First Full Papua New Guinea Census Counts Three Million

by Reginald Gilbert

Papua New Guinea conducted its first full-count national census in 1980. Previous national censuses in 1966 and 1971 had been sample censuses of the rural villages with complete counts in the towns and rural nonvillages (plantations, missions, and so forth). The Government of Papua New Guinea decided to do a full count in 1980 for a variety of reasons, a major one being the need for basic small-area data for development planning.

The task of a complete census was never underestimated. Papua New Guinea does not have good communications. Many areas have no access by road and can be reached only by river patrols or long walking patrols. The road network, however, has improved considerably since 1971, and it was agreed that a complete census was possible if considerable cooperation was given by all branches of government and other organizations.

It was decided that it would not be wise to attempt a very large questionnaire throughout the country for this first complete census. Many questions were essential, however, at least for national estimates, to make the exercise worth its cost. Thus a compromise strategy was endorsed:
- All persons would be asked a basic set of questions.
- Persons in urban areas, rural nonvillages (RNVs), and a sample of villages would be asked additional questions.

In practice, then, the plan was a “short” questionnaire (12 questions) for nonsample villages and a “long” questionnaire (25 questions) for urban areas, RNVs, and the rural village sample.

As planning proceeded, field officers stated that this strategy was too complex. Field staff would have great difficulty coping with two questionnaires, two sets of training materials, and two operational plans. The original strategy was tried in a major pilot test, and it was also found that people were missed be...
cause of boundary problems between sample and non-sample areas. It was thus decided in early 1980 to change the strategy to postpone the long-form rural village sample until 1981 but to cover all rural villages with the short form in 1980.

The revised strategy did prove much more manageable. All rural village patrols used the short form, and the urban and RNV long-form component was taken as a separate exercise usually under different control. The 1981 rural village sample is starting now, and field staff are finding it very easy to manage as a separate operation and are confident that high-quality data will be produced as a result of the change in strategy.

The actual enumeration was spread over quite a long time period. Rural patrols started in the most remote areas in May 1980 with all provinces in operation by July 1980. Long-form operations were largely completed in September and October with the main enumeration period for urban and peri-urban areas between 22 September and 3 October 1980.

As could be expected, there were many problems in the enumeration. Some of these are discussed below:

- It is not practical to conduct a house-to-house census in most Papua New Guinea rural villages. There is a long tradition of village census books which were originally established by Australian patrol officers. These had fallen into disuse in some areas and a major task during 1979 and early 1980 was to have these books reactivated and brought up to date. These village books then served as the key basis for the census. People gathered at an agreed-upon point in the village or at a rest house to be censused on their census day. Pretests were tried on house-to-house enumeration, but the time taken made it impractical, and quite large outlying hamlets, garden houses, and so forth were very likely to be missed. Publicity was thus directed at getting people to come to the census for their village. Checks were made against the village books and house-to-house checks were made in the evenings wherever possible. Generally the public cooperated very well, and the census totals were often well over the village book figures.

- Coverage rules had to be a mixture of de jure and de facto but had to be as simple as possible. The final rules adopted were:
  1. In towns and RNVs count everyone who slept in each house the night before the census interviewer came.
  2. In rural villages count everyone who "belonged" to the village and who was not absent in a town or RNV on the previous night.

The rules were not ideal but they seem to have worked fairly well in practice.

- Staffing was a problem. Schools were closed where required for the main long-form enumeration period, but in remote rural areas interviewers were recruited from school leavers down to grade 6 level. The resulting quality of data has generally proved better than expected and the enthusiasm of the school leavers for the task was a major feature of the operation. The PNG Defense Force offered great assistance and censused many of the most remote areas. The population of these areas responded very well to the soldiers, and their curiosity about the soldiers seems to have resulted in better coverage rather than the converse.

- Transport was a major problem. Virtually every kind of craft was used—boats, planes, helicopters, and other types. The delivery of census material and its retrieval was a particular problem. The nation's capital, Port Moresby, is not linked by road to most of the country. The Royal Australian Air Force assisted by ferrying most of the materials out and back in C-130 Hercules aircraft. They also supplied Caribou aircraft and Chinooks and Iroquois helicopters at other stages.

- Training was, of course, a key to the operation. Pretests showed that a fully scripted verbatim guide with a workbook for each enumerator and supervisor was the best way of maintaining quality and comparability of interpretation. This docu-

(continued on page 14)
INDIA

The population of India as recorded at sunrise on 1 March 1981 was 683,810,051. Provisional results were published within three weeks of the conclusion of the census, when the Office of the Registrar General and Census Commissioner for India released Paper 1 of 1981, *Provisional Population Totals*. The paper gives population figures for the country and for states and territories and includes a brief analysis of population distribution, growth rates, density, sex ratio, and literacy.

The population total came as a surprise to many—it was 12 million more than had been estimated in earlier official projections. Despite an investment since the last census of about $850 million for curbing population growth, the growth rate during the last ten years (24.75) is only slightly lower than that of the 1961–71 decade (24.80). It is apparent that India's target of stabilizing the population at around 900 million by 1995 is no longer possible.

The figures include the projected population for Assam and Jammu and Kashmir. A census could not be done in Assam because of the disturbed conditions there, and the census in snowbound Jammu and Kashmir was scheduled for April and May 1981.

India's population is the second largest in the world, exceeded only by that of China. Although about 15.5 percent of the world's people live in India, the country has only 2.4 percent of total world area. Of the total Indian population, there were 353,347,249 males and 330,462,802 females, for a sex ratio of 935 females per thousand males. More than 135.6 million persons have been added to the population since the 1971 Census. Population density in the country is 221 persons per square kilometer. The literacy rate of 36.17 percent is nearly twice as high for males (46.74 percent) as it is for females (24.88 percent). A person who can read and write in any language is deemed literate for census purposes.

Uttar Pradesh, with more than 88 million persons, is the most populous state in the country. It is followed by Bihar (69.8 million), Maharashtra (62.7 million), West Bengal (54.5 million), and Andhra Pradesh (53.4 million).

The householding operations, which constitute the first phase of India's census, were completed during 1980. The actual enumeration began on 9 February and ended on 28 February, with 1 March being the reference date. A revisional round was conducted 1–5 March. About a million and a quarter enumerators and supervisors were hired to carry out the fieldwork. Each enumerator was responsible for canvassing 600 to 750 persons, and one supervisor was appointed for every five enumerators.

Census schedules are being processed in regional tabulation offices that have been established all over the country. Basic data will be generated through a system of manual tabulation, and further processing will be carried out by computer. The announcement of preliminary results so soon after the census operation was made possible by compiling basic data right from the enumerator's block through the various levels—charge, district, and state—in record time. India's census is the largest single administrative exercise in the world, according to *Provisional Population Totals*, which points out that the system might be made to work better. Under the Census Act of 1948, various census functionaries were appointed, but “the 1981 census experience clearly indicates the urgent need for a hard look at the Census Act. Unlike the palmy days when the count was on one day or when the Collectors could order all dogs to be chained and lamps to be lit and placed in windows to help enumerators, in today's world we have found that constant vigilance was necessary at every stage merely to ensure that enumerators were available and carrying out the operations as required.” The report suggests that penalties under the law need to be stiffened if the next census is to be carried out successfully.

CHINA

Vice Premier Chen Muhua announced in Beijing on 9 March that China's State Council had decided to postpone the nation's third census until 1 July 1982. She made the statement at the opening session of the National Conference of the Directors of Provincial and Municipal Offices of the census. News of the announcement was provided for the *Census Forum* by Mr. Chihsien Tuan, EWPI Research Associate.

The 1982 Census will ask questions about more than 20 items, including sex, age, nationality, education, marital status, and fertility. Labor force and the distribution of occupations over different economic sectors will also be investigated. The United Nations Fund for Population Activities (UNFPA) is providing support for the census.

A pretest of the census schedule and census operations was held in 1980. The test aroused great interest among census workers in other provinces, who insisted that similar pretests be taken within their own jurisdictions not only to train personnel and accumulate experience but also to determine whether the schedule was suitable. Allowing time for additional pretests was one of the major reasons for again postponing the census, which was originally scheduled for 1980. Chen Muhua said that all provinces and municipalities under direct supervision of the central government should conduct a pretest this year to prepare for the actual enumeration. Census officials at the provincial level will play a vital role in carrying out the enumeration in China.

At the same time, an important measure was taken by the Standing Committee of the People's Congress to form a permanent agency to promote China's planned birth policy. The National Committee of Planned Birth, under the State Council, will replace the temporary Small Leading Group of Planned Birth. Now that the total fertility rate has reached the replacement level (the figure for 1979 was 2.25) or even fallen below it, other elements, many of them only indirectly related to fertility, must be considered if China's new one-child policy is to be effective. These secondary variables, which include such things as old-age security, economic, social and psychological care, the family system, and parent-child obligations, must be
addressed and perhaps changed if China is to be successful in achieving the one-child family. Executing a policy that involves such a host of variables needs constant attention, so it was necessary to have a permanent body to be responsible for supervision and coordination of the work. The new Committee ranks above a Ministry and is presided over by Vice Premier Chen Muhua. The establishment of the Committee carries an important message: that planned birth is a long-term project of strategic importance in China.

AUSTRALIA

☑ The tenth national census conducted under the Census and Statistics Act of 1905 will be held in Australia on 30 June 1981. News of the preparations was sent by Mr. Brian Doyle, Director of Evaluation and User Services in the Population Census Branch of the Australian Bureau of Statistics (ABS). Australia’s census has been held every five years since 1961. This year’s questionnaire contains 31 personal questions and four dwelling questions, a significant reduction from the 41 personal and 12 dwelling questions asked in 1976.

To encourage cooperation with the census and to achieve the highest level and quality of response, the Australian government is launching a substantial public awareness campaign. The campaign is intended to make the public aware of the census and its importance, explain the nature and content of the census, and indicate how assistance may be obtained in completing the form if it is needed. Australia is spending A$1.2 million on the campaign, the largest amount ever spent on publicizing a census. About A$200,000 will be spent for public relations, and nearly A$1.0 million is allocated for advertising. According to Doyle, the cost of collecting and processing all the information from the census will be about A$30 million.

Target groups for the public relations effort are migrant and other special-interest groups with particular needs. ABS has native material translated into 22 languages for use in posters and in the ethnic press, radio, and television. In addition to explaining the census to leading members of a wide variety of community groups, the ABS will seek “feedback” from these groups to discover whether there might be a need to correct misconceptions or remove apprehensions about the collection of census data or the uses to which the data are put.

An explanatory brochure titled “Census 81” will be distributed by census collectors to every household in Australia when they deliver census forms. The brochure gives in a few pages a broad picture of the census—what questions are asked and why, how census forms are delivered and collected, how confidentiality is preserved, and so on. The brochure also explains why names are needed on the census forms, but it emphasizes that names are not retained in ABS records and that all census forms are destroyed.

Collectors will also carry copies of a multilingual folder for households in which English is not spoken. The folder describes the purposes and value of the census, offers advice on filling in the form, and points the way to further help through the Telephone Interpreter Service of the Department of Immigration and Ethnic Affairs.

National advertising, using both print and electronic media, will be concentrated in the three weeks preceding Census Day. It will be designed to reach all segments of the public, particularly the ethnic communities. Advertising will reiterate and encapsulate the themes developed during the public relations campaign. The program will climax on Census Day with a newspaper advertisement offering practical advice on filling in the census form, and in the evening a two-minute television commercial will be shown on every station in Australia during the peak viewing periods.

The advertising campaign will not come to an abrupt halt on 30 June. Some days after Census Day, a press advertisement will appear thanking the people of Australia for the cooperation that ABS expects them to extend.

About 30,000 persons are being recruited and trained as field staff for the enumeration phase of the census. Delivery of forms to every household begins on 23 June, and collection of the completed forms will be done between 1 and 12 July.

The processing center for the 1981 Census is located in Melbourne (it was in Sydney for the 1976 Census processing), and ABS will use the same technology used for 1976: coded data will be transcribed onto machine-readable forms that will be read by Universal Document Readers linked to ICL 2903 and 2904 computers. The ABS does not plan to release preliminary counts; the first results to be published will appear in March 1982.

UNITED STATES

☑ Mr. Howard G. Brunsman, a pioneer in the development of computer processing techniques for census data, died 18 April 1981 in Dacca, Bangladesh, where he had just completed an assignment for the United Nations as advisor on computer processing for the 1981 Census of Bangladesh. He was 76 years old. As Chief of the U.S. Census Bureau’s Population Division from 1948 to 1966, he was responsible for planning the content of the U.S. population censuses of 1950, 1960, and 1970. From 1966 until his retirement in 1970 he was Special Assistant to the Director of the Census Bureau. He was advisor to the U.S. delegate to the United Nations Population Commission from 1957 to 1965, and he was consultant to census organizations in many countries, among them Nigeria, Nicaragua, Guatemala, Uganda, Malawi, and Honduras.

One of Mr. Brunsman’s most notable achievements was the development of CENTS (Census Tabulation System), one of the first computer packages for tabulating census and survey data. He also worked on COCENTS, the COBOL version of CENTS. More recently he played a major role in developing the CONCOR (Consistency and Correction) program for POPSTAN, the U.S. Census Bureau’s case study for 1980 censuses. Tabulation packages have made census processing possible for countries that lack the expertise to produce programs of their own.

Mr. Brunsman was well known to staff and participants of the East-West Population Institute. He contributed to numerous conferences and workshops and acted as consultant on several occasions. His contributions were many, and he will be greatly missed, both professionally and personally.
Regression Estimates of Mortality from Incomplete Death Registration

by Subbiah Gunasekaran, James A. Palmore, and Robert W. Gardner

Two common summary indices of population mortality are the crude death rate (CDR) and the expectation of life at birth ($e_0$). Since the CDR depends on the age structure of the population as well as on the age-specific death rates, its use for comparing mortality levels between countries or in one country over an extended time period may be misleading because of differences in age structure. The life expectancy at birth, on the other hand, is completely determined by age-specific death rates, does not depend on the population's age structure, and hence is often recommended for studies of mortality trends and differentials. Unfortunately, the data requirements for the computation of $e_0$ are rigorous. For any fixed time interval, the age distribution of both population and deaths is required. These data, even if complete, may need smoothing before the life table can be constructed.

Because of the stringent data requirements, the calculation of $e_0$ is problematic in most developing nations, where registration of vital events is incomplete or inaccurate or both. In such cases, one must use indirect methods to estimate life expectancy. Two types of indirect estimation are common. The first type is based on theoretical relationships between fertility, mortality, and the age distribution in stable and quasi-stable populations (examples are found in Preston and Hill, 1980; United Nations, 1967, 1968; Carrier and Hobcraft, 1971; Brass, 1975; and Brass and Swamy, 1980). The second type of indirect estimation relies on methods independent of the stability assumption. These methods, instead, use regression equations based on populations with reliable data and subsequently apply the equations to populations with unreliable data. More specifically, relationships are established between life expectancy at birth and certain other easily computed indices, and these relationships are then used to estimate $e_0$ for countries with inadequate data. Peter Mazur (1972), for example, used a regression model to estimate $e_0$ for the Soviet Union and its subregions. This model was later refined and applied to a wider range of nations in two technical notes in this publication (then known as the Asian and Pacific Census Newsletter): Swanson and Palmore, 1976, and Swanson, Palmore, and Sundaram, 1977. The utility of the refined model was demonstrated by the reasonably close agreement between model-derived estimates and known figures for countries with reliable data.

This paper also uses a regression approach to estimate life expectancy at birth, but employs as input parameters a set of data different from that required in the Swanson and Palmore equations. The Swanson and Palmore techniques require two parameters: the crude death rate and the percentage of the population 65 years of age or older. To use the techniques proposed here, the crude death rate is not needed; instead, one needs to know the death rates in several age categories—but the death registration need not be complete. The present model, therefore, attempts to use incomplete vital registration to estimate what the complete vital data would be. Several previous attempts along the same lines are discussed below.

Other Methods that Use Vital Statistics to Estimate Mortality

One method that uses vital statistics registration data for estimating mortality was developed by Carrier (1958). In a stationary population, only the distribution of deaths is needed to compute a life table. The proportion of deaths beyond age $x$ is the same in a period as in a cohort; hence it provides estimates of $l_x$ (when $l_0 = 1$) values of the life table directly, and from these $e_0$. If underregistration is uniform at all ages, underregistration does not affect computed values of $l_x$. If the population is not stationary but is stable and the growth rate $r$ is known, the relative deaths in each age group can be adjusted by multiplying the proportion by $e^{-rx}$. The method depends on the validity of three assumptions: (1) age reporting of deaths is accurate; (2) the growth rate has been constant; and (3) the proportion underregistered is the same at all ages.

This technique was modified by Brass (1975) using additional information on the population age distribution. Brass's method is based on the basic demographic equation in a closed population, $r = b - d$, where $r$ is the growth rate, $b$ the birth rate, and $d$ the death rate. It follows that for people beyond age $x$,

$$d(x+) = (bx+) - r(x+)$$  \hspace{1cm} (1)

where $d(x+)$ is the death rate of the population beyond age $x$, $r(x+)$ is the growth rate of the population beyond age $x$, and $b(x+)$ is the rate at which the population arrives at age $x$.

If death registration is incomplete, Equation (1) may be written as:

$$f[\hat{d}(x+)] = b(x+) - r(x+)$$  \hspace{1cm} (2)

where $\hat{d}(x)$ is the death rate over age $x$ according to the death registration statistics and $f$ is a correction factor for the underregistration of deaths. Equation (2) can be rewritten as:

$$\hat{d}(x+) = \frac{1}{f} [b(x+) + r(x+)]$$  \hspace{1cm} (3)

In a stable population the rate of increase is the same at all ages, so that $r(x+) = r$. If the proportion of deaths that is underregistered is the same at all ages, $1/f$ can be estimated by plotting $\hat{d}(x+)$ against the $b(x+)$ values for each age: the slope of the straight line provides an estimate of $1/f$. This method was improved by Martin (1978, 1980), who used simulation procedures for estimation when the population is undergoing destabilization and underregistration is not uniform at all ages.

Other methods use the ratio of deaths in specific age categories to estimate the crude death rate. One such method (Fargues and Courbage, 1972) involves the following procedures: Age-specific death rates from a number of countries similar to the country of interest and in which death registration is reasonably complete and accurate are applied to the age distribution of the country of interest. Crude death rates and
ratios of deaths over 60 years of age to those over five years of age are calculated. The latter ratios are plotted against the corresponding crude death rates and a line is fitted. The crude death rate of the population of interest is estimated by calculating the ratio of deaths of those 60 and over to deaths of those five and over from registration records and applying this ratio to the relationship established. Results from this method depend on which countries are selected for calculating the first relationship and upon the completeness of death reporting at ages beyond 50 years.

Another method uses the same principle but estimates the relationship between the crude death rate and the ratio of deaths in different age categories directly from sample registration data pertaining to different states in India, where the age distribution does not vary much between states (Gunasekaran and Krishnamurthy, 1974). This method uses the data on deaths beyond five years of age only and assumes that the rate of incompleteness is constant beyond five years of age. For obvious reasons, the equations developed using the Indian data are inappropriate for other populations.

This paper describes a method using ratios of death rates in broad age categories, instead of ratios of deaths, to estimate life expectancy at birth under two alternative assumptions: (1) the proportion of incompleteness of death registration is the same at all ages; or (2) the proportion of incompleteness of death registration is the same at all ages over five years. The validity of the first alternative is clearly questionable, since registration of deaths of children under five has frequently been observed to be less complete than that for older ages. There is, however, evidence to suggest that the second assumption is more reasonable (e.g., Arnold and Kuhner, 1977).

The Models and the Rationale: Estimating \( e_0 \)

The basic rationale for our method derives from empirical observation. Careful study of mortality experience in several countries with reliable data indicates that when mortality falls from high to low levels, the changes in death rates are more drastic (in absolute terms) in childhood and at older ages, relative to the ages between the two extremes. This phenomenon was very succinctly summarized by Coale (1972) in observing differences among age-specific death rates in model life tables of the same family and sex. The changes follow a U-shaped pattern by age, and this pattern consists of three components: (1) relatively large absolute changes in death rates at ages 0–5; (2) relatively small changes at ages 5–45; and (3) relatively large changes at ages over 45.

This characteristic pattern of mortality change implies that the ratio of death rates in these three broad age groups should also suggest the level of mortality in the population. Based on this premise, we developed regression equations with life expectancy at birth as the dependent variable and several ratios of death rates in different age groups as independent variables, using the 96 life tables belonging to Coale and Demeny (1966) model life table families. For reasons that are unclear, these equations yielded grossly inaccurate estimates, even for countries with good data.

We then tried, more successfully, to base the regressions on the real populations given in Keyfitz and Flieger (1968). We considered the following broad age groups: 0–4, 5–14, 15–49, and 50 and over.\(^1\) The death rates in these age groups for 280 populations of at least 1,000,000 persons were used in varying combinations to arrive at the best-fitting models for males and females separately. Because the populations involved varied in size, we used a weighted regression procedure (see Draper and Smith, 1966) in computing these models, the weights being the sizes of the populations included. The models thus calculated are given below:

\[
e_0^m = 76.6970 - 0.1005 \times \frac{sM_{50}^m}{M_{50}^m} \times 100 - 1.0840 \times \frac{35M_{50}^m}{M_{50}^m} \times 100 + 0.0058 \times \left( \frac{35M_{50}^m}{M_{50}^m} \times 100 \right)^2
\]

\( R^2 = 0.9579; \) standard error of estimate = 2.6052

and

\[
e_0^m = 77.4061 - 1.2420 \times \frac{19M_{50}^m}{M_{50}^m} \times 100 - 1.2939 \times \frac{35M_{50}^m}{M_{50}^m} \times 100 + 0.0153 \times \left( \frac{35M_{50}^m}{M_{50}^m} \times 100 \right)^2
\]

\( R^2 = 0.9317; \) standard error of estimate = 3.0201

**Females**

\[
e_0^f = 81.6884 - 0.1125 \times \frac{sM_{50}^f}{M_{50}^f} \times 100 - 1.1446 \times \frac{35M_{50}^f}{M_{50}^f} \times 100 + 0.0020 \times \left( \frac{35M_{50}^f}{M_{50}^f} \times 100 \right)^2
\]

\( R^2 = 0.9736; \) standard error of estimate = 2.2156

and

\[
e_0^f = 82.3084 - 1.4708 \times \frac{10M_{50}^f}{M_{50}^f} \times 100 - 1.5162 \times \frac{35M_{50}^f}{M_{50}^f} \times 100 + 0.0296 \times \left( \frac{35M_{50}^f}{M_{50}^f} \times 100 \right)^2
\]

\( R^2 = 0.9597; \) standard error of estimate = 2.6198

where \( e_0^m/e_0^f \) are male/female life expectancies at birth, respectively, and \( M_{x} \) is the death rate for ages \( x \) to \( x+n \).

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1 To conform with Coale's description of mortality patterns, we might have chosen age 45 as the old-age cutoff point, but this would have precluded the application of these models for several developing countries where registered deaths are tabulated in ten-year age groups. To allow wider application, we therefore used age 50 as the old-age cutoff point.
Equations (4) and (6) assume a constant rate of underregistration at all ages. Equations (5) and (7) assume a constant rate of underregistration only at ages five and over.

Application of the Procedure

The above models were first applied to 43 populations with reliable data. Resulting estimates of \( e_0 \) are given in Table 1. Two sets of estimates are presented, based on the alternative assumptions about registration completeness mentioned earlier. Estimates obtained using the procedures explained in Swanson, Palmore, and Sundaram (1977) are also shown for comparison.

The two sets of equations give good results, and neither is clearly superior in estimating \( e_0 \) when the figures are compared to the United Nations estimates from the 1976 Demographic Yearbook. Ratios of our estimates, using Equations (5) and (7), to UN estimates range from 0.91 to 1.08 for males and from 0.89 to 1.10 for females. The closeness of the estimates is, in fact, surprisingly good when one considers the large number of factors that could lead to differences.

The standard error of estimate is, of course, a primary source. With a standard error of estimate around 3 (3.0201 for Equation (5) and 2.6198 for Equation (7)) and a life expectancy of 60, the ratios for the 95 percent confidence interval would be 0.90 to 1.10—which is not far exceeded by the observed range. A second reason for differences is that the time period for our estimates and those of the UN are not always the same. A third reason may be that data for our estimates refer to only one year, whereas in some countries (e.g., the

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<tr>
<th>Country</th>
<th>( e_0 ) in years for males</th>
<th>( e_0 ) in years for females</th>
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<tr>
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<td>70.0 (1971-73)</td>
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<td>74.2 (1971-73)</td>
</tr>
<tr>
<td>France</td>
<td>64.4 (1971-73)</td>
<td>74.2 (1971-73)</td>
</tr>
<tr>
<td>Germany, D.R.</td>
<td>64.4 (1971-73)</td>
<td>74.2 (1971-73)</td>
</tr>
<tr>
<td>Germany, F.R.</td>
<td>64.4 (1971-73)</td>
<td>74.2 (1971-73)</td>
</tr>
<tr>
<td>Greece</td>
<td>64.4 (1971-73)</td>
<td>74.2 (1971-73)</td>
</tr>
<tr>
<td>Hungary</td>
<td>64.4 (1971-73)</td>
<td>74.2 (1971-73)</td>
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<td>Ireland</td>
<td>64.4 (1971-73)</td>
<td>74.2 (1971-73)</td>
</tr>
<tr>
<td>Italy</td>
<td>64.4 (1971-73)</td>
<td>74.2 (1971-73)</td>
</tr>
<tr>
<td>Netherlands</td>
<td>70.0 (1971-73)</td>
<td>74.2 (1971-73)</td>
</tr>
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<td>Norway</td>
<td>64.4 (1971-73)</td>
<td>74.2 (1971-73)</td>
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<td>64.4 (1971-73)</td>
<td>74.2 (1971-73)</td>
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<td>Portugal</td>
<td>64.4 (1971-73)</td>
<td>74.2 (1971-73)</td>
</tr>
<tr>
<td>Romania</td>
<td>64.4 (1971-73)</td>
<td>74.2 (1971-73)</td>
</tr>
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<td>Spain</td>
<td>64.4 (1971-73)</td>
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<td>74.2 (1971-73)</td>
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<td>New Zealand</td>
<td>64.4 (1971-73)</td>
<td>74.2 (1971-73)</td>
</tr>
<tr>
<td>Australia</td>
<td>64.4 (1971-73)</td>
<td>74.2 (1971-73)</td>
</tr>
</tbody>
</table>

NOTE: Equations 4 and 6 incorporate death rates below age five; Equations 5 and 7 do not.
  a Calculated according to the procedures in Swanson, Palmore, and Sundaram (1977).
  b Figures in parentheses indicate year or years to which UN estimates relate.
  c For Fijian population only.
### Table 2: Estimates of Life Expectancy at Birth ($e_o$) for Countries or Areas with Poor Registration

<table>
<thead>
<tr>
<th>Country</th>
<th>$e_0$ in years for males</th>
<th>$e_0$ in years for females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Equation 4</td>
<td>Equation 5</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Algeria</td>
<td>1965</td>
<td>47.4</td>
</tr>
<tr>
<td>Angola</td>
<td>1961</td>
<td>39.4</td>
</tr>
<tr>
<td>Ghana</td>
<td>1970</td>
<td>43.8</td>
</tr>
<tr>
<td>Kenya</td>
<td>1969</td>
<td>42.7</td>
</tr>
<tr>
<td>Liberia</td>
<td>1971</td>
<td>35.4</td>
</tr>
<tr>
<td>Libya</td>
<td>1972</td>
<td>58.2</td>
</tr>
<tr>
<td>Honduras</td>
<td>1961</td>
<td>47.2</td>
</tr>
<tr>
<td>Kenya</td>
<td>1970</td>
<td>57.5</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>1960</td>
<td>49.3</td>
</tr>
<tr>
<td>Panama</td>
<td>1970</td>
<td>60.4</td>
</tr>
<tr>
<td>Colombia</td>
<td>1972</td>
<td>65.0</td>
</tr>
<tr>
<td>Ecuador</td>
<td>1971</td>
<td>56.9</td>
</tr>
<tr>
<td>Paraguay</td>
<td>1970</td>
<td>60.5</td>
</tr>
<tr>
<td>Peru</td>
<td>1970</td>
<td>64.3</td>
</tr>
<tr>
<td>Venezuela</td>
<td>1970</td>
<td>53.8</td>
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<tr>
<td>India</td>
<td>1970</td>
<td>57.9</td>
</tr>
<tr>
<td>Iraq</td>
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<tr>
<td>Jordan</td>
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<td>Kuwait</td>
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<td>Korea, South</td>
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<tr>
<td>Kuwait</td>
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</tr>
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<td>Philippines</td>
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<tr>
<td>Sabah</td>
<td>1970</td>
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<td>Sarawak</td>
<td>1970</td>
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<tr>
<td>Syria</td>
<td>1964</td>
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</tr>
<tr>
<td></td>
<td>1970</td>
<td>62.3</td>
</tr>
</tbody>
</table>

na—Not applicable.  
c—Cannot be calculated.

* Figures in parentheses refer to year of U.N. estimates.
* c—Estimates for both sexes.
* Estimates of life expectancy at birth for 25 countries known to have incomplete death registration are shown in Table 2. The table also shows the United Nations estimates of $e_0$ for these countries. Ratios of our estimates to the UN estimates for male and female $e_0$, respectively, range from 0.83 to 1.23 for males and from 0.83 to 1.53 for females. A perusal of Table 2 also indicates that the estimates of $e_0$ obtained from the models that do not use death rates for children under five are usually closer to the UN estimates than the ones that use rates for this age group. This seems to support the view that underregistration of deaths may be more prevalent in the age range 0–4 than in older ages for most of the countries, and we therefore feel it is less hazardous to use the model that does not include the 0–4 age group. We would like to reiterate here that pooling of deaths for more than one year would undoubtedly have resulted in more accurate estimates.  

A logical extension of the above approach would be to similarly compute a regression equation with the crude death rate as the dependent variable and life expectancy (or a function of it) and one or more age structure variables included among the independent variables. If such an equation were...
available, then estimates of life expectancy obtained from Equations (4) through (7) could be used to provide an estimate of the crude death rate. The registered crude death rate could then be divided by the estimated crude death rate to get a measure of the completeness of registration. We have experimented with several models of this kind, but none has yielded satisfactory results to date.

Summary and Conclusions
Regression models using data from 280 populations listed in Keyfitz and Flieger (1968) have been used to develop a procedure to estimate life expectancy at birth using incomplete vital registration data under the alternative assumption of constant rules of incompleteness at (1) all ages and (2) all ages over five years. The model based on the latter assumption is preferred, since registration is usually less complete at ages below five than at older ages. These models were applied to 43 countries with reliable death registration data and 25 countries with incomplete registration data. The estimates of life expectancy at birth were found to be generally consistent with the UN estimates and Swanson, Palmore, and Sundaram (1977) estimates.

In sum, by use of a tabulation of registered deaths and population by broad age categories, we are able to estimate with reasonable accuracy a commonly used measure of mortality, \( e_0 \). The procedures are applicable regardless of the extent of underregistration under the basic assumption of constant rates of registration completeness at ages beyond five. Application to data for several countries lends support to the plausibility of this assumption and results in fairly accurate estimates of \( e_0 \). This paper also illustrates the importance of exploring empirical relationships between demographic indices and the usefulness of publishing vital registration data on a regular basis, even when registration is very incomplete.

REFERENCES


Mr. Subbiah Gunasekaran is a Ph.D. candidate in the Department of Sociology at the University of Hawaii. Dr. James A. Palmore is a Research Associate at the East-West Population Institute, Director of the University of Hawaii's Population Studies Program, and Professor of Sociology at the University of Hawaii. Dr. Robert W. Gardner is a Research Associate at the East-West Population Institute and Assistant Professor of Public Health at the University of Hawaii.
Fitting the Age Pattern of Infant and Child Mortality with the Weibull Survival Distribution

by Minja Kim Choe

The mortality experience of a human population is most often described by a life table that is not easily summarized by one or two parameters. The Brass model life system is sometimes considered as a two-parameter model, but in actuality it is based not only on two parameters but also on a standard life table, the choice of which is extremely important in applications. When the focus of mortality study is limited to an age range where the age-specific mortality rates change monotonically (e.g., mortality at the older ages), it is possible to find a simple mathematical formula that approximates the age pattern of mortality satisfactorily. One example of such a formulation is the Gompertz function, which is found to fit mortality at older ages quite well. For other age groups, there are no widely used mathematical models.

The purpose of this paper is to model, using the Weibull survivorship function, the age pattern of mortality at childhood ages where mortality decreases monotonically with age.

The Weibull Function

The Gompertz function, with appropriate choice of parameters, can describe mortality that declines with age as well as mortality that increases with age. But it does not fit well mortality at very young ages (i.e., before age two). As is well known, mortality in this age range falls very rapidly with age, then reaches a plateau during late childhood before rising in early adulthood.

Another function that can describe monotonically decreasing mortality at childhood ages is the Weibull function, which has been used in reliability theories and more recently for the analysis of patient mortality (Gross and Clark, 1975). According to the Weibull model, the distribution of survivorship (i.e., the probability of surviving from birth to age \( x \)) takes the form

\[
G(x) = e^{-\lambda x^\gamma}, \lambda > 0, \gamma > 0.
\]  

(1)

The distribution can be identified alternatively by describing the instantaneous force of mortality, or the hazard rate, as

\[
\mu(x) = \frac{-G'(x)}{G(x)} = \gamma \lambda x^{\gamma-1}
\]  

(2)

When \( 0 < \gamma < 1 \), \( \mu(x) \) is a monotonically decreasing function, which suggests application to mortality at young ages. Some examples of Weibull hazard functions are graphed in Figures 1 and 2.

Interpretation of Parameters

From Equation (1), we get

\[
G(1) = e^{-\lambda}
\]

and therefore

\[
\lambda = \frac{1}{e^{-\lambda}}.
\]

Figure 1  Illustrative Weibull Hazard Functions, Based on \( \gamma = 0.2 \) and Variable Values of \( \lambda \)

It is evident from this latter equation that \( \lambda \) rises and falls with infant mortality, and it is evident from Equation (2) and Figure 1 that \( \lambda \) is directly proportional to the hazard rate. Therefore, we shall interpret \( \lambda \) as a level parameter.

From Equation (2), we get

\[
\frac{\mu'(x)}{\mu(x)} = \gamma \lambda x^{\gamma-2}
\]

and

\[
\frac{\mu'(x)}{\mu(x)} = \frac{\gamma^{-1}}{x}.
\]

Therefore, at a given age, for \( 0 < \gamma < 1 \), the relative rate of change of the hazard rate is more highly negative the smaller the value of \( \gamma \). That is, when \( \gamma \) is smaller, child mortality is more concentrated at very young ages. For this reason, we can interpret \( \gamma \) as a shape parameter (note, however, that in general \( \gamma \) also affects the level of \( \mu \), as is evident from Equation (2) and Figure 2). The extreme value of \( \gamma = 1 \) corresponds to a constant hazard rate of \( \mu(x) = \lambda \).

Comparison of Weibull Function with Gompertz Function

The Gompertz hazard function is given as

\[
\mu_G(x) = \alpha e^{\beta x}.
\]  

(3)

When \( \beta < 0 \) it describes a decreasing hazard function. The difference between the Gompertz and Weibull models is seen most clearly when we take logarithms of the corresponding hazard functions. From (3) we get

\[
\ln[\mu_G(x)] = \ln \alpha + \beta x
\]  

(4)
and from (2) we get
\[
\ln[\mu(x)] = \ln(\gamma) + (\gamma - 1)\ln x.
\]  
(5)
Comparing Equations (4) and (5), we see that the logarithm of the
Weibull hazard function is linear in the logarithm of age
whereas the logarithm of the Gompertz hazard function is
linear in age. Thus, for appropriately chosen parameters,
Weibull and Gompertz hazard functions differ in the pace of
change, the Weibull function decreasing more rapidly during
younger ages and more slowly during older ages than the
Gompertz function.

A quick check on how the Gompertz and Weibull models
fit observed life tables can be done graphically as follows.
The Gompertz survival function based on Equation (3) is
\[
\ell_G(x) = e^{-\alpha e^{\beta x}}
\]  
(6)
which transforms to the linear form
\[
\ln \frac{1}{\ell_G(x)} = \ln \alpha + \beta x
\]  
(7)
whereas the Weibull survival function (1) transforms to
\[
\ln \frac{1}{\ell(x)} = \ln \lambda + \gamma \ln x
\]  
(8)
By plotting \(\gamma(x), \ln x\) for the Gompertz model and
\(y(x), \ln x\) for the Weibull model, where
\[y(x) = \ln \ln \frac{1}{\ell(x)},\]
and checking linear trends we can see how well each model fits
the observed life table. Figure 3 shows \(y(x), \ln x\) plots and
Figure 4 shows \(y(x), x\) plots for Japanese and U.S. life tables,
indicating clearly that the Weibull model fits observed life
tables very well while the Gompertz model does not fit well at
very young ages. [In Figure 3, a small discontinuity below age
one (\(\ln x = 0\)) is suggested for the U.S. life tables. This may oc-
cur because mortality below age one in U.S. vital statistics
is reported as proportions of babies born alive dying before spec-
cified ages among all live births, whereas mortality after age one
is reported as the usual period mortality rates, with population
rather than live births in the denominator.]

A number of observed life tables reported in the United Na-
tions Demographic Yearbook (United Nations, 1975) were
fitted to Weibull models with results similar to those shown in
Figure 3.

Applications
1. Interpolation. The extremely good fit of Weibull function
to life table \(\ell(x)\) values for the childhood period suggests that
the parameterization may be used for interpolation of \(\ell(x)\)
values. To see if this application works satisfactorily, 1960
U.S. white female life table values of \(\ell(1), \ell(5),\) and \(\ell(10)\)
were used to estimate \(\ell(x)\) values for \(x = 2, 3, 4\) and \(x = 6, 7, 8, 9.\)

Since the Weibull model has two parameters, a pair of \(\ell(x)\)
values is sufficient to estimate them. Values of \(\ell(1)\) and \(\ell(5)\)
give estimates of \(\lambda = \exp(-3.9203)\) and \(\gamma = 0.0967,\) obtained
by means of Equation (8). These estimates in turn give interpo-
lated values of \(\ell(x)\) for \(x = 2, 3, 4\) shown in Table 1. Similarly,
given \(\ell(5)\) and \(\ell(10)\) values, \(\lambda = \exp(-3.94618)\) and
\(\gamma = 0.11281,\) leading to interpolated values of \(\ell(x)\) for \(x = 6, 7, 8, 9\) shown in Table 1. The two sets of estimated parameter
values are virtually identical, and interpolated \(\ell(x)\) values are
very close to observed values, indicating that the model fits

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**Figure 2** Illustrative Weibull Hazard Functions, Based on
\(\lambda = 0.05\) and Variable Values of \(\gamma\)

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**Figure 3** Test of Weibull Model: \(\ln \frac{1}{\ell(x)}\) Plotted against \(\ln x\)
well. This procedure is very simple, involving just two end points to interpolate intermediate values, and it provides very satisfactory estimates.

2. Inaccurate Data: Taiwan Vital Statistics are known to be quite accurate. However, reported mortality rates for ages under five are thought to be inaccurate owing to such factors as underregistration of neonatal deaths and erroneous computations of age at death (Sullivan, 1971). In this section, it is shown how a life table that may be locally inaccurate can be analyzed and corrected using the Weibull model. The method basically involves extrapolation. Since the Weibull model assumes only two parameters, it is possible to estimate the parameters based on a small number of accurate statistics, and these parameters can then be used to estimate statistics whose accuracies are in question.

Reported life table values for Taiwan in 1970–71 are given in Table 2. The plot of

\[ \ln \ln \frac{1}{\hat{z}(x)} \]

against \( \ln x \) values shown in Figure 5 reveals that the points corresponding to \( x = 1, 2, 3 \) are much below the straight line suggested by subsequent points at older ages, indicating severe relative underreporting of \( iq_x \). It is difficult to make any inferences about other values of \( iq_x \) at this point. After age three, the plot for females approximates a straight line, but the plot for males has a slight inflection.

If reported values of \( iq_x \) are accurate for \( x \geq 5 \), as suggested by other researchers (Sullivan, 1971), the Weibull parameters \( \lambda \) and \( \gamma \) can be estimated using nonlinear regression methods. The estimation of parameters should not be based on \( \hat{z}(x) \) values, since these values reflect cumulative mortality experience before age \( x \), implying that when reported mortality is not accurate for certain age groups, all subsequent values of \( z(x) \) will also be inaccurate.

This problem can be circumvented as follows. According to the Weibull model,

\[ \hat{z}(x) = e^{-\lambda x^\gamma} \]

**Table 1** Life Table Interpolation for U.S. White Females, 1959–61

<table>
<thead>
<tr>
<th>Age (x)</th>
<th>Observed ( \hat{z}(x) )</th>
<th>Estimated ( \hat{z}(x) )</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>98,036</td>
<td>98,036</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>97,904</td>
<td>97,901</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>97,824</td>
<td>97,818</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>97,762</td>
<td>97,757</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>97,709</td>
<td>97,709</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>97,663</td>
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<td>1</td>
</tr>
<tr>
<td>7</td>
<td>97,622</td>
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<td>1</td>
</tr>
<tr>
<td>8</td>
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</tr>
<tr>
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<td>0</td>
</tr>
<tr>
<td>10</td>
<td>97,525</td>
<td>97,525</td>
<td>-</td>
</tr>
</tbody>
</table>

**Hence**

\[ \hat{z}(x+1) = e^{-\lambda x^\gamma} \]

This expression for \( \hat{z}(x) \) is unaffected by the cumulative problems that affect \( z(x) \) and hence provides a satisfactory basis for estimation.

Computer programs such as BMDPAR allow the user to specify the dependent variable (\( iq_x \) in our case) as a function of independent variables (\( x \) in our case) and parameters to be estimated (\( \lambda \) and \( \gamma \) in our case); estimates of parameters are...
Table 2  Reported and Estimated Life Table Values for Taiwan, 1970–71

<table>
<thead>
<tr>
<th>Age</th>
<th>Females</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(\hat{a}_x)</td>
<td>Reported</td>
<td>Estimated</td>
<td>(\hat{z}(x))</td>
<td>Reported</td>
<td>Estimated</td>
<td>(\hat{a}_x)</td>
<td>Reported</td>
</tr>
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<td>100,000</td>
<td>100,000</td>
<td></td>
<td></td>
<td>1,864</td>
<td>2,955</td>
</tr>
<tr>
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<td></td>
<td></td>
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<td>306</td>
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<tr>
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<tr>
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<td>40</td>
<td>40</td>
<td>97,393</td>
<td>96,906</td>
<td></td>
<td></td>
<td>67</td>
<td>67</td>
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<tr>
<td>9</td>
<td>37</td>
<td>37</td>
<td>97,354</td>
<td>96,887</td>
<td></td>
<td></td>
<td>63</td>
<td>61</td>
</tr>
</tbody>
</table>

NOTE: The estimated Weibull parameters are \(\lambda = 0.025\) and \(\gamma = 0.11\) for females and \(\lambda = 0.030\) and \(\gamma = 0.14\) for males. See text for discussion of the fitting method.


obtained by minimization of sums of squares of residuals based on observed data (Dixon and Brown, 1979). Columns 2, 4, 6, and 8 of Table 2 show the results of this estimation procedure. Values of \(\hat{a}_x\) are first estimated on the basis of Equation (9); then \(\hat{z}(x)\) values are obtained recursively as \(\hat{z}(x+1) = \hat{z}(x)(1 - \hat{a}_x)\).

For the female life table, estimates of parameters were based on \(\hat{a}_x\) values for \(x = 5, 6, 7, 8, 9\), and for the male life table, \(\hat{a}_x\) values for \(x = 3, 4, \ldots, 9\). For the male life table, \(\hat{a}_x\) values for \(x = 5, 6, 7, 8, 9\) change unusually little for the level and result in unreasonably small values of \(\hat{a}_x\) for younger ages. The male life table also shows a very abrupt change between \(\hat{a}_3\) and \(\hat{a}_4\) and between \(\hat{a}_4\) and \(\hat{a}_5\), compared with changes at subsequent ages. This observation led to the choice of \(\hat{a}_x\), \(x = 3, 4, \ldots, 9\) for the estimation of parameters.

The comparison of reported and estimated life tables in Table 2 reveals differences similar to those reported earlier by Sullivan (1971). Reported \(\hat{a}_0\) values are much too low and reported \(\hat{a}_x\) values for \(x = 1, 2, 3\) are too high, especially for \(x = 1\). In addition, for males, reported values of \(\hat{a}_3\) and \(\hat{a}_6\) may be too low.

In conclusion, it is evident that the Weibull distribution can be used quite satisfactorily to model the age pattern of early childhood mortality. Application to Taiwan life tables shows how the model may be used to examine and correct locally deficient data. Sometimes the procedure includes steps of trial and error for determining the basis for parameter estimations, but this can usually be done without undue difficulty by careful examination and evaluation of the data aided by information obtained from other relevant sources. Once parameters are estimated, childhood mortality can be described in detail by such statistics as single-year life tables without relying on other model life tables.

REFERENCES


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Papua New Guinea Census (continued from page 2)

mentation was very bulky and took a considerable effort to produce. However, this innovation for PNG seems to have been a great success, and the data quality is far better than expected.

- Tribal fighting did break out in some highland areas during the census. Field staff had to defer the census of these areas until a fight was settled; in some cases a truce was arranged for the duration of the census.

- Considerable effort was put into mapping for urban and rural areas. It was found that the maps were of limited use in the field, particularly in rural areas, as the standard of map reading by enumerators was very low. Local knowledge was the key in rural areas. In urban areas house numbering, the use of aerial photographs, and actually showing enumerators their bound-

Villagers gather at a central point to be censused during the pretest in Madang.

The preliminary field counts for all census units were released on schedule on 30 December 1980. The total population was 3,006,799 persons. Problems have been encountered when comparing the 1980 data to the previous censuses since they were samples and a major adjustment for underenumeration was made to the 1971 data. Moreover, very inadequate records were kept for the two previous censuses. Considerable research work needs to be done on the data, and it is hoped to have the services of an experienced demographer soon.

Generally the results have been very well received. The government has been very pleased also with the operation as an example of how various departments and organizations can work together for a national objective.

Mr. Reginald Gilbert is Census Director for Papua New Guinea. He reports that basic demographic information from the census should be available within two years after enumeration.

The woman above holds a Child Health and Nursing Services card during the 1979 pretest in the Eastern Highlands. (Photograph by Brenda Meagher.)

ary areas and route proved most effective. The maps have proved of great value for planning, however; they are in great demand and have been very well received.

- The census is being processed in PNG for the first time. A Honeywell Level 6 has been purchased with funds from the United Nations Fund for Population Activities (UNFPA), which is paying most of the processing expenses. Considerable problems have been experienced with high staff turnover, inadequate software, and slow machine speeds. Steps are being taken to correct these factors, and it is hoped that processing can be completed only a few months behind schedule.

These family members are answering census questions outside their house in the Eastern Highlands Province during the 1979 Census pretest. (Photograph by Neil Gray.)

Asian and Pacific Census Forum
by Alice D. Harris

ESCAP Releases New Publications

The sixth in its series of country monographs has just been distributed by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). The Population of Nepal (Bangkok: UN ESCAP, 1980) follows earlier population studies of Hong Kong, Korea, Thailand, Sri Lanka, and the Philippines. Work is in progress to complete similar monographs for Bangladesh, India, Japan, Malaysia, and Papua New Guinea. Each country monograph has been prepared in cooperation with country experts and with financial support from the United Nations Fund for Population Activities.

For the Nepal monograph, ESCAP staff worked with the National Planning Commission of Nepal, the Family Planning/Maternal Child Health (FP/MCH) project, Ministry of Health, Ministry of Education, Central Bureau of Statistics, the Nepal Rasta Bank, and Tribhuvan University. The book adheres to the outline of earlier reports: an introductory chapter on the physical geography, history, economy, and society of Nepal is followed by chapters on the growth and distribution of Nepal's population, age and sex composition, ethnicity and religion, fertility, mortality, and marital status. Other chapters address population policy and family planning, population projections, and the implications of population growth for health, education, and welfare. The financial costs to the government of population growth and the impact of law on family life and population policy are covered in the final chapters. Annexes contain evaluations of demographic data available for Nepal.

I found this a very readable monograph, partly because the writing is better than that of earlier country studies, and partly because of the fascination of Nepal itself. This remote nation capped by the snowy Himalayas conveys a sense of romance. (I am sure it seemed far less romantic to the census enumerators who had to climb mountains on foot to enumerate the population!) Despite the difficulties with getting accurate data, there is a great deal of information about Nepal. I would only add that I missed a separate chapter on migration activity, but perhaps this is to appear in another ESCAP publication.

Another new publication from ESCAP is the Review of Demographic Sample Surveys in Asia and the Pacific, 1970-79 (Bangkok: UN ESCAP, 1981). Prepared by Richard Leete, Consultant on Demographic Surveys to ESCAP's Statistics Division, it covers more than a hundred surveys carried out in 17 countries within the region during the 1970s. All are national surveys taken to meet the needs of government policy makers and planners for reliable and timely data on fertility, mortality, and family planning. The data are necessary to assess current and future rates of population growth and to evaluate the effectiveness of family planning programs. The surveys covered topics ranging from family life to economic activity; many of them use new methodologies and procedures to overcome data collection problems.

The aims of the review monograph were “first, to review some of the important methodological issues raised through the design and implementation of demographic surveys based on the survey-taking experience of ESCAP countries, and second, to describe on a country by country basis the various types of demographic surveys that have been conducted.” Most of the surveys collected data on fertility and mortality; some multipurpose or KAP (knowledge, attitudes, and practice of contraception) surveys are also reviewed. The main emphasis is on the different survey strategies used—for example, single-round, multi-round, or multipurpose. Subject content is indicated so that readers will know the kinds of demographic data collected by different types of surveys.

Leete gives a short account of the collection and interpretation of data on births and deaths gathered through civil registration and population censuses so the reader will know the extent of demographic information available in a particular country. This knowledge is essential in planning the type and extent of a demographic survey that will be conducted on a national level. The second chapter of the review discusses the methodological considerations arising from the demographic surveys. Leete recommends three essentials for future surveys: well-trained field staff, short survey questionnaires, and questions that obtain data relevant to meet specific needs.

The rest of the review is a country by country discussion of the surveys, from Australia to Thailand. A bibliography concludes the review. This is an indispensable reference tool for researchers who want to know what surveys have been done in ESCAP countries; it should be in population libraries to help researchers and librarians locate these surveys quickly. Both the Review of Demographic Surveys and The Population of Nepal are available from the Publications Office, ESCAP, United Nations Building, Rajadamnern Road, Bangkok 2, Thailand.

New Monographs Reflect Renewed Interest in Mortality

The determinants and consequences of population growth and the reduction of human fertility have occupied prominent space in the demographic literature of the past decade. Mortality, however, assumed by many to have been dropping steadily in all countries, has received less attention until recently. With the exception of Samuel Preston's monographs, Causes of Death: Life Tables for National Populations (New York: Seminar Press, 1972) and The Effects of Infant and Child Mortality on Fertility (New York: Academic Press, 1978), there have been few noteworthy titles. Now demographers are looking at mortality trends with renewed interest, as is apparent from several new publications. The Great Mortalities: Methodological Studies of Demographic Crises in the Past (Liège, Belgium: Ordina Editions, 1980) contains the revised versions of papers presented at an International Union for the Scientific Study of Population (IUSSP) seminar at Montebello (near Montreal) in 1975. The seminar was organized by the Department of Demography at the University of Montreal in cooperation with IUSSP's Commission on Historical Demography. Seventy-four demographers and historians from 21 countries met in the three-day seminar; one of the problems they addressed was that of identifying and classifying the great mortality crises in mankind's population history.
Thomas Hollingsworth of the University of Glasgow laid the groundwork for the other scholars with his background papers on the definition and measurement of population crises. The other papers used his methodology or struck off in independent directions with varying degrees of success. Most used data from European countries, which have the longitudinal information necessary for doing this kind of historical demography. The recurring pattern of “crises” that emerged in the seventeenth and eighteenth centuries became hardly noticeable in the nineteenth century as better living standards and new medical technologies lowered mortality. I would have liked to see more studies on the mortality crises in the developing world. Das Gupta has covered the Indian famines, but future sessions could incorporate work on Africa, Bangladesh, and Southeast Asia. Peter C. Smith, a Research Associate at EWPI, has examined crisis mortality in the Philippines using parish records, and there should be information for further studies of this nature.

The Great Mortalities was edited by Hubert Charbonneau and André Larose. Papers are in either French or English, and the book includes an international bibliography on mortality crises by J. Dupaquier, T. Hollingsworth, W. Köllman, and N. Sanchez-Albornoz. It can be purchased from Ordina Editions, 5, rue Forgeur, B-4000, Liège, Belgium, for approximately US$45.00.

In 1966 Ansley Coale and Paul Demeny published Regional Model Life Tables in order to provide researchers at Princeton University’s Office of Population Research with a means of estimating population parameters for a study being done on tropical Africa. Since that time, their book has been one of the most heavily consulted reference tools in demographic centers throughout the world. The new interest in mortality decline in developing countries, however, has generated a demand for updated life tables that reflect actual mortality experience in those countries. The last 20 years have also seen the production of data from censuses, surveys, and vital statistics that would permit construction of new tables. In 1975, Professor Guillaume Wunsch, then President of the Department of Demography of the Catholic University of Louvain, suggested to the Development Centre of the Organization for Economic Cooperation and Development (OECD) that this would be a feasible project. Since the Centre was already working on social indicators, they agreed, and in 1976 began the huge task of data collection. More than 100 national statistical organizations were contacted for data, and OECD spent many hours in libraries and consulting with appropriate research institutions and with national and international organizations. Once all the data had been catalogued and analyzed, the OECD issued a three-volume annotated bibliography for Africa, Asia, Latin America, and the Caribbean. The bibliography was sent free to population institutes along with an announcement of the final product, Mortality in Developing Countries (Paris: OECD, 1980), which may be purchased for US$115.00.

The set had numerous authors, among them Julien Conde, Michelle Fleury-Brousse, Dominique Wautersperger, Rémy Clairin, and Guillaume Wunsch. Volume 1 contains the unsmoothed population distributions of developing countries by single years and by 5- and 10-year age groups. Computer-generated population pyramids are included and they show clearly the effect of age-heaping on population structure. Unfortunately, the printed text headings are difficult to read in this section. Volume 2 is bound with Volume 1 and contains raw data on deaths, mortality rates, and life tables developed within the countries themselves. Volumes 3 and 4, also bound into one large volume, contain evaluations of the data and adjustment techniques used on them. The last two volumes (5 and 6) contain the new model life tables themselves and chapters reviewing various mortality models and discussing the data available for the study of mortality.

Evaluation of the multivolume project by demographers is still forthcoming. It should be interesting to read the experts’ opinions as they appear. In the meantime, however, speaking as a population information specialist, I foresee that these new tables will be used by students and researchers alike. The books also gather a great deal of population information on developing countries in one place; those who cannot buy and store censuses of all the countries represented in these volumes will still have access to population distributions and life tables. My only complaints are with format and production matters. Why were Volumes 5 and 6 made several inches smaller than the two earlier tomes? And why wasn’t the print made easier to read throughout? Despite these small concerns, I recommend the purchase of the set by population and statistical libraries. The possibilities these data present for research go beyond the subject of mortality; there is a wealth of data for scholars of many persuasions. The OECD Development Centre could consider updating the information periodically in supplemental volumes. For now, researchers have access to life tables for developing countries that reflect the recent mortality events.

This set of books may be purchased from any local OECD Publications Center or from OECD Publications Office, 2, rue André Pascal, 75775 Paris, Cedex 16, France.

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THE EAST-WEST CENTER is a national educational institution established in Hawaii by the U.S. Congress in 1960 to promote better relations and understanding between the United States and the nations of Asia and the Pacific through cooperative study, training, and research. Each year more than 1,500 men and women from many nations and cultures work together in problem-oriented institutes or on “open” grants as they seek solutions to problems of mutual consequence to East and West. For each Center participant from the United States, two participants are sought from the Asian and Pacific area. The U.S. Congress provides basic funding for programs and a variety of awards; and the Center is administered by a public, nonprofit corporation with an international Board of Governors.

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