censuses in the south pacific, 1976–77

by Ko Groenewegen

Editor's Note: The 1976–77 period was a busy time for census takers in the South Pacific: ten countries in the region counted their people. In this article, Drs. Ko Groenewegen looks at these censuses, the planning that preceded them, and the cooperative efforts of census planners to standardize concepts and procedures where possible. He compares census schedules, mapping operations, enumeration, and data processing, and he lets us know what publications we can expect as a result of these censuses.

In a further installment, to be published in the Census Forum in May, Groenewegen explores in detail census topics and definitions used by the ten South Pacific countries. He also draws a few conclusions about the recent censuses and offers some suggestions for future improvements.

Census-taking in the island groups of the South Pacific has had a varied history. Some countries (Fiji, for example) had already had their first census by the 1880s, whereas others, such as the New Hebrides, have had only one national census or have never taken a full census (Papua New Guinea). On the whole, the frequency of censuses has been fairly high. Ten of the 20 countries and territories in the region have had between one and four census operations in the 30 years since World War II, and the other ten have been censused from five to eight times.

Countries with a high frequency of censuses have tended to hold them at five-year intervals, whereas those with a low frequency have usually conducted censuses on a decennial basis. In practice, however, censuses have often not been held at regular intervals. Urgent ad hoc needs for information, lack of funds, or priority given to such other activities as elections were reasons to advance or postpone census taking. Nevertheless, there has been a tendency for countries and territories to conduct censuses in years ending in certain digits. The American territories have usually followed the United States pattern in holding censuses in years ending with a zero, whereas most of the other Pacific Island groups have tended to have censuses in years ending with the digits one or six.

It is therefore not surprising that eight of the 20 countries and territories in the region of the South Pacific Commission decided to conduct a census in 1976. Two other censuses originally planned for the same year were conducted in early 1977. Table 1 shows that in the countries involved some 1.3 million of the 4.5 million people in the region were enumerated. At the time of writing, the first detailed census results have just been published. The following paragraphs will therefore deal only with census planning and execution. A detailed evaluation will have to await completion of the final census publications.

The 1976–77 round of censuses in the Pacific Islands was unique in that for the first time an official effort was made to standardize census procedures. Censuses held in earlier years often had aspects in common because they were copied from the same metropolitan example, or because they were designed by the same person. In this respect the name of Dr. Norma McArthur should be mentioned. But the first regional attempt to discuss census planning and standardization was initiated by the Second Regional Conference of Statisticians organized by the South Pacific Commission in Noumea in August 1974.

Realizing the desirability of achieving standardization, participants in the conference very strongly recommended that a Meeting of Census Planners be convened in early 1975. Thanks to the financial support given by the United Nations Fund for Population Activities, the South Pacific Commission was able to organize this Meeting in March 1975.

The participants in this Meeting considered in general terms the desirability of standardization of the 1976–77
round of Pacific censuses and agreed that it was advisable to adopt common concepts, definitions, classifications, forms of presentation, and procedures wherever possible. They considered that this standardization would lead to improvement in the comparability of population census data between the countries and territories of the region and with other regions and would make the most of the scarce resources available for census design and processing.

It was stressed, however, that such standardization would have to be subject to the special circumstances and particular needs of each individual country or territory and that account must be taken of the prime importance of being able to make within-country comparisons with earlier censuses and other surveys. Since the Meeting of Census Planners, ten censuses have been planned and prepared. It is interesting to see what action was taken and to what extent standardization has been achieved.

### Timing of the Pacific censuses

In most countries included in Table 1 the time interval between the 1976–77 Census and the previous one was relatively short. Only Fiji, Nauru, and Tonga adhered to an interval of ten years or more. The seven other countries applied a shorter time interval: three conducted their censuses five years after the preceding census, two (French Polynesia and Solomon Islands) observed a six-year gap, and two others (New Caledonia and Wallis and Futuna) a seven-year gap. The countries following a system of quinquennial intervals acted on existing legislation. By doing so they also responded to the strong preference of the Census Planners' Meeting for “frequent censuses, preferably at about five-yearly intervals.” Frequent censuses were considered necessary because of the rapid population changes taking place in the region, and the five-year time span between censuses was advocated because it allows easy cohort analysis from census to census when the results are tabulated according to the usual five-year age groups.

Because the Meeting considered that the United Nations recommendation of concentrating censuses in or about years ending in zero might jeopardize the availability of outside expertise for the territories in the region, it favored staggering census dates.

### Table 1 Census dates and population figures: South Pacific countries

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<tbody>
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<td>Cook Islands</td>
<td>1 Dec. 1971a</td>
<td>1 Dec. 1976</td>
<td>21,317</td>
<td>18,112</td>
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<tr>
<td>Fiji</td>
<td>12 Sept. 1966</td>
<td>13 Sept. 1976</td>
<td>476,727</td>
<td>566,068</td>
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<tr>
<td>Nauru</td>
<td>30 June 1966</td>
<td>22 Jan. 1977</td>
<td>6,057</td>
<td>7,254</td>
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<tr>
<td>New Caledonia</td>
<td>11 March 1969b</td>
<td>23 April 1976</td>
<td>100,579</td>
<td>132,233</td>
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<tr>
<td>Tonga</td>
<td>30 Nov. 1966</td>
<td>30 Nov. 1976</td>
<td>77,429</td>
<td>90,128</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wallis and Futuna</td>
<td>March 1969</td>
<td>26 March 1976</td>
<td>8,546</td>
<td>9,192</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Western Samoa</td>
<td>3 Nov. 1971</td>
<td>3 Nov. 1976</td>
<td>146,626</td>
<td>151,983</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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a An intercensal count on 1 December 1973 showed a population of 20,348.

b An intercensal count on 23 April 1974 showed a population of 131,686.

### Population censuses in combination with other censuses

Because a census usually involves considerable overhead costs, particularly for travel, the Census Planners' Meeting favored extending inquiry beyond demographic items. It supported the idea of obtaining information on housing, particularly urban dwellings, concurrently with the population census but opposed including agricultural items.

The action taken in the 1976–77 round of censuses did not strictly follow the Meeting's proposals. In the Solomon Islands and Fiji, early plans to introduce housing questions in the census operation were canceled when it became clear from pilot surveys that inclusion of such questions—necessarily accompanied by complex explanations and instructions—would overload the abilities of the available enumerators and might therefore also jeopardize the population census itself. In the Solomon Islands no great need was felt for housing information except for the urban center of Honiara, and a separate urban survey was held there in November 1976. The census instructions in Nauru stipulated that only Nauruan households (approximately 60 percent of the population) were to provide housing information.

The housing topics investigated in the other countries followed the existing UN recommendations to some extent, but numerous exceptions can be found (see Table 2). Many topics were not investigated, especially in the case of Western Samoa. Others, such as the question on “floor space” of houses in the Cook Islands, were added to the UN list. Very popular additions to the list of topics were questions on “capital” goods possessed by the housing unit. Ownership of such items as refrigerators, radios, canoes, boats, and cars was investigated in eight of the ten censuses in the region. These topics, which are more related to households than to occupants of housing units, were included in the questionnaires as socioeconomic indicators. They are expected to show a development trend when they are repeated in later censuses.

Contrary to the proposals of the Census Planners’ Meet—

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Demographer Ko Groenevegen gives us an expert’s look at the ten South Pacific censuses conducted in 1976–77

**Technical notes**
William Brass presents a new way of using census data to detect errors in vital registration

Griffith Fenney suggests a method to correct age heaping on multiples of five

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Census mapping

Alice Harris reports on her visit to Bangkok and some of the new publications she found there

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AFGHANISTAN

- The first national census of Afghanistan is scheduled for July, when more than 10,000 enumerators will count the country's estimated 15 million people. Census plans and copies of questionnaires were brought to EWPIL by Mr. Mohammad N. Nasser, General Director of Design and Analysis in Kabul's Central Statistics Office. Mapping of the villages and pre-listing of households have been completed and a small-scale pilot census has been held, according to Mr. Nasser. A test of the questionnaires and of enumerators' instructions and procedures covered more than 10,000 households in three sectors: urban, rural, and nomadic.

The population will be asked questions about age, sex, relationship to head of household, place of birth, ethnic group, mother language, religion, educational level, marital status, occupation, and fertility. A separate set of questions for urban dwellers inquires about the type of house, heating and cooking fuel, bathroom facilities, and construction materials of house. Nomads and nomadic people will be asked about the locations of their camps in all seasons and how long they plan to stay at each camp. Afghanistan's nomadic population is estimated at about 2.5 million, but the nomads are likely to be stationary during July and thus easier to enumerate.

Because this is Afghanistan's first census, there is an acute lack of experienced and trained personnel to work on the census. In addition, the population is not accustomed to undergoing censuses and must be educated about the necessity of cooperating with census takers. The level of literacy in the country is low, said Mr. Nasser, but most people have access to a radio so census publicity will be concentrated on radio messages.

SRI LANKA

- Planning for the 1981 Census of Sri Lanka is well underway, writes Miss Soma Perera of the Department of Census and Statistics in Colombo. A steering committee chaired by Mr. W.A.A.S. Peiris, Director of Census and Statistics, has studied data requirements of users, and the questionnaire is now being finalized. Sri Lanka is fortunate to have the services of some of the officers who played key roles in the well-conducted 1971 Census as well as a full set of documents from that census.

A novel feature of the 1981 questionnaire is the identification of biological family structure. Individuals will be grouped as members of biological family units to obtain data for comparative studies of family composition and to provide a sampling frame for future surveys on such topics as fertility. Information about physically and mentally handicapped persons will be collected as a prelude to a more detailed sample survey on handicapped persons to be undertaken later by the Social Service Department.

As in 1971, demographic and labor force data will be collected from 100 percent of the population and information on fertility and migration will be asked of a 10 percent sample. A census of housing will be taken along with the census of population. All housing units in urban areas will be enumerated, but samples will be used in rural areas. A postenumeration survey is planned to estimate coverage of the census.

INDIA

- Mr. K.K. Chakravorty, India's Assistant Registrar General, sent news of the pilot test for the 1981 Census of India along with a volume of agenda papers from the second Data Users' Conference, held in New Delhi in December. Following discussions at the first Data Users' Conference in February 1978, a questionnaire was prepared, primarily, for testing the economic questions, and tested in ten states. The results of this pilot study were used in redesigning the entire set of census questionnaires—household form, household establishment schedule, individual slip, and population record—and a pretest was then conducted in most states and union territories during September-October 1978.

Results of the pretest are still being analyzed, but a preliminary appraisal was presented at the December Data Users' Conference. A second pretest is planned. Meanwhile, says Mr. Chakravorty, expert group meetings have been held and analytical studies have been conducted for developing methodology, concepts, and definitions and for determining the sample size.

- Mr. P. Padmanabha, Registrar General and Census Commissioner of India, led the Indian delegation at the second session of the UN ESCAP Committee on Population in Bangkok.

UNITED NATIONS

- The new draft principles and recommendations for population and housing censuses (Document E/CN.3/515/Add. 1-3) have been published by the United Nations. Prepared by the UN Statistical Office with the assistance of the Expert Group on Global Recommendations for the 1980 Population and Housing Censuses, the document has been circulated to national statistical offices to assist them in census planning activities.

The new recommendations omit any reference to a specific year in the title, reflecting the move away from an emphasis on international simultaneity in census taking. They will remain in force until the Statistical Commission considers that revisions are warranted. Another change in the document is the combining of recommendations for population and housing censuses, as is appropriate to a combined operation.

Sections dealing with the operational aspects of population and housing censuses have been substantially revised and expanded to reflect recent technical and policy developments in census taking. Moreover, many revisions have been made to make these portions of the recommendations more relevant to the needs and circumstances of developing countries.

With respect to census content, it was necessary to ensure that the global recommendations would complement rather than supersede recommendations made at the regional level. The Expert Group agreed that "the regional commissions should take the lead in the determination of topics and tabulations."

There is considerable continuity between the present draft recommendations and those adopted by the Statistical Commission for the 1970 round of censuses, particularly with respect to census content. The Expert Group noted that the recommendations on census content remained largely valid for the 1980 census program.
### Table 2 Housing questions asked in censuses of the South Pacific, 1976–77

<table>
<thead>
<tr>
<th>Topics investigated</th>
<th>Cook Islands</th>
<th>Fiji</th>
<th>French Polynesia</th>
<th>Nauru&lt;sup&gt;a&lt;/sup&gt;</th>
<th>New Caledonia</th>
<th>Niue</th>
<th>Solomon Islands&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Tonga</th>
<th>Wallis and Futuna</th>
<th>Western Samoa</th>
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</tbody>
</table>

<sup>a</sup> Questions were asked of Nauruan citizens only. 
<sup>b</sup> A separate survey was conducted in the urban center of Honiara only. 
<sup>c</sup> Question could potentially be answered on the basis of relationship statements. 
<sup>d</sup> Question to be answered by Census Office on the basis of relationship statements.

Half of the countries censused in 1976–77 chose a de facto enumeration (see Table 3). In the Solomon Islands and Fiji no other information about the usual residence of people was collected. Inclusion of this topic in the census questionnaire was considered but eventually discarded, as it was thought that census staff should not be overloaded and that other topics had higher priority. In the Cook Islands and Western Samoa the people were enumerated in the households where they were found on census night. If they happened to be only temporarily present, they were asked to state their usual place of residence. No statement was requested, however, from the heads of households about absent usual residents, so that for these countries only a tabulation of the enumerated population by usual residence and not a truly de jure population can be produced. The census in Niue was basically a de facto census, but additional questions on usual residence of temporarily absent people and on the whereabouts of temporarily absent ones also allow the calculation of a de jure population.

The French territories (New Caledonia, French Polynesia, and Wallis and Futuna) arranged their enumeration according to a de jure approach. In addition, persons temporarily present in housing units were enumerated separately, by usual address, and so were people who were de jure members of housing units but absent for a prolonged period. The latter group included the so-called population comptée à part, which includes people temporarily living away from home in a collective unit, such as members of the armed forces or students in boarding schools. The method, how-

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<sup>b</sup> A separate survey was conducted in the urban center of Honiara only. 
<sup>c</sup> Question could potentially be answered on the basis of relationship statements. 
<sup>d</sup> Question to be answered by Census Office on the basis of relationship statements.

ing, five of the countries conducting censuses (Cook Islands, Nauru, Niue, Solomon Islands, and Tonga) included agricultural questions. These questions were of a very limited and simple nature, however, and were included mainly as a means of obtaining sample frames for future agricultural surveys.

### Sampling methods

All ten censuses of the 1976–77 round were based on a full enumeration of the population. The Meeting of Census Planners had already observed that “apart from Fiji and Papua New Guinea, the countries and territories of the region lacked sufficient population to enable samples to be drawn which would result in worthwhile economies.” But in Fiji, too, a full census was preferred in 1976, because this type of census can portray geographical distribution and cross-tabulation of characteristics in much greater detail than a sampling census. The use of a full census as a solid base for future specialized sample surveys was therefore considered a more efficient approach.

### De facto versus de jure

The Census Planners’ Meeting considered the pros and cons of de facto and de jure methods of enumerating people and concluded that obtaining population by both methods would be desirable, if feasible. It was thought that a de facto count was likely to be more accurate than a de jure one, but that a de jure count was more useful for such administrative purposes as the preparation of electoral rolls.
ever, does not allow the calculation of a de facto population, because short-term absentees from the household are not distinguished. Moreover, persons temporarily present were not tabulated separately, although they were enumerated on separate forms.

The 1976 Census of Tonga was a de jure enumeration: households were required to report members usually living there, including those abroad for given periods of study or work. But no provision was made for distinguishing absent household members from those present on census night, nor were persons temporarily present in a household enumerated separately. Thus, it will not be possible to calculate the de facto population of the various geographical subdivisions. This is unfortunate, because it will be impossible to compare the results of the 1976 census with those of the 1966 census, which was a purely de facto enumeration.

In Nauru the census was conducted on a de jure basis for Nauruan citizens, including long-term absentees. Non-Nauruans, however, were enumerated from a purely de facto point of view.

ENumeration and its preparations

Responsibility for directing the census

A census should be considered as a project of top national importance, and the organization of the census should be at a sufficiently high level to obtain full cooperation from all government departments and sectors of the community. The Meeting of Census Planners suggested that this objective might be best achieved by constituting a census committee whose members had sufficient power to ensure such cooperation. The committee should include the head of the central statistical office or his representative.

In practice, some of the countries participating in the 1976–77 round of censuses made use of census committees, but their composition and scope varied. The function of the census committee in the Solomon Islands, for instance, was restricted mainly to determining the contents of the questionnaire. It had only a limited role in the execution of the project. In Niue, however, the decisions about the contents of the census and its execution were taken directly by the cabinet. In the French territories official census committees were not established, but the officer-in-charge of the census consulted with government departments and representatives of the private sector.

The Census Planners’ Meeting, stressing the importance of each country’s selecting a suitable Director of Census, favored the appointment of an experienced administrator with a good knowledge of the region, who should be advised in census design and analysis by a demographer or a technical expert. In the 1976–77 round of censuses, the head of the statistical office was in charge of most census operations in most countries. Exceptions were Niue, where this task was left to the Secretary of Justice, and French Polynesia, New Caledonia, and Wallis and Futuna, where an officer of the French National Statistical Institute (Institut National de la Statistique et des Etudes Economiques) was in charge. In Nauru the Ministry of Industries and Island Development was given the task of conducting the census.

In some countries—for example, Fiji, Tonga, and Western Samoa—the role of the statistician was mainly a supervisory one, whereas in others the statistician carried a heavy operational load. All countries, except Nauru and Niue, relied on full-time technical assistance from the United Nations, the Ministry of Overseas Development, or metropolitan statistical services. Most of the countries also obtained part-

<table>
<thead>
<tr>
<th>Country</th>
<th>Basic type of enumeration, 1976–77</th>
<th>Additional information, 1976–77</th>
<th>Method in previous census</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cook Islands</td>
<td>De facto</td>
<td>Usual residence if temporarily present</td>
<td>As in (2) and (3)</td>
</tr>
<tr>
<td>Fiji</td>
<td>De facto</td>
<td>Whereabouts of long-term absentees</td>
<td>As in (2) and (3)</td>
</tr>
<tr>
<td>French Polynesia</td>
<td>De jure</td>
<td>Whereabouts of long-term absentees</td>
<td>As in (2) and (3)</td>
</tr>
<tr>
<td>Nauru</td>
<td>De jure for Nauruans; de facto for others</td>
<td></td>
<td>De facto</td>
</tr>
<tr>
<td>New Caledonia</td>
<td>De jure</td>
<td>Whereabouts of long-term absentees</td>
<td>As in (2) and (3)</td>
</tr>
<tr>
<td>Niue</td>
<td>De facto</td>
<td>De jure population</td>
<td>As in (2) and (3)</td>
</tr>
<tr>
<td>Solomon Islands</td>
<td>De facto</td>
<td></td>
<td>As in (2) and (3)</td>
</tr>
<tr>
<td>Tonga</td>
<td>De jure</td>
<td></td>
<td>De facto enumeration</td>
</tr>
<tr>
<td>Wallis and Futuna</td>
<td>De jure</td>
<td>Whereabouts of long-term absentees</td>
<td>As in (2) and (3)</td>
</tr>
<tr>
<td>Western Samoa</td>
<td>De facto</td>
<td>Temporarily present</td>
<td>As in (2) and (3)</td>
</tr>
</tbody>
</table>

Pretesting

The Census Planners’ Meeting stressed the importance of pretesting and full pilot surveys to test all phases of the census operation. Although some kind of pretest or survey was done in all countries involved except Nauru, often only certain elements were tested and not the full range of the census operations. Because code schemes and computer programs were often not available at the time of the pilot survey, these aspects were tested only after the census had been finalized. Moreover, the Meeting’s specification that pilot surveys should be conducted in representative sample areas was not met. The survey areas were generally selected on a purposive basis, partly because the census authorities were satisfied when the census plans proved workable in known problem areas and partly because time was usually not available for the design of a proper sample survey. Nevertheless, pilot surveys proved to be useful because they helped to identify weaknesses not only in the questionnaires and the manuals but also, particularly, in the training of staff. In several cases, the pilot surveys led to improvements and extensions of the training schedules (up to five full days for enumerators in some countries).
It should be noted that in one country (Solomon Islands) a small proportion of the pilot survey interviews were recorded on cassettes, which were then translated, transcribed, and compared with the completed questionnaires. The method provided a good insight into the reactions of the respondents and the error patterns of the enumerators.

Mapping

The needs and problems of mapping for census purposes in the South Pacific region are diverse. Whereas in some islands—e.g., Niue—people live concentrated in stable villages, which are easily accessible and divisible into subdivisions by roads and tracks, people in other islands live dispersed in bush and mountain ranges for which no adequate maps or aerial photographs exist. With this variety in mind, the Census Planners’ Meeting did not consider mapping an appropriate area for standardization. It stipulated as an essential requirement, however, that in order to avoid omissions and duplications, enumerators be supplied with precise maps of their enumeration districts. Most censuses of the 1976—77 round attempted to supply maps, with more or less success.

In places like Niue maps could be drawn in the census office with only a few field checks. But in the Solomon Islands, the four superintendents of census had to patrol their districts intensively during many months in order to establish and map enumeration area boundaries. Even so, it was found that in some areas villages had moved within or over the boundaries of the enumeration area during the time between the cartographic tour of the superintendents and the census enumeration. Name changes of villages were also common. Because enumerators were, if possible, selected for their local knowledge of their enumeration areas, the implications of these changes and movements for the completeness of the census were probably limited.

In the Cook Islands, the enumerators were given not only sketch maps of the demarcation lines of each enumeration area but also the approximate location of listed and numbered households therein. This information had been obtained from previous operations. Rough maps of buildings or households within enumeration areas were also made in the censuses of Niue, Tonga, and Western Samoa.

In Niue these detailed sketch maps had to be produced by the enumerators themselves in a first reconnaissance visit to their enumeration areas, for which boundaries had been established previously. In Western Samoa, each census officer was assigned the task of making a sketch map of the physical features in his census area and of drawing in the buildings in that map, as well as listing them, in order to delineate census blocks of a size that could be enumerated by the assigned enumerators in the available time. In Tonga buildings were also mapped and listed, but, as in Niue, the work was done by the enumerator, not the census officer, and boundaries of the census blocks (enumeration areas) were already fixed before the start of the detailed mapping exercise. In Tonga, numbers corresponding with the numbers on the maps and lists were written by the enumerators on the buildings to reduce further the chances of omissions and double counts. In Fiji, no detailed sketch maps of buildings or households were made, but houses were labeled to indicate that the occupants had been censused. In the French territories detailed mapping was limited to main centers of population.

The size of the enumeration areas varied, but they generally satisfied the Census Planners’ Meeting preference for small areas, which are easier to use later in area sampling. The average population of enumeration areas ranged from about 100 persons in Niue and Western Samoa to about 500 persons in Fiji and New Caledonia. The averages in the Cook Islands, Solomon Islands, and Wallis and Futuna varied between 250 and 350 persons. Naturally, enumeration areas in towns or densely settled and accessible districts contained more people than those in isolated rural regions.

Enumeration

Two main methods of enumerator-population contacts were used. The countries that had opted for a de facto enumeration—Cook Islands, Fiji, Niue, Solomon Islands, and Western Samoa—followed a system that is classic in the South Pacific. It entails enumerators’ enumerating their areas during a short period before census day and subsequently returning to the households immediately after census night to update the information received. Babies born and persons who arrived between the first visit and census night are added, and deaths and departures in the same period are subtracted to arrive at the updated figures.

The periods set aside for the precensus enumeration and the postcensus updating varied from country to country and with the average population per enumeration area, which in itself was partly a function of the availability of suitable enumerators and the opportunity to train them. The range of time available for the first visit was from two days to two weeks (in Niue and the Solomon Islands respectively) and for the updating tour from half a day (in Western Samoa) to seven days (in the Solomon Islands).

The second method applied in the 1976—77 round of censuses consisted of one or more visits by the enumerators to the households beginning immediately after census day. This method was followed by French Polynesia, New Caledonia, Tonga, and Wallis and Futuna, all countries that organized their enumerations on a de jure basis. In Tonga an enumerator only had three days for completing the enumeration, whereas in New Caledonia he had almost a month. The shorter period probably leads to more concentrated and efficient work.

The emphasis generally was on enumeration by interviews rather than on self-enumeration. In Fiji, the Solomon Islands, and Tonga self-enumeration was not officially provided for. In Niue and Western Samoa people were allowed to fill in their own questionnaires on request, whereas in the French territories, Nauru, and Cook Islands both methods were permitted. The interview method is probably most costly because of increased enumerator time, but it still deserves emphasis where populations have limited education and little experience in filling in forms.

Enumeration forms

Basically two types of forms were used. Four countries—Fiji, Solomon Islands, Tonga, and Western Samoa—used a single household form designed to contain all required information on the household and its members, whereas the other countries had separate forms for housing or household information and for each individual. Both approaches had advantages and disadvantages. Lack of printing or writing space, despite large-sized paper (which could be cumbersome in census operations), was an obvious drawback of the single-form approach, but the display of all relevant data about a household and its occupants on a single sheet was very efficient at both enumeration and checking stages. Moreover, this approach lessened the weight of the paper and made life easier for enumerators moving through difficult terrain. It also saved freight costs in forwarding the forms to and from the enumeration areas or to an overseas computer processing center. Single forms, however, impose
limits on the number of questions that can be asked and the way they can be formulated. It is therefore not surprising that the countries that used separate questionnaires for each individual were more or less those that allowed self-enumeration, since individual forms have more space for instructions and explanations to the public.

Postenumeration surveys

The Meeting of Census Planners recognized the value of postenumeration surveys for giving users of census results a measure of the accuracy of data collected. In the discussions at the Meeting, however, there was emphasis on the importance of postenumeration surveys. The survey was to be effective, especially in de facto censuses, postenumeration surveys should be held very shortly after census day. In the Pacific Islands, where there are few people who can act as high-quality enumerators, such timing is not opportune as most of the available people would already be occupied in the census itself. The result is that the postenumeration survey often has to be carried out by people who are hardly more qualified than the original enumerators. The survey will therefore give not a picture of what the census should have shown, but only a second opinion on the demographic situation in the area, which might be closer to the truth than the census but might equally well be further from it.

In Fiji, Nauru, New Caledonia, Niue, and Wallis and Futuna no serious attempt was made to undertake a postenumeration survey. In the Solomon Islands, the supervisors who were overseeing the work of about six enumerators were instructed to enumerate one household of at least five persons in each enumerator area, thus covering a widely scattered sample of about 1.5 to 2 percent of the population. Households were not selected on a strictly random basis, however, and the survey was certainly not independent, as it preferably should have been, because the supervisors were required to explain the discrepancy between their own findings for the surveyed households and those reported for those households by the census enumerators. The "survey" showed a population 3 to 4 percent smaller than the full census and is not considered reliable by the census staff involved.

Data processing

After the completed questionnaires were received in the census office, they were checked for correctness of numbers of enumerator areas, households, and males and females in households. Some countries made an additional manual check of the completeness and accuracy of the information on characteristics of persons and households. In some cases, such as the Solomon Islands and Western Samoa, this check was done to ensure that data that were to be processed overseas would be as free of errors as possible. In other cases (Cook Islands, Nauru, and Niue) the manual check was required because manual tabulations were envisaged.

On all questionnaires, except those of the Solomon Islands and Niue, codes were entered directly on the questionnaires (Table 4). The Solomon Islands Census authorities decided to code on separate code sheets to protect the census materials against loss since the data had to be sent overseas for computer processing at the University of Auckland, New Zealand. Thanks to strict quality control, this system worked well, causing only a low error rate. Coding in Niue was done on small cards, which were initially used for manual sorting. At a later stage this information was entered on computer tape for further tabulation at the University of Canterbury in New Zealand.

Tabulation of the Cook Islands census data was carried out entirely by using margin punchcard needle sorting. This method is generally considered outdated because it lacks flexibility, does not provide satisfactory edit facilities, and requires much tedious work. At the time of the design of the Cook Islands census, however, it was felt that arguments could be made in favor of manual sorting. The amount of time that has to be invested in system analysis and computer programming is proportionally large for small populations and therefore relatively expensive. Moreover, manual processing provides work and keeps in the country funds that have been obtained from international sources, whereas electronic data processing would mean payment to overseas computer facilities. Expected problems of communication with overseas computer centers and extremely slow services provided by such organizations in previous censuses also contributed to the preference for manual processing in the Cook Islands. The decision to use the manual method implied coding of the information of the completed questionnaires by punching appropriate holes in needle-sorting cards.

The questionnaire of Western Samoa was designed for field precoding of most of the census questions, and coding procedures in the census office could have been avoided to a large extent. When it became clear after census day, however, that computer processing had to be done overseas (at the Electronic Data Processing Services of the Fiji Government), it was decided to transcribe codes onto code sheets so as to safeguard the original data against loss during transport.

Coding in the other countries involved in the 1976–77 round of censuses was done on the questionnaires. In Fiji and Tonga, where a limited amount of field precoding was carried out, the codes were written onto the information collected in the field. The questionnaires of the French territories required a fair amount of field precoding and also provided a special area where all the codes had to be written.
Table 4 Processing methods and publications: South Pacific censuses, 1976–77

<table>
<thead>
<tr>
<th>PROCESSING</th>
<th>Cook Islands</th>
<th>Fiji</th>
<th>French Polynesia</th>
<th>Nauru</th>
<th>New Caledonia</th>
<th>Niue</th>
<th>Solomon Islands</th>
<th>Tonga</th>
<th>Wallis and Futuna</th>
<th>Western Samoa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where coded</td>
<td>Questionnaire (in field)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Questionnaire (in office)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Separate codesheets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Punch cards or sorting cards</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Editing</td>
<td>Manual edit</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Computer edit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Computer edit with imputations</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Tabulation</td>
<td>Manual</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Computer, in country</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Computer, overseas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Status of processing</td>
<td>Completed</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

**PUBLICATIONS**

| | Provisional results | x | x | x | x | x | x | x | x | x |
| | Prereleases | x | x | x | x | x | x | x | x | x |
| Census report | Basic tables | x | x | d | b | x | d | d | e | x |
| | Administrative report | b | e | | | b | b | | | |
| Analysis | | | | | x | b | b | | |

a Some preceding on the questionnaires in the census office.
b Planned.
c Releases contained descriptive text.
d In press.
e In progress.

Entry of the census data of the Solomon Islands and Niue onto computer tapes was carried out by means of punch cards. In the other countries using computer processing methods, key-to-tape or key-to-disc (floppy disc) systems were used. No optical reading devices were tried by the South Pacific countries that conducted censuses in 1976–77.

As could be expected, all countries involved in computer processing also applied extensive edit programs. In the programs of Fiji and the French territories, corrections were partially made by imputations based on fixed instructions. For the other countries the data files were cleaned up by manual correction of erroneous records.

By September 1978, all the tabulation work of the countries involved in 1976–77 censuses (except Nauru) had been completed. The speed with which these tasks were performed differed widely in the various countries. The tabulations of the census data of Fiji, New Caledonia, and Wallis and Futuna—countries with direct access to a government computer—were completed in less than a year after the census date. The Western Samoa and Tonga tabulations, processed in Fiji, were available about one year after the census, about the same amount of time required for phase one of the manually processed Cook Islands tables. The tabulations of the Solomon Islands and Niue, processed in New Zealand, took more time, partly because of communication difficulties. In Nauru only manual tabulations have been completed so far.

**Publications**

All countries involved provided provisional figures on the total population and some of its main geographic subdivisions shortly after completion of the enumeration (Table 4). They also released official data on some topics before publishing the main census reports. Those of New Caledonia and Nauru were accompanied by a text providing comments on the published data. The actual census reports of the Pacific Island countries traditionally consist of three elements: basic tables, an administrative report, and an analysis with in-text tables. Volumes containing basic tables of the Cook Islands, Fiji, New Caledonia, and Western Samoa have appeared recently. Volumes for Niue, French Polynesia, Wallis and Futuna, and the Solomon Islands were in press, and the report for Tonga was in progress. Analytical reports were planned or in progress for several countries, but none of them had been published.

Drs. Ko Groenewegen, Demographer for the South Pacific Commission (SPC), earned his doctorandus degree in human geography from the University of Utrecht in the Netherlands. He joined SPC in 1969, where his activities include assisting governments in the region in the design of population surveys and censuses. He is particularly interested in demographic methods for estimating fertility and mortality using incomplete data.
EVALUATION OF BIRTH AND DEATH REGISTRATION USING AGE DISTRIBUTIONS AND CHILD SURVIVORSHIP DATA

by William Brass

A common approach to the evaluation of vital registration data consists of using registered births and deaths by age to estimate numbers of persons alive at single years of age and then comparing these values to the numbers recorded by a census. If all recording is accurate and complete, the number of children under one year of age at a census equals the number of persons born during the past year minus the number of deaths to these persons. This assumes that there is no migration, but even if there is migration, the effect is likely to be very small. Similarly, the number aged one at the census equals the number of persons born in the period one to two years before the census minus the number who have died. Since censuses may be held at any time and registration is usually by calendar years, some adjustments are usually needed. Often it is sufficient to calculate survivors to the census from births in calendar years and then interpolate for census ages, but more refined procedures using births by quarters, months, or weeks are sometimes desirable.

Although this approach is useful, it has serious limitations and has frequently been misleading. The problem is that it does not distinguish between errors in birth and errors in death registration. If both births and deaths are underreported, the latter to a greater extent than the former, the comparison of survivors with census numbers can be spuriously close and comforting. Examples can be quoted from a series of such checks for Pacific Islands.

Survivorship ratios from child survivorship data

To avoid this weakness an independent source of data on births or deaths is needed. Fortunately, a better estimate of child mortality is often available from questions on the number of children born to a woman and the number that are still living. Procedures for estimating mortality from such data are well known, but most of them assume constant mortality prior to the census. A new procedure is given here that does not assume constant mortality and is specifically designed for the calculation of life table $L_X$ values to be used for survivorship or reverse-survivorship purposes.

The procedure may be illustrated by application to the Fijian data given in Table 1. The $P_2/P_3$ value in Table 1 is calculated and used to interpolate in Exhibit 1 to obtain the "standard" proportions of dead children $D_i^f$ shown in Table 1. Exhibit 1 shows proportions of children dead by age group of woman for a particular life table and for a model fertility distribution characterized by the one location parameter, $P_2/P_3$ the ratio of the mean number of children born to women aged 20–24 to the mean number born to women aged 25–29. Since both $D_i^f$ values for given $P_2/P_3$ values are equal for a female of certain age, the logit system gives

$$\logit(D_i^f) = \alpha + \beta x \logit(D_i^q), \quad i = 1, \ldots, 7,$$

where $x = 0.5 \ln x/(1 - x)$. Hence we may fit a straight line to estimate values of $\alpha$ and $\beta$. The logit values for the Fijian data in Table 1 are as follows.

<table>
<thead>
<tr>
<th>Age group</th>
<th>Index</th>
<th>Logit $(D_i^q)$</th>
<th>Logit $(D_i^f)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>15–19</td>
<td>1</td>
<td>-1.3938</td>
<td>-0.9279</td>
</tr>
<tr>
<td>20–24</td>
<td>2</td>
<td>-1.7358</td>
<td>-0.7592</td>
</tr>
<tr>
<td>25–29</td>
<td>3</td>
<td>-1.2662</td>
<td>-0.6731</td>
</tr>
<tr>
<td>30–34</td>
<td>4</td>
<td>-1.1388</td>
<td>-0.6192</td>
</tr>
<tr>
<td>35–39</td>
<td>5</td>
<td>-1.0302</td>
<td>-0.5739</td>
</tr>
<tr>
<td>40–44</td>
<td>6</td>
<td>-0.8994</td>
<td>-0.5248</td>
</tr>
<tr>
<td>45–49</td>
<td>7</td>
<td>-0.7858</td>
<td>-0.4670</td>
</tr>
</tbody>
</table>

These values are plotted by dots in Figure 1, with the exception of the 15–19 age group values, which are omitted because the proportion of dead children for women in this age group is often erratic for sampling and other reasons.

Various fitting procedures are possible and we choose the simplest, considering that more elaborate methods are unlikely to yield superior results. Averaging the logit values for the age groups in the 20–34 and 35–39 age ranges yields two points, plotted by circles in Figure 1, and we take the line passing through these points as the fitted straight line. This leads to the equations

$$-1.2569 - \alpha + \beta x(-0.6883)$$
$$+0.9051 = \alpha + \beta x(0.5219)$$

which give $\alpha = 0.2289$ and $\beta = 2.1729$.

The logit relation is usually operated in the form

$$\logit(1 - L_X) = \alpha + \beta x \logit(1 - L_X)$$

but it can equally well be expressed as

$$\logit(1 - L_X) = \alpha + \beta x \logit(1 - L_X)$$

The $L_X$ values corresponding to the logit system parameters $\alpha$ and $\beta$ may therefore be calculated by

$$L_X = 1 - \text{antilogit} \left[ \alpha + \beta x \logit(1 - L_X) \right]$$
where antilogit $y = \left[1 + e^{-2y}\right]^{-1}$

for any number $y$. For example,

$$L_0 = 1 - \text{antilogit}[0.2289 + 2.1729 \times (-0.5827)]$$

$$= 1 - \text{antilogit}(-1.0372)$$

$$= 0.8884$$

Note that values of $\logit(1 - L_X^I)$ and $\logit(1 - L_X^o)$ are given in Exhibit 2. For the first year of life it is better to determine $L_1$ by the same formula with $L_X^o$ replacing $L_X^I$ and to estimate $L_0$ by

$$L_0 = p + (1 - p)L_1$$

where $p$ denotes a separation factor appropriate to the population, taken as 0.3 in this instance.

Thus $L_0 = 1 - \text{antilogit}[0.2289 + 2.1729 \times (-0.8670)]$

$$= 1 - \text{antilogit}(-1.6550)$$

$$= 0.9648$$

$$L_0 = 0.3 + 0.7 \times 0.9648$$

$$= 0.9754$$

It should be noted that there is no need to assume that the desired $L_X^o$ are values from a single current life table. If child mortality is changing, the $D_t$ proportions of children dead by age group of women will be the outcome of different rates for different cohorts. The method described essentially graduates and interpolates with a convenient function.

**Evaluation of birth registration**

Table 2 shows values of $L_X^o$ for Fijians and Indians calculated by the procedure described in the preceding section. The values of $\alpha$ and $\beta$ for Indians are $-0.3459$ and $1.1836$, respectively. The $L_X^o$ values are then used to calculate “expected” numbers of births from the census age distribution, and these numbers are compared with registered births by calculating ratios of registered to expected births.

A set of registered-to-expected birth ratios that is fairly consistently less than one can generally be taken as evidence of birth underregistration relative to census coverage. Reported births can then be corrected by dividing by the average ratio. More complicated corrections allowing for trends in coverage are theoretically possible but in practice are unlikely to be justified. When the numbers of births have been corrected, the survivorship proportions estimated previously can be applied to give “expected” numbers of deaths experienced by the cohorts. These numbers may then be compared with the corresponding numbers of registered deaths to give estimates of the completeness of death registration for the different birth cohorts. Since such a high proportion of child deaths occurs in the first two or three years of life, the completeness estimates will effectively refer to this age range.

Note that these levels of registration completeness are relative to the census coverage. Where the census provides the population at risk for the calculation of fertility and mortality it is entirely appropriate that completeness of registration should be relative to the census. If, however, the census numbers of children were to be adjusted, the same correction factor would have to be applied, over and above the others, to derive absolute numbers of births and dead.

**Exhibit 2 Logits for calculation of life table survivorship ($L_X^o$) values from child survivorship data**

<table>
<thead>
<tr>
<th>$x$</th>
<th>$\logit(1 - L_X^o)$</th>
<th>$x$</th>
<th>$\logit(1 - L_X^o)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-7.717</td>
<td>8</td>
<td>-5.619</td>
</tr>
<tr>
<td>2</td>
<td>-6.807</td>
<td>9</td>
<td>-5.536</td>
</tr>
<tr>
<td>3</td>
<td>-6.360</td>
<td>10</td>
<td>-5.464</td>
</tr>
<tr>
<td>4</td>
<td>-6.104</td>
<td>11</td>
<td>-5.403</td>
</tr>
<tr>
<td>5</td>
<td>-5.946</td>
<td>12</td>
<td>-5.324</td>
</tr>
<tr>
<td>6</td>
<td>-5.827</td>
<td>13</td>
<td>-5.251</td>
</tr>
<tr>
<td>7</td>
<td>-5.717</td>
<td>14</td>
<td>-5.173</td>
</tr>
</tbody>
</table>

$\logit(1 - L_X^o) = -0.8670$
Table 2  Registered and expected births: Fiji, 1956–66

<table>
<thead>
<tr>
<th>Age at census</th>
<th>Fijian Alive at census</th>
<th>Births Expected</th>
<th>Registered</th>
<th>R/E</th>
<th>Indian Alive at census</th>
<th>Births Expected</th>
<th>Registered</th>
<th>R/E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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<td>10,110</td>
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<td>.903</td>
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<td>10,478</td>
<td>8,966</td>
<td>.858</td>
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<td>10,635</td>
<td>8,755</td>
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<td>9,681</td>
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<td>7,535</td>
<td>8,809</td>
<td>8,654</td>
<td>.890</td>
</tr>
</tbody>
</table>

SOURCE: Zwart, 1968. Census population taken from Table 6, page 66. Registered births obtained by adding male and female values in Table C, page 12.

NOTE: See text for an explanation of calculation of $L_X$ values. Expected births calculated by dividing number alive at census by $L_X$ value. R/E denotes registered births divided by expected births.

Although the ratios of registered to expected births in Table 2 fluctuate (age errors, late registration, and time variations in mortality probably are the important contributions), the patterns are reasonably consistent. They suggest a deficit of some 10–15 percent in births relative to the census at ages three to nine years but a much smaller deficit (in fact a slight excess for Indians) over the first three years of life. The plausible explanation is an under-registration of births of the order suggested by the comparisons at three to nine years and census underregistration at ages under three. Age error might make some contribution to the contrast between the agreement for younger and older children, but it could hardly account for much. A stronger but not very convincing possibility is that birth registration might have improved greatly in the few years before the census. This idea can be discarded if the study is carried beyond the 1956–66 interval into 1949–56. The R/E ratios for the 1956 census and registration can be found by using the methods described above. A similar pattern of ratios nearer to one at under three years is apparent. But extension of the 1968 comparison to ages 10–14 does not reveal this feature. Since the cohorts aged 10–14 years in 1966 are those aged 0–4 in 1956, it is clear that census underenumeration at early ages, rather than improved registration, is operating.

For Fijians, the average ratio of registered to expected births for the period three to nine years prior to the census is 0.866. If the census figures were exact, this would imply a completeness of birth registration of 87 percent. Census underenumeration would of course imply a lesser completeness of registration. The corresponding figures for Indians are 0.877 and 88 percent.

Evaluation of death registration

The average of the registered-to-expected birth ratios may be divided into the numbers of registered births to obtain estimates of total births. Application of the $L_X$ values of Table 2 to the corrected births by years will give survivors and hence, by subtraction, deaths to each cohort. These estimates can be compared with the deaths registered for each cohort. The latter are found by addition of the deaths in each yearly time period at the ages reached by the cohort in the period. Separation by the Lexis diagram and some interpolation is, in principle, required, but fairly crude methods are often sufficient.

The application to Fiji is shown in Table 3. The registered cohort deaths are taken directly from the 1966 Cen.

Table 3  Registered and expected deaths for birth cohorts: Fiji, 1956–66

<table>
<thead>
<tr>
<th>Age at census</th>
<th>Fijians Corrected births</th>
<th>Cohort deaths Expected</th>
<th>Registered</th>
<th>R/E</th>
<th>Indians Corrected births</th>
<th>Cohort deaths Expected</th>
<th>Registered</th>
<th>R/E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$L_X$</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
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<td>211</td>
<td>103</td>
<td>.49</td>
<td>9,611</td>
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<td>158</td>
<td>.38</td>
<td>9,888</td>
<td>739</td>
<td>292</td>
<td>.40</td>
</tr>
<tr>
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<td>7,942</td>
<td>602</td>
<td>238</td>
<td>.40</td>
<td>10,463</td>
<td>952</td>
<td>339</td>
<td>.36</td>
</tr>
<tr>
<td>3</td>
<td>7,835</td>
<td>710</td>
<td>290</td>
<td>.41</td>
<td>9,590</td>
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<td>.46</td>
<td>10,401</td>
<td>1,099</td>
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<td>.35</td>
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<td>809</td>
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<td>.47</td>
<td>9,899</td>
<td>1,135</td>
<td>462</td>
<td>.41</td>
</tr>
<tr>
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<td>415</td>
<td>.52</td>
<td>8,683</td>
<td>1,034</td>
<td>385</td>
<td>.37</td>
</tr>
</tbody>
</table>

SOURCES: Corrected births are calculated by dividing registered births by 0.866 for Fijians and 0.877 for Indians. Registered cohort deaths are taken from the 1966 census report by addition of male and female values (Zwart, 1968: Table C, page 12).
A TECHNIQUE FOR CORRECTING AGE DISTRIBUTIONS FOR HEAPING ON MULTIPLES OF FIVE

by Griffith Feeney

Age distributions enter into the calculation of virtually every standard demographic measure of fertility, mortality, and population growth. Where vital registration data do not exist or are deficient, moreover, age distributions are essential input data to virtually all special estimation techniques, from those based on stable population theory to the own-children type of methods. One scarcely exaggerates in saying that age distributions are an essential, structural part of the foundation on which the entire edifice of refined demographic statistics rests. If the foundation is inadequate, the structure is endangered. If we are concerned with the accuracy of demographic statistics, logic obliges us to be concerned with the accuracy of the age distributions that enter into their calculation. This note is concerned with the problem of deriving reliable information on the true age distribution of a population from recorded age distributions that exhibit substantial heaping on multiples of five.

Redistributing excess numbers at multiples of five

The obvious way to attempt to undo the effects of heaping on ages that are multiples of five is to develop procedures for distributing the excess numbers of persons at multiples of five to the surrounding ages. Suppose we transfer numbers of persons from a given multiple of five to the eight immediately surrounding ages in such a way that (1) the adjusted numbers in the surrounding ages are proportional to the original numbers; and (2) the adjusted numbers at the lower four ages, the central age, and the upper four ages form a linear progression. For reasons that will become clear below, we consider only the numbers of persons at ages that are multiples of five and the total numbers of persons at the intermediate ages. Some elementary algebra shows that, considering any age x, a multiple of five, in isolation, the redistribution described by conditions (1) and (2) may be effected by applying the formulas

\[ P'_x = P_x - (\Delta_x - 1)P + P_x + \]

\[ P'_x = P_x - (\Delta_x - 1)P_x + P_x + \]

\[ P'_x = P_x + (\Delta_x - 1)P_x + (\Delta_x + 5 - 1)P_x + \]

where \( P_x \) denotes the number of persons at age \( x \), \( P_x \) the total number of persons at the four ages immediately below age \( x \), and \( P_x \) the number at the four ages immediately above age \( x \); the primes (') on the left denote preliminary adjusted values, and \( \Delta_x \) is calculated as

\[ \Delta_x = \frac{8}{9} \left[ \frac{P_x + P_x + P_x + P_x}{P_x + P_x + P_x + P_x} \right] \]

These formulas apply to any multiple of five considered in isolation. When all ages are considered together, the increments to the numbers of persons intermediate between two successive multiples of five are made independently from the lower and upper multiple of five, as described by the general formulas

\[ P'_x = P_x - (\Delta_x - 1)P_x + P_x + \]

\[ P'_x = P_x + (\Delta_x - 1)P_x + (\Delta_x + 5 - 1)P_x + \]

\[ P'_x = (\Delta_x + 5 - 1)P_x + \]

for \( x = 0, 5, \ldots, 5 \) where \( \Delta_0 \) and \( \Delta_5 \) are taken equal to one, \( c \) denoting the age, assumed to be a multiple of five, that begins the open-ended age group with which age distributions are generally terminated. Should this open-ended age group begin with something other than a multiple of five, the distribution should be truncated so that the open-ended age group of the truncated distribution begins with the greatest multiple of five given by the recorded distribution.

Exhibit 1 shows the application of this procedure to the Indonesian age distribution shown in Table 1.

### Iteration and convergence

The values of \( \Delta_x \) in Exhibit 1 may be taken as a rough measure of heaping on age \( x \). The more \( \Delta_x \) exceeds one, the greater the extent of the heaping on age \( x \). Values of \( \Delta_x \) less than one signify a deficit of persons at age \( x \). Because numbers of persons at successive multiples of five are distributed independently to the surrounding ages, and because the surrounding ages overlap, intermediate age groups evidently get a "double dose" of redistributed persons. We would therefore expect the intermediate age groups to receive too large an increment, leaving a deficit of persons at multiples of five. This expectation can be tested by calculating \( \Delta_x \) values for the adjusted distribution. These values are shown in the last column of Exhibit 1 and bear out the expectation. What is unexpected is the magnitude of these \( \Delta_x \) values. Though the largest \( \Delta_x \) value for the recorded

### Exhibit 1 Redistribution of numbers of persons at multiples of five

<table>
<thead>
<tr>
<th>Age (x)</th>
<th>( P_x )</th>
<th>( P_x )</th>
<th>( \Delta_x )</th>
<th>( P'_x )</th>
<th>( P'_x )</th>
<th>( \Delta_x )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2,337</td>
<td>15,763</td>
<td>1.0000</td>
<td>2,337</td>
<td>15,737</td>
<td>1.0000</td>
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<td>3,734</td>
<td>14,354</td>
<td>0.9982</td>
</tr>
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<td>3,457</td>
<td>10,093</td>
<td>1.0156</td>
<td>3,078</td>
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<td>1.0094</td>
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<td>9,119</td>
<td>0.9945</td>
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<td>1,753</td>
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<td>1,059</td>
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<td>0.9761</td>
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<td>763</td>
<td>3,675</td>
<td>0.9739</td>
</tr>
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<td>1.4812</td>
<td>628</td>
<td>2,570</td>
<td>0.9783</td>
</tr>
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<td>0.9669</td>
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<td>1,515</td>
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</tr>
<tr>
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<td>670</td>
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<td>897</td>
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<td>291</td>
<td>1.7702</td>
<td>156</td>
<td>515</td>
<td>0.9865</td>
</tr>
</tbody>
</table>

### NOTATION AND COMPUTATIONAL PROCEDURE

\( P_x \) = number of persons aged \( x \) in completed years
\( P_x \) = number of persons aged \( x \cdot 5 \) to \( x + 4 \) in completed years
\( P_x \) = number of persons aged \( x \cdot 5 \) to \( x + 4 \) in completed years
\( \Delta_x = \frac{8}{9} \left[ \frac{P_x + P_x + P_x + P_x}{P_x + P_x + P_x + P_x} \right] \]

\( x = 5, \ldots, 70 \) (where \( \Delta_0 = \Delta_5 = 1 \))

\( P'_x = P_x - (\Delta_x - 1)P_x + P_x + \)

\( P'_x = (\Delta_x + 5 - 1)P_x \)

\( x = 0, \ldots, 70 \)
Table 1: Population of Indonesia, 22 provinces, by single year of age: Census of 24 September 1971

<table>
<thead>
<tr>
<th>Age (x)</th>
<th>Population at indicated age (in thousands)</th>
<th>x</th>
<th>x+1</th>
<th>x+2</th>
<th>x+3</th>
<th>x+4</th>
</tr>
</thead>
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<td>3,873</td>
<td>3,882</td>
<td>3,962</td>
<td>4,056</td>
</tr>
<tr>
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<td>17,841</td>
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<td>3,687</td>
<td>3,683</td>
<td>3,611</td>
<td>3,175</td>
</tr>
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<td>3,457</td>
<td>2,379</td>
<td>3,023</td>
<td>2,375</td>
<td>2,316</td>
</tr>
<tr>
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<td>2,014</td>
<td>2,123</td>
<td>2,584</td>
<td>1,475</td>
</tr>
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<td>7,585</td>
<td>3,066</td>
<td>1,299</td>
<td>1,236</td>
<td>1,052</td>
<td>992</td>
</tr>
<tr>
<td>25</td>
<td>4,777</td>
<td>3,550</td>
<td>1,334</td>
<td>1,314</td>
<td>1,337</td>
<td>942</td>
</tr>
<tr>
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<td>7,524</td>
<td>3,951</td>
<td>1,128</td>
<td>1,108</td>
<td>727</td>
<td>610</td>
</tr>
<tr>
<td>35</td>
<td>6,242</td>
<td>3,919</td>
<td>1,221</td>
<td>868</td>
<td>979</td>
<td>637</td>
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<td>5,829</td>
<td>3,408</td>
<td>687</td>
<td>687</td>
<td>533</td>
<td>313</td>
</tr>
<tr>
<td>45</td>
<td>4,448</td>
<td>2,488</td>
<td>677</td>
<td>426</td>
<td>524</td>
<td>333</td>
</tr>
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<td>3,689</td>
<td>2,259</td>
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<td>363</td>
<td>290</td>
<td>226</td>
</tr>
<tr>
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<td>1,153</td>
<td>379</td>
<td>217</td>
<td>223</td>
<td>152</td>
</tr>
<tr>
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<td>89</td>
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<td>96</td>
<td>97</td>
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<td>75</td>
<td>745</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Not stated 15 0 0 0 0 0

Total 112,627 0 0 0 0 0

SOURCE: Census of Indonesia, 1971, Series E; Numbers 1–26 (126 volumes), Table 01, pages 1–4, in each volume.

NOTE: There are 26 provinces in Indonesia; data in the table describe 22 provinces. The provinces not included here are Nusa Tenggara Barat, Nusa Tenggara Timur, Moluku, and Irian Jaya.

Distribution is \( \Delta q = 1.77 \), indicating considerable heaping at age 70, while the lowest \( \Delta x \) value for the adjusted distribution is \( \Delta G_x = 0.96 \), indicating a relatively small deficit at age 65.

This striking contraction of the \( \Delta x \) values toward one suggests that if the procedure is applied repeatedly, the result may be an adjusted distribution for which all \( \Delta x \) values are one. This convergence does indeed occur, in various numerical cases, at any rate. We do not consider proof of convergence. The resultant values are shown in the first two columns of Exhibit 2.

Interpolation between corrected numbers of persons at multiples of five

It may become a surprise that the final step in the correction procedure is not the apparently obvious one of aggregating the adjusted numbers in the first two columns of Exhibit 2 into standard five-year age groups. The convergence of the \( \Delta x \) values to one signifies that the age distribution, as represented by the first two columns of Exhibit 2, has been forced into a series of straight line segments centered on multiples of five. In consequence, a deficit of persons in one intermediate age group may result in an excess of persons in the next intermediate age group, a deficit in the next, and so forth. This phenomenon is indicated quite clearly in Figure 1, in which numbers of persons at multiples of five are plotted by circles and numbers of persons at intermediate ages (average per year of age) by dots.

The penultimate step in the correction procedure consists of interpolating among the adjusted numbers at multiples of five (the \( P_x \) column of Exhibit 2), regarded as estimates of the age distribution density function at ages \( x + 2.5 \). Various interpolation approaches are possible. The simplest, which will often give satisfactory results, is as follows.

Interpolate linearly among adjusted numbers at multiples of five to obtain values of the age distribution density function at points 7.5, 12.5, ..., 67.5 (shown in column 3 of Exhibit 2), and multiply these values by 5 to give adjusted numbers of persons aged 5–9, 10–14, ..., 65–69 (shown in column 4). The numbers for the remaining age groups, 0–4, 70–74, and 75 and over, are taken directly from the recorded distribution.

Exhibit 2: The correction procedure

<table>
<thead>
<tr>
<th>Age (x)</th>
<th>( P_x ) (1)</th>
<th>( P_x + 2.5 ) (2)</th>
<th>( f(x + 2.5) ) (3)</th>
<th>( 5P_x ) (4)</th>
<th>( 5P_x ) (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2,337</td>
<td>15,724</td>
<td>na</td>
<td>18,100</td>
<td>18,004</td>
</tr>
<tr>
<td>5</td>
<td>3,758</td>
<td>14,338</td>
<td>3,489</td>
<td>17,444</td>
<td>17,351</td>
</tr>
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<td>3,085</td>
<td>10,342</td>
<td>2,819</td>
<td>14,093</td>
<td>14,018</td>
</tr>
<tr>
<td>15</td>
<td>2,419</td>
<td>9,005</td>
<td>2,197</td>
<td>10,985</td>
<td>10,927</td>
</tr>
<tr>
<td>20</td>
<td>1,864</td>
<td>5,907</td>
<td>1,777</td>
<td>8,884</td>
<td>8,837</td>
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<td>25</td>
<td>1,646</td>
<td>7,260</td>
<td>1,638</td>
<td>8,188</td>
<td>8,145</td>
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<td>30</td>
<td>1,625</td>
<td>7,388</td>
<td>1,573</td>
<td>7,865</td>
<td>7,823</td>
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<tr>
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<td>7,067</td>
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<tr>
<td>40</td>
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<td>4,106</td>
<td>1,156</td>
<td>5,779</td>
<td>5,748</td>
</tr>
<tr>
<td>45</td>
<td>983</td>
<td>3,518</td>
<td>870</td>
<td>4,349</td>
<td>4,326</td>
</tr>
<tr>
<td>50</td>
<td>745</td>
<td>2,442</td>
<td>661</td>
<td>3,307</td>
<td>3,289</td>
</tr>
<tr>
<td>55</td>
<td>536</td>
<td>1,842</td>
<td>486</td>
<td>2,428</td>
<td>2,415</td>
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<tr>
<td>60</td>
<td>410</td>
<td>1,437</td>
<td>361</td>
<td>1,804</td>
<td>1,794</td>
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<tr>
<td>65</td>
<td>287</td>
<td>855</td>
<td>241</td>
<td>1,203</td>
<td>1,197</td>
</tr>
<tr>
<td>70</td>
<td>171</td>
<td>509</td>
<td>na</td>
<td>987</td>
<td>982</td>
</tr>
<tr>
<td>75 and over</td>
<td>745</td>
<td>na</td>
<td>na</td>
<td>745</td>
<td>741</td>
</tr>
<tr>
<td>Not stated</td>
<td>15</td>
<td>na</td>
<td>na</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Total 112,627 0 0 0 0

na—not applicable.

NOTES:

(1) The procedure begins with repeated application of the redistribution (see Exhibit 1) until all \( \Delta x \) values converge to one. The resulting numbers for the data in Table 1 are given in columns (1) and (2).

(2) The adjusted numbers at age \( x \) are then regarded as values of the age distribution density function at exact age \( x + 2.5 \), for all ages \( x \) beyond 0, and linear interpolation is performed between these values to obtain values of the age distribution density function at ages 7.5, 12.5, ..., the limiting value for \( x \) in this case being 67.5. If the open-ended age group terminating the original age distribution begins at age \( c \), a multiple of five, then the adjusted values at age \( x \), a multiple of five, obtained by redistribution (Exhibit 1) range from 0 to \( c \) in steps of five; therefore the interpolated values for ages \( x + 2.5 \) range from \( x = 5 \) to \( x = c - 10 \). These interpolated values are given in column (3). The interpolation weights are 0.6 and 0.4. For example, the first entry in column (3) is calculated as \( 0.6 \times 3,758 + 0.4 \times 3,085 \).

(3) The interpolated values of the age distribution density function at \( x = 7.5, 12.5, ..., \) are multiplied by 5 to give preliminary adjusted numbers of persons in the age groups 5–9, 10–14, .... These adjusted values are combined with the recorded values for the 0–4 age group and, in this case, the 70–74 and the 75 and over age groups (Table 1). The resulting values, and their total, are shown in column (4).

(4) The total of the adjusted values in column (4) does not equal the original total, though the difference is very small, on the order of 0.5 percent. The last step in the procedure is to multiply the values in column (4) by a factor which makes the resulting total conform to that of the given distribution. The result of this multiplication is given in column (5).

(5) Column (5) shows the final result of applying the correction procedure to the data given in Table 1.

(6) Variations in the procedure are obviously possible, as for example using a higher order of interpolation than linear.
Figure 1 Number of persons at ages that are multiples of five and at intermediate ages: Indonesia, 1971

The final step is to reconcile the total of the adjusted values with the total of the recorded age distribution, taking into account both the discrepancies introduced by the interpolation and the cases where age was not stated. The final result is shown in the last column of Exhibit 2 and is plotted in Figure 2. The corrected and the recorded distributions are compared in Table 2, which shows that the correction procedure transfers large numbers of persons between standard five-year age groups.

Conclusion

The term “correction” has been used in preference to “smoothing” because the procedure described here is specifically designed to undo the effects of heaping on multiples of five. It should be understood, however, that age distributions obtained by application of the procedure will at best be better approximations to the true age distribution than the recorded age distribution. The procedure takes no account of census underenumeration and has been designed for application to age distributions that exhibit substantial heaping on multiples of five. Applied to an accurately recorded age distribution that exhibits sharp fluctuations, the “corrected” distribution may be less correct than the recorded distribution, and the most one can hope for by applying the procedure is to obtain the correct age distribution of the enumerated population.

The merits and demerits of any data analysis procedure can be argued only halfway in the abstract. The rest depends on success or failure in the actual analysis of data. Preliminary analyses on the Indonesian age data suggest that the procedure is remarkably effective, far more so than any existing procedure for smoothing or otherwise correcting age distributions. It is put forward here that others may test its efficacy in practice.

ACKNOWLEDGMENTS

Much of this research was conducted during a visit to the Central Bureau of Statistics (CBS) of Indonesia during early 1978. I am grateful to Mr. M. Abdulmadjid, Director General of the CBS, for the opportunity this visit provided. It is a pleasure to acknowledge many useful conversations with Dr. Sam Suharto, Director of the Data Processing Center of the CBS, and with Dr. Hananto Sigit. I am grateful also for numerous useful comments of the staff of the CBS when this material was presented at an informal seminar arranged by Dr. Sigit.

My thinking on the subject of age distribution analysis over the past year has been greatly influenced by many long conversations with Dr. Budi Utomo of the University of Indonesia School of Public Health, who spent ten months at the East-West Population Institute as a research intern, Ms. Bondan Supraptilah, of the Institute of Demography of the University of Indonesia, presently a research intern at EWPI, read the manuscript and pointed out several errors.

REFERENCE


Figure 2 Corrected age distribution: Indonesia, 1971

Table 2 Comparison of recorded and corrected age distribution for 22 Indonesian provinces: Census of 24 September 1971

<table>
<thead>
<tr>
<th>Age group</th>
<th>Number of persons</th>
<th>Difference</th>
<th>Percentage difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–4</td>
<td>18,100</td>
<td>800</td>
<td>+4%</td>
</tr>
<tr>
<td>5–9</td>
<td>17,841</td>
<td>226</td>
<td>+1%</td>
</tr>
<tr>
<td>10–14</td>
<td>13,550</td>
<td>1,068</td>
<td>+8%</td>
</tr>
<tr>
<td>15–19</td>
<td>10,782</td>
<td>1,526</td>
<td>+14%</td>
</tr>
<tr>
<td>20–24</td>
<td>7,685</td>
<td>1,477</td>
<td>+20%</td>
</tr>
<tr>
<td>25–29</td>
<td>8,477</td>
<td>1,526</td>
<td>+20%</td>
</tr>
<tr>
<td>30–34</td>
<td>7,524</td>
<td>329</td>
<td>+6%</td>
</tr>
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<td>35–39</td>
<td>7,624</td>
<td>329</td>
<td>+6%</td>
</tr>
<tr>
<td>40–44</td>
<td>5,829</td>
<td>172</td>
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<td>45–49</td>
<td>4,448</td>
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<td>50–54</td>
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<td>55–59</td>
<td>2,124</td>
<td>1,068</td>
<td>+30%</td>
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<td>60–64</td>
<td>2,226</td>
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<td>+30%</td>
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<tr>
<td>65–69</td>
<td>1,081</td>
<td>1,068</td>
<td>+30%</td>
</tr>
<tr>
<td>70–74</td>
<td>987</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>75 and over</td>
<td>475</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Not stated</td>
<td>15</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

Total: 112,627

SOURCE: Recorded numbers from Table 1; corrected numbers from Exhibit 2, last column.

NOTE: See Exhibit 2 for description of correction procedure.
EWPI CONDUCTS
VITAL REGISTRATION WORKING GROUP

by Griffith Feeney

The Working Group on Vital Registration, held at EWPI from 7 August to 1 September 1978, discussed techniques for evaluating the completeness and accuracy of vital registration data and for deriving useful demographic measures from imperfect data. The emphasis was on techniques utilizing vital registration and census data directly to produce estimates of population change and its components.

A large variety of indirect estimation techniques has been developed over the past 20 years for determining basic demographic measures from unorthodox data (that is, from sources other than vital registration). If any of these techniques can be applied for a population which has some form of vital registration, evaluation is clearly possible. Strictly speaking, then, all such indirect estimation techniques fall within the general subject of the Working Group. The primary emphasis, however, was on approaches in which vital registration data play a central role in the estimation procedure.

Although the underlying ideas of the approaches are elementary and, in some form, old, no textbook or review paper covers them. In view of the fundamental importance of vital registration, this may seem odd, and it is certainly regrettable in view of the substantial resources invested throughout the world in vital registration systems, data from which, though too incomplete to be useful for the direct calculation of standard demographic measures, surely contain useful demographic information that ought not be wasted. A number of contributing reasons may be suggested for this unfortunate state of affairs:

- Historically, demographic study in many countries consists of work done by statisticians with little training in demography.

- The early estimates from vital registration data were often so poor and unreliable that the demographers concentrated on new methods not utilizing vital registration data (retrospective and dual recording techniques, for example) rather than on improving the means of using vital registration data.

- Although the ideas are simple, much of their effective application uses sophisticated models that have emerged only recently and depends on quite heavy calculations, which can now be done much more easily by modern calculators and computers.

The Working Group presented an opportunity to begin to redress the balance by examining systematically a series of approaches to vital registration data analysis and exploring their characteristics with application to actual data.

(continued on page 17)
CENSUS MAPPING WORKING GROUP
by B.K. Roy, Gregory Chu, and Iris Shinozara

Last fall, specialists from 14 countries met in Honolulu to map out plans for the 1980 censuses—literally. The Census Mapping Working Group, which met at the East-West Population Institute 4 October—17 November 1978, was the second in a series of EWPI census mapping activities.

Maps are used in planning census enumeration and determining manpower requirements, as well as to ensure complete geographic coverage in data collection. Working Group participants were concerned with the definition and symbolization of enumeration districts and with the technical production of census maps for both planning and field use. Participants also discussed the status of enumeration district mapping in their home countries.

Definition and symbolization of enumeration districts
The criterion for determining the boundaries of an enumeration district is often a set number of people or households. Because of the difficulties in identifying people and households, however, geographical boundaries (both physical and man-made) are frequently used instead for demarcation.

In cases where such maps must be plotted by hand, the process of bounding poses difficult questions. Areas are either enlarged or reduced to include a larger or smaller number of people, calling for judgment on the part of the enumerator. The delineation of new boundaries requires a special symbol and number with a description on the map, and the choice of appropriate symbols is vital in communicating effectively with the map user. Working Group participants suggested improvements in the mapping section in existing enumerator training manuals, better cartographic design, and improved enumerator supervision as ways to approach this problem.

Technical production of census maps
The availability of base maps and mapping reproduction facilities is of paramount concern to cartographers. In the event that topographic maps (most frequently used for census base maps) are not available, the alternatives of aerial photographic systems and field sketching must be considered.

Participants worked with technical equipment—the copy camera, varigraphs, and the diazo machine—that is used to produce enumeration maps efficiently and economically. Photographic methods can appropriately adjust the scale of maps to be used in planning or fieldwork. Participants also considered the technical production of postenumeration maps to portray the data collected in the 1980 round of censuses.

Status of census mapping in participating countries
The 14 countries represented in the Working Group have had a wide range of experience with census mapping and vary in their plans for the application of mapping techniques in the upcoming round of censuses.

Specific information about each country's mapping plans is outlined below.

Bangladesh. Procedures for census mapping for the 1973–74 census were developed in collaboration with the Directorate of Land Records, Survey of Bangladesh, Board of Telephone and Telegraph, municipal committees, and the malaria eradication program. In the 1980 census round, these procedures will be supplemented by the use of satellite imagery.

India. During the 1971 census, a program of preparing “National Maps” of villages and urban areas was conducted. The updating of jurisdictional maps for use in the 1981 census has been under way since March 1978.

Indonesia. In the 1971 census, enumerators prepared sketch maps and household lists. Indonesia is embarking on a program of producing multi-purpose maps to satisfy 1980 census enumeration needs as well as for use in surveys on crop cutting and agricultural statistics.

Iran. For the 1986 census, the National Cartographic Center will update aerial photographs used to delineate enumeration areas in the 1976 census.

Malaysia. Maps of enumeration blocks produced for the 1970 census in collaboration with the Directorate of National Mapping were updated for the 1976–77 agricultural census and will be further refined for the 1980 population census.

Pakistan. During the 1972 census, enumeration areas were demarcated in towns and listings were prepared in urban areas. A new plan for census mapping at both rural and urban levels is being prepared for the 1981 census.

Papua New Guinea. The census office is planning to strengthen its mapping unit. Aerial photographs will be used to update topographical maps, and village headmen will assist in identifying enumeration areas for the 1980 census.

Philippines. Extensive fieldwork is involved in the preparation of more than 4,000 urban and rural enumeration maps needed for use in the 1980 census.

Republic of Korea. As in 1975, the 1980 census base maps will be prepared by the National Bureau of Statistics and distributed to local government offices for updating.

Singapore. The Census Planning Committee is considering developing a new set of enumeration district maps for their (continued on page 17)
Vital Registration Working Group  (continued from page 15)

It must be emphasized that all of the methods depend on model formulations of how particular errors in vital registration might show up in checks. The absence of error signposts is usually reasonable evidence that the data are satisfactory, although balancing and compensating errors are not an impossibility. The presence of such signposts, however, can be taken only as validating the model of error if the possibility that they are due to other errors can be dis- counted. In practice this judgment can be a difficult one. Indeed, the interpretation of the results of a particular procedure is generally more difficult than the application itself.

This difficulty may be illustrated by considering the well-known “balance equation,”

\[ N_2(P) = N_1(P) + B(P) - D(P), \]

which states that the number \([N_2(P)]\) of persons in some population or subpopulation denoted by \(P\) at time 2 equals the number at time 1 plus births less deaths. If estimates of the components in this relationship are available and there is a discrepancy, it is often tempting to conclude that the \(B(P)\) term is responsible on the grounds that it is usually the most suspect. But the error may in fact be in \(N_2(P), N_1(P), D(P), U(P)\) (an unknown migration not allowed for), or \(P\) (that is, the assumption that the section of the population is the same for the different components). Practical applications often leave one uncomfortably close to the situation suggested by the folk saying: “If we had some eggs, we could have some ham and eggs, if we had some ham.”

In the experience of the author, the most difficult deci- sions are whether or not to correct data and if so, to what extent. Many factors will influence that decision, including some that are external to the evaluation results, such as how the estimates are to be used and auxiliary evidence. The only rule that can be propounded is that of minimum interference with raw data. Never correct unless you are convinced that serious damage will come from not doing so. Small adjustments or complicated ones are seldom justified.

The demographic models needed in the applications are of mortality by age and fertility by age of woman. They are needed mainly for graduation and interpolation purposes in the tidying up of measures and for their translation into the precise values needed for applications. The results are not highly dependent on the models used, and alternatives are possible. Choice is likely to depend on convenience and taste rather than on judgment about “best” in an absolute sense. This is as it should be in the present context, where we are seeking reasonably firm estimates for populations with respectable, if not high quality, data rather than rough orders of magnitude from very limited and unreliable in- formation. In the latter case more weight must be placed on the specific relevance of the model chosen, with consequent vulnerability.

CORRECTION

Mr. Tatsuya Itoh’s name was inadvertently omitted from the list of participants in the Census Fertility Estimation Working Group, which met at EWPI 5 April–31 May 1978. A report on the Working Group appeared in the November 1978 issue of the Census Forum. Mr. Itoh is Technical Officer, Institute of Population Problems, Ministry of Health and Welfare, Japan.

Census Mapping Working Group  (continued from page 16)

1980 census because of changes in census divisions and districts since the 1970 census.

Sri Lanka. After relying on a listing system in 1971, Sri Lanka proposes to set up a new map unit to develop census mapping on a limited, experimental basis in 1980.

Taiwan. Existing maps are being updated for the 1980 cen- sus. Enumeration area boundaries will be identified in relation to villages (lin). Thailand. The Royal Thai Survey Department will update 1970 enumeration area maps, with work to be completed at least six months ahead of the April 1980 census.

United States. The U.S. Bureau of the Census is enlarging its Geographic Base File (GBF) and, with the use of the Dual Independent Map Encoding (DIME) program, the percentage of schedules mailed out may increase to cover 90 percent of the nation’s population during the 1980 census.

CENSUS MAPPING WORKING GROUP

4 October–17 November 1978

COORDINATORS: Mr. Gregory Chu, Cartographer, EWPI; and Dr. Bhupendra K. Roy, Assistant Registrar General, Office of the Registrar General, India

PARTICIPANTS

Bangladesh: Mr. Pramanik Abdus Sobhan, Research Officer, Bangladesh Bureau of Statistics

Indonesia: Mr. Machin Erwan, Chief of Sub-Division, Central Bureau of Statistics

Iran: Mr. Allameh Najmeddin, Survey Engineer, Statistical Centre of Iran

Republic of Korea: Mr. Bun Nam, Section Chief, National Bureau of Statistics

Malaysia: Mr. Sukhdev Singh, Statistician, Statistics Department

Pakistan: Mr. Abdu Sattar, Geographer, Population Census Organization

Papua New Guinea: Mr. Nelson Charope, Mapping Supervisor, Bureau of Statistics

Philippines: Mr. Dario Luna, Chief Cartographic Engineer, National Census and Statistics Office

Singapore: Mr. Soon Kiang Wee, Surveyor, Survey Department

Sri Lanka: Mr. Chullapala Galihtiyawawa, Statistical Officer, Department of Census and Statistics

Taiwan: Mr. Tze-Hwa Fan, First Division Chief, Bureau of Statistics

Thailand: Mr. Vicharat Pengpol, Field Supervisor in Census Mapping, National Statistical Office

United States: Dr. John C. Sherman, Professor of Geography, University of Washington; Dr. Everett Wingert, Associate Professor of Geography, University of Hawaii; Dr. Eugene Kinney, Associate Professor of Geography, University of the District of Columbia; Dr. Mei-Ling Hsu, Professor of Geography, University of Minnesota; Ms. Iris Shinohara, EWPI Research Intern

This activity was part of the EWPI Project on Development and Application of Techniques for Censuses, Surveys, and Vital Registration.
STATISTICAL INSTITUTE FOR ASIA AND PACIFIC HOLDS SEMINAR ON CENSUS TABULATIONS

by Kozo Ueda

The Statistical Institute for Asia and the Pacific (SIAP) of Tokyo conducted a five-week Seminar on Tabulation and Analytical Processing of Population Census Data 14 August to 15 September 1978. Eleven senior government officials from ten countries in the ESCAP region met to discuss the general issues of tabulation and data processing for a population census, problems encountered, and ways to improve future censuses. Countries represented were Afghanistan, Bangladesh, Hong Kong, India, Japan, Philippines, Singapore, Sri Lanka, Thailand, and Western Samoa.

SIAP faculty members and guest lecturers from abroad led sessions of the Seminar, which included both general discussions and workshops on newly developed data processing techniques. Guest lecturers were Mr. Than Maung from the ESCAP Statistics Division, Mr. M.R. Lackner from the UN Statistical Office, Ms. Minjae Choe from the East-West Population Institute, and Mr. H. Midzuno and several other experts from Japan's Bureau of Statistics.

Five major topics were addressed during Seminar sessions: basic considerations of census tabulations; pretabulation operations; arrangements of the population census database; census tabulations and quality control; and examples of analytical processing of census data. Within the framework of these major topics, participants discussed problems they had actually encountered in tabulating and processing census data.

A five-day workshop at the Bureau of Statistics allowed participants to observe actual data-processing operations and to use analysis and programming techniques on some of the data from Japan's 1975 population census. In addition, demonstrations of such census data-processing software package programs as UNEDIT and XTALLY were arranged. Participants also visited several electronic computer companies in Japan to observe their latest models.

The Seminar stressed the importance of supplying census results promptly to users. Many countries prepare preliminary and advance tabulations, which are generally limited to tables of a basic and general nature only. It was agreed that efforts should be made to achieve an earlier release of census data with a more extensive range of regional and topical contents.

Seminar participants pointed out the necessity of considering tabulation techniques at an early stage of census planning to ensure smooth data-processing operations. Often only a slight change in the design of final table formats—for example, fewer columns, rows, or cells—would eliminate difficulties caused by the technical limits of data processing by machines.

A remarkable tendency noted in the Seminar discussion was that many countries preserve the census data base in the computer file in addition to the census tables prepared for publications. Such a tendency with the advance in computerization should also be taken into account in the basic plan of final census tables.

It was suggested that automatic data processing be used to carry out final checking and imputations before publication, since errors may have been introduced at various earlier stages. Some participants commented, however, that in many developing countries manual review and correction would be necessary even at the final stage because of the large number of remaining errors.

As for the method of organizing data-processing operations, the Seminar recognized that availability of human and mechanical resources was very crucial. Some countries reported difficulty in getting enough trained people to undertake the different types of data-processing work, such as programming or keypunching. Well-trained persons often leave their government jobs to join the private sector, which offers better salaries. The problem was tackled in some countries by applying more restrictive terms of employment or by providing continuous training to the data-processing staff.

The application of sampling techniques for quality control in editing was suggested as a means to assure the efficiency of editing operations. The Seminar observed that many censuses are edited on a sample basis after a certain stage of data processing. Coding on some classifications of a complex nature, such as detailed occupations and industry, can also be performed on a sample basis.

Participants acknowledged the importance of a well-organized group of coders and editors in the central census office and agreed that continual efforts should be made to train them properly. This will continue to be true even if automatic data processing is further developed and applied to various types of processing operations to a considerable extent.

In connection with census data-processing software packages, the Seminar recognized generally that in many instances a drastic change of tabulation processes was not recommended, particularly for large-scale statistical operations like a census. The census planner, however, should pay greater attention to the development of new techniques in the relevant field and should try to bring them in gradually whenever possible to raise the efficiency of the census data processing.

Kozo Ueda (right) is Statistician (Demographic and Social Statistics) at the Statistical Institute for Asia and the Pacific and Coordinator of Institute Seminars.

NOTICES TO READERS

Readers who wish to become authors of articles in the Asian and Pacific Census Forum are invited to write to the Managing Editor and request “Guidelines for Forum Authors,” a set of notes about how to prepare your manuscript. The editors welcome contributions, particularly about the collection and use of census data with reference to the Asian and Pacific region.

Librarians and other collectors will be interested to know that an index for Volume 4 of the Asian and Pacific Census Newsletter will soon be prepared and sent to readers. Following Volume 4, the title of this publication was changed from Newsletter to Forum. In the future indexes for the Asian and Pacific Census Forum will be issued every two years.
Just before the last issue of the Asian and Pacific Census Forum appeared in print, your reviewer left for Bangkok, Thailand, to participate in the Second Regional Training Institute for the Development of Staff of Population Resource Centres in Asia and the Pacific. The Institute, informally known as Bangkok II, was held 15–24 November at the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). Cosponsors were ESCAP, the International Planned Parenthood Federation (IPPF), and the Association for Population/Family Planning Libraries and Information Centers, International (APLIC); funding was provided by the United Nations Fund for Population Activities. Bangkok II was held to assess the progress made toward the establishment of a regional population information network in the five years since the convening of the Working Meeting on Asian Resources for a Population Library Information Network in Bangkok in September 1973.

Bangkok II brought together 24 information specialists from 14 countries in the ESCAP region: Afghanistan, Bangladesh, Fiji, India, Indonesia, Iran, Malaysia, Nepal, New Zealand, Pakistan, Philippines, Republic of Korea, Sri Lanka, and Thailand. Resource persons came from the National Family Planning Coordinating Board, Indonesia; Population Center Foundation, Philippines; World Health Organization’s Regional Office for Southeast Asia, New Delhi; the IPPF Southeast Asia and Oceania Regional Office, Kuala Lumpur; East-West Population Institute, Honolulu; International Planned Parenthood Federation, London; and the Press Foundation of Asia. Meetings were held at the new United Nations Building in Bangkok, and ESCAP made its staff and facilities available for the entire meeting.

It was immediately apparent to me, as a participant in both the Bangkok meetings, how far many of the countries represented there had progressed since 1973. Tables were filled to overflowing with the printed output of the various population centers and government agencies. Many of these were published bibliographies, indexes, and resource guides to population and family planning literature within the several countries. One of the problems encountered in the 1973 meeting had been the lack of documentation of population materials, but by the looks of the printed items now available, this problem no longer exists.

A conclusion reached in 1973 was that regional population information networks could not be formed until there were strong central or national population information centers. By 1978, countries like India, Indonesia, Iran, Korea, and Malaysia had established national documentation centers. Plans for centralized storage and indexing of the country population reports were in operation, and all population and family planning libraries were linked together through communication and training activities.

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.

What also emerged from the working sessions of Bangkok II was the need to solve other problems before a population information network for the ESCAP region could be fully operative. Many participants cited the need for more staff and more funds for acquiring and processing data and for training information specialists in the field of population and family planning. For most countries, at least for the time being, computerized information and retrieval activities were considered beyond their resources unless they could secure outside funding. One ESCAP proposal urged the development of cooperative projects along the lines of TCDC (Technical Cooperation among Developing Countries), a concept that has already been adopted in agricultural and industrial projects in the ESCAP region. Outside funding for such projects may be sought, but wherever possible the United Nations has been promoting the concept of self-help among several countries. Eight projects were formulated at the conference, among them the training of population librarians in Indonesia and India; the development of a subregional population network for Indonesia, Malaysia, Thailand, and the Philippines; and the preparation of a list of all population documents held in Bangladesh. The Bangladesh Institute of Development Studies has already made a substantial start on this activity with its two publications, Popindex Bangladesh: Bangladesh Literature on Population Control and Family Planning and Organizations Generating Literature on Population Control and Family Planning in Bangladesh.

The final session of the Bangkok conference adopted more than 35 recommendations for future activities in the field of population information networking and stressed the supportive role played by ESCAP, IPPF, and APLIC in future endeavors. I was delighted to have the opportunity to renew friendships with professional colleagues from the 1973 meeting and was impressed by the advances in population and family planning documentation evidenced at the sessions. In future columns I hope to be able to review some of the excellent publications on display at Bangkok II.

World Fertility Survey: new publications

A number of documents have recently arrived from the World Fertility Survey (WFS). One of these is the Annual Report for January-December 1977, which summarizes the
principal meetings, research, activities, and publications of WFS during that period. Appendices to the report contain a policy statement on the analysis of WFS data, WFS publications as of 31 December 1977, a list of libraries in the WFS depository system, and Country Reports available. English-language summaries of several country reports may be obtained free of charge from the International Statistical Institute, 428 Prinsep Beatrixlaan, 2270 AZ Voorburg, Netherlands. The most recent summaries are numbers 9–11: *The Colombia Fertility Survey, 1976; The Panama Fertility Survey, 1976;* and *The Indonesia Fertility Survey, 1976. These summaries cover the salient features of each country report and are helpful for researchers who cannot use the reports in their language of publication.*

Technical Bulletin series number 5, *Generalized Linear Models for Cross-Classified Data from the WFS,* by Roderrick J.A. Little, is also available without cost. Little presents linear models for cross classification of means and proportions which are particularly applicable for use with data collected by fertility surveys. He discusses the standard linear normal models used in the analysis of variance as well as log-linear and logit-linear models. Included are discussions of model fitting, model selection, the estimation and interpretation of parameters and fitted values, standardization, and the treatment of within-cell sample variances. Little illustrates his methodology with data on fertility and contraceptive use from the Fiji Fertility Survey, using the computer program GLIM.

**Fiji census papers**

The Bureau of Statistics of the Government of Fiji published the first volume of *Report on the Census of Population, 1976* (for details see "Enumerations" in *Asian and Pacific Census Forum*, vol. 5, no. 2, November 1978). A second volume containing the complete analysis of census data is due this year. In order to meet the needs of government planners and others who need statistical information as rapidly as possible, however, the Bureau has released two Occasional Papers. The first, *Economic Activity in Fiji,* is an analysis of information on adult participation in the labor force, unemployment, and the employment status and occupation of those working as of September 1976. A great deal of the information collected is not available from earlier censuses.

At the time of the 1976 census there were 175,785 employed people in Fiji—just 50.8 percent of the population 15 years old and over. Of these workers, about 83 percent were male and 17 percent were female. Of those who were not economically active, the largest proportion were engaged in unpaid home duties, with students as the next largest group. Agriculture, forestry, and fishing remained the principal occupations of those working in 1976, just as they had been at the time of the 1966 census. But the percentage of people employed in these occupations declined from 54 to 44 percent by 1976, a trend evident in many other developing countries.

A second Occasional Paper analyzes data on school attendance, adult educational attainment, and household and family size. Both papers may be obtained free from the Bureau of Statistics, P.O. Box 2221, Government Building, Suva, Fiji.

**Shorter notices: Singapore and Papua New Guinea**

The Department of Statistics of Singapore conducted its third Household Expenditure Survey in 1977 and 1978, and results of the first phase of the Survey have been published in *Report on Survey of Households, April 1977.* Data were collected from 8,000 representative households, about one household in 75. The report contains information on the demographic and socioeconomic characteristics of the population and of households. In addition to an analysis of the data collected, the report gives a description of the survey methodology. It may be purchased for S$3.50 (postage) from Singapore National Printers (Pte), Ltd., Publications Sales Division, Fullerton Building, Singapore 1.

Results of the second phase of the Survey will be published in a separate volume, which will contain information about the expenditure patterns of private households. Survey data will be used in revising Singapore’s Consumer Price Index.

The Bureau of Statistics in Papua New Guinea has published a description of activities that will be undertaken in the next census, now scheduled for 1980. This will be the first census taken since Papua New Guinea gained independence. The report, *National Population Census Project Document,* contains information on the census methodology, field enumeration, and the actual questionnaires to be used. It may be of interest to other census offices; if so, a letter to the Bureau of Statistics, Port Moresby, Papua New Guinea, might suffice to get a copy.

**Brass: Registration evaluation (continued from page 11)**

sus Report. The results are quite consistent and suggest that only about 40 percent of the deaths of young children were registered, the Indian coverage being slightly worse than the Fijian.

**REFERENCE**


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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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