Introducing the *Asian and Pacific Census Forum*

by Griffith Feeney

With this inaugural issue I am pleased to introduce readers to the *Asian and Pacific Census Forum,* for which I will be serving as technical editor. Elizabeth B. Gould, editor of the former *Newsletter,* will assume the responsibilities of managing editor of the *Forum* with the next issue.

The objectives of the *Forum* are to promote the effective collection and use of population data by providing an international forum for the exchange of knowledge between countries, by promoting communication between data collectors, data users, and policy makers, and by introducing technical innovations in the analysis of population data in a manner that will promote their practical application. The *Forum* will strive for excellence in academic and technical quality, practical relevance, and general interest and readability. We believe that if the *Forum* fulfills these objectives it will make a significant contribution to the East-West Center goal of promoting mutual understanding and better relations between countries of Asia, the Pacific, and the United States.

As technical editor of the *Forum,* I will be exploring ways to achieve these objectives. Although there is much to learn, two general directions seem clear. We will first of all move to establish new communication channels for reader response to the content, format, and organization of the *Forum.* The *Forum* itself is, of course, a channel of communication from us to you. We have inherited from the *Newsletter* two channels of communication from you to us, the network of *Newsletter* correspondents and the periodic population census conferences that have been held at the Institute over the past seven years. We hope to stimulate even more communication through these channels than we have had in the past, for this communication has been invaluable in producing the *Newsletter* and in planning for the *Forum.* Many of the directions and innovations we are now considering for the *Forum,* for example, resulted from sessions of the Sixth Population Census Conference that took place at the East-West Center last May. A report on this conference, incidentally, is scheduled to appear in the next issue of the *Forum.*

I feel that it would be useful to establish a broader and more continuous input from readers, however, and we therefore plan to establish a Reader Response Department beginning with the next issue of the *Forum.* You are encouraged to send us your reactions to the *Newsletter* and your ideas for the *Forum.* We should like to know, for example, what contents you found most useful in the *Newsletter,* and what general or specific subjects you believe the *Forum* should devote space to. We would welcome your opinions as to the type of organization and style of presentation that will most effectively achieve the objectives we have set for the *Forum.* It will not be possible to publish in the *Forum* all letters received, and those published will be subject to normal editing. I assure you, however, that I will personally read all letters and see that all are answered.

We will also move to secure contributions to the *Forum* from a broad spectrum of persons involved in the collection and use of population data throughout the East-West Center region. We will accordingly be actively soliciting and encouraging the production of material suitable for the *Forum.*

In these areas, and in the others that will no doubt develop as we gain experience in this new enterprise, Ms. Gould and I will be working closely together. News items and announcements such as those that appeared in the *Newsletter* will be an important part of the *Forum.* Ms. Gould will solicit and compile this material as she has in the past, as well as prepare feature articles for publication.
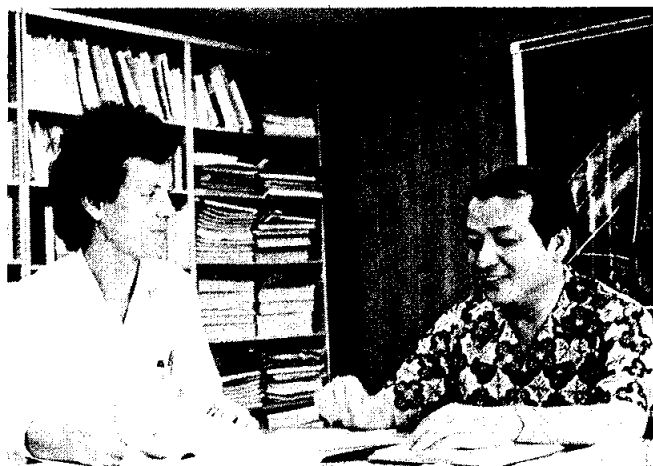
EWPI Director Dr. Lee-Jay Cho (right) *and Dr. Griffith Feeney, technical editor, discuss new directions for the* Asian and Pacific Census Forum.

Over the next year we will be developing editorial policy and procedures for the *Forum.* The details of the policy and procedures are not yet set, but it is possible to indicate some of the directions in which we will be moving. We anticipate that the contents of the *Forum* will fall into five broad categories: data collection, data utilization, data processing and computation, events and activities, and reader response. Within the first three categories may be distinguished presentations of new ideas, reports on practical implementation of new ideas, and expositions of fundamental concepts.

Exhibit 1 suggests a number of potential subject areas for contributions to the *Forum.* With respect to commentary on publications issued by national statistical organizations and other sources, the regular *Newsletter* column by Alice Harris called "Publications That Count" will continue in the *Forum.* With respect to events and activities, we look forward to the continued cooperation of country correspondents.

An important editorial requirement is that all material submitted for publication be typed double-spaced with ample margins. All manuscripts, news items, announcements, and correspondence should be addressed to *Asian and Pacific Census Forum,* East-West Population Institute, East-West Center, Honolulu, Hawaii 96848, USA.

On a more personal note, I would like to express my pleasure in assuming the responsibilities of technical editor of the *Forum.* Since joining EWPI in 1972 I have pursued research in indirect fertility and mortality estimation techniques and have participated in numerous EWPI conferences and workshops.

There is no activity, however, that engages my interest and enthusiasm more than the development of the *Asian and Pacific Census Forum.* I see in it a unique opportunity to develop a publication that will turn human knowledge to useful human purposes, that will bridge gaps between countries, between disciplines, and between theory and practice in an area generally recognized to be of profound significance for the future of us all. I look forward to the challenge and will do my best to meet it.

In concluding, I invite you to send letters to the Reader Response Department. I look forward to hearing from you! □

Exhibit 1 Potential subject areas for contributions to the
Asian and Pacific Census Forum

DATA COLLECTION

(1) Proposals for innovations in data collection processes

(2) Reports of experience with innovations in data collection processes

(3) Reports on publications issued by national statistical organizations

(4) Expositions of fundamental concepts and tools for data collection

DATA UTILIZATION

(1) Presentations of new techniques for analysis of population data

(2) Papers presenting experience with and evaluation of new techniques for analysis of population data

(3) Papers reporting results of research which uses population data

(4) Expositions of fundamental concepts and tools for analysis of population data

DATA PROCESSING AND COMPUTATION

(1) Reports on new computer programs for the collection, processing, and utilization of population data

(2) Papers presenting experience with and evaluation of new computer programs

(3) Expositions of fundamental concepts and tools for data processing and computation

(4) Papers anticipating and assessing the significance of future developments in computer hardware and software

EVENTS AND ACTIVITIES

(1) Notices of events and activities of international interest

(2) Reports on activities of international interest, including reports on East-West Population Institute activities

(3) Notices and reviews of relevant publications

READER RESPONSE

(1) Comments on specific *Forum* pieces

(2) Suggestions for specific or general topics for inclusion in the *Forum*

(3) Suggestions for organization and style of presentation of the *Forum*

Elizabeth B. Gould, managing editor of the Asian and Pacific Census Forum, *is returning to the East-West Population Institute after a year's leave of absence in Australia, England, and Finland. She was formerly Asian and Pacific Census News-letter editor.*

enumerations...

INDONESIA

- Indonesian correspondent Dr. Sam Suharto writes that publications on the 1976 Intercensal Population Survey (SUPAS) and the 1976 National Labor Force Survey are now becoming available. The intercensal survey, carried out in early 1976, consisted of three phases. Phase I, with 257,000 sample households, and Phase II, with 60,700, were conducted throughout Indonesia. Phase III, carried out only in Java and Bali with a sample of 10,500 ever-married women, is part of the World Fertility Survey (WFS).

  Phase I produced age-sex distribution and marital status by subprovincial areas (unpublished) and fertility estimates. The analysis of the fertility estimates has been published by the East-West Population Institute in *Preliminary Estimates of Indonesian Fertility Based on the 1976 Intercensal Population Survey* by Sam Suharto and Lee-Jay Cho (Paper No. 52, May 1978). Publications on Phase II consist of a tabulation series and a monograph series. Three publications of the tabulation series, *Fertility of the Indonesian Population, The Indonesian Labor Force,* and *Demography of the Indonesian Population,* and one in the monograph series, *The Organization and Methods of SUPAS 1976,* have been completed. Two more in each series will be published in the near future.

  A two-volume report of the Indonesia Fertility Survey, based on Phase III, will be available by October 1978. The report will result from collaborative effort between the Indonesian Central Bureau of Statistics and WFS, London. Volume I will contain basic analyses of data on demographic characteristics, nuptiality, family planning, fertility, and mortality. Volume II will contain only complete tabulations.

  Recently published also were two volumes from the 1976 National Labor Force Survey. The survey covered about 96,000 households from 26 provinces. The publications, *The Labor Force Situation in Indonesia* and *Household Conditions in Indonesia,* both refer to September through December 1976.

  Those interested in obtaining any of the above publications should contact the Annual Statistics and Publication Division, Central Bureau of Statistics, P.O. Box 3, Jakarta, Indonesia.

HONG KONG

- Correspondent Joseph M.K. Lee sent a progress report on 1976 By-Census publications and on planning for the 1981 Census of Hong Kong. The main report of the By-Census, which contains detailed analysis and interpretation of demographic, educational, economic, and housing characteristics, has been drafted and is scheduled to be published in October. In preparation for the 1981 Census staff members of the Census and Statistics Department are engaged in consultation with government departments and other users to finalize a proposed list of questions to be included in the census. A census plan formulated on the basis of the consultation will be submitted to the government for approval by November. The results of a feasibility study of the cost-effectiveness of data processing systems being considered for the census will also be included in the plan.

SRI LANKA

- Mr. W.A.A.S. Peiris, Acting Director of Census and Statistics, sent a report on recent developments in the Sri Lanka Department of Census and Statistics. The 1971 Census operations were successfully concluded with the release of the *General Report,* which covers the taking of the census, population growth, distribution and density, internal migration, and age and sex composition. *Census of Population 1971,* Volume II, Part II, covers all-island tables on occupation, industry, employment, and underemployment. Another recent publication is *Sri Lanka Life Tables 1970–72,* which updates the series of life tables published for three-year periods centered on the census years since 1921.

- A timetable for the major operations of the 1981 Census has been established. Preliminary discussions of the objectives and scope of the census are now in progress. A primary goal is attaining greater speed and accuracy than was attained previously. The Department intends to make maximum use of sampling procedures at both the data collection stage and the data processing and tabulation stages. Only basic demographic items will be collected on a 100 percent basis. The topics to be included in the census have not yet been determined. Census data users will be invited to comment on a tentative list of tabulations before the final decision on tabulation plans is made later this year. For 1981 the Department plans to focus special attention on evaluation of the census coverage and the quality of collected data.

  Arrangements are being made to upgrade the IBM 360 model 25 computer presently in use to enable speedier processing of the 1981 Census data. The feasibility of installing data preparation equipment that allows direct feeding of data to the computer is being investigated. Specially developed software packages for census processing will also be used. In the dissemination of census data the early release of preliminary results based on the processing of a 10 percent sample will be given priority.

NEW ZEALAND

- Mr. Michael A. Moore, correspondent from New Zealand, has recently assumed the position of Executive Officer, Population Statistics Section. This section is responsible for the planning and organization of the 1981 Census of Population and Dwellings. Mr. Moore reports that Bulletin No. 13, *New Zealand National Statistics,* will be released in August. It contains 46 cross-classified tables based on the full set of data collected in the 1976 Census.

- As part of the preparations for the 1981 Census all major users of census statistics have been invited to submit topics for the personal and dwelling questionnaires. In the area of field enumeration, decisions are being made on the determination of enumeration districts; the Department of Lands and Survey will then prepare maps for each of the census districts, which will later be divided into subdistricts. Further developments in areal classification are also taking place. Previously only the 24 main urban areas in New Zealand were divided into statistical subdivisions; this practice is now being extended to include other towns with populations of 8,000 or more. At the same time existing subdivisions are being reviewed.

EWPI WORKSHOP EXPLORES CENSUS MAPPING

by Gregory Chu

How does a census bureau begin to prepare enumeration maps for a country composed of 13,000 islands containing 135 million people? How does it ensure that data will be collected in such a way that the small area statistics desired by local governments will be available? These and related issues were explored by individuals involved in census mapping operations in 12 countries at a Census Mapping Workshop held at the East-West Population Institute in Honolulu 21 February–17 March 1978. The workshop was one in a series of Institute census-related activities bringing together Asian, Pacific, and American census officials and researchers to exchange ideas on the conduct and analysis of the 1980 round of censuses. The principal objective of the mapping workshop was to improve the quality of the 1980 round censuses in the region through better mapping of census enumeration units.

Workshop participants considered the elements involved in a census mapping program, map production techniques, mapping practices of the countries represented, and technological innovations that hold promise for census mapping.

Elements of a census mapping program

One of the first steps involved in preparing census maps is the collection and updating of base maps; a base map can be any map containing relevant geographic information. Enumeration maps from previous censuses are often an important component of the base map collection. If previously used enumeration maps are not available, topographic maps are the most desirable as base maps because they are accurate and show easily identifiable land features that can be used to mark the boundaries of an enumeration district. If no topographic maps are available, transportation maps, land tax maps, or malaria eradication maps may be used. If existing base maps are inadequate, enumeration maps can be constructed through surveying or from information gathered from aerial photography, but these methods may be expensive.

When adequate base maps have been collected and updated, enumeration district boundaries are delineated on them. Criteria used in determining enumeration district (ED) boundaries include

- ensuring that enumeration districts coincide with administrative boundaries to make possible tabulated census results by administrative areas

- basing the size of the ED on the average workload of an enumerator and the distance to be traveled

- establishing ED boundaries to correspond with physical features whenever possible to facilitate boundary recognition in the field and thus minimize under or over counting.

Another task performed while the ED boundaries are being delineated is geocoding, the assignment of a unique identification number to each ED. This control mechanism is important for both the field operation and tabulation. Geocoding facilitates keeping track of progress during the enumeration and tabulating data afterward. In a country with a large number of major administrative units, such as the Philippines, which has more than 70 provinces, geocoding is the most efficient way to relate tabulated data to geographic location.

Mr. Gregory Chu, right, is Cartographer at the East-West Population Institute. A native of Hong Kong, he received his M.S. in geography from the University of Wisconsin. Chu coordinated the Census Mapping Workshop reported on in the accompanying article.

Production of census maps

The intended use of a map and the number of copies needed influence the choice of reproduction technique. At the enumeration stage two kinds of maps are used: detailed enumeration maps of each ED showing the extent of the ED, physical features, and in some cases housing units located in the ED that are used in carrying out the census count; and maps of larger areas that are used in central offices or by supervisors for control purposes and for recording of progress.

In many countries represented at the workshop enumeration maps are drafted with pen and ink on tracing paper and reproduced by the diazo process, in which the original map is transferred by a light process to chemically treated paper which is then developed by exposure to ammonia vapor. (The blueprint is an example of diazo processing.) The cost of diazo processing is a few cents per copy. A diazo copy is not permanent but lasts long enough for enumeration purposes. If few copies of an enumeration map are needed (for the enumerator, supervisor, and a district office, for example), this method of reproduction is suitable. If, on the other hand, enumeration maps are intended to be made available to a large number of data users so that they can correlate tabulated data with the location of enumeration units, as in the United States, a more appropriate method of reproduction is offset printing. Mass production of maps compensates for the higher set-up cost of printing so that the price per copy is low.

Instead of acquiring base maps covering the whole country to compile census information, some countries ask their enumerators to make a direct sketch map of the enumeration district each is responsible for prior to the enumeration date. These sketches are made in the field, then checked, corrected, and verified by local officials; they may or may not be redrafted before being given back to the enumerator for use in enumeration. The biggest advantage of this practice is that since the map information is compiled by the enumerator, who does not face the enormous amount of work a central cartographic unit has, a little more time can be spent on the sketch so that details of each housing unit can be included. Sketching the map also gives the enumerator some knowledge of the ED before enumeration begins; it provides a chance to plan the enumeration route, and if the sketch map shows housing units, it may help the enumerator monitor enumeration progress. The cost of a map sketched by an enumerator is likely to be lower than that of an ED map made in a central cartographic unit. A disadvantage is that since there are different enumerators making sketch maps of different EDs, there is a much higher chance of boundaries not matching than if ED maps are made in a central location; nonmatching boundaries may result in double counting or omission. Because any mistake made on the sketch and any oversight on the verifier's part can cause

confusion, especially when no other base maps are available for reference, careful verification by local officials is important. Since the majority of enumerators and local officials are not experienced map makers, the training program for enumerators should include basic techniques in the sketching and interpretation of maps if this method of map production is used.

Census mapping practices in countries represented

For the 1970 Census of Malaysia the Department of Statistics prepared a new set of census maps in cooperation with the Directorate of National Mapping. The enumeration blocks (EBs) were determined several months before the first stage of the census, the housing census. At the beginning of the first stage each enumerator was given a houselisting book containing a map and a description of his EB. Since these maps are not available as base maps for the next census, Malaysia is initiating a new mapping program in anticipation of the 1980 Census.

A similar situation exists in Indonesia. For the 1971 Census, enumerators prepared sketch maps of their assigned areas during the household listing phase held in 1970. Copies of these maps were kept for the enumeration, but not all of them are available now. In instituting a new mapping program for the 1980 Census, Indonesia is interested in developing a set of multipurpose census maps that can be used not only for a population census but also for agricultural, industrial, and economic censuses.

The census organization of Sri Lanka had no central cartographic unit in 1971; local government officers conducted a preliminary listing of buildings prior to enumeration; at the same time they grouped buildings into census blocks and drew a rough sketch map of each census block on the listing form. Recognizing the importance of census maps, Sri Lanka is at present considering establishing a cartographic unit.

For India's 1971 Census, maps of all administrative areas were updated; village and town maps were prepared and areas coded within state, district, and county units. During the houselisting phase a few months before the enumeration, each housing unit was listed on a form and indicated on a map that was used to prepare enumerator assignment areas and then used by the enumerator during the census. Enumerators indicated any discrepancies found in the maps, which were then corrected. For the 1981 Census, the same procedures will be followed; the central cartographic unit is also investigating the potential of mapping innovations.

In the 1973–74 Census of Bangladesh, the Directorate of Land Records and the Survey of Bangladesh prepared maps of each village. Malaria eradication maps, which showed the location of individual houses, roads, and other landmarks, provided detail and recent information. The maps were further updated during the houselisting operation. In preparation for the next census, Bangladesh is experimenting with the use of satellite imagery to identify geographic problems (such as the shifting of river channels) that directly affect boundary representation on census maps.

For the 1970 Census in the Republic of Korea base maps

OWN-CHILDREN FERTILITY ESTIMATES BY DURATION SINCE FIRST MARRIAGE: PRELIMINARY RESULTS FOR CHEJU PROVINCE, REPUBLIC OF KOREA

by Lee-Jay Cho
and Robert D. Retherford

Introduction

The own-children method of fertility estimation is a reverse-survival technique, typically applied to census data, for estimating age-specific fertility in years previous to enumeration (Cho 1973, 1975; Retherford and Cho 1978). Despite difficulties with imperfect data, the method has proved quite useful in developing countries where vital registration data are inadequate. It has also proved useful in developed countries for estimating rates by characteristics. Such rates cannot normally be computed from vital registration data, because detailed characteristics are not ordinarily asked on the birth certificate.

Given that age at or year of first marriage is increasingly asked in censuses, the question arises as to whether or not the own-children method can be extended to estimate rates by marital duration. Such an extension appears indeed to be feasible. Of course, one cannot simply substitute the duration variable for the age variable, because reverse-survival factors are by nature age-specific, not duration-specific. An intermediate step must consist of estimating birth rates specific for both age and duration, which may then be aggregated over age to provide purely duration-specific measures.

This technical note develops necessary methodology and illustrates it with an application to Cheju Province of the Republic of Korea, based on a 25 percent sample from the 1975 Census, which for the first time included a question on age at first marriage. Preliminary estimates of age-duration-specific ever-marital birth rates are computed for the periods 1964–68 and 1969–73. Aggregation produces, for each period, estimates of age-specific ever-marital birth rates, duration-specific ever-marital birth rates, and an ever-marital total fertility rate computed by summing rates over duration instead of age. This latter measure can be interpreted as completed family size for an ever-married woman implied by current duration-specific rates, and as such it constitutes a useful summary measure of ever-marital fertility. Summing over duration instead of age has the advantage of not giving undue weight to the extremely high ever-marital fertility of women aged 15–19, very few of whom have yet married.

Methodology

We have the following definitions:

C_a^x : Number of enumerated own children aged x to $x+1$ of mothers aged a to $a+1$

C_{ad}^x : Number of enumerated own children aged x to $x+1$ of mothers of age a to $a+1$ and duration d to $d+1$

$B_{ad}(t)$: Births over the period t to $t+1$ to women of duration d to $d+1$ who were aged a to $a+1$ at time t

$W_{ad}(t)$: Ever-married women of age a to $a+1$ and duration d to $d+1$ at time t

$F_{ad}(t)$: Single-year central age-duration-specific ever-marital birth rate for the calendar year t to $t+1$

U_a^W : Adjustment factor for census underenumeration and age misreporting of women aged a to $a+1$

U_x^C : Adjustment factor for census underenumeration and age misreporting of children aged x to $x+1$

U_{xa}^C : Adjustment factor for census underenumeration and age misreporting of children aged x to $x+1$ of mothers aged a to $a+1$; computed as

$$(U_a^W U_x^C \sum_x C_a^x)/(\sum_x U_a^W C_a^x)$$

(see Retherford, Choe, and Wanglee 1978 for derivation of formula)

V_x : The reciprocal of the proportion of children aged x to $x+1$ living with their mothers at the time of enumeration

$R_{a \leftarrow b}$: Reverse-survival factor, from age group b to $b+1$ to age group a to $a+1$, for both sexes. If mortality is constant over the estimation period, $R_{a \leftarrow b} = L_a/L_b$, $a < b$, where L_a denotes life table person-years lived between exact ages a and $a+1$. If mortality is changing, then $R_{a \leftarrow b} = \prod_{u=1}^{b-a} [L_{b-u}(t-u)/L_{b-u+1}(t-u)]$, where $L(t)$ is taken from the period life table for year t. $R_{a \leftarrow b}^f$ denotes the reverse-survival factor for females only.

$r_{a \leftarrow b}$: Reverse-survival factor, from age group b to $b+1$ to exact age a, for both sexes. If mortality is constant over the estimation period, $r_{a \leftarrow b} = \ell_a/L_b$, $a \leqslant b$, where ℓ_a denotes life table survivors at exact age a. If mortality is changing, then

$$r_{a \leftarrow b} = \begin{cases} \dfrac{\ell_a(t-b+a-1)}{L_a(t-b+a-1)} \prod_{u=1}^{b-a} \dfrac{L_{b-u}(t-u)}{L_{b-u+1}(t-u)} & , a < b \\[2ex] \dfrac{\ell_a(t-1)}{L_a(t-1)} & , a=b \end{cases}$$

Let us consider W_{ad} and C_{ad}^x at time of enumeration. We denote age at first marriage by A_m. Suppose $a - A_m = 0$. For these women d ranges from exactly 0 up to but not including exactly 1. Hence, we assign them to $W_{a,0}$. Suppose $a - A_m = 1$. For these women d ranges from exactly 0 up to but not including exactly 2. Hence we assign half of them to $W_{a,0}$ and the other half to $W_{a,1}$. Suppose $a - A_m = 2$. For these women d ranges from exactly 1 up to but not including exactly 3. Hence we assign half of them to $W_{a,1}$ and the other half to $W_{a,2}$. The procedure is similar for higher values of $a - A_m$. Parallel assignments are made for the children C_a^x of these women, with children for whom $x > a - A_m$ omitted from consideration. In this way values of W_{ad} and C_{ad}^x at enumeration are obtained.

For time periods previous to enumeration we then have

$$B_{ad}(t-x-1) = \tfrac{1}{2}[C_{a+x+1,d+x}^x + C_{a+x+1,d+x+1}^x] U_x^C V_x r_{0 \leftarrow x}, \; d > 0 \tag{1}$$

$$B_{a,0}(t-x-1) = [C_{a+x+1,x}^x + \tfrac{1}{2}C_{a+x+1,x+1}^x] U_x^C V_x r_{0 \leftarrow x}, \; d=0 \tag{2}$$

$$W_{ad}(t-x-1) = W_{a+x+1,d+x+1}(t) U_{a+x+1}^W R_{a \leftarrow a+x+1}^f \tag{3}$$

$$F_{ad}(t-x-1) = [B_{a-1,d}(t-x-1) + B_{ad}(t-x-1)]/[W_{ad}(t-x-1) + W_{ad}(t-x)], \tag{4}$$

where enumeration is at time t.

To clarify equation (1), consider, for example, the case of $x = 0$. We consider $C^0_{a+1,d}$ concentrated at $d+0.5$ and $C^0_{a+1,d+1}$ concentrated at $d+1.5$. We then consider the average of these two quantities concentrated at exactly $d+1$. Therefore, one year ago the average marriage duration of mothers of these children was exactly d. The births $B_{ad}(t-1)$ over the past year corresponding to these children therefore occurred on average between exact durations d and $d+1$, which is what we desire. Similar reasoning applies to the case of non-zero x.

A special case, given in equation (2), occurs when $d = 0$. Were equation (1) to be used, half the children $C^x_{a+x+1,x}$ in equation (2) would end up assigned to $B_{a,-1}(t-x-1)$. Since this is impossible, given our earlier assumptions, equation (2) simply constrains all these births to $B_{a,0}(t-x-1)$. Note, however, that not all births are being constrained to positive durations. Births corresponding to children for whom $x > a - A_m$ do not appear at all on the left sides of equations (1) and (2).

In equation (4) numerator and denominator are each obtained by an averaging procedure. Multiplicative factors of ½ cancel in the quotient and are not shown.

Duration-specific ever-marital birth rates may be obtained by aggregating numerator and denominator over age before taking the quotient in equation (4). Age-specific ever-marital birth rates may similarly be obtained by aggregating numerator and denominator over duration before taking the quotient in equation (4). Rates for age groups, duration groups, and time periods in excess of one year are easily obtained from the single-year rates by dividing the appropriate sum of numerators by the appropriate sum of denominators.

We may obtain an ever-marital total fertility rate (EMTFR) by summing duration-specific rates over all durations, thereby obtaining a synthetic period measure of completed family size for ever-married women. The summation is straightforward enough for single years of duration up to 15. A minor problem arises, however, in ascertaining the number of years of exposure by which to multiply the duration-specific birth rate for the duration interval 15+. We solve this problem as follows: Let A_m denote mean age at first marriage as before. Since the EMTFR cohort is synthetic, the method for calculating its A_m is to some extent arbitrary. Fortunately the value of the EMTFR will be affected very little by this choice. This is because the duration-specific rate for the duration interval 15+ is very low, and because the range of estimates of mean age at first marriage is usually only a year or two, regardless of what estimation method is used. One alternative is to calculate A_m as the mean reported age at first marriage for ever-married women aged 15–50 in the sample. Another would be to use the singulate mean age at marriage (SMAM). We have opted for the first alternative in computing the preliminary estimates presented later in this paper. We have, finally, for our computation formula

$$\text{EMTFR} = \left(\sum_{d=0}^{14} F_d \right) + [50 - (A_m + 15)] F_{15+} \tag{5}$$

where the summation on the left is over single years of duration. The quantity in square brackets on the right estimates the mean number of years of reproductive life remaining at the point where 15 years of marriage duration is attained.

Some censuses ask, for each child, whether mother is living or dead, allowing simplification of the calculations. Dead women and their children are treated simply as if they never existed, and it is assumed that dead women had the same age-duration-specific fertility while alive as did their contemporaries who survived. Equations (1)–(4) remain the same as before, except that C and W denote smaller numbers, V_x is smaller because of omission of non-own children whose mothers are dead, and the reverse-survival factors for women are set to unity.

Application

The above methodology is illustrated by means of a trial application to Cheju Province of the Republic of Korea, based on a 25 percent sample from the 1975 Census, comprising 135,446 individuals. Life tables, from which reverse-survival ratios were computed, were derived by matching estimates of child survivorship obtained by the Brass method (United Nations 1967) to Coale and Demeny (1966) Model West life tables. The life table level numbers implied by Brass estimates of $q(2)$ and $q(3)$ were averaged to determine the level number of the final life table, which was 19.5, corresponding to a female life expectancy of 66.3 years. Since underenumeration adjustments were not available for Cheju Province, these were all set to unity. The question on mother living or dead was not included in the 1975 Census; hence, it was not possible to use the simplified computational procedure described at the end of the previous section.

Results are shown in Table 1, with rates given by single years of duration for five-year age groups for the periods 1964–68 and 1969–73. The duration-specific rates in the total row of the first two panels are graphed in Figure 1.

Table 1 shows that the ever-marital total fertility rate (EMTFR), as summed over duration, declined slightly between the two periods, from 5,797 to 5,658. This result differs strikingly from the EMTFR summed over age, which increased markedly from 7,380 to 8,305 (these values, which are obtained by summing and multiplying by 5 age-specific entries in the total column in each of the first two panels of Table 1, are not shown in the table). The reason for the large discrepancy between these two results is, as alluded to earlier, that summing over age gives undue weight to the extremely high ever-marital fertility of women aged 15–19, very few of whom have yet married (only 3.5 percent of women in this age group were ever married in 1975). Since the EMTFR summed over age assumes marriage at age 15, whereas the EMTFR summed over duration does not, the two measures in fact have very different meanings. In populations like that of Cheju Province, where age at marriage is significantly greater than 15, the EMTFR summed over duration gives a much more realistic estimate of average completed family size for ever-married women than does the EMTFR summed over age.

Looking more closely at Table 1, we find that change in the EMTFR is a product of offsetting decreases and increases. Ever-marital fertility rose at the younger ages and lower durations and fell at the older ages and higher durations. This pattern is smoother in the marginals than in the body of the table, where the number of cases in individual cells is smaller and the rates more subject to sampling error. Although the regularity of the pattern of changes over age and duration lends credibility to the estimates, the size of the changes at ages 15–19 and at duration zero is large enough to be questionable. As shown in panel 3, estimated ever-marital fertility at duration zero increased by 25 percent and at ages 15–19 by 58 percent. The figure of 58 percent, which is particularly implausible, is of course based on very few women. We shall come back later to examine some possible sources of error.

For each of the two periods, a striking feature of the curve of fertility by single years of duration, graphed in

Table 1 Own-children estimates of age-duration-specific birth rates: Cheju Province, 1964—68 and 1969—73

Period and age group	Duration since first marriage (in years)																Total
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+	
1964—68																	
15—19	246	281	271	*	*	*	*	*	*	*	*	*	*	*	*	*	259
20—24	380	325	331	361	363	376	368	470	341	*	*	*	*	*	*	*	353
25—29	444	364	373	353	335	322	325	328	320	308	313	324	399	417	*	*	338
30—34	285	346	390	327	283	314	312	282	277	274	267	254	238	233	227	223	256
35—39	*	*	*	*	*	*	*	220	311	283	248	229	222	230	207	166	181
40—44	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	77	78
45—49	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	11	11
Total	374	333	348	353	338	328	323	315	301	287	275	256	240	234	216	92	5,797
1969—73																	
15—19	408	388	449	559	*	*	*	*	*	*	*	*	*	*	*	*	410
20—24	460	386	384	370	372	368	336	391	466	*	*	*	*	*	*	*	401
25—29	515	395	378	360	348	342	341	324	312	291	296	278	371	338	*	*	353
30—34	443	304	303	301	336	344	311	282	275	278	261	242	221	213	203	221	258
35—39	*	*	*	*	*	*	308	251	234	216	213	217	205	186	182	144	162
40—44	*	*	*	*	*	*	*	*	*	*	*	*	*	110	87	69	70
45—49	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	7	7
Total	467	386	379	361	352	343	331	306	289	277	259	239	218	199	184	77	5,658
Ratio of 1969—73 to 1964—68																	
15—19	1.66	1.38	1.66	*	*	*	*	*	*	*	*	*	*	*	*	*	1.58
20—24	1.21	1.19	1.16	1.02	1.02	0.98	0.91	0.83	1.37	*	*	*	*	*	*	*	1.14
25—29	1.16	1.09	1.01	1.02	1.04	1.06	1.05	0.99	0.97	0.94	0.95	0.86	0.93	0.81	*	*	1.04
30—34	1.55	0.88	0.78	0.92	1.19	1.10	1.00	1.00	0.99	1.01	0.98	0.95	0.93	0.91	0.89	0.99	1.01
35—39	*	*	*	*	*	*	*	1.14	0.75	0.76	0.86	0.95	0.92	0.81	0.88	0.87	0.90
40—44	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0.90	0.90
45—49	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0.64	0.64
Total	1.25	1.16	1.09	1.02	1.04	1.05	1.02	0.97	0.96	0.97	0.94	0.93	0.91	0.85	0.85	0.84	0.98

* Indicates a rate based on fewer than ten births.

Figure 1, is its smoothness, which suggests that misstatement of age at first marriage may not seriously bias the pattern of fertility by duration. This is not to say that misstatement of age at first marriage does not occur in Cheju Province, only that it does not noticeably manifest itself in this way.

The reason that misstatement of age at first marriage does not seriously distort the estimated pattern of fertility by single years of duration is similar to the reason that misstatement of woman's age does not seriously distort the estimated pattern of fertility by single years of age. To cite an example given elsewhere (Engracia et al. 1977), if, owing to age misstatement, the census or survey shows unusually large numbers of women aged 30, it also shows unusually large numbers of own children to mothers aged 30. Since women aged 29 and 31 have about the same child-woman ratios as women aged 30, heaping on age 30 has little impact on the child-woman ratios for women aged 30. In general, the age patterns of child-woman ratios and derived own-children birth rate estimates for a given year are not affected very much by age misreporting of women, even when this misreporting is severe.

It seems plausible that the same kind of argument should apply to birth rates by duration. Of course, if remarriage is common, and if substantial numbers of remarried women erroneously report age at second or subsequent marriage in place of age at first marriage, the consequences of misstate-

ment of age at first marriage may be more serious. We shall see later that this does not appear to be the case for Cheju Province.

Misstatement of children's ages is a more serious matter than misstatement of women's ages and durations, because heaping of children on, say, age 5 results in own-children estimates of number of births and birth rates in the sixth year previous to enumeration that are too high. It is to minimize the effects of children's age heaping that calendar years are grouped in Table 1 and Figure 1 into two five-year time periods, 1964—68 and 1969—73, corresponding to children aged 2—6 and 7—11. The years 1974 and 1975, corresponding to ages 0 and 1, are omitted because of problems of underenumeration.

Figure 2, which graphs own-children estimates of the TFR and the EMTFR for single calendar years over the same time span 1964—1973, gives some indication of the impact of misstatement of children's ages, which is presumed to account for most of the irregularity of the curve. An unusual feature of the curve is that it indicates heaping on ages 4, 6, and 9, with dips at 5 and 10. This feature, which also characterizes the conventional TFR curve, may stem in part from errors of converting lunar calendar ages into solar calendar ages. Refined adjustments for such errors are being developed in collaboration with the Korean Bureau of Statistics and Princeton University, but have not been used in these preliminary estimates.

Table 2 Own-children estimates of female age-specific proportions ever married for Cheju Province, 1964—1973, based on the 1975 Census (in percent)

Age group	1964	1965	1966	1966[a]	1967	1968	1969	1970	1970[b]	1971	1972	1973
15—19	3.6	3.8	4.1	2.5	4.1	3.8	3.7	3.8	2.9	3.7	3.5	3.4
20—24	52.1	50.7	49.2	48.8	46.7	45.4	45.5	46.6	46.2	48.1	47.8	46.5
25—29	94.9	94.4	94.1	95.6	94.0	93.6	93.2	92.9	93.5	93.0	92.7	92.2
30—34	99.1	99.1	99.1	99.3	99.2	99.2	99.1	99.1	99.1	99.1	99.2	99.1
35—39	99.7	99.6	99.6	99.7	99.6	99.5	99.6	99.5	99.6	99.5	99.6	99.6
40—44	99.9	100.0	99.9	100.0	99.9	99.9	99.8	99.7	99.5	99.7	99.7	99.6
45—49	99.9	99.9	99.9	99.8	100.0	99.9	99.9	100.0	100.0	99.9	99.9	100.0

a   Comparison values from 1966 Population Census Report of Korea, 12-12 Jeju-Do (Cheju Province).

b   Comparison values from 1970 Population and Housing Census Report, Vol. 2 (based on 10 percent census sample).

Figure 1 Own-children estimates of duration-specific ever-marital birth rates for Cheju Province: 1964—68 and 1969—73
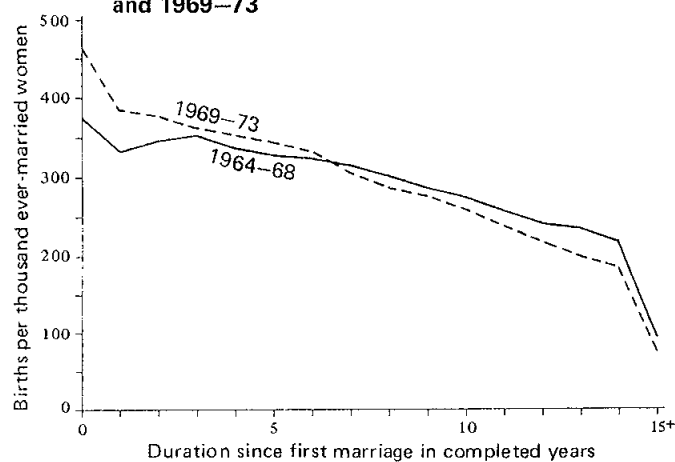
Source: Table 1.

We return now to possible sources of error which might explain why own-children estimates of ever-marital fertility at ages 15—19 increase so dramatically between 1964—68 and 1969—73. It seems unlikely that changes in the timing of marriage and first birth could be an important factor, since age-specific proportions ever-married changed little over the period, as shown in Table 2. A more likely factor is misstatement of age and age at first marriage. That this is fairly common is indicated by the fact that 12 percent of ever-married women aged 15—19 at the time of enumeration reported an age at first marriage greater than their current age. This percentage declines to 4 percent at ages 20—24 and to 0.4 percent at ages 25—29. One would of course expect a sharp decline in the percentage, since the longer a woman is married the greater the gap between her current age and her age at first marriage. The decline in the percentage does not mean that older women are less likely to misstate their age and age at first marriage. Just the opposite is probably true.

Table 3 shows own-children estimates of births to never-married women as a percentage of total births. Births to never-married women are estimated as the difference between own-children estimates of births to all women and births to ever-married women. It seems likely that most of the apparently premarital births are in fact ever-marital, having occurred to mothers of negative marital duration because of misreporting of age and age at first marriage. It is noteworthy that the proportion premarital at ages 15—19 rises, albeit somewhat irregularly, as one goes back in time,

from 6 percent in 1975 to 39 percent in 1964. One would expect this pattern if most of the premarital births were in fact due to age misreporting, because as one goes back in time, fertility at ages 15—19 is based on progressively older enumerated women who are more likely to misstate age and age at first marriage than younger women.

If this kind of age misstatement is indeed occurring, one might expect own-children estimates of age-specific proportions married to underestimate the true proportions, the more so the further back in time. This expectation is par-

Figure 2 Own-children estimates of total fertility rates and ever-marital total fertility rates for Cheju Province: 1964—1973
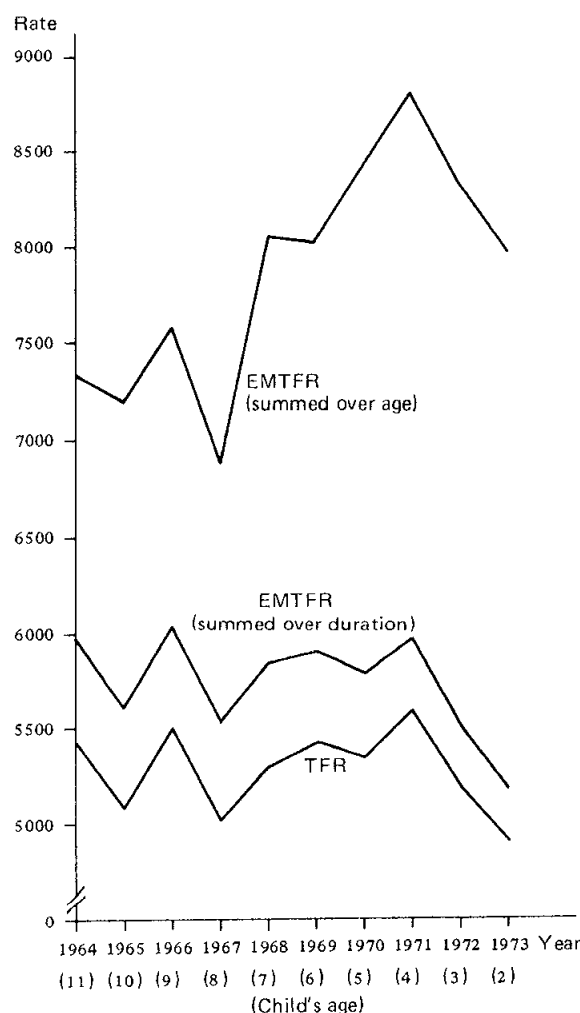
Table 3 Own-children estimates of births to never-married women as a percentage of total births: Cheju Province

Age group	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1964–68	1969–73
15–19	39	34	34	37	22	27	21	22	27	31	24	6	33	26
20–24	11	9	10	9	10	13	11	10	10	10	9	3	10	11
25–29	1	1	1	2	1	1	1	1	2	2	2	0	1	1
30–34	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35–39	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40–44	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45–49	0	0	0	0	0	0	0	0	0	0	0	0	0	0

tially borne out by Table 2, which shows an underestimate of the proportion ever-married aged 15–19 in 1966, relative to the published value in the 1966 Census. But the table also shows an unexpected overestimate for 1970. These comparisons cannot be regarded as conclusive because the small differences in proportions may be obscured by sampling and other types of errors.

In any case, it is not clear what effect the misclassification of ever-marital births as premarital would have on the own-children estimates of ever-marital fertility. If all ever-married women in a given age-duration group are equally likely to misstate age and age at first marriage, this misstatement should have no effect on the own-children estimate of their birth rate, because the women and children mistakenly assigned to negative durations would be characterized by the same child-woman ratio on average as women and children who were correctly assigned to the true positive duration. On the other hand, if women of higher fertility, being generally of lower status with less education, are more likely to misstate age, one would expect disproportionate numbers of them and their children to be mistakenly assigned to negative durations. To the extent that this occurs, the own-children estimates of ever-marital fertility would be increasingly too low the further back from the enumeration date.

But this effect could not be very large. Even if we assume that all premarital births to women aged 15–19 actually occurred to ever-married women of the same age mistakenly classified as single, and that the birth rate of these incorrectly classified women was twice that of the correctly classified women, the proportionate increase in the ever-marital birth rate for this age group between 1964–68 and 1969–73 would be reduced from 58 percent to 51 percent, which still seems implausibly large.

Yet another possible source of error, alluded to earlier, might stem from misreporting of age at first marriage on the part of women in a second or subsequent marriage. It is possible that some of these women mistakenly report age at most recent marriage in place of age at first marriage. But unpublished tabulations from the 1976 National Survey of Fertility and Family Planning, conducted by the Korean Institute for Family Planning, indicate that only 3 percent of currently married Korean women aged 15–49 were in a second or subsequent marriage. If, as seems likely, the percentage for Cheju Province is of the same magnitude, then substitution of age at second or subsequent marriage for age at first marriage among remarried women could not introduce significant error into the own-children estimates.

Conclusion

Based on this preliminary application to Cheju Province, the extension of the own-children method to estimate fer-

tility by duration since first marriage appears promising, though not without some unresolved problems. A further check on methodology is now being conducted using World Fertility Survey data for Korea, the strategy being to compare own-children estimates of duration-specific fertility with parallel estimates derived from pregnancy histories. If results of this additional work are favorable, the method will be applied to all of the Republic of Korea, providing estimates of duration-specific fertility and related measures for the whole country, for major geographic subdivisions, and by socioeconomic characteristics. □

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publications that count...

by Alice D. Harris

Guides to population literature

Participants at the Sixth Population Census Conference held by the East-West Population Institute in Honolulu in May 1978 made several excellent suggestions to improve the reporting of new publications. We hope to be able to incorporate these ideas into future issues of the *Forum*. We would like to include listings of the official statistical publications of countries in the region, if these can be sent to the managing editor. In the meantime, to answer those who wondered how to get general lists of population materials, I would like to supply two references.

One of the most important bibliographical tools for the broad field of population studies is *Population Index*. It is published quarterly for the Population Association of America by the Office of Population Research, Princeton University. The editor is Mr. Richard Hankinson, whose background includes a number of years in the field of population information. *Population Index*, started in 1935 by the late Irene Taeuber, has grown to include more than 19 separate subject areas, among them general and regional population studies, spatial distribution, fertility, nuptiality, mortality, migration, censuses, vital statistics, and population policy. Other areas cover the interrelationships of demographic factors and economics, social institutions, and policy making. Each issue of *Population Index* is arranged by subject with author and geographical indexes. Annual indexes are published as well, and there have been two multivolume sets to cumulate all the years 1935–1969 by author and by geographical region. All citations included (about 1900 per issue) are in English, although some represent publications in different languages. Each citation contains complete bibliographical information; most also contain brief annotations. The *Index* includes books, journal articles, government documents, and recently, selected dissertations. Conference papers and individual chapters in books are listed separately.

The *Population Index* staff regularly consult several comprehensive indexes and bibliographies, the holdings of libraries such as that of the Office of Population Research, and many other reference sources for items to include in each issue. Other features of the *Index* are announcements of new periodicals and professional meetings and profiles of population agencies. Scholarly and technical articles by well-known names in population research are also featured. The October issue may be devoted, as it has been in the past several years, to one subject. For example, the October 1977 issue contains a list of all government serial publications containing vital or migration statistics. This issue can help readers locate the statistical information they need for a given country. The list, which gives the name of the publication, the issuing agency, and the kinds of tables that can be found in the yearbook or report, will be updated in future issues.

Alice Harris is Resource Materials Specialist at the East-West Population Institute. She and her staff maintain the Institute's collection of documentation and reference materials, including a sizable body of census publications. Readers and publishers who have new publications of interest to the readers of the census newsletter may send review copies to Ms. Harris at the Resource Materials Collection, East-West Population Institute, 1777 East-West Road, Honolulu, Hawaii 96848.

In my opinion there is no more comprehensive and useful reference work for the population field. It belongs in every population collection no matter how small. Members of the Population Association of America receive it as part of their membership; others may subscribe for only US$25 a year. Write to Office of Population Research, Princeton University, 21 Prospect Avenue, Princeton, New Jersey 08540, to place a subscription. You will be glad you did!

Another valuable list of population materials is *Sourcebook on Population 1970–1976*. This publication of the Population Reference Bureau (Washington, D.C., 1976, ISBN 0-917136-01-2) contains 900 citations of the major population-related books, monographs, reports, and bibliographies issued in the English language between 1970 and 1976. Although the *Sourcebook* does not contain books in other languages, it includes international, regional, and national studies. It is an excellent buying guide because it contains publication information and prices. Also included are lists of graduate training programs in demography in the United States, major private organizations in the fields of population and family planning located in the United States, population libraries and information sources around the world, and population and family planning programs of the U.S. government and of international agencies. The *Sourcebook* meets the needs of individual researchers and educators as well as population information specialists. To order a copy send US$3.95 to Population Reference Bureau, Inc., P.O. Box 35012, Washington, D.C. 20013.

Census mapping manual available

One of the most important considerations in any census or survey program is the availability of up-to-date, accurate maps. Good base maps are needed for outlining the census enumeration districts; the enumeration district maps in turn are vital to enumerators for the location of households. Recognition of the importance of mapping to the success of census programs has led to a recent increase in workshops and training sessions on mapping. (See the report by Gregory Chu on one such workshop on page 4.) Unfortunately, trainers have lacked sufficient working materials on census mapping. Now, the United States Bureau of the Census, as part of its ongoing series of instruction manuals, has released *Mapping for Censuses and Surveys* (Statistical Training Document ISP-TR-3 and 3W, 1978). This document has been prepared especially for administrators and specialists engaged in planning and implementing censuses and surveys in their countries. It sets forth guidelines and illustrative procedures for a national census mapping program. Written simply and concisely, the document can be adapted to the particular needs and resources of a given country.

The manual is divided into chapters consisting of text and figures. Chapters 1 and 2 are directed to individuals supervising mapping programs. Chapters 3 and 4 discuss elements of interpretation and use of maps and aerial photographs. Chapters 5 through 9 cover the operational steps in map preparation—from making a map inventory and acquiring adequate maps to editing maps and graphs for publication. Chapters 10 and 11 are concerned with the technical aspects of the drafting and reproduction of maps. The next three chapters focus on the handling of problem areas, mapping for sample surveys, and new developments, such as satellite imagery and automated cartography. The final chapter contains a discussion of statistical areas. Appendices contain illustrations of sample materials, such as organiza-

tion charts, map packages, and training exercises, as well as a glossary of mapping terminology. The entire document represents the collaboration of specialists in census and geographical techniques.

The supplementary workbook accompanying the manual can be used as a training tool because the pages can be removed and used as tests. It includes material arranged by chapters in the same sequence as the manual. Exercises in the form of multiple choice or short answer questions and simple computations reinforce the principles and procedures discussed in the manual. The workbook can be used in group training or as a self-teaching aid.

The publication of *Mapping for Censuses and Surveys* supplies a detailed and authoritative resource for the census mapping field, and the Bureau of the Census should be commended for making this resource available. It should enable those involved in census programs to set up guidelines and implement mapping for censuses and surveys in any country. There are a few improvements that might be incorporated into future editions; for example, a bibliography and an index would facilitate the use of the manual. Chapter 14 on new developments might have placed more emphasis on the dangers of attempting to use expensive techniques, such as remote sensing and computer mapping, in countries where the overall census budget is tight. Some of these innovations may not be feasible on a national basis. Another feature that might have added to the value of the manual is a detailed cost breakdown for the implementation of a central mapping program and for alternative, less expensive plans. Although this would have to be in dollars, it would give officials some idea of what to budget for in future proposals. Many of the recommendations in the manual come from the experience of the United States Bureau of the Census; a chapter on how other countries presently handle mapping activities might be included in a revised edition.

These suggestions for improvement aside, the manual and workbook are valuable resources and should be a part of every census collection. To get copies write to International Statistical Programs Center, Bureau of the Census, Washington, D.C. 20233, U.S.A.   □

Census mapping workshop *(continued from page 5)*

were prepared by the Bureau of Statistics and distributed to local government offices, where ED boundaries were delineated on them; houses and other features were added by the enumerators. At the present time, the 1970 enumeration maps are being updated to include split and combined EDs. These updated sketch maps made by enumerators in the field may then be redrawn for uniformity.

In the Philippines, 1960 Census maps were updated for the 1970 Census. A vast collection of maps showing political boundaries of cities, municipalities, municipal districts, and enumeration districts was prepared. Ten-digit geographic codes were used to identify the EDs. The cartographic unit in the National Census and Statistics Office is at present attempting to improve the mapping program by delineating ED boundaries in rural areas more precisely and by solving the problem of matching maps of varying scales drawn by different enumerators.

For the 1970 Population and Housing Census of Thailand enumeration district maps and master maps were prepared. An inspector went to each municipal area to determine the boundaries of EDs; then ED maps showing boundaries, houses, and blocks within an ED were prepared. In nonmunicipal areas, a village was usually considered an ED, except for large villages, which were split into several parts. Maps of nonmunicipal EDs showed village boundaries, im-

portant places, and houses. A master map for each municipal area showed the location of all EDs in the area and one for each district showed all large villages in the district. The same procedure, supplemented by some improvements in the geocoding system, is being followed for the production of enumeration maps to be used in 1980. Thailand is also attempting to obtain photographic equipment that will produce maps of higher quality.

The three Pacific Island areas represented—American Samoa, the Northern Marianas, and the Trust Territory of the Pacific Islands—all have a special relationship with the United States and conduct their censuses in cooperation with the U.S. Bureau of the Census, which assists in map preparation. New census maps produced for the 1974 Census of American Samoa and those used in the 1973 Census in the Trust Territory of the Pacific Islands will be updated for 1980.

Technological innovations

New mapping techniques that show promise for improving census mapping include remote sensing and computer mapping. Remote sensing, which refers to the acquisition of information about an object or a place from a distance, includes aerial photography and satellite imagery. Satellite imagery has not yet been used extensively in the mapping of census districts because of the high cost, but both methods have been used in some countries to assist in the preparation of base maps, to update geographic information, and to assist in the identification of boundary lines.

Although computer programs that generate high quality maps and define enumeration units are available, computer produced maps are not economically feasible for enumeration purposes in most countries at present. Use of the computer may be more appropriate in geocoding and after enumeration in producing large numbers of maps that graphically portray for analysis such tabulated data as the geographic pattern of population distribution. As these new techniques evolve and become less expensive, they may prove increasingly valuable for census mapping.   □