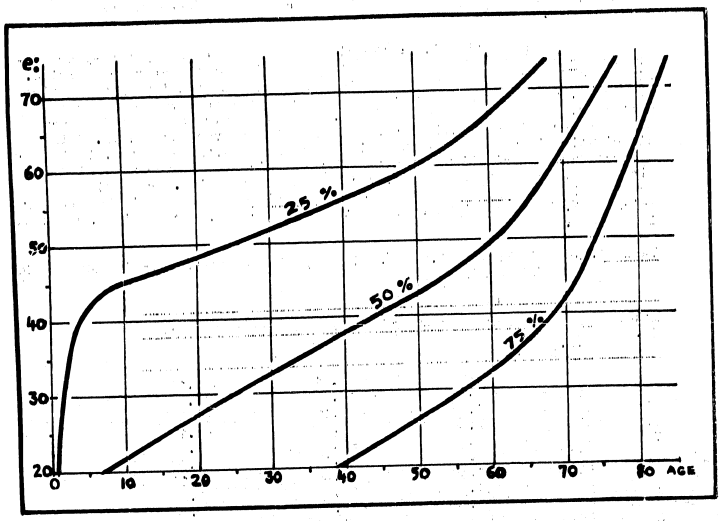

Fig. 4. Median and Quadrille Ages at Death at various levels of General Mortality.- (e_0^o, both sexes from 20 to 74 yrs.)

IV. POSSIBLE USES OF MODEL POPULATIONS.

Model populations offer a good standard, against which peculiarities in structure and dynamics of actual population may be compared and more or less assessed as to their nature and origin. They also are useful for predicting future population trends by age-sex groups. Finally, they provide an easy method for determining the approximate levels of general mortality, and by implication, levels of fertility and of population growth, on the basis of a few key population data, even if a completed set of these data is lacking.

As a first step the quinquennial age-specific death-rates are multiplied by the corresponding coefficients in order to arrive at the life-table mortality-function by age groups. [8] From this function it is easy to pass on to the next function of persons surviving at the beginning of each age-interval, out of an initial cohort of 10.000 births, [9] and to that of persons dying within each age interval. Tables D and F, in the Appendix, give the complete expectation of life and the percentage age distribution of the corresponding stationary populations. These values may be taken from the model closest to the indicated mortality level, or be further improved by interpolating the data of the two adjoining models, around the indicated life expectancy at birth.

One more step, that of equalizing the two populations, by multiplying the proportional age distribution of the stationary population by the total number of persons in the actual population, will provide a basis for comparison between the age structures of the actual versus the corresponding stationary populations. In the following example an attempt is made to apply this method on the 1950 population census of Switzerland. Collateral data as they exist for the Swiss population were freely used in this example in order to illustrate the various possibilities of the methods.

As a first step, the expectation of life at birth for the census date was approximated on the basis of the following data:

Age groups	Population (000)	Births (000)	Survival Ratio	e_0^o
Under 1 yr.	76.5	84.9	.9017	48.6
" 5 yrs.	412.2	435.3	.9468	65.0
" 10 "	814.2	839.3	.9582	68.3
" 15 "	1110.7	1158.8	.9585	68.8

Because of an obvious underenumeration of small children, the most probable life expectancy at birth, resulting from the application of the survival ratios, was found in the last line in which the population under 15 years of age and the births registered during the 15 years prior to the date of the census were compared. On the basis of this indication the corresponding stationary population was constructed as in col. 5 of table 5.

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8) For a detailed and more elaborate method of converting m_x to q_x see: L. Reed and M. Merrel, "A Short Method for Constructing an Abridged Life-Table" in the American Journal of Hygiene, Vol. 30, No. 2, September 1939.

9) If the average number of births registered during the preceding five-year period is used instead of the conventional radix, the result would correspond to a stationary population which could be constructed on the basis of the current number of births at the observed mortality level.

TABLE 5.- APPLICATION OF THE METHOD TO THE 1950 CENSUS POPULATION OF SWITZERLAND FOR AGE GROUPS UNDER FORTY.

Age Group	Correspond. Period	Census Popul. (000)	Regist. Births (000)	Station. Popul. (000)	Mid-period Estimates for T. Popul. (000)	Life Expect.	Surviv. Ratios	Expect. Births (000)	Expect. Popul. (000)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
0 - 4	1946-50	412.2	435.3	331.7	4573	67.6	.9591	338.4	417.5
5 - 9	1941-45	392.0	403.9	328.7	4338	65.4	.9362	331.8	378.1
10 - 14	1936-40	306.5	319.6	327.5	4210	63.6	.9176	330.5	293.3
15 - 19	1931-35	327.8	338.6	326.3	4122	61.9	.8963	332.8	303.5
20 - 24	1926-30	349.8	350.6	323.9	3998	59.9	.8659	333.8	303.6
25 - 29	1921-25	357.7	380.2	321.2	3911	57.3	.8209	341.2	312.1
30 - 34	1916-20	319.0	370.8	318.0	3860	55.0	.7737	351.3	286.9
35 - 39	1911-15	345.4	439.1	314.6	3796	53.2	.7262	356.8	318.9

Note: Relevant data refer to age-groups or past quinquennial periods starting from the date of cencus. (1 Dec. 1950)

Col. 5. - Stationary population for the census date computed on the indicated e_0^o = 68.8.

" 6. - Total population based on the data of past censuses and official estimates.

" 7. - Life expectancy at birth both sexes, interpolated from series of official life tables.

" 8. - Survival ratios corresponding to the data of col. 7.

" 9. - Births expected at the stationary level, derived from the life table birth-rate (the reciprocal of figures in col. 7) and the mid-period total population (col. 6).

" 10. - Population expected in each age group on the basis of registered births (col. 4) and the survival ratios (col. 8).

If no other information had been available for this population, comparisons would have been restricted between the age structure of the actual and the stationary populations. However, in this case, collateral data provide a series of estimates on total population (col. 6) and on life expectancy at birth (col. 7) for the entire period under review. With this information the survival ratios (col. 8) appear to reflect more faithfully the actual trends in population growth and in mortality improvements during this period. On this basis the number of births expected to occur at the stationary level were computed as in col. 9. Similarly, the number of persons which would have survived at the various age groups out of the number of births registered in the corresponding periods were found to be as in col. 10.

This illustration is given only as an example of application of the method without much claim of accuracy in the final results. A more comprehensive scrutiny of the original data would have been necessary if the results were to be taken as final answers. However, some tentative conclusions may still be reached from this application, as follows:

(a) The expectation of life at birth for the population of Switzerland (both sexes) at the census date of 1950 appears to be in the neighbourhood of 69 years. (The last official life table for the period 1939-44 gave 62.7 years for males and 67.0 years for females.) An abridged life table for that date may be reconstructed by means of the Appendix tables of this report.

(b) The trend of mortality improvements over this period, which in this example was taken from the series of existing life tables, could also have been approximately derived from the quotients between the census population by age groups and the corresponding number of registered births.

(c) Fertility appears to have followed an undulating trend. Measured from the numbers required at the stationary level, actual births were in excess by over 20 % at the period of 1911-15, but diminished in numbers during the first World War. After a temporary revival at the end of the war, births followed a steep downward trend, reaching a point below replacement in the period just before World War II; the number of births increased again at an accelerated rate during the decade prior to the last census.

(d) With the exception of the first quinquennial age groups, the enumerated population in all other age groups was greater than that expected to survive on the basis of the registered births and the mortality conditions assumed. This excess would indicate a positive net migration if all factors involved in these computations were absolutely accurate. However, in view of some apparent weaknesses in the original data and the graduations used in the development of this example the results obtained should be treated as indicative of trends rather than as quantitative answers.

In theory, the method is sound but since its findings are developed on the basis of a few population data, these data should possess the maximum accuracy possible. To this end, the use of sampling methods or other special surveys in order to strengthen the precision of existing data or, in their absence, to procure the necessary basic figures, are particularly recommended.

Once these key population data are secured and their exactness well established, the model populations offer a short cut method to arrive at results which under normal circumstances would have necessitated a far greater number of factual data and considerably more time and labour. For example, the exact knowledge of the number of live births and of infant deaths in a population during a normal calendar year, provides already a good basis for roughly estimating the life expectancy at birth for the total population. If this information is extended to cover the population in the age group under five years and the number of births which occurred during the five preceding

years, the corresponding life-table may be based on a more secure ground. Finally, when the entire age structure of the population is known, together with the number of births which occurred in the recent past, a good insight of the population's life history may be obtained, with approximate but reasonably good estimates of past levels of mortality as well as implications about past trends of fertility, migration and of the rate of population growth in general.

Résumé

LA COMPARAISON DES POPULATIONS REELLES AVEC LES POPULATIONS STATIONNAIRES

La présente étude offre une série de douze "populations modèles" du type stationnaire, correspondant aux principaux niveaux de la mortalité, l'espérance de vie à la naissance variant de 20 à 74 ans. Les caractéristiques de ces modèles sont analysées et des méthodes sont indiquées pour passer rapidement d'une population réelle à la population stationnaire correspondant à son niveau de mortalité.

En utilisant une série de "coefficients", on peut, à partir des taux de mortalité par âge, calculer très simplement par groupes de cinq ans les probabilités de décès classiques des tables de mortalité. De même au moyen d'une série de "taux de survie" reliant la population d'un groupe d'âges au nombre de naissances dont cette population est issue, on peut établir une relation directe entre le nombre des naissances et la structure par âge (et par sexe) de la population. De telles comparaisons donnent des renseignements à la fois sur l'évolution passée de la mortalité et de la fécondité et, indirectement, sur les migrations passées et plus généralement sur le taux d'accroissement de la population.

Les "modèles" considérés ici ont été conçus pour donner des résultats utiles mêmes en l'absence d'une série complète de chiffres sur la structure de la population et l'enregistrement des statistiques démographiques. Avec seulement quelques chiffres fondamentaux, cette méthode fournit un moyen rapide d'obtenir des résultats qui normalement auraient exigé des statistiques beaucoup plus nombreuses et aussi beaucoup plus de temps et de travail. Toutefois, et c'est là une condition essentielle de succès, il est très important que les données servant de base aux calculs possèdent le maximum de précision possible.

TABLE B. NUMBER OF PERSONS DYING WITHIN THE SPECIFIED AGE INTERVAL OUT OF 10,000 BORN ALIVE, EXPRESSED AS PERCENT TO ALL DEATHS ACCUMULATED FROM BIRTH TO THE INDICATED AGE GROUP, AT VARIOUS LEVELS OF GENERAL MORTALITY.

Model Lev.	e^0	Sex	Under 1	1 – 4	5 – 9	10 – 14	15 – 19	20 – 24	25 – 29	30 – 34	35 – 39	40 – 44	45 – 49	50 – 54	55 – 59	60 – 64	65 – 69	70 – 74	75 – 79	80 – 84	85 – 89	90 – 94	95 – 99	100 +
I	20.0	BS	30.42	48.05	53.43	56.74	61.23	64.23	68.31	72.42	76.56	80.70	84.74	88.53	91.96	94.87	97.16	98.73	99.59	99.92	99.99	100.00		
	20.1	M	31.20	48.27	53.73	56.83	60.02	63.62	67.44	71.44	75.55	79.73	83.91	87.90	91.58	94.73	97.19	98.82	99.66	99.95	100.00			
	19.9	F	29.60	47.62	53.12	56.64	60.45	64.88	69.23	73.44	77.61	81.71	85.61	89.18	92.35	95.00	97.13	98.64	99.52	99.89	99.99	100.00		
II	25.0	BS	26.35	42.18	46.67	49.57	52.84	56.62	60.58	64.68	68.89	73.19	77.51	81.84	86.00	89.95	93.52	96.51	98.54	99.59	99.94	100.00		
	24.7	M	27.40	43.21	47.43	50.17	53.20	56.05	60.42	64.42	68.61	72.97	77.43	81.94	86.33	90.30	94.15	97.09	98.93	99.77	99.98	100.00		
	25.3	F	25.25	41.32	45.88	48.96	52.46	56.59	60.74	64.94	69.17	73.41	77.58	81.72	85.65	89.37	92.87	95.91	98.14	99.41	99.90	100.00		
III	30.0	BS	23.05	37.64	40.77	43.27	46.34	49.89	53.66	57.58	61.66	65.85	70.14	74.55	79.10	83.87	88.70	93.28	96.84	98.97	99.82	99.99	100.00	
	29.4	M	24.67	37.89	41.57	43.96	46.82	50.12	53.79	57.69	61.78	66.04	70.46	75.12	79.98	85.02	89.96	94.44	97.64	99.37	99.93	100.00		
	30.6	F	21.99	36.16	39.95	42.58	45.85	49.66	53.53	57.18	61.54	65.66	69.80	73.96	78.18	82.65	87.37	92.05	95.99	98.55	99.71	99.99	100.00	
IV	35.0	BS	24.22	32.56	35.59	37.66	40.42	43.05	47.13	50.78	54.54	58.44	62.50	66.84	71.60	77.04	83.12	89.27	94.56	98.09	99.62	99.98	100.00	
	34.2	M	21.25	33.42	36.40	38.37	41.00	44.45	47.47	51.12	54.91	58.90	63.15	67.79	72.93	78.77	84.99	91.08	95.89	98.76	99.82	100.00		
	35.8	F	19.25	31.75	34.83	36.59	39.89	42.31	46.54	50.49	54.21	58.01	61.87	65.89	70.25	75.25	81.17	87.38	93.16	97.39	99.41	99.96	100.00	
V	40.0	BS	17.57	28.65	30.53	32.23	34.64	37.57	40.72	43.59	47.41	50.99	54.87	59.23	64.24	70.28	77.47	85.20	92.12	96.98	99.34	99.96	100.00	
	38.9	M	18.57	28.91	31.35	33.00	35.32	38.13	41.26	44.54	48.01	51.72	55.83	60.55	66.03	72.47	79.79	87.51	93.92	97.94	99.66	99.99	100.00	
	41.0	F	16.53	27.17	29.68	31.44	33.95	37.01	40.18	43.45	46.81	50.25	53.88	57.86	62.37	67.98	75.02	82.76	90.22	95.96	99.01	99.93	100.00	
VI	45.0	BS	14.93	23.39	25.40	26.79	28.90	31.55	34.33	37.20	40.24	43.55	47.29	51.66	56.99	63.61	71.76	80.95	89.53	95.80	99.02	99.93	100.00	
	43.5	M	15.93	24.36	26.33	27.69	29.75	32.34	35.11	37.99	41.08	44.53	48.53	53.30	59.13	66.18	74.47	83.56	91.00	96.96	99.41	99.98	100.00	
	46.2	F	13.87	22.39	24.42	25.84	28.00	30.71	33.50	36.37	39.59	42.50	45.96	49.92	54.72	60.89	68.91	78.21	87.36	94.59	98.62	99.88	100.00	
VII	50.0	BS	12.37	18.53	20.11	21.25	23.03	25.32	27.76	30.32	33.06	36.15	39.72	44.08	49.60	56.78	65.86	76.46	86.72	94.42	98.60	99.89	100.00	
	48.5	M	13.40	19.58	21.16	22.30	24.06	26.35	28.78	31.35	34.15	37.38	41.24	46.01	52.06	59.70	68.93	79.40	88.96	95.72	99.05	99.96	100.00	
	51.5	F	11.32	17.46	19.04	20.18	21.98	24.29	26.74	29.30	31.98	34.90	38.17	42.10	47.06	53.75	62.68	73.39	84.38	93.06	98.14	99.81	100.00	
VIII	55.0	BS	9.41	13.90	15.12	16.04	17.53	19.43	21.53	23.74	26.18	28.99	32.39	36.70	42.37	49.95	59.69	71.37	83.16	92.59	98.00	99.81	100.00	
	53.4	M	10.74	14.96	16.16	17.10	18.66	20.53	22.63	24.85	27.37	30.35	34.06	38.81	45.05	53.12	63.46	74.62	85.76	94.15	98.53	99.91	100.00	
	56.6	F	8.83	12.83	14.02	14.91	16.37	18.24	20.35	22.54	24.90	27.54	30.62	34.48	39.56	46.63	56.18	67.97	80.43	90.94	97.44	99.70	100.00	
IX	60.0	BS	7.27	9.77	10.67	11.36	12.52	14.06	15.72	17.52	19.59	22.10	25.28	29.48	35.14	42.88	52.98	65.60	79.04	90.38	97.13	99.66	100.00	
	58.2	M	8.05	10.46	11.61	12.34	13.54	15.15	16.81	18.62	20.76	23.47	26.97	31.64	37.90	46.20	56.64	69.17	81.96	92.13	97.79	99.80	100.00	
	61.7	F	6.46	8.87	9.73	10.37	11.49	12.95	14.60	16.38	18.37	20.69	23.53	27.24	32.25	39.40	49.16	61.87	75.98	88.54	96.44	99.50	100.00	
X	65.0	BS	5.46	6.32	6.92	7.39	8.18	9.25	10.43	11.73	13.29	15.31	18.07	21.93	27.30	34.88	45.16	58.49	73.45	87.01	95.84	99.40	99.99	100.00
	63.2	M	5.56	6.96	7.60	8.12	8.99	10.14	11.37	12.70	14.33	16.53	19.60	23.96	30.03	38.43	49.39	62.70	76.95	89.24	96.72	99.61	100.00	
	66.7	F	4.42	5.65	6.20	6.61	7.31	8.31	9.44	10.70	12.20	14.03	16.46	19.80	24.44	31.17	40.74	54.07	69.78	84.68	94.93	99.17	99.98	100.00
XI	70.0	BS	2.85	3.43	3.74	4.02	4.50	5.15	5.86	6.69	7.72	9.15	11.31	14.61	19.51	26.70	36.95	50.63	66.89	82.80	94.03	98.96	99.96	100.00
	68.2	M	3.20	3.83	4.18	4.50	5.09	5.86	6.68	7.58	8.69	10.25	12.67	16.45	22.11	30.27	41.90	55.48	71.15	85.60	95.20	99.27	99.98	100.00
	71.7	F	2.45	3.03	3.30	3.54	3.91	4.43	5.02	5.78	6.72	8.02	9.91	12.71	16.80	22.97	32.18	45.55	62.43	79.86	92.79	98.64	99.94	100.00
XII	74.0	BS	1.06	1.33	1.49	1.63	1.88	2.24	2.65	3.12	3.73	4.67	6.21	8.80	12.99	19.48	29.08	42.41	59.27	77.31	91.24	98.13	99.89	100.00
	72.3	M	1.21	1.51	1.69	1.86	2.19	2.68	3.20	3.75	4.42	5.47	7.22	10.25	15.19	22.85	33.92	48.33	65.07	81.56	93.36	98.74	99.95	100.00
	75.7	F	.94	1.14	1.27	1.39	1.56	1.81	2.12	2.50	3.05	3.91	5.26	7.42	10.88	16.24	24.42	36.74	53.62	73.45	89.43	97.67	99.84	100.00

TABLE C. PROBABILITY OF DYING WITHIN THE SPECIFIED AGE INTERVAL OUT OF 1000 PERSONS ALIVE AT THE BEGINNING OF THE INTERVAL, AT VARIOUS LEVELS OF GENERAL MORTALITY.

Model No.	e^0	Sex	0	1-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99
I	20.0	BS	304.2	253.4	103.5	71.0	80.7	110.7	114.0	129.6	150.1	176.7	209.3	248.1	289.9	361.4	447.3	553.3	677.0	810.0	937.5		
	20.1	M	312.0	251.0	102.0	67.0	74.0	90.0	105.0	123.0	144.0	171.0	206.0	248.0	304.0	374.0	467.0	581.0	714.0	856.0	1000.0		
	19.9	F	296.0	256.0	105.0	75.0	88.0	112.0	124.0	137.0	157.0	183.0	213.0	248.0	293.0	347.0	425.0	526.0	645.0	772.0	928.0		
II	25.0	BS	263.5	215.0	77.6	54.3	64.8	80.2	91.2	103.9	119.2	138.1	161.0	192.5	229.3	282.1	355.6	461.6	583.0	721.5	855.4	1000.0	
	24.7	M	274.0	213.0	77.5	52.2	60.8	73.7	87.0	101.1	117.7	138.8	165.0	200.0	243.0	305.0	384.0	502.0	634.0	784.0	925.0	1000.0	
	25.3	F	252.5	215.0	77.7	56.5	68.9	86.9	95.7	106.9	120.8	137.6	156.9	184.7	215.0	259.0	329.0	426.0	515.0	685.0	834.0	980.0	
III	30.0	BS	230.5	181.8	59.3	42.2	54.2	66.1	75.2	84.6	96.1	109.3	125.5	147.8	178.8	228.0	299.7	445.0	530.0	674.4	824.6	973.0	
	29.4	M	240.7	182.0	59.2	40.6	51.4	62.0	73.6	84.3	96.7	111.4	130.3	157.8	195.4	252.0	330.0	446.0	576.0	731.0	883.0	1000.0	
	30.6	F	215.9	181.6	59.4	43.8	57.0	70.3	76.9	84.9	95.4	107.2	120.7	137.8	162.0	204.7	272.0	371.0	496.0	638.0	795.0	952.0	
IV	35.0	BS	202.2	154.7	44.9	32.1	44.3	54.2	61.8	69.1	76.4	85.8	97.8	115.7	143.9	191.4	264.7	364.4	493.0	649.3	800.5	949.0	
	34.2	M	212.5	154.6	44.8	31.0	42.6	51.7	61.2	69.4	77.5	88.5	103.5	125.8	159.7	215.8	293.0	406.0	539.0	699.0	857.0	987.0	
	35.8	F	192.5	154.8	45.1	33.2	46.0	56.9	62.2	68.6	75.1	83.0	91.9	105.5	127.8	166.2	239.0	330.0	458.0	618.0	774.0	937.0	
V	40.0	BS	175.7	127.2	34.4	24.5	35.6	44.9	50.5	55.2	61.1	68.0	79.1	96.4	122.8	168.8	241.8	342.9	467.5	613.3	782.2	940.0	
	38.9	M	185.7	127.0	34.3	24.0	34.7	43.5	50.6	55.8	62.6	71.6	85.2	106.9	138.8	189.6	266.0	382.0	513.0	662.0	834.0	973.0	
	41.0	F	165.3	127.5	34.4	25.1	36.6	46.4	50.4	54.6	59.5	64.7	73.0	86.4	107.1	145.0	220.0	310.0	433.0	587.0	738.0	927.0	
VI	45.0	BS	149.3	99.5	26.2	18.6	28.8	37.3	40.6	43.7	48.4	55.3	66.2	83.0	110.2	253.9	224.1	325.4	450.6	599.2	767.4	930.0	
	43.5	M	159.3	100.0	26.3	18.5	28.5	36.9	41.0	44.4	49.9	58.6	72.2	92.7	124.8	172.4	245.0	356.0	489.0	638.0	807.0	962.0	
	46.2	F	136.7	98.9	26.1	18.8	29.1	37.6	40.2	43.2	46.9	51.9	60.2	73.3	95.8	136.2	205.0	299.0	420.0	572.0	744.0	924.0	
VII	50.0	BS	123.7	70.3	19.4	14.3	22.5	29.8	32.7	35.5	39.3	46.1	55.9	72.4	98.8	142.4	220.2	310.4	435.9	579.6	750.0	928.0	
	48.5	M	136.0	71.3	19.7	14.5	22.6	30.1	33.0	36.1	40.8	49.1	61.6	81.2	112.1	159.3	229.0	337.0	464.0	612.0	777.0	956.0	
	51.5	F	113.2	69.2	19.2	14.1	22.5	29.6	32.3	35.0	37.9	42.9	50.2	63.5	85.6	126.4	193.0	287.0	413.0	556.0	732.0	900.0	
VIII	55.0	BS	98.1	45.3	14.2	10.8	17.7	23.1	26.1	28.1	32.0	38.1	47.9	63.8	89.6	131.5	194.7	289.7	411.7	559.7	729.6	908.0	
	53.4	M	107.4	46.6	14.8	11.2	18.1	23.7	26.4	28.7	33.6	41.1	53.3	72.0	101.9	146.9	212.0	313.0	439.0	589.0	748.0	938.0	
	56.6	F	88.3	43.9	13.7	10.4	17.2	22.5	25.8	27.5	30.5	35.2	42.5	55.6	77.6	116.9	179.0	269.0	389.0	537.0	717.0	882.0	
IX	60.0	BS	72.7	27.0	10.0	7.7	13.1	17.6	19.3	21.2	25.1	31.2	40.8	56.2	80.2	119.3	176.9	268.4	392.6	541.0	708.8	880.0	
	58.2	M	80.5	28.3	10.7	8.3	13.7	18.6	19.6	21.8	26.5	34.0	45.7	63.9	91.6	133.7	196.0	289.0	415.0	564.0	729.0	909.0	
	61.7	F	64.6	25.8	9.4	7.1	12.5	16.5	19.0	20.9	23.8	28.4	35.8	48.5	68.8	105.6	162.0	250.0	370.0	523.0	689.0	859.0	
X	65.0	BS	50.0	13.9	6.4	5.0	8.5	11.7	13.0	14.5	17.7	23.3	32.6	47.1	68.8	104.3	157.9	243.0	360.4	510.8	679.8	865.0	980.0
	63.2	M	55.6	14.8	6.9	5.6	9.5	12.6	13.7	15.0	18.7	25.7	36.7	54.2	79.8	120.0	178.0	263.0	382.0	533.0	[illegible]	880.0	990.0
	66.7	F	44.2	12.9	5.8	4.4	7.5	10.8	12.3	13.9	16.8	20.8	28.3	40.0	57.8	89.1	139.0	225.0	342.0	493.0	[illegible]	837.0	976.0
XI	70.0	BS	28.5	6.0	3.2	2.9	5.0	6.8	7.5	8.8	11.0	15.5	23.8	37.2	57.4	89.3	139.8	217.0	329.4	480.5	652.8	825.0	964.0
	68.2	M	32.0	6.5	3.6	3.3	6.2	8.1	8.7	9.6	12.0	17.1	27.0	43.3	67.8	104.8	161.0	239.0	352.0	503.0	689.0	867.0	973.0
	71.7	F	24.9	5.5	2.8	2.5	3.4	5.4	6.2	8.0	10.0	13.9	20.5	31.1	46.9	74.2	119.5	197.2	310.0	464.0	612.0	812.0	954.0
XII	74.0	BS	10.6	2.6	1.6	1.4	2.5	3.7	4.2	4.8	6.3	9.8	16.2	27.6	45.9	74.6	119.2	187.9	292.8	442.9	633.8	787.0	940.0
	72.3	M	12.1	3.0	1.8	1.7	3.4	5.0	5.4	5.7	7.0	11.0	18.5	32.7	55.0	90.3	143.5	218.0	324.0	472.0	660.0	880.0	960.0
	75.7	F	9.2	2.2	1.3	1.2	1.7	2.5	3.2	3.9	5.6	8.9	14.1	22.8	37.4	60.1	97.7	163.0	270.0	425.0	602.0	780.0	930.0

TABLE D. COMPLETE EXPECTATION OF LIFE IN YEARS, AT EXACT AGE, AS SPECIFIED, BY SEX, AT VARIOUS LEVELS OF GENERAL MORTALITY

Model No.	e^{o}_{0}	Sex	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
	20.0	BS	20.1	27.7	32.5	31.0	28.2	25.4	23.0	20.6	18.3	16.1	14.0	12.1	10.3	8.6	7.0	5.6	4.4	3.5	2.8	2.5
I	20.1	M	20.3	28.5	33.3	31.8	29.0	26.1	23.4	20.8	18.4	16.1	13.9	11.9	10.0	8.2	6.7	5.3	4.2	3.2	2.6	2.4
	19.9	F	19.8	27.0	31.7	30.1	27.3	24.7	22.5	20.4	18.2	16.1	14.2	12.3	10.6	8.9	7.3	5.9	4.7	3.8	2.9	2.5
	25.0	BS	25.0	32.9	37.4	35.3	32.2	29.3	26.6	24.0	21.5	19.1	16.8	14.5	12.4	10.3	8.4	6.7	5.2	4.1	3.2	2.5
II	24.7	M	24.8	33.1	37.6	35.6	32.4	29.3	26.4	23.7	21.1	18.6	16.2	13.9	11.7	9.7	7.8	6.1	4.7	3.7	2.9	2.4
	25.3	F	25.3	32.8	37.2	35.1	32.1	29.3	26.8	24.4	22.0	19.7	17.4	15.2	13.1	11.0	9.0	7.2	5.6	4.4	3.3	2.5
	30.0	BS	30.0	37.9	41.9	39.4	36.0	32.9	30.0	27.3	24.6	21.9	19.3	16.7	14.2	11.7	9.4	7.4	5.7	4.4	3.4	2.6
III	29.4	M	29.4	37.7	41.7	39.1	35.7	32.5	29.4	26.6	23.8	21.1	18.4	15.8	13.3	10.9	8.7	6.8	5.3	4.0	3.1	2.5
	30.6	F	30.5	38.1	42.1	39.6	36.3	33.3	[illegible]	28.0	25.4	22.8	20.2	17.7	15.1	12.5	10.1	7.9	6.1	4.7	3.5	2.7
	35.0	BS	34.9	42.7	46.2	43.2	39.6	36.3	33.2	30.3	27.3	24.4	21.4	18.5	15.6	12.8	10.2	8.0	6.1	4.6	3.5	2.6
IV	34.2	M	34.2	42.3	45.6	42.7	39.0	35.4	32.4	29.3	26.3	23.3	20.3	17.4	14.6	11.9	9.4	7.3	5.6	4.2	3.2	2.5
	35.8	F	35.7	43.2	46.7	43.8	40.2	37.1	34.1	31.2	28.4	25.5	22.5	19.6	16.6	13.6	10.9	8.5	6.5	4.9	3.7	2.7
	40.0	BS	39.9	47.3	49.9	46.6	42.7	39.2	35.9	32.7	29.5	26.2	22.9	19.7	16.5	13.5	10.7	8.4	6.4	4.9	3.6	2.7
V	38.9	M	38.8	46.6	49.1	45.8	41.9	38.3	34.9	31.6	28.3	25.1	21.8	18.6	15.5	12.6	10.0	7.7	5.9	4.5	3.4	2.6
	41.0	F	40.9	48.0	50.7	47.4	43.6	40.1	37.0	33.8	30.6	27.4	24.1	20.8	17.5	14.3	11.4	8.9	6.8	5.1	3.8	2.8
	45.0	BS	44.8	51.6	53.1	49.5	45.4	41.6	38.2	34.7	31.1	27.6	24.1	20.6	17.2	14.1	11.2	8.6	6.6	5.0	3.7	2.8
VI	43.7	M	43.6	50.8	52.2	48.5	44.4	40.6	37.1	33.6	30.0	26.5	23.0	19.5	16.3	13.3	10.5	8.1	6.2	4.7	3.5	2.7
	46.2	F	46.1	52.5	54.1	50.4	46.4	42.7	39.2	35.8	32.3	28.7	25.2	21.6	18.2	14.8	11.8	9.1	7.0	5.2	3.9	2.9
	50.0	BS	49.9	55.9	55.9	52.0	47.7	43.8	40.0	36.3	32.5	28.8	25.0	21.4	17.9	14.5	11.5	8.9	6.8	5.2	3.8	2.9
VII	48.5	M	[illegible]	54.9	54.9	51.0	46.7	42.7	39.0	35.2	31.4	27.7	24.0	20.4	17.0	13.8	10.9	8.4	6.5	4.9	3.6	2.8
	51.5	F	51.4	56.9	57.0	53.0	48.7	44.8	41.1	37.4	33.7	29.9	26.1	22.4	18.7	15.2	12.1	9.4	7.1	5.4	4.0	3.0
	55.0	BS	54.9	59.8	58.6	54.4	49.9	45.8	41.8	37.9	33.9	29.9	26.0	22.2	18.5	15.1	12.0	9.3	7.1	5.3	4.0	3.0
VIII	53.4	M	53.3	58.7	57.5	53.3	48.9	44.7	40.7	36.8	32.8	28.8	25.0	21.2	17.7	14.4	11.5	8.9	6.8	5.1	3.8	2.9
	56.6	F	56.5	61.0	59.7	55.5	51.0	46.9	42.9	39.0	35.0	31.0	27.1	23.2	19.4	15.8	12.6	9.7	7.4	5.5	4.1	3.1
	60.0	BS	59.8	63.5	61.2	56.8	52.2	47.9	43.7	39.5	35.3	31.1	27.1	23.1	19.3	15.8	12.6	9.7	7.4	5.6	4.2	3.1
IX	58.2	M	58.2	62.2	60.0	55.6	51.1	46.7	42.6	38.4	34.2	30.0	26.0	22.1	18.5	15.1	12.0	9.3	7.1	5.4	4.0	3.0
	61.7	F	61.5	64.7	62.4	58.0	53.4	49.0	44.8	40.6	36.4	32.2	28.1	24.1	20.1	16.5	13.1	10.1	7.7	5.7	4.3	3.2
	65.0	BS	64.9	67.3	64.2	59.6	54.9	50.3	45.9	41.5	37.0	32.7	28.4	24.2	20.3	16.6	13.3	10.3	7.8	5.8	4.3	3.2
X	63.2	M	63.2	65.9	62.9	58.3	53.6	49.1	44.7	40.3	35.9	31.5	27.3	23.2	19.4	15.9	12.7	9.9	7.5	5.6	4.2	3.1
	66.7	F	66.6	68.7	65.6	60.9	56.2	51.6	47.1	42.7	38.2	33.9	29.5	25.3	21.3	17.4	13.9	10.7	8.1	6.0	4.4	3.3
	70.0	BS	69.8	70.8	67.3	62.5	57.6	52.9	48.3	43.6	39.0	34.4	29.9	25.6	21.5	17.6	14.1	11.0	8.3	6.2	4.5	3.4
XI	68.2	M	68.1	69.4	65.8	61.0	56.2	51.6	47.0	42.3	37.7	33.2	28.7	24.4	20.4	16.7	13.4	10.5	8.0	6.0	4.4	3.3
	71.7	F	71.6	72.3	68.8	64.0	59.1	54.3	49.6	44.9	40.3	35.6	31.1	26.7	22.5	18.5	14.7	11.4	8.6	6.3	4.6	3.5
	74.0	BS	74.0	73.8	70.0	65.1	60.2	55.3	50.5	45.7	40.9	36.2	31.5	27.0	22.7	18.7	15.0	11.7	8.9	6.5	4.8	3.5
XII	72.3	M	72.3	72.2	68.4	63.5	58.6	53.8	49.1	44.3	39.6	34.8	30.2	25.7	21.5	17.6	14.1	11.0	8.4	6.3	4.6	3.4
	75.7	F	75.8	75.5	71.6	66.7	61.8	56.9	52.1	47.2	42.4	37.6	32.9	28.4	24.0	19.8	15.9	12.4	8.3	6.8	5.0	3.6

TABLE E. SURVIVAL RATIOS FROM BIRTH TO THE SPECIFIED AGE GROUPS AT VARIOUS LEVELS OF GENERAL MORTALITY.

Model No.	e^{o}_{0}	Sex	0 – 4	5 – 9	10 – 14	15 – 19	20 – 24	25 – 29	30 – 34	35 – 39	40 – 44	45 – 49	50 – 54	55 – 59	60 – 64	65 – 69	70 – 74	75 – 79	80 – 84	85 – 89	90 +
	20.0	BS	.6370	.4926	.4492	.4152	.3777	.3373	.2963	.2551	.2137	.1728	.1336	.0976	.0659	.0399	.0205	.0086	.0024	.0004	.0000
I	20.1	M	.6311	.4890	.4472	.4138	.3808	.3447	.3056	.2649	.2235	.1817	.1409	.1026	.0686	.0404	.0199	.0076	.0019	.0002	.0000
	19.9	F	.6431	.4963	.4512	.4165	.3733	.3296	.2866	.2447	.2034	.1634	.1260	.0923	.0632	.0393	.0211	.0092	.0029	.0006	.0000
	25.0	BS	.6832	.5557	.5188	.4879	.4527	.4140	.3786	.3322	.2897	.2466	.2034	.1609	.1203	.0826	.0498	.0247	.0093	.0023	.0003
II	24.7	M	.6741	.5478	.5120	.4831	.4508	.4147	.3798	.3348	.2921	.2481	.2032	.1587	.1159	.0768	.0438	.0199	.0065	.0012	.0000
	25.3	F	.6926	.5640	.5259	.4930	.4547	.4133	.3716	.3294	.2872	.2450	.2035	.1631	.1249	.0888	.0561	.0297	.0122	.0034	[illegible]
	30.0	BS	.7222	.6109	.5797	.5519	.5188	.4822	.4438	.4038	.3625	.3201	.2766	.2317	.1851	.1371	.0901	.0494	.0209	.0060	[illegible]
III	29.4	M	.7133	.6028	.5725	.5462	.5153	.4805	.4427	.4028	.3610	.3176	.2721	.2245	.1749	.1250	.0779	.0395	.0149	.0035	[illegible]
	30.6	F	.7316	.6194	.5873	.5578	.5224	.4840	.4449	.4049	.3640	.3227	.2812	.2393	.1958	.1499	.1029	.0598	.0273	.0087	[illegible]
	35.0	BS	.7556	.6588	.6333	.6092	.5793	.5457	.5101	.4731	.4348	.3990	.3530	.3075	.2566	.1990	.1379	.0808	.0367	.0114	[illegible]
IV	34.2	M	.7470	.6509	.6261	.6031	.5748	.5424	.5070	.4698	.4309	.3897	.3652	.2963	.2414	.1811	.1296	.0651	.0287	.0072	[illegible]
	35.8	F	.7666	.6671	.6409	.6156	.5840	.5492	.5133	.4765	.4389	.4006	.3612	.3193	.2725	.2179	.1572	.0973	.0472	.0160	[illegible]
	40.0	BS	.7890	.7070	.6861	.6685	.6388	.6084	.5763	.5428	.5078	.4706	.4294	.3825	.3273	.2612	.1867	.1136	.0545	.0184	[illegible]
V	38.9	M	.7801	.6987	.6782	.6586	.6327	.6030	.5709	.5372	.5013	.4622	.4180	.3670	.3074	.2386	.1634	.0928	.0407	.0120	[illegible]
	41.0	F	.7983	.7157	.6944	.6730	.6452	.6140	.5818	.5457	.5147	.4793	.4413	.3988	.3482	.2850	.2111	.1351	.0691	.0251	[illegible]
	45.0	BS	.8226	.7560	.7390	.7216	.6978	.6704	.6424	.6128	.5811	.5459	.5053	.4568	.3971	.3232	.2365	.1476	.0733	.0258	[illegible]
VI	43.5	M	.8133	.7466	.7298	.7128	.6895	.6627	.6345	.6046	.5719	.5347	.4908	.4378	.3734	.2548	.2099	.1242	.0572	.0181	[illegible]
	46.2	F	.8325	.7659	.7487	[illegible]	.7064	.6789	.6506	.6214	.5907	.5577	.5206	.4768	.4219	.3510	.2644	.1721	.0902	.0339	[illegible]
	50.0	BS	.8565	.8067	.7931	.7785	.7581	.7344	.7096	.6829	.6537	.6205	.5808	.5314	.4699	.3866	.2883	[illegible]	.0943	.0349	[illegible]
VII	48.5	M	.8468	.7964	.7828	.7683	.7481	.7265	.6995	.6727	.6425	.6070	.5638	.5097	.4412	.3549	.2584	.1582	.0766	.0262	[illegible]
	51.5	F	.8667	.8175	.8039	.7892	.7686	.7448	.7198	.6936	.6656	.6346	.5986	.5542	.4959	.4178	.3196	.2111	.1128	.0440	[illegible]
	55.0	BS	.8897	.8549	.8442	.8322	.8153	.7953	.7737	.7505	.7242	.6932	.6545	.6046	.5363	.4517	.3446	.2273	.1213	.0471	[illegible]
VIII	53.4	M	.8805	.8447	.8337	.8214	.8042	.7841	.7625	.7388	.7113	.6778	.6355	.5806	.5091	.4198	.3116	.1981	.1004	[illegible]	[illegible]
	56.6	F	.8993	.8657	.8553	.8436	.8269	.8070	.7855	.7628	.7378	.7092	.6745	.6298	.5690	.4859	.3752	[illegible]	.1431	[illegible]	[illegible]
	60.0	BS	.9204	.8977	.8897	.8806	.8669	.8510	.8332	.8144	.7914	.7630	.7261	.6768	.6099	.5206	.4070	[illegible]	.1529	.0624	[illegible]
IX	58.2	M	.9126	.8888	.8803	.8707	.8566	.8402	.8228	.8030	.7788	.7478	.7070	.6526	.5795	.4858	.3709	.2443	.1295	[illegible]	[illegible]
	61.7	F	.9285	.9070	.8995	.8907	.8778	.8622	.8451	.8262	.8047	.7789	.7461	.7025	.6417	.5572	[illegible]	.3107	.1774	.0751	[illegible]
	65.0	BS	.9469	.9338	.9285	.9222	.9129	.9016	.8893	.8749	.8570	.8331	.8000	.7538	.6840	.5977	[illegible]	[illegible]	.1976	[illegible]	[illegible]
X	63.2	M	.9413	.9272	.9214	.9145	.9044	.8925	.8797	.8649	.8458	[illegible]	.7822	.7300	.6577	.5609	.4395	[illegible]	.1690	.0702	[illegible]
	66.7	F	.9528	.9407	.9359	.9304	.9219	.9112	.8993	.8855	.8688	.8475	.8187	.7780	.7229	[illegible]	.5259	[illegible]	.2270	[illegible]	[illegible]
	70.0	BS	.9706	.9641	.9611	.9573	.9517	.9449	.9372	.9275	.9156	.8976	.8703	.8293	.7669	[illegible]	.5621	[illegible]	.2535	.1158	[illegible]
XI	68.2	M	.9670	.9600	.9567	.9522	.9454	.9374	.9288	.9188	.9055	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	71.7	F	.9741	.9683	.9658	.9627	.9583	.9527	.9460	.9375	.9263	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	74.0	BS	[illegible]	.9857	.9844	.9826	.9793	.9754	.9707	.9655	.5576	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
XII	72.3	M	.9823	.9810	.9823	.9798	.9757	.9706	.9652	.9591	.9505	.9365	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	75.7	F	.9903	.9879	.9867	.9852	.9832	[illegible]	.9764	.9722	.9652	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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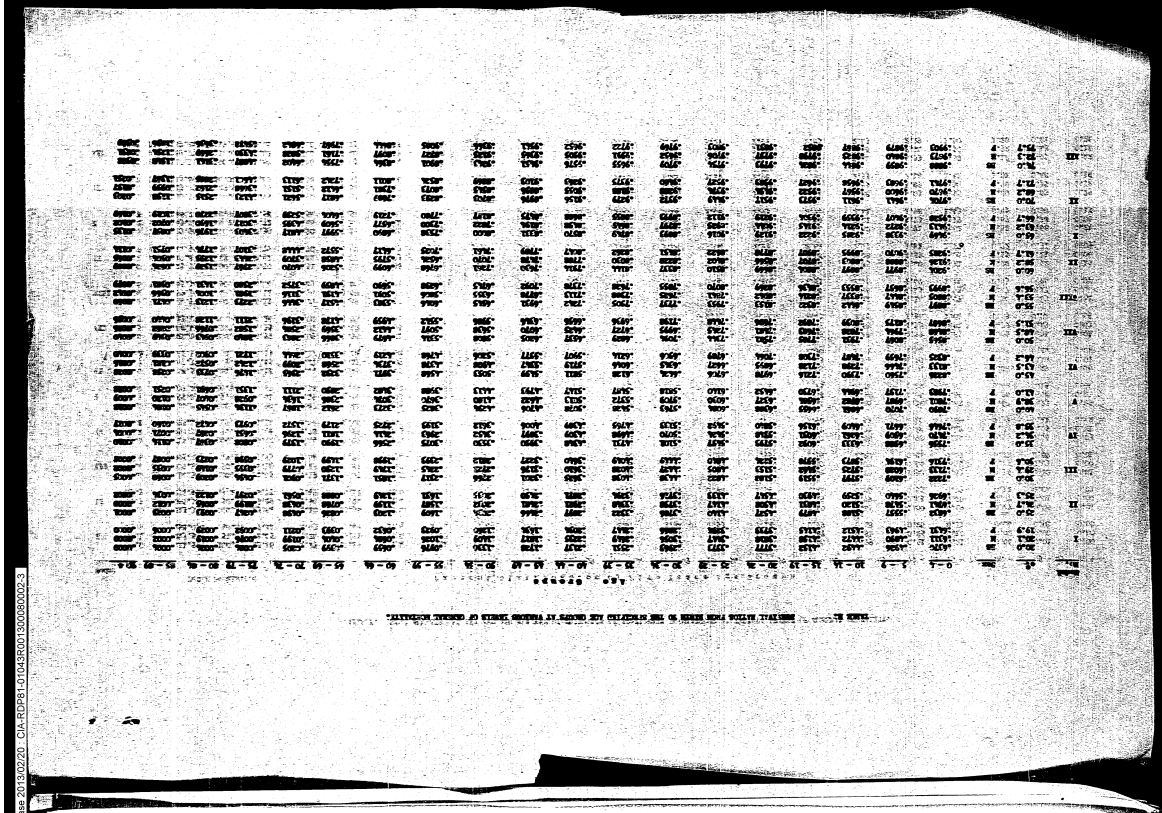

TABLE F. TOTAL NUMBERS AND SEX AND AGE PERCENT DISTRIBUTION OF STATIONARY POPULATIONS AT VARIOUS LEVELS OF GENERAL MORTALITY.

Level	Sex	Total Population	Percent Distribution by Five Years Age Groups																			
			0 - 4	5 - 9	10 - 14	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	65 - 69	70 - 74	75 - 79	80 - 84	85 - 89	90 +
I	M	100.000	15.46	12.23	11.19	10.34	9.01	8.10	7.38	6.58	5.92	5.28	4.63	3.95	3.24	2.45	1.64	0.93	0.51	0.24	0.08	0.03
	F	100.000	12.86	10.03	9.30	9.07	8.47	8.16	7.90	7.36	6.85	6.30	5.62	4.80	3.91	2.92	1.88	1.07	0.59	0.30	0.10	0.03
	T	100.000	14.13	11.13	10.25	9.70	8.74	8.13	7.64	6.97	6.39	5.79	5.13	4.38	3.58	2.69	1.76	1.00	0.55	0.27	0.09	0.03
II	M	100.000	13.66	11.30	10.54	9.85	8.92	7.96	6.85	5.78	4.83	4.06	3.51	2.86	2.16	1.45	1.00	0.59	0.29	0.09	0.03	0.00
	F	100.000	9.63	8.69	8.53	8.54	8.26	8.04	7.86	7.46	6.85	6.25	5.58	4.85	3.98	2.92	1.89	1.09	0.58	0.23	0.08	0.00
	T	100.000	11.65	10.00	9.54	9.20	8.59	8.00	7.36	6.62	5.84	5.16	4.55	3.86	3.07	2.19	1.45	0.84	0.44	0.16	0.05	0.00
III	M	100.000	12.08	10.39	9.69	9.11	8.65	8.05	7.40	6.74	6.05	5.34	4.61	3.87	3.09	2.29	1.50	0.83	0.35	0.10	0.03	0.00
	F	100.000	10.51	9.26	8.85	8.57	8.46	8.31	8.08	7.78	7.34	6.81	6.21	5.52	4.72	3.78	2.70	1.66	0.91	0.34	0.13	0.03
	T	100.000	11.29	9.82	9.27	8.84	8.56	8.18	7.74	7.26	6.69	6.07	5.41	4.69	3.90	3.04	2.10	1.25	0.63	0.22	0.08	0.00
IV	M	100.000	10.82	9.46	8.90	8.50	8.20	7.82	7.38	6.83	6.28	5.66	5.06	4.40	3.67	2.85	1.98	1.16	0.53	0.16	0.04	0.00
	F	100.000	9.48	8.58	8.38	8.32	8.22	8.08	7.93	7.73	7.47	7.13	6.71	6.19	5.53	4.72	3.77	2.65	1.68	0.80	0.29	0.05
	T	100.000	10.16	9.03	8.65	8.42	8.21	7.95	7.66	7.28	6.88	6.40	5.89	5.31	4.60	3.77	2.87	1.90	1.09	0.48	0.16	0.03
V	M	100.000	9.90	8.87	8.25	8.05	8.02	7.83	7.59	7.27	6.87	6.37	5.81	5.19	4.50	3.71	2.84	1.92	1.06	0.42	0.14	0.03
	F	100.000	8.99	8.19	8.04	8.07	8.07	8.01	7.91	7.74	7.45	7.06	6.57	5.97	5.26	4.41	3.53	2.58	1.65	0.86	0.36	0.08
	T	100.000	9.44	8.53	8.14	8.06	8.04	7.92	7.75	7.50	7.16	6.72	6.19	5.58	4.88	4.06	3.18	2.25	1.36	0.64	0.25	0.06
VI	M	100.000	8.59	7.95	7.60	7.37	7.31	6.85	6.36	6.22	5.83	5.33	4.80	4.20	3.59	2.89	2.14	1.65	0.95	0.45	0.16	0.04
	F	100.000	8.25	7.55	7.32	7.32	7.39	7.39	7.30	7.12	6.80	6.40	5.92	5.36	4.72	3.98	3.13	2.27	1.53	0.81	0.39	0.13
	T	100.000	8.39	7.74	7.45	7.34	7.35	7.16	6.83	6.67	6.31	5.86	5.36	4.76	4.15	3.43	2.63	1.89	1.24	0.63	0.27	0.08
VII	M	100.000	7.79	7.49	7.53	7.53	7.55	7.26	6.86	6.66	6.21	5.68	5.05	4.33	3.56	2.67	1.96	1.34	0.77	0.37	0.11	0.02
	F	100.000	7.58	7.29	7.32	7.36	7.43	7.39	7.26	7.09	6.77	6.34	5.80	5.16	4.41	3.56	2.68	1.93	1.22	0.67	0.27	0.06
	T	100.000	7.68	7.39	7.42	7.44	7.49	7.32	7.06	6.88	6.49	6.01	5.42	4.74	3.98	3.11	2.32	1.63	0.97	0.52	0.19	0.04
VIII	M	100.000	7.30	7.21	7.43	6.95	6.85	6.56	6.34	6.37	5.83	5.31	4.73	4.11	3.44	2.73	2.08	1.58	1.02	0.56	0.22	0.05
	F	100.000	7.03	6.94	7.17	7.03	6.97	6.82	6.64	6.51	6.21	5.85	5.40	4.85	4.21	3.46	2.68	1.93	1.29	0.80	0.36	0.08
	T	100.000	7.16	7.07	7.30	6.99	6.91	6.69	6.49	6.44	6.02	5.58	5.07	4.48	3.82	3.09	2.38	1.76	1.16	0.68	0.29	0.06
IX	M	100.000	6.88	6.82	6.77	6.71	6.65	6.56	6.43	6.36	5.96	5.51	4.98	4.40	3.73	2.98	2.25	1.64	1.09	0.63	0.26	0.06
	F	100.000	6.64	6.59	6.64	6.64	6.65	6.59	6.47	6.39	6.14	5.89	5.60	5.20	4.69	4.03	3.20	2.35	1.59	0.99	0.46	0.12
	T	100.000	6.76	6.71	6.71	6.68	6.65	6.58	6.45	6.38	6.05	5.70	5.29	4.80	4.21	3.51	2.72	2.00	1.34	0.81	0.36	0.09
X	M	100.000	6.50	6.47	6.52	6.47	6.41	6.34	6.26	6.17	5.83	5.43	4.98	4.49	3.91	3.26	2.58	1.97	1.42	0.91	0.46	0.12
	F	100.000	6.27	6.24	6.31	6.31	6.29	6.25	6.19	6.12	5.89	5.61	5.28	4.90	4.45	3.91	3.27	2.54	1.88	1.19	0.63	0.18
	T	100.000	6.38	6.35	6.41	6.39	6.35	6.29	6.22	6.14	5.86	5.52	5.13	4.69	4.18	3.58	2.92	2.25	1.65	1.05	0.54	0.15
XI	M	100.000	6.18	6.17	6.27	6.27	6.21	6.14	6.07	5.98	5.69	5.36	4.98	4.55	4.04	3.43	2.77	2.09	1.49	0.96	0.49	0.13
	F	100.000	6.01	6.00	6.12	6.17	6.16	6.12	6.07	6.00	5.78	5.51	5.19	4.81	4.36	3.81	3.18	2.46	1.81	1.16	0.62	0.18
	T	100.000	6.09	6.08	6.19	6.22	6.18	6.13	6.07	5.99	5.73	5.43	5.08	4.68	4.20	3.62	2.98	2.28	1.65	1.06	0.55	0.16
XII	M	100.000	5.96	5.98	6.12	6.17	6.12	6.07	6.02	5.95	5.68	5.38	5.04	4.66	4.23	3.69	3.09	2.44	1.85	1.26	0.73	0.23
	F	100.000	5.79	5.82	5.97	6.04	6.04	6.01	5.97	5.91	5.69	5.43	5.14	4.81	4.42	3.93	3.34	2.66	2.01	1.36	0.78	0.25
	T	100.000	5.87	5.90	6.05	6.11	6.08	6.04	5.99	5.93	5.68	5.40	5.09	4.73	4.32	3.81	3.21	2.55	1.93	1.31	0.75	0.24

TABLE F. TOTAL NUMBERS AND SEX AND AGE PERCENT DISTRIBUTION OF STATIONARY POPULATIONS AT VARIOUS LEVELS OF GENERAL MORTALITY.

Model No.	e0	Sex	Total Population N.	S	Percent Distribution by Five Years Age Groups 0 – 4	5 – 9	10 – 14	15 – 19	20 – 24	25 – 29	30 – 34	35 – 39	40 – 44	45 – 49	50 – 54	55 – 59	60 – 64	65 – 69	70 – 74	75 – 79	80 – 84	85 – 89	90 +
I	20.0	BS	431.595	100.00	15.86	12.27	11.19	10.34	9.43	8.60	7.38	6.35	5.32	4.39	3.35	2.43	1.64	0.99	0.51	0.21	0.06	0.01	0.00
	20.1	M	213.349	51.88	8.05	6.26	5.71	5.30	4.87	4.40	3.90	3.38	2.85	2.32	1.80	1.31	0.87	0.51	0.25	0.10	0.02	0.00	0.00
	19.9	F	198.086	48.12	7.81	6.03	5.48	5.04	4.54	4.00	3.48	2.97	2.47	1.98	1.53	1.12	0.77	0.48	0.26	0.11	0.04	0.01	0.00
II	25.0	BS	513.344	100.00	13.46	11.10	10.36	9.74	9.04	8.27	7.46	6.63	5.78	4.92	4.06	3.21	2.40	1.65	1.00	0.49	0.19	0.05	0.01
	24.7	M	248.382	50.72	6.89	5.60	5.26	4.94	4.62	4.26	3.84	3.42	2.99	2.54	2.08	1.62	1.19	0.79	0.45	0.20	0.07	0.01	0.00
	25.3	F	252.962	49.28	6.75	5.49	5.12	4.80	4.43	4.03	3.62	3.21	2.79	2.39	1.98	1.59	1.21	0.86	0.55	0.29	0.12	0.04	0.01
III	30.0	BS	614.389	100.00	12.05	10.19	9.47	9.21	8.65	8.05	7.40	6.74	6.05	5.34	4.61	3.87	3.09	2.29	1.50	0.83	0.35	0.10	0.01
	29.4	M	309.160	50.31	6.10	5.15	4.89	4.67	4.40	4.11	3.78	3.44	3.09	2.71	2.32	1.92	1.50	1.07	0.66	0.34	0.13	0.03	0.00
	30.6	F	305.289	49.69	5.95	5.04	4.78	4.54	4.25	3.94	3.62	3.30	2.96	2.63	2.29	1.95	1.59	1.22	0.84	0.49	0.22	0.07	0.01
IV	35.0	BS	715.486	100.00	10.82	9.44	9.07	8.73	8.33	7.82	7.21	6.78	6.23	5.66	5.06	4.40	3.67	2.85	1.98	1.16	0.53	0.16	0.03
	34.2	M	358.316	50.08	5.48	4.78	4.59	4.43	4.22	3.98	3.72	3.45	3.16	2.86	2.53	2.17	1.77	1.33	0.88	0.48	0.20	0.05	0.01
	35.8	F	357.144	49.92	5.34	4.66	4.48	4.30	4.09	3.84	3.59	3.33	3.07	2.80	2.53	2.23	1.90	1.52	1.10	0.68	0.33	0.11	0.02
V	40.0	BS	816.878	100.00	9.90	8.87	8.61	8.35	8.07	7.63	7.23	6.81	6.37	5.91	5.39	4.80	4.11	3.28	2.34	1.42	0.68	0.23	0.05
	38.9	M	407.437	49.90	5.61	4.49	4.36	4.23	4.09	3.87	3.67	3.45	3.22	2.97	2.69	2.36	1.98	1.53	1.05	0.60	0.26	0.08	0.01
	41.0	F	409.261	50.10	4.89	4.38	4.25	4.12	3.97	3.76	3.56	3.36	3.15	2.94	2.70	2.44	2.13	1.74	1.29	0.83	0.42	0.15	0.04
VI	45.0	BS	918.526	100.00	9.18	8.44	8.25	8.05	7.84	7.48	7.17	6.84	6.48	6.09	5.64	5.10	4.43	3.66	2.64	1.65	0.82	0.29	0.06
	43.7	M	457.374	49.79	4.65	4.27	4.17	4.07	3.96	3.79	3.63	3.46	3.27	3.05	2.81	2.56	2.13	1.69	1.20	0.71	0.33	0.10	0.02
	46.2	F	461.190	50.21	4.53	4.17	4.08	3.98	3.87	3.69	3.54	3.38	3.21	3.04	2.83	2.60	2.30	1.91	1.44	0.94	0.49	0.19	0.04
VII	50.0	BS	1.021.543	100.00	8.59	8.09	7.95	7.81	7.69	7.37	7.11	6.85	6.56	6.22	5.83	5.33	4.69	3.88	2.89	1.85	0.95	0.35	0.08
	48.5	M	508.449	49.75	4.35	4.09	4.02	3.95	3.84	3.72	3.59	3.46	3.30	3.12	2.90	2.62	2.27	1.83	1.33	0.81	0.39	0.13	0.03
	51.5	F	513.494	50.25	4.24	4.00	3.93	3.86	3.75	3.65	3.52	3.39	3.26	3.10	2.93	2.71	2.43	2.05	1.56	1.04	0.55	0.22	0.05
VIII	55.0	BS	1.128.935	100.00	8.11	7.79	7.69	7.58	7.43	7.25	7.05	6.84	6.60	6.31	5.96	5.51	4.91	4.12	3.14	2.07	1.10	0.43	0.11
	53.4	M	559.567	49.74	4.11	3.94	3.89	3.83	3.75	3.66	3.56	3.45	3.32	3.16	2.96	2.71	2.38	1.96	1.45	0.93	0.47	0.17	0.04
	56.6	F	569.368	50.26	4.00	3.85	3.80	3.75	3.68	3.59	3.49	3.39	3.28	3.15	3.00	2.80	2.53	2.16	1.69	1.14	0.63	0.26	0.07
IX	60.0	BS	1.225.791	100.00	7.70	7.51	7.44	7.36	7.25	7.12	6.97	6.81	6.62	6.38	6.07	5.66	5.10	4.35	3.40	2.31	1.28	0.52	0.15
	58.2	M	610.828	49.83	3.91	3.81	3.77	3.73	3.67	3.60	3.52	3.44	3.34	3.20	3.03	2.79	2.48	2.08	1.59	1.05	0.55	0.21	0.06
	61.7	F	614.963	50.17	3.79	3.70	3.67	3.63	3.58	3.52	3.45	3.37	3.28	3.18	3.04	2.87	2.62	2.27	1.81	1.27	0.72	0.31	0.09
X	65.0	BS	1.329.984	100.00	7.36	7.20	7.16	7.11	7.03	6.95	6.85	6.74	6.61	6.42	6.17	5.81	5.31	4.62	3.71	2.62	1.52	0.66	0.21
	63.2	M	663.784	49.91	3.72	3.66	3.64	3.61	3.57	3.52	3.47	3.41	3.34	3.24	3.09	2.88	2.60	2.21	1.73	1.15	0.67	0.28	0.08
	66.7	F	666.220	50.09	3.58	3.54	3.52	3.50	3.46	3.43	3.38	3.33	3.27	3.18	3.08	2.93	2.71	2.41	1.98	1.43	0.85	0.38	0.13
XI	70.0	BS	1.430.966	100.00	6.95	6.90	6.88	6.86	6.82	6.77	6.71	6.65	6.56	6.43	6.24	5.96	5.51	4.88	4.03	2.95	1.80	0.83	0.29
	68.2	M	715.270	49.98	3.55	3.52	3.51	3.49	3.47	3.44	3.41	3.37	3.32	3.25	3.14	2.96	2.71	2.35	1.89	1.34	0.79	0.35	0.12
	71.7	F	715.696	50.02	3.40	3.38	3.37	3.36	3.35	3.33	3.30	3.28	3.24	3.18	3.10	2.98	2.80	2.53	2.14	1.61	1.01	0.48	0.16
XII	75.0	BS	1.517.114	100.00	6.68	6.66	6.65	6.64	6.62	6.59	6.56	6.52	6.47	6.39	6.24	6.01	5.65	5.10	4.33	3.30	2.12	1.05	0.42
	72.3	M	749.272	50.45	3.42	3.40	3.40	3.39	3.38	3.36	3.34	3.32	3.29	3.24	3.16	3.02	2.80	2.48	2.04	1.50	0.92	0.43	0.16
	77.7	F	767.842	49.95	3.26	3.26	3.25	3.25	3.24	3.23	3.22	3.20	3.18	3.14	3.09	2.99	2.85	2.63	2.25	1.80	1.20	0.61	0.26