

# MortPak-

**The United Nations Software Package for Mortality Measurement**

Batch-oriented Software for the Mainframe Computer



**United Nations**

New York, 1988

**NOTE**

**Symbols of United Nations documents are composed of capital letters combined with figures.**

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## Preface

The present volume contains the working manual for MORTPAK, a software package for demographic measurement in developing countries, with special emphasis on mortality measurement. **MORTPAK** includes 16 applications in the areas of life-table and stable-population construction, graduation of mortality data, indirect mortality estimation, indirect fertility estimation, and other indirect procedures for evaluating age distributions and the completeness of censuses. The package incorporates developed techniques that take advantage of the United Nations model life tables and generalized stable-population equations.

The present document is one of two produced by the United Nations providing such software. It contains a batch-oriented interface which is designed for mainframe computer users but which nevertheless is easily installed on a microcomputer. An earlier publication, entitled MORTPAK-LITE - The United Nations Software Package for Mortality Measurement. Interactive Software for the IBM-PC and Compatibles,\* includes identical demographic applications using software and data entry devised specifically for the microcomputer.

The Population Division of the Department of International Economic and Social Affairs of the United Nations Secretariat has long conducted demographic estimation and projection activities at the country level, incorporating methodological advances in the construction of model life tables, for example. As a by-product of these activities, an extensive body of computer software has been developed for the internal use of the Population Division. These computer programs have often been written in a way that permits easy transfer to facilities outside the Population Division. The Population Projection Program of the Population Division is probably the most well-known of these computer programs. It has been well documented (most recently in **ESA/P/WP.77**) and is used throughout the world. The present publication adds to the list of Population Division software and complements the Projection Program by providing a storehouse of techniques for demographic estimation.

MORTPAK has already been well tested and is now widely used for analysis of developing country data and in developing country institutions. For this, the Population Division would like to thank its colleagues from the Software and Support for Population Data Processing Project of the Department of Technical Co-operation for Development, who tested the package, trained demographic researchers in its use, and provided feedback on ways to improve its accessibility and relevance. We are also grateful to Eduardo Arriaga, who provided early versions of the FORTRAN coding for the FERTCB and FERTPF

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\* To be issued as a United Nations publication.

programs, The main program - subroutine design of **MORTPAK**, as well as the program **MATCH** - has its origins in the United States Census Bureau package, Computer Programs for Demographic Analysis (**Arriaga, Anderson and Heligman, 1976**). These origins are also gratefully acknowledged.

The Population Division would be pleased to receive comments on experiences in using **MORTPAK** that would enhance the international usefulness of future software development activities. For information about obtaining the **MORTPAK** software, please write to the Director, Population Division, United Nations, New York, NY 10017, USA.

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## I. INTRODUCTION:

### DEMOGRAPHIC PROCEDURES AND COMPUTER ASPECTS

This volume presents a set of 16 computer programs for undertaking demographic analyses in developing countries, including empirical and model life-table construction, graduation of mortality data, mortality and fertility estimation, and evaluation of census coverage and age distributions.

The package as presented here has been constructed for batch-type input data, that is, the necessary input data are entered into the machine by typing "card images" of certain numbers into designated columns. This input approach is usual for mainframe computer work environments. Nevertheless, these programs are easily downloaded onto microcomputers and will generally run without problems. In addition to this volume, a companion volume is also being issued, which describes a version of this software constructed specifically for the **microcomputer (MORTPAK-LITE: The United Nations Software Package for Mortality Measurement, Interactive Software for the IBH-PC and Compatibles)**. The most important difference between the two packages is that the microcomputer version includes a worksheet-style, full screen data entry procedure that reduces dependence on a manual and takes advantage of the interactive capabilities of the microcomputer.

#### A. The procedures

The 16 applications included have been selected by the Population Division as useful for evaluating demographic data from censuses and surveys and preparing reliable estimates of demographic parameters. These applications incorporate techniques for evaluation and estimation of demographic data, particularly those techniques that incorporate the United Nations model life-table system (United Nations, 1982) and generalized stable population equations (Preston and Coale, 1982).

Table 1, at the end of this chapter, presents a brief description of the applications, categorized according to their major functions: life-table and stable population construction, graduation of mortality data, indirect mortality estimation, indirect fertility estimation, and other indirect estimation procedures. The primary type of input data is also indicated. The package emphasizes mortality estimation, reflecting the larger number of techniques available and the further advanced mortality estimation is compared to that of other demographic components. (Of the nine chapters in the United Nations manual on Indirect Techniques for Demographic Estimation (United Nations, 1983), five are dedicated solely, and two partially, to mortality analysis.)

The LIFTB and STABLE programs calculate empirical life tables and stable populations respectively based on age-specific mortality rates, plus, in the latter case, an intrinsic growth rate. The life-table method used is based on the approach of **Greville (1943)**, which permits calculation of age-specific separation factors based on the age pattern [**trend**] of the mortality rates themselves. It is, hence, potentially more accurate than methods which assume constant separation factors, and more robust, under developing country circumstances, than methods which estimate separation factors based on population age distributions. Although fertility decline is rendering calculation of stable populations less applicable for many countries, for others fertility has changed little and stable population analysis remains useful for evaluation of age distributions and rough approximation of birth and death **rates**.<sup>1/</sup> In addition, the STABLE program is useful for static simulation of the effects of changed growth rates and/or mortality rates on age distribution.

The applications **UATCH**, **COMPAR** and **BESTFT** construct model life tables and compare or graduate empirical data with respect to a model life table. The procedure **UATCH** not only generates any United Nations or Coale and Demeny model life table but also enables the entering of a user-designated mortality pattern which then can be adjusted to correspond to any desired level. This user-designated model may be a pattern from a third model life-table system such as the Brass standard (Brass and others, **1968**) but, perhaps, most importantly can be an age pattern of mortality for a particular country. In the latter case a demographer can generate a model life-table system specific for a country of interest by using **WATCH** to construct a series of life tables at different levels of life expectancy, all consistent with the country's average pattern. Comparison of an empirical set of age-specific mortality rates to model life-table patterns, through **COMPAR**, aids the demographer in the choice of a model life table. However, as data quality improves, the demographer will wish to retain as many characteristics of the original data as possible. **COMPAR** is then very useful for examining deviations of empirical mortality patterns from the models due to either true differences in age patterns or to data errors. Similarly, **BESTFT** offers the opportunity to graduate observed age-specific mortality rates with respect to a model life table (standard), either to smooth a series of observed rates or to estimate consistent rates for age groups in which data are lacking.

The procedures **UNABR** and **ICM** graduate mortality rates in traditional age grouping into single-year values; **UNABR** considers the entire age range and **ICM** under age 10 only. The procedures are of immediate use when undertaking single-year population projections or special studies of specific age groups such as the school-age population or the elderly.

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<sup>1/</sup> However, for countries whose fertility decline is recent and **mortality** change has not greatly altered the adult age distribution, **STABLE** could be useful for evaluating age distributions and studying population dynamics among adults.

The remaining programs all relate to indirect estimation of demographic parameters. The five procedures of CEBCS, ORPHAN, **WIDOW**, COUBIN and BENHR are mortality-specific. CEBCS provides estimates of infant and child mortality based on data of children ever born and children surviving tabulated either by age of mother or duration of her marriage. ORPHAN and WIDOW carry out variations of the maternal orphanhood or widowhood techniques to estimate levels of adult mortality. The procedure COUBIN "combines\*\* early age mortality estimates (perhaps produced by CEBCS) with adult mortality estimates (perhaps produced by ORPHAN and WIDOW) and produces a full, consistent life table. The technique BENHR is an application of the Bennett-Horiuchi (1981) technique; it exploits the generalized stable population equation to estimate the completeness of death registration using population age distributions from two censuses and intercensal registered deaths.

Two fertility estimation techniques are included. FERTCB estimates age-specific fertility rates based on tabulations of average number of children ever born by age of woman. The essential methodology was developed by G. Uortara (1949). The variation included here was proposed by Arriaga (1983); it has the advantage of providing estimates of fertility change over time. In the same 1983 article, Arriaga presented an extension of the P/F technique originally developed by Brass (Brass and others, 1968). The Arriaga extension, presented in FERTPF, allows the demographer to estimate fertility at two points in time under conditions of fertility change. Children ever born data and the pattern of age-specific fertility are necessary from two enumerations when fertility has not been constant.

CENCT and PRESTO provide techniques for evaluating relative coverage and age recording in censuses, as well as estimates of intercensal mortality and fertility. CENCT provides an estimate of the coverage of one census relative to another and hence is an important first step before applying other estimation techniques which assume consistency in coverage between two censuses (such as BENHR and PRESTO). Based on two populations, tabulated by age, and the appropriate model life table, PRESTO enacts the "integrated method" developed by Preston (1983), providing consistent estimates of the birth rate, life expectancy and intercensal age distributions.

## B. Computer aspects

The computer software is written in **FORTRAN** IV for the **IBM System/34**. This version of **FORTRAN** is compatible with nearly all existent **FORTRAN** compilers. The programs will operate on a computer with relatively small memory; in the case of a microcomputer, 256K RAM is sufficient. One change in the **FORTRAN** source listings that is likely to be necessary is the assigned unit numbers for input and output. These programs use unit 5 for input and unit 6 for output. The unit numbers are specified by **NREAD = 5** and **NPRNT = 6** statements near the beginning of each program to ease the changing of unit numbers to conform to the computer facility's requirements.

If the programs are downloaded to a microcomputer, additional small modifications will probably be necessary. First, OPEN statements will be needed in the main programs to assign identifying unit numbers to the input and output data sets. The current assignments are as indicated above. Secondly, CHARACTER statements will need to be added to indicate that the variable is of CHARACTER (A format) and the number of bytes needed.

Chapter II contains the documentation for each procedure. This includes program description, required data, input entry instructions, and an illustrative example. Chapter III is intended for programmers and contains detailed computer information about the program subroutines and their argument strings. Chapter IV contains source listings of all the programs.

Table 1. Listing of procedures

Major function	Primary type of input data
<b>LIFE-TABLE AND STABLE POPULATION CONSTRUCTION</b>	
<b>LIFTB</b> Construction of a life table based on a set of age-specific central death rates or age-specific probabilities of dying.	Age-specific mortality data
<b>STABLE</b> Calculation of a stable age distribution based on a set of age-specific central death rates or age-specific probabilities of dying and the intrinsic rate of natural increase.	Age-specific mortality data
<b>MODEL LIFE-TABLE CONSTRUCTION</b>	
<b>MATCH</b> Calculation and printing of United Nations, Coale-Demeny or user-designated model life tables corresponding to given levels of mortality. As the user-designated model can be a mortality pattern specific to a certain population, HATCH can generate a country-specific model life-table system.	Model life table entry point
<b>COMPAR</b> Comparison of an empirical set of age-specific central death rates or age-specific probabilities of dying to all United Nations and Coale-Demeny model life-table patterns, and printing of indices of similarity.	Age-specific mortality data

Table 1. (continued)

Major function	Primary type of input data
BESTFT Finding the one, two or three component United Nations model life table which best fits one or more probabilities of dying given as input.	Age-specific mortality data
<b>GRADUATION OF MORTALITY DATA</b>	
UNABR Graduation of a set of age-specific probabilities of dying in age groups 0-1, 1-5, 5-10, ..., producing a smooth set of values and an estimated unabridged life table.	Age-specific mortality data
ICM Estimation of single-year probabilities of dying for ages under five from probabilities of dying in age groups 0-1, 1-5 and 5-10.	Age-specific mortality data
<b>INDIRECT MORTALITY ESTIMATION</b>	
CEBCS <b>Indirect</b> estimation of early age mortality from data on the average number of children ever born and the average number of children surviving, tabulated by either age group of mother or by duration of her marriage.	Survival of kin
ORPHAN Indirect estimation of female adult mortality from tabulations on proportion of population with mothers still alive by age group of respondents.	Survival of kin
WIDOW Indirect estimation of male and female adult mortality from data on proportion of the ever-married population whose first spouse is still living tabulated by age of respondent.	Survival of kin
COMBIN Calculation of a <b>**model*</b> life table from an estimate of life expectancy at age 20 combined with an estimate of survivorship to age one, survivorship to age five, or both.	<b>Model life table entry point</b>
BENHR Estimation of completeness of adult death registration based on population age distributions from two censuses and registered deaths by age for the intercensal period.	<b>Population and deaths by age</b>

Table 1. (continued)

Major function	Primary type of input data
INDIRECT FERTILITY ESTIMATION	
FERTCB Estimation of age-specific fertility rates from data on children ever born tabulated by age of mother recorded at either one or, optionally, two points in time.	Lifetime fertility
FERTPF Estimation of age-specific fertility rates from data on children ever born tabulated by age of mother and the age pattern of fertility, recorded at either one or two points in time.	Lifetime and current fertility
OTHER INDIRECT ESTIMATION PROCEDURES	
CENCT Estimation of completeness of one census relative to a second census from population age distributions from two censuses and either assumption of a United Nations or Coale-Demeny model life table or provision of registered deaths or death rates by age for the intercensal period.	Population by age
PRESTO Provides integrated estimates of intercensal mortality, fertility and age distribution based on recorded age distributions from two censuses and assumption of a United Nations, Coale-Demeny or user-designated model life-table pattern.	Population by age