A METHODOLOGY FOR SEGREGATING RURAL AND URBAN MORTALITY

by

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(ABSTRACT)

This study involved the design and testing of the Rural Urban Mortality Measurement (RUMM) technique. The technique generates independent estimates of rural and urban mortality for all age-groups by segregating death registration data into areas of similar characteristics to urban and rural areas. These areas are referred to as inferred urban and inferred rural populations in the study.

In order to assess the reliability and validity of the RUMM technique, it was applied to the Philippine death registration data of 1975 and 1980, and to the 1980 death registration data for Thailand and Peninsular Malaysia. This application followed several procedural stages involving evaluation and assessment of the reliability and completeness of death and population data.

Application of the RUMM technique to Thailand and Peninsular Malaysia allowed the comparison of inferred urban and inferred rural mortality estimates to the estimates generated for urban and rural areas. This is because Thailand and Peninsular Malaysia have rural and urban data on death registration.

The assessment procedure which compared the closeness of the patterns and levels of mortality between inferred urban and urban areas, and

between inferred rural and rural areas, showed no difference. The differences in survival ratios for each age-group and the mean differences were found to be close to zero. This led to the conclusion that the mortality estimates for inferred urban and inferred rural populations are valid representations of levels and patterns of mortality found in urban and rural areas. Therefore, in cases where rural and urban tabulations of deaths do not exist, RUMM technique provides a valid method for calculation of mortality estimates.

This study also presented the strengths and weaknesses of the technique especially when applied to sub-national populations. Mainly, weaknesses result from using the Brass Growth Balance Equation to assess completeness of death registration. Substitution of alternative estimates of death registration completeness tends to strengthen the technique.

Finally, this study showed the robustness of the RUMM technique as well as its non-dependence on any specific index of urbanization and on any technique of assessing completeness of death registration.

To

Dr. John A. Ballweg
mentor & friend

Simply because he cares!

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I: INTRODUCTION

STATEMENT OF THE PROBLEM

Incomplete mortality data in Third World countries limit the implementation of effective programs for improving health, nutrition, sanitation, and economic development. A serious deficiency in many countries is the absence of mortality data which segregate urban from rural mortality (Anderton, et al., 1983). Because of regional and socio-economic inequalities within countries, such data limitations distort the overall picture of life expectancy. The distortion tends to disguise high mortality levels in the countryside and underestimates the greater life expectancy of the urban residents.

Such is the case in the Philippines, India, Brazil, Thailand, Malaysia, and many other countries. For some of these countries (e.g. Indonesia, India, Malaysia, etc.), enumerated deaths for the total country do not even exist (Haines, et al., 1983; Somoza, 1981). For many countries, however, while enumerated deaths exist, reports are usually incomplete and deficient, requiring correction or adjustment before any analysis can be attempted (Arretx, 1984; Brass, 1975; Bennet and Horiuchi, 1981; Kinsella, 1984; Flieger, et al., 1981; Lingner, 1974; Linder, 1981; Palloni, 1984).

The problem of availability and quality of data is compounded when efforts are made to examine mortality differentials according to subgroups (Anderton, et al., 1983; Hillery and Saunders, 1968). While total country estimates can be adequately calculated by applying indirect techniques to census and survey data or by adjusting the deficient death registration data, the absence of enumerated deaths by characteristics such as age, place of residence, socio-economic status, and education makes it virtually impossible to study differential mortality in many Third World countries. For example, the United Nations' Demographic Yearbook (United Nations, 1984), which provides the statistical series for mortality and fertility for all countries, shows complete mortality information for all developed nations but incomplete information for most Third World countries. Such lack of complete information is particularly true for rural and urban mortality.

Absence of rural and urban classifications of registered deaths makes it virtually impossible to estimate adult and infant mortality by place of residence. Existing estimates of rural and urban mortality levels in most Third World countries are derived through indirect techniques; most apply the Brass (1975) method for estimating infant mortality rates from data on children ever born and children surviving.

Consequently, planning for human services and population projections rely heavily on national estimates. While national estimates are important, they do not respond to the needs of local planners (Flieger, et al., 1981: 5-6). To assume that rural and urban mortality levels are similar and to undertake development plans based on this assumption are unrealistic. Likewise, the apparent rapid growth of all urban areas in Third World countries, as well as the inequalities that exist between rural and urban communities (Castillo, 1979: 344-345), makes it imperative to separate estimates of mortality.

This study attempts to meet the need for more accurate data by designing a technique to estimate rural and urban mortality in countries where death enumeration is not tabulated by rural or urban place of residence. The technique provides a method for segregating mortality into two groups with one group being closer in characteristics to rural areas and with another group being closer in characteristics to urban areas. The method developed in this study is described as the Rural Urban Mortality Measurement (RUMM) technique, and the RUMM acronym will be used in the design and operational accounts which follow.

OBJECT OF THE STUDY

The Rural Urban Mortality Measurement (RUMM) technique is designed to generate independent estimates of rural and urban mortality for all age groups as well as the total population in Third World countries. This technique was applied to the Philippine death registration data of 1975 and 1980, and to the 1980 death registration data of Peninsular Malaysia and Thailand.

In order to assess the reliability and validity of the RUMM technique, the following hypotheses were evaluated:

1. That the Brass Growth Balance Correction Factors (f) for each of the study countries are consistent with existing estimates of death registration completeness for each country.

2. That in countries with rural and urban death registrations (e.g. Thailand and Peninsular Malaysia), estimates of mortality for inferred rural and inferred urban will not significantly differ from estimates of mortality for rural and urban areas.

3. That in countries with inferred rural and inferred urban mortality estimates for two time-periods (e.g. Philippines 1975 and 1980), estimates of mortality for inferred urban and inferred rural populations for 1975 are consistent with estimates of mortality for the 1980 period.

4. That the total country mortality levels estimated by the RUMM technique will provide data consistent with existing national mortality estimates of each study country.

5. That the estimates of infant mortality for inferred urban and inferred rural populations are consistent with infant mortality estimates for rural and urban areas derived by other indirect techniques with data from surveys and censuses.

THE NATURE OF THE DATA SETS

Data used in this study are the 1980 death registration data by age and by geographic unit for Peninsular Malaysia, the Philippines, and Thailand. The RUMM technique was first tested by applying it to the 1975 Philippine death registration data by age and by region. Results of this previous application are also presented in this study.

Data on children ever born and children still living by age of mother are taken from the Country Report provided by the World Fertility Survey (WFS) for Peninsular Malaysia (1979) and the Philippines (1979). While similar data exist for Thailand (1977), an alternative source of data in a more recent period is available. For Thailand, the data for children ever born and children still living by age of mother are taken from a more recent survey, the Contraceptive Prevalence Survey of 1981 (1982).

SELECTION OF COUNTRIES FOR THE STUDY

Indirect techniques are designed to cope with data limitations and inadequacies. Since they began with a premise that data which allow direct calculations of rates do not exist, data requirements are minimized and techniques are designed to use alternative data sources if the desired data is not available for a particular country.

Since no two countries have the same data sources, application of any indirect technique requires modification from country to country, depending on the availability of data. Such is the case for the RUMM technique.

Because of the different adequacy and availability of data between the developed and the Third World countries, application of the RUMM technique to a developed country is not expected to encounter the problems that are evident when the technique is applied to a Third World country. While the technique can be applied to a developed country, there is no great need of doing it since rural-urban segregation of deaths already exist. Such technique, however, is greatly needed in countries where death registration by place of residence does not exist. For this reason, the present application of the RUMM technique is restricted to Third World countries. However, future studies may include developed countries.

There are three main sources of data for this type of demographic analysis. (1) Data within each country gathered by a census, vital registration system, surveys, and other agencies. Each country has a data base available for in-country analysis. In most cases these data provide the best source of information. (2) The United Nations gathers and publishes vital information for each country. However, these data pertain to the total country and seldom include desired subgroups of the population. (3) Center for International Research of the U.S. Bureau of the Census obtains data from a number of countries and uses these data for analysis of specific topics. While these include a sizeable number of countries, Third World countries are not well represented (and if they are, often inadequate) in the U.S. Census data base. Primarily, this is because most countries are reluctant to release a broad data base to outside institutions. Providing a technique that would allow local scientists to conduct discriminate analyses of demographic data within the country permit a more standardized reporting technique and avoid the necessity to use agencies outside the country.

In procuring data for the analysis, this study utilized the data base found at the U.S. Bureau of the Census. The only exception is Thailand. For Thailand, in-country data of death registration was procured through a special request to the Director of the Ministry of Health. Thailand was selected because of two reasons: (1) census population data are already available within the campus, and (b) its 1980 death registration data are unpublished and unanalyzed.

Philippines and Peninsular Malaysia were selected because of the availability of necessary data at the U.S. Bureau of the Census. Application to Peninsular Malaysia allows the testing of the RUMM technique to a sub-national data. While additional countries can be included in the analysis using the RUMM technique, the present study is restricted to the three specified countries since they represent the variations in type required.

DEFINITION OF TERMS

This study contains several demographic terms that require clarification. Many of these terms are discussed thoroughly in the chapter where they are used. However, this section offers brief definitions.

Age-specific Death Rate. The average annual number of deaths to a given age-group during a specified period of time per 1,000 persons in the same age-group based on midperiod population.

Age-specific Fertility Rate. The average annual number of births to women in a given age-group during a specified period of time per 1,000 women in the same age-group based on midperiod population.

Agricultural household. A private household whose head of household is engaged in agriculture regardless of status (owner or worker).

Brass Growth Balance Equation. A procedure for estimating the completeness of death registration based on the relationship between the age distribution of both registered deaths and the population. A more elaborate discussion on this technique will be presented in Chapter III.

Brass Mortality Technique. A method of estimating the level of infant and childhood mortality based on information on children ever born and children surviving, provided by women in five-year age-groups, and on assumed relationships between certain Life Table values and the proportion of children ever born who are still surviving. A more elaborate discussion will be presented in Chapter II.

Child or Childhood Mortality. Death during the early childhood years, one to four years.

Children Ever Born. The number of live births to a woman, regardless of whether the children are currently living or dead, or living with or away from the mother.

Child Survivorship Technique. Various techniques used to estimate the level of infant and child mortality based upon children ever born and children surviving data (see mortality techniques developed by Brass, Feeney, Sullivan, and Trussell).

Children Surviving or Children Still Living. The number of children ever born to a woman who are still alive at the time of the inquiry, regardless of whether the children are currently living with or away from the mother.

Crude Death Rate. The average annual number of deaths during a specified period of time per 1,000 persons based on midperiod population.

Feeney Mortality Technique. A method of estimating the trend in infant mortality based on information on children ever born and children surviving, provided by women in five-year age-groups, and on assumed relationships between certain Life Table values and the proportion of children ever born who are still surviving.

Forward Derivation Technique. A method that adjusts age-sex distributions by projections and rejuvenations (reversed projection) of two census populations, taken 10 years apart. The first population distribution (P^t) is projected five years up to year t+5 while the second population (P^{t+10}) is rejuvenated to year t+5. The average of the projected and the rejuvenated distributions is projected to year t+10 and rejuvenated to year t as the "adjusted" population.

Incomplete Registration. A term used to indicate that the coverage of registered data is less than 90 percent of all events.

Inferred Urban Population. The populations of units that are identified by this study as urban. The criteria of classification include four indices of urbanization that are applied to a unit of each country. Those that are not classified as inferred urban become the inferred rural population. A more detailed discussion of these populations will be presented in Chapters IV, V, and VI.

Indirect Techniques. These are methods that have been developed both in the search for alternative approaches to mortality and fertility estimation and to assess the reliability of conventional data. They are indirect because they involve steps beyond the simple calculation of basic rates. Examples are: Brass Growth Balance Equation, Survivorship Techniques, and the Arriaga Fertility technique.

Infant Mortality Rate. A measure of the frequency of deaths between birth and age one, during a specified period of time; usually calculated as the number of deaths to infants under one year of age per 1,000 live births occurring in the same calendar year.

Life Expectancy at Birth. The average number of years a birth cohort could be expected to live, assuming they are exposed to a given set of age-specific death rates.

Life Table. A statistical table representing the life history of a hypothetical cohort exposed to a given set of age-specific death rates. A detailed discussion of Life Tables will be presented in Chapter III.

Net Coverage Error. The balance between the number of persons omitted in a census or survey and those erroneously included, expressed as a percentage of the adjusted population. An excess of persons omitted is referred to as net underenumeration; an excess of persons erroneously included is net overenumeration.

Projections. A term used to describe population data and vital rates for years since the latest reliable population census figures, complete vital registration data, or sample survey data.

Registration. A method of continuously recording information on vital events as they occur, either through a civil or a special recording system.

Reliability. For this report, reliability is defined as the consistency of data obtain from different data collection systems. Examples of reliability measures for demographic data can be found in evaluations reported by the U.S. Bureau of the Census. The Bureau of the Census evaluated the 1970 census counts by compiling, combining, and manipulating demographic data independently from the census being evaluated. The compiled data were then compared with census counts (Siegel, et al., 1977).

RUMM Technique. The Rural Urban Mortality Measurement technique or RUMM is an indirect technique of segregating mortality data into inferred urban and rural populations and generates estimates of mortality for these populations. A detailed discussion of the method will be presented in Chapter III.

Stable Population Distribution. A stable distribution is the age composition a population would attain if it were to continue to grow with unchanged mortality and fertility after disturbances brought about by migration or other factors have been eliminated.

Sullivan Mortality Technique. A modification of the Brass mortality technique for estimating the level of infant and child mortality. Results from a regression analysis of empirically-based fertility and mortality schedules are incorporated into the procedure of converting the proportion of children ever born who are still surviving per woman in a given five-year age-group into precise Life Table measures.

Survival Ratios. The proportion of persons in a given age group who will be alive after a specified number of years.

Third World Countries. These are countries that the United Nations (1981) have classified as "less developed." Sometimes, these countries are referred to as Developing Countries or Periphery. These include countries in Latin America, most of Asia, Middle East, and Africa. Of the world's 202 countries and territories, the United Nations classified 158 as "less developed" and 44 as "more developed."

Trussell Mortality Technique. A refinement of the Brass and Sullivan mortality techniques for estimating the level of infant and child mortality. Additional independent variables are included in the regression analysis and Coale-Trussell model of fertility schedules are substituted in place of empirical fertility schedules.

Urban Areas. This paper utilizes a concept of urbanized areas that are defined by the Census Bureau of each specific country.

Urban Areas in the Philippines. The Philippine Bureau of Census defines urbanized areas as: (1) All cities and municipalities having a population density of at least 1,000 persons per square kilometer. (2) Poblaciones or central districts of municipalities and cities which have a population density of at least 500 persons per kilometer. (3) Poblaciones or central districts (not included in 1 and 2), regardless of the population size, which have the following: a street pattern, i.e., a network of streets in either parallel or right-angle orientation; at least six establishments (commercial, manufacturing, recreational and/or personal services); and at least three of the following: (a) a town hall, church or chapel with religious services at least once a month; (b) a public plaza, park or cemetery; (c) a market place or building like a school, hospital, puericulture and health center or library. (4) Barangays having at least 1,000 inhabitants which meet the conditions set forth in three above, and where the occupation of the inhabitants is predominantly non-farming or fishing. All areas not falling under any of the above classifications are considered rural.

Urban Areas in Thailand. An urban area in Thailand is composed of a municipal area and an urban sanitary district. A municipal area is a legal unit established by the Royal Decree of the 1953 Municipal Act. This includes: Nakhon (city), Muang (town), and Tambon (commune). A Tambon municipality is established wherever it is deemed appropriate. A Muang municipality is established in areas where the administrative seat of the provincial government is located or where the population is at least 10,000 persons, with an average density of not less than 3,000 persons per square kilometer. The sources of tax revenue must also be sufficient for the execution of municipal affairs as stipulated in the 1953 Municipality Act.

A Nakhon municipality is established in areas where the population is at least 50,000 persons, with an average density of not less than 3,000 persons per square kilometer. Tax revenues must also be sufficient for the execution of municipal affairs as stipulated in the 1953 Municipality Act.

Sanitary districts are also established in Thailand by the Ministry of Interior under the provisions of the Sanitary District Act of 1952. Any sanitary district established as a municipal area becomes an urban sanitary district.

Areas that do not belong to any of the above classifications are then defined as rural areas.

Urban Areas in Peninsular Malaysia. The 1980 Population and Housing Census of Malaysia defines urban areas as any central place with a population of 10,000 or more.

Underenumeration. A listing of the population which erroneously counts fewer persons than those who actually belong to it.

Underregistration. The failure to record all events which occur during a specified time-period in a given population. These events can either be death or birth.

Validity. A descriptive term used of a measure that accurately reflects the concept that it is intended to measure (Babbie, 1975). Validity refers to the representativeness of the estimates. A technique is judged to be valid, if the estimates it produce are identical, whenever it is applied to a particular data set.

CHAPTER II: REVIEW OF RELATED LITERATURE

AVAILABLE MORTALITY DATA AND THEIR QUALITY

The quality of mortality data for most Third World countries is inadequate (Adegbola, 1985; Arthur and Stoto, 1983; Haines, et al., 1983; Kinsella, 1984; Premi, 1982; Sivamurthy, 1981). Most of these studies suggest that the quality of data has not improved in the past generation. According to the United Nations (1982), only five Third World countries--Hongkong, Singapore, Malaysia, Sri Lanka, and Costa Rica--claim to have "complete" vital registration in 1975. Because of the inadequacy of data, mortality has been estimated through indirect techniques; the estimates generated are affected not only by the errors in the data but also by the methods of estimation (Sivamurthy, 1981).

I. CIVIL REGISTRATION SYSTEM

The most common method of obtaining information about vital events is the civil registration system wherein births and deaths are reported and recorded shortly after their occurrence. Although the Indian (Premi, 1982), Philippine (Lingner, et al., 1977), and Thai (U.S. Bureau of the Census, 1978) registration systems are more than a century old, the registration of births and deaths continues to be deficient in content, coverage, and completeness. Brazil, whose National System of Vital Statistics is barely ten years old, is also incomplete (Merrick, 1985; Altman and Ferreira, 1979). Deficiencies in vital registration accuracy are not associated with tenure but with a range of other causes.

In studies by Linder (1981), Lingner, et al. (1977), and Premi (1982), several factors responsible for the underreporting of vital events in Third World countries are discussed: low level of literacy, low level of awareness of the importance of civil registration, the overwhelmingly rural population, the inadequacy of registration machinery, and insufficiency of financial resources. Likewise, Mortel (1975: 84), in discussing the Vital Registration System of the Philippines, identified four major reasons for non-registration. These reasons are: ignorance, forgetfulness, distance of residence from registration office, and belief that registration was done automatically by the person who attended to the event. When individuals or families who "forgot" to register the death are made aware of their registration duty or confronted by the necessity to produce a document for legal transactions, they either have forgotten the actual date of death or attempt to minimize the time that has elapsed since the event took place in order to minimize the late-registration fee. In some cases, they may choose not to register the death to avoid paying the late-registration fine.

While the developed countries' vital registration for reporting all births and deaths is close to 100 percent (Linder, 1981), most Third World countries are described as reporting between 60 and 70 percent (Mijares, 1975; Lingner, et al., 1977; Premi, 1982). For example, the 1975 death registration of the Philippines (Pagtolun-an, 1984) showed an undercoverage of more than 30 per cent. In India, despite efforts to improve the reporting of vital events, the Office of the Registrar General and Census Commissioner (ORGCC) estimated the underregistration of births and deaths in 1979 as 58 and 65 percent (Premi, 1982). Similarly, in Thailand, the birth and death registrations for 1970 were estimated to be 20 and 42 percent incomplete (U.S. Bureau of the Census, 1978).

While the quality of registration data remains a major problem, there are other inadequacies which limit its use. As Anderton, et al. (1983) point out, many registration systems in Third World countries do not tabulate data by rural and urban subgroups. Therefore, even when an adequate and highly robust indirect technique for correcting underregistration exists, the fact that deaths are not tabulated by rural/urban residence limits mortality estimation to national population. Lingner, et al., (1977) also maintain that insufficiency of financial resources and the inexperience of the civil registrars in data processing and tabulation are the main reasons for the limited tabulation of death registration in Third World countries. As a consequence, mortality analysis by rural and urban place of residence suffers.

However, the problem with quality of mortality data has not deterred some pioneer demographers from using them, after correcting them for underregistration, and producing plausible estimates. An example is Flieger, et al.'s (1981) estimate of national, regional, and provincial mortality from the 1970 death registration data corrected by the correction factor derived by the Brass Growth Balance equation. In a similar manner, the Center for International Research of the U.S. Bureau of the Census, in an effort to create an International Data Base (IDB), utilized the country's death registration data in estimating mortality (e.g. Kinsella, 1984; Rowe and O'Connor, 1984; Rowe, 1984; Way, 1984).

II. CENSUS ENUMERATION SYSTEM

Like the Civil Registration System, Census Enumeration Systems in Third World countries are often rated with a certain degree of skepticism. It is accepted that census data are deficient and incomplete (Arriaga, 1968; Mijares, 1975; Premi, 1982). In Thailand, for example, the 1960 and 1970 censuses indicate four and six percent undercount of the total population as well as an undercount of vital events (U.S. Bureau of the Census, 1978). A four percent undercount of the population was estimated by Kinsella (1984) for the 1960 census of the Philippines. In addition, in the Philippine Census of 1970, though data on children ever born and children surviving were collected, these figures nonetheless suffer from severe underreporting and age misstatements. Direct and indirect estimates, based upon census data, prove unacceptable when contrasted with later and prior estimates from alternative sources (Kinsella, 1984: 465).

Another source of error for most census data is age misstatement, particularly, age heaping at certain preferred ending digits (Premi, 1982). Sometimes differential undercount occurs between sexes, as in the case of Peninsular Malaysia (Finch and Sweetser, 1979), Thailand (U.S. Bureau of the Census, 1978), and India (Premi, 1982). In some cases, differential undercount also occurs in other subgroups of the population such as age, rural and urban residence and many others (Arthur and Stoto, 1983; Kinsella, 1984; Madigan, et al., 1976; Premi, 1982).

Unlike the registration data, census data are usually tabulated by rural/urban place of residence. Ideally, mortality analysis should be more straightforward, but the high degree of underreporting prevents direct estimation. Furthermore, since most censuses in Third World countries do not gather direct information on mortality, most estimates are generated through the use of indirect techniques such as the Brass (1975) child-survivorship method or the Brass (1975) one-parameter logit system based on two successive age distributions from two censuses.

III. DEMOGRAPHIC SURVEYS

The World Fertility Survey (WFS) is the most recent large-scale demographic survey covering 43 Third World countries (World Fertility Survey, 1982). Peninsular Malaysia, the Philippines, and Thailand were included in this survey. While WFS data do not make possible estimation of adult mortality, it is one of the very few sources of reliable information on infant and childhood mortality for most Third World countries.

The WFS focuses on fertility and family planning and includes data on children ever-born and children still living, according to the age of mother. This information allows the estimation of infant and childhood mortality by applying the Brass (1975) child-survival technique.

Another source of mortality information for the Philippines is the dual-record survey which has been conducted for nearly a decade in this country. Dual-record surveys gather vital events by using two independent systems. Besides permitting direct calculation of mortality estimates, the dual-record system affords the opportunity to calculate undercoverage for each system as well as undercoverage for the survey (Chandra and Deming, 1971). The weakness of the dual-record survey is that it includes a very small non-probability sample of the population. Since the technique is very expensive, scope of the study is generally kept to the minimum (Madigan and Herrin, 1977).

One example of a more broadly-based use of the dual-record system took place in the Philippines. In 1973, the Philippine Bureau of Census and Statistics conducted a national dual-record survey to assess the degree of census underenumeration and vital events underregistration (Mijares, 1975). The underregistration rate produced by Mijares has been used in other studies to adjust and correct death registration for underenumeration. These studies include Kinsella's (1984) **Philippine Data Base** and Flieger, et al.'s (1981) **On the Road To Longevity.**

There are also numerous existing National demographic surveys in the three study countries; surveys for either fertility, family planning, or mortality are conducted annually in each of the three study countries. Most of these surveys, while not directly focused toward recording births and deaths, can be used to calculate indirect mortality estimates. For example, the National Demographic Surveys (Alcantara, 1975; Flieger and Smith, 1976), Area Fertility Studies or Pregnancy History Studies (Ballweg, 1982; Concepcion and Cabigon, 1982; Madigan, 1981), Value of Children Studies (Arnold and Pejaranonda, 1977; Bulatao, 1975; Bulatao and Lee, 1983), Contraceptive Prevalence Surveys (Knodel, et al., 1982; Kamnuansilpa and Chamratrithirong, 1982), in the Philippines, Peninsular Malaysia, and Thailand provide adequate data for mortality estimation.

INDIRECT TECHNIQUES AND THEIR LIMITATIONS

If adequate and complete mortality data are available, mortality estimation is direct and straightforward. Such is the case in developed nations where mortality rates and life expectancies can be directly calculated from death registration and/or from two census distributions. However, when mortality data are not available and/or incomplete, estimations become complicated and indirect. For example, instead of using direct data on the number of people who died in a certain period, it is necessary to use information on the proportion of people who survived out of the total number born. Ideally, when census data are reliable, estimates of probability of dying q(x) can be obtained by identifying a group at birth and following them for x years and recording how many do not survive. However, in countries where census data are unreliable, this direct method cannot be used. Hill (1984) aptly describes indirect techniques as those techniques that have been developed both in the search for alternative approaches to mortality estimation and in the assessment of the reliability of conventional data. They are referred to as indirect because they involve steps beyond the simple calculation of basic rates.

Rashad (1981), in his review of the techniques of mortality estimations, classifies recent indirect techniques of mortality estimations into two broad categories: (1) techniques that estimate mortality from survivorship reports of births, kin, and spouses; and (2) techniques that manipulate defective data to obtain plausible mortality measures. Hill (1984) also groups his evaluation of indirect methods for estimating mortality into two similar categories: (1) methods that are essentially assessments of conventional data; and (2) methods that are based on unconventional indicators of mortality.

I. ESTIMATIONS OF MORTALITY FROM SURVIVORSHIP REPORTS

The pioneering work of Brass (1968, 1973, 1975) in the area of mortality estimation has become the basis of many recent works in indirect techniques. The Brass method for estimating life survival rates from children ever born and children surviving data, from single surveys or censuses, is described by Ewbank (1982) as a technique that revolutionized the study of mortality in populations that are not covered by complete registration of vital events. The fact that Brass (1975: 56) claims that his technique is robust has led many demographers to depend on it for estimating mortality in a wide variety of populations (Ewbank, 1982: 459). In fact, most mortality analyses in Third World countries rely heavily on the Brass child-survivorship technique (Adegbola, 1985; Carvalho and Wood, 1978; Haines, et al., 1983; Rashad, 1981).

The Brass Child-Survivorship technique, which was later refined by Preston and Palloni (1977), Feeney (1976), Sullivan (1972), and Trussell (1975), generates infant mortality rates and life expectancies at birth by primarily estimating probabilities of dying q(x) from birth to specified age x based on data of children ever born and children still living, by age of mother. In practice, the use of this technique is usually limited to the estimation of q(2), q(3), and q(5) since these are considered to be the most reliable of the estimates (Brass, 1975; Calvalho and Wood, 1978; Ewbank, 1982).

However, according to Ewbank (1982: 459-473), Brass' recommendation to focus on the second, third, and fourth age-groups does not eliminate all sources of bias because reporting errors (including underreporting of birth, age misstatements) are not the only errors in the technique. Ewbank classifies three sources of errors for the estimates: sampling variance, reporting errors, and errors due to the simplification of the assumptions of the model. Ewbank (473) concludes that besides reporting errors, errors due to sampling variance and simplifying the assumptions of the model are significant contributors to total errors.

Another indirect technique presented by Brass and Hill (1973), Brass (1975), and Hill (1975) relies on the question of maternal orphanhood (i.e., by posing the question "Is your mother alive?") to estimate female adult mortality and on the question of paternal orphanhood ("Is your father alive?") to estimate male adult mortality.

The Brass and Hill technique, known as the orphanhood method, estimates adult mortality based on proportions of persons orphaned by age. The technique rests on the notion that the proportions orphaned at age x must be related to the probability of a parent's dying between his (or her) age at the time of the child's birth and that age plus x. A similar approach to estimate mortality rates from data on widowhood was proposed by Hill and Trussell (1981). This technique utilizes widowhood information provided by a female population on the death of the first husband in order to estimate male adult mortality.

The most serious limitation of survivorship methods is that the mortality estimates do not refer to a defined time-period but rather reflect an average mortality characteristic of the time frame for the survival interval estimated (Adlakha, et al., 1976). Other problems with respect to these methods should also be noted. Age misreporting for mothers, orphans and widows, and underreporting of children ever born (e.g. omission of dead children) may distort results (Brass, 1975; Adlakha, et al., 1976). The orphanhood method automatically excludes the mortality experience of childless persons (Brass, 1975) and the child-survivorship technique automatically excludes children of dead mothers (Brass, 1975).

In relation to rural and urban mortality estimation, all indirect techniques are also limited by the lack of available data on deaths tabulated by place of residence of the deceased. Unless the required data are tabulated and/or segregated by rural and urban residence, estimation of rural and urban mortality by applying indirect techniques is impossible. In fact, the absence of adult rural/urban mortality estimates in most Third World countries is due to the non-existence of urban and rural tabulations of deaths. Indirect techniques discussed above generate mortality estimates; they do not segregate mortality into rural and urban areas.

II. TECHNIQUES THAT MANIPULATE DEFECTIVE MORTALITY DATA

There are several methods designed to evaluate and correct defective mortality data rather than to estimate mortality. All of these techniques attempt to estimate the underregistration of deaths at adult ages. Their basic requirements are the age distributions of deaths and population. According to Rashad (1981: 370), "the common features of these methods are their dependence on stable populations and their use of the simple but effective idea that the proportionate distribution of deaths is not affected by equal underregistration."

The most promising of these methods was developed by Brass (1975). The Brass method which is widely known as the "Brass Growth Balance Equation" (detailed discussion of the method and its limitations will be presented in the next chapter) makes use of age distributions of deaths and population in order to estimate the correction factor (f) to adjust underregistration.

Hill (1984: 163), in his evaluation of the Brass Growth Balance Equation, showed the importance of the procedure for assessing the consistency of reported deaths by age with a reported population. He, however, cautioned the user by saying that the internal and external consistency of the method must be assessed.

The Brass growth balance technique was later refined by Preston, et al., (1980). While the Brass technique relies heavily on age distribution, Preston's model employs a combination of information: rate of increase, age distribution of deaths, and age distribution of the population. Preston's model was designed to have a higher degree of robustness even in situations where age distributions of the population are not stable.

A model designed to do away with the assumption of stability was proposed by Courbage and Fargues (1979). The method, which only requires equal underregistration of deaths, is based on the notion that the age structure of deaths of the country under study is similar to a set of standard age-specific death rates. In principle, the basis for the method is that knowledge of age distribution for deaths and of a family of Life Tables to which this distribution can be related, makes it possible to deduce the true level of mortality from the relation between age structure of deaths and level of mortality (Rashad, 1981).

In summary, the review of related literature reveals that as long as mortality data in Third World countries remain defective, incomplete, and inaccurate, the only way to derive plausible estimates of mortality for these countries is to use indirect techniques of mortality estimation. As long as indirect techniques exist, estimation is possible. However, when indirect techniques do not exist or are inapplicable to a specific situation, the investigator is required to either design a new indirect technique or refine the old ones.

There is one area of mortality estimation where indirect techniques do not exist. This is the area of segregating mortality data for rural and urban mortality estimation. This study bridges the gap by pioneering in this area. It is envisioned that this study will motivate others to venture into the area of rural and urban mortality estimation and, therefore, create the possibility of increasing indirect techniques that deal with rural/urban mortality segregation.

CHAPTER III: THE METHODOLOGY

The Rural Urban Mortality Measurement (RUMM) method requires as data base the mortality tabulation by age and by some geographic unit, such as province, state, region, or island, and the age distribution of the population which corresponds to this mortality tabulation. With these data, the following procedures are performed. First, evaluation of the census population age distribution. Second, selection of appropriate indices of urbanization. Third, application of the indices to each geographic unit to obtain an urbanization score for each unit. Fourth, identification and classification of each unit into inferred rural and/or inferred urban populations based on their respective urbanization scores. Fifth, summation of death registration of units classified as inferred urban and the summation of death registration of units classified as inferred rural. Population age distribution of these two units is, likewise combined. Sixth, assessment of the completeness of death registration for inferred rural and inferred urban populations by applying the Brass Growth Balance technique. Seventh, adjustment of death registration for inferred urban and inferred rural populations based on "factors" generated by the Brass Growth Balance technique. Eighth, calculation of the age-specific death rates for inferred rural and inferred urban populations. And finally, estimations of Life Tables for each area.

EVALUATION OF THE CENSUS POPULATION AGE DISTRIBUTION

The accuracy of the age distribution in the three study countries is an important requirement for this analysis. Since both the Brass Growth Balance equation and the mortality estimation rely heavily on the stability and the accuracy of the age distribution, this study began the analysis by evaluating the accuracy of this distribution.

The evaluation procedure used was the U.N. Age-Sex Accuracy Index. This index is primarily designed to measure the net age misreporting and, for the most part, does not measure net coverage error. This index does not take into consideration expected declines in the sex ratios with increasing age, normal fluctuations in the number of births and deaths, nor real fluctuations due to migration, war, and epidemic (U.S. Bureau of the Census, 1978; Shryock and Siegel, 1976).

The United Nations describes the age distributions as "accurate", "inaccurate", and "highly inaccurate" depending on whether the U.N. Index is under 20, 20 to 40, or over 40 respectively.

Any country or population in this study showing a U.N. Age-Sex Accuracy Index of more than 20 was adjusted by using the age-adjustment procedure proposed by Arriaga, Anderson, and Heligman (1976) known as Forward Derivation (FWDRV). This technique adjusts age-sex distributions obtained from two population censuses, taken ten years apart. The basic assumption behind this technique is that both distributions have the same net undercounts or overcounts by age and sex.

However, in countries where population age-sex distributions are adjusted for underenumeration before publication by that country's Bureau of the Census, the Forward Derivation method, being an age-sex adjustment procedure, will adjust the published figures. To avoid adjusting the same population twice, thereby pulling the figures farther away from the actual data, this study did not use Forward Derivation in cases where populations had already been adjusted. Instead, an age smoothing procedure was performed using the technique derived by the United Nations (1956). The U.N. smoothing procedure is different from other mathematical graduation or smoothing procedures inasmuch as it does not estimate under or overenumeration and, therefore, does not adjust the figures by using this estimate. What the method basically does is to smooth a population distribution in five-year age-groups, except for the first two and last two five-year age-groups by comparing a specific age-group to two other age-groups above and below it. For example, age-group 10-14 is smoothed in relation to age-groups 0-4 and 5-9 and then to age-groups 15-19 and 20-24. The formula for this procedure is as follows:

$$ {}_5SM_x = 1/16\ [- {}_5MP_{x-10} + 4\ {}_5MP_{x-5} + 10\ {}_5MP_x + 4\ {}_5MP_{x+5} - {}_5MP_{x+10}], $$

where ${}_5SM_x$ is the smoothed male population age x,x+5 and ${}_5MP_x$ is the male population age x,x+4. The female distribution is smoothed in the same manner as the male distribution.

IDENTIFICATION OF AREAS DESIGNATED AS URBAN AND RURAL

Since registered deaths for most Third World countries are not available by rural-urban residence but only by state, province, region, etc., the problem was how to classify these as urban or rural. By making the assumption that some units are more urbanized than others, the task was to identify those units and to combine them into urban complexes. It is inferred that the remaining units can be defined as rural.

In applying this underlying assumption to the three study countries, information on the degree of urbanization for each unit in each study country was necessary. While there are many appropriate indices of urbanization, the choice was limited by the availability of data in each study country. For example, the degree of urbanization of each region in Thailand was assessed by calculating the proportion of urban population, the mean city population size, the proportion of agricultural population, and the population density. On the other hand, each region and state in the Philippines and Peninsular Malaysia were assessed by calculating the proportion of urban population, the mean city population size, the total number of cities, and the population density.

The calculations of the proportion of urban population made use of the urban and total populations of a geographic unit. If U and P are to be defined as urban and total populations of a geographic unit, then proportion of urban population is:

$$\text{Prop Urban} = U/P.$$

After calculating a Prop Urban for each geographic unit, ranks were assigned to each one with the highest number assigned to the unit with the lowest score in Prop Urban.

The Mean City Population Size (Arriaga, 1975) makes use of the list of cities of size 50,000 or more for each geographic unit with its corresponding population. Cities of 50,000 inhabitants or more were chosen because a city of this size in Third World countries was classified as medium size (Arriaga, 1984). An average size of cities where the population resides was calculated by applying the expression:

$$U_j = \frac{\sum_{i=1}^{m} C_{ij}^2}{P_j},$$

where Cij is the population of city i in geographic unit j, Pj is the total population of the geographic unit j, and m is the number of cities with 50,000 or more inhabitants in a geographic unit j.

The calculation of the mean city population size for each geographic unit provides information on the average size of the cities relative to the total population in the unit. Ranking each unit in relation to its mean city population size provided another combination of urban areas. Again, the procedure was to assign "1" to the unit with the highest index and the highest number to the unit with the lowest index.

Although the index provided adequate information on the degree of urbanization, it was biased towards units with extremely large cities. This was because in squaring their population, extremely large cities are also assigned extremely large weights, thereby inflating the index for that unit. To avoid such an effect, a unit needed to be ranked according to the total number of cities it included. This type of ranking offsets the extremely large weight contributed by large cities, since each city (large or small) is given an equal weight of one.

This improvement on Arriaga's Mean City Population Size was based on an underlying assumption that the greater the number of big cities in a geographic unit, the more widespread its influence on urbanization. The "sense of urban life" can be experienced by those who reside in areas that might be defined as rural by censuses and surveys if these areas are near enough to the cities. Their mortality levels may not be as low as the city in a unit classified as inferred urban, but may be of comparable level to those who reside in cities of units classified as inferred rural.

Another index of urbanization used in assessing the degree of urbanization in each geographic unit was the population density. This index was computed as population per square kilometer of land area. If P is the total population of a geographic unit and A is the total land area in square kilometer, then the population density is:

$$\text{Density} = P/A.$$

Geographic units with higher density scores were assigned lower number ranks while units with lower density scores were assigned higher number ranks.

The proportion of the agricultural population is simply defined as:

$$\text{Prop Farm} = F/P,$$

where F and P are the agricultural and the total populations in each geographic unit. Again, units were ranked according to their score in this index.

In assessing the results provided by these different types of indicators, ranks assigned to each unit were summed up to make a total rank TR, which could simply be expressed as:

$$TR = R_1 + R_2 + R_3 + R_4$$

where R_1, R_2, R_3, and R_4 are ranks obtained from the indices of urbanization used in a particular country. For Thailand, TR is the sum of R_1, R_2, R_3, and R_4 from the proportion of urban population, the mean city population size, proportion of agricultural population, and the population density. For the Philippines and Peninsular Malaysia R_1, R_2, R_3, and R_4 refer to the proportion of urban population, the mean city population size, the total number of cities, and the population density.

A summary measure for the degree of urbanization for each unit was generated by summing the ranks assigned to that unit. This sum of the ranks, referred to as Total Rank served as the basis of ordering the units from lower-numbered ranks to the highest. By calculating the cumulative population of these "ordered" units, one can examine the unit with a cumulative population that comes closest to the total number of urban population for the total country. Any unit below the "boundary" unit was classified as inferred rural. The "boundary" unit plus all the other remaining units was classified as inferred urban.

ESTIMATING COMPLETENESS OF DEATH REGISTRATION

When the geographic units of each study country were properly identified and classified as inferred rural and/or inferred urban, registered deaths and the corresponding population age distribution of these areas were combined. These procedures provided the required tabulations of deaths and population by age for inferred rural and inferred urban populations, allowing the assessment of the completeness of death registrations in each population through the application of the Brass Growth Balance technique.

Basically, the Brass technique takes advantage of the relationships that exist between birth rate (b), growth rate (r), and death rate (d) in the population. This relationship which can simply be expressed as:

$$b = r + d$$

is true for any segment of the population. For example, if we consider a population composed of persons above a given age x as a segment, a relationship could then be expressed as:

$$b_y = r_y + d_y \ .$$

where b_y is the birth rate above age x; r_y is the growth rate and d_y is the death rate of the population age x and over. When the assumption of stability is met, the equation is simply reduced to:

$$b_y = r + d_y ,$$

with growth rate (r) remaining constant at all ages.

Since b_y is a birth rate above age x, if achievement of age x is regarded as being "born" into the population age x and over, then

$$b_y = n_x/P_y \quad \text{and}$$
$$d_y = d_y^*/P_y ,$$

where n_x is the number of people at age x, d_y^* is the number of deaths at age x and over, and P_y is the population at age x and over or the number at risk. Equation (3) can then be re-written as:

$$n_x/P_y = r + d_y^*/P_y .$$

However, equation (4) assumes that d_y^*, the number of deaths at age x and over is accurately measured. If deaths are not accurately measured, equation (4) must be modified into:

$$n_x/P_y = r + fd_y'/P_y,$$

where d_y' is the reported deaths at age x and over and f is the estimated ratio of true to reported deaths that can be applied as a "correction factor" to adjust d_y', the reported deaths.

On the basis of equation (5), n_x/P_y can be plotted against d_y'/P_y for each age. If the points fall on a straight line, its slope will provide an estimate of completeness, 1/f. The growth rate (r), which is the intercept of the line, can be ignored since it is constant and, therefore, does not affect the slope of the line.

GENERATION OF LIFE TABLES

After adjusting for underenumeration of registered deaths by applying the "correction factor" generated by the Brass Growth Balance technique, age-specific death rates were calculated for five-year age-groups by using the census population age distribution as base.

These central death rates were then used to generate abridged Life Tables for both inferred rural and inferred urban populations.

If the infant mortality rates are found to be reasonably reliable, another set of Life Tables is also estimated using infant mortality rates as input for age under one. In most Third World countries, census data for age under one are highly inaccurate. Using the number of births as denominator instead of census enumeration for age below one minimizes the effect of undercount upon the mortality estimates. The number of births for each study country was taken from different sources or calculated by different techniques. For example, the total number of births used as denominator for the Philippines, was taken from the Philippine Yearbook of 1984 (Philippine Census and Statistics Office, 1984). For Thailand, the age-specific fertility estimates by Knodel, et al. (1982) taken from the 1981 Contraceptive Prevalence Survey were used. And for Peninsular Malaysia, the birth registration data for 1980 (Department of Statistics Malaysia, 1984) were utilized.

The Life Table is a mathematical model representing the life history of a hypothetical cohort exposed to a given set of empirical age-specific death rates. For example, the Life Table for the Philippines inferred urban population is presented in the next chapter as Table 4.17. The table takes a hypothetical cohort of 100,000 inferred urban population and shows how many would die at each age and how many would survive to each age, if they were exposed to the probabilities of death at each age that were estimated for the inferred urban population in the year 1980.

The Life Tables presented in this study were based on population and death figures which are categorized in five-year age-groups. Each of the Life Tables has eight columns. The first one is labeled AGE, followed by $1{,}000\,{}_nm_x$, $1{,}000\,{}_nq_x$, ${}_nl_x$, ${}_nd_x$, ${}_nL_x$, T_x, and by e_x.

Column two, labeled $1000\,{}_nm_x$, contains the 1980 age-specific death rates for each study country multiplied by 1,000. These rates were obtained by dividing the number of deaths by the corresponding populations in that age-group. For example, the age-specific death rate for the Philippines inferred urban population aged 15-19 is 3023/2121332 = 0.00143. When multiplied by 1,000, the rate indicated that out of every 1,000 inferred urban Filipinos between the age of 15-19 years, 1.43 died during the year 1980.

The next column shows the ${}_nq_x$ values multiplied by 1,000. This column was calculated by using the following expression:

$${}_nq_x = n\ {}_nm_x/1 + n/2\ {}_nm_x,$$

where n is the age-group interval. This $_nq_x$ value indicates the probabilities of individuals of exact age x in 1980 to die before reaching age x + n, i.e., the next age-group. For example, the $_5q_{15}$ value of Table 4.17 is shown to be 0.00712. This indicates that a Filipino inferred urban population of exact age 15 in 1980 has a chance of 7 in 1,000 to die before reaching the age of 20.

The fourth column shows the $_nl_x$ values. If we assume a cohort of 100,000 persons, all born at the same time and, throughout life, exposed to the probabilities of dying ($_nq_x$) presented in column two, we can calculate how many of them will die before reaching age one. This is accomplished by multiplying 100,000 by q_o which will give us d_o. Then 100,000 - d_o will give us $_4l_1$. The general formulae to calculate $_nl_x$ and $_nd_x$ values are interchangeable. The values can be expressed as:

$$_nd_x = {_nl_x} \times {_nq_x} \text{ and}$$

$$_nl_x = {_nl_{x-n}} - {_nd_{x-n}}$$

The sixth column represents the $_nL_x$ values. This column contains the total number of years that members of the cohort of 100,000, who survive to age x, will live during the age interval x to x + n. The $_nL_x$ values can be calculated by :

$$_nL_x = n/2 \; ({_nl_x} + {_nl_{x+n}}).$$

The L_x value for the last age-group (80+), in which all members of the cohort will die is calculated by dividing l_{80} with m_{80}.

The L_x values allow the calculation of ${}_nS_x$, the proportion of people that will survive n years or simply called Survival Ratios. For example, ${}_nS_x$ is calculated by dividing ${}_nL_{x+n}$ with ${}_nL_x$. The probability of Filipino inferred urban population to survive from age-group 15-19 through age-group 20-24 is

$${}_5S_{15} = {}_5L_{20}/{}_5L_{15} = 451,701/455600 = 0.0014$$

Column seven is labeled T_x or the total number of life years that the members of the cohort who survived to age x can expect until all of them are dead. The T_x values are calculated by summing all ${}_nL_x$ values, starting with the last age-group (80+).

The last column shows the average number of life years that any member of the cohort who reaches exact age x can still expect, or simply the average life expectancy at age x. The general formula for calculating the average life expectancy at exact age x is

$$e_x = T_x/{}_nl_x.$$

The Life Table has many uses which go beyond ordinary mortality measures. For example, the ${}_nl_x$ column allows the calculation of the chances of living from any age x to any given age x+n by using the ratio

$${}_nl_{x+n}/{}_nl_x.$$

Applying the formula to Table 4.17, the chances of a Filipino inferred urban population of age 40 in 1980 to live to retirement age is $_5l_{65}/_5l_{40}$ = 64,912/85,618 = 0.7582. Using such calculations, the planner can gain some idea as to what proportion of the current population can be expected to reach retirement age, or working age, or school age.

Another important use of Life Table that goes beyond ordinary mortality measures is the ability to project population forward in time. For example, to project the Philippine inferred urban population 15-19 in 1980 to 1985, we multiply the enumerated population 15-19 in 1980 by the survival ratio $_5S_{15}$, i.e, 2,130,332 x 0.99144 = 2,103,173. Since all persons 15-19 years of age in 1980 will be 20-24 years old in 1985, therefore, according to this projection, we will have 2,103,173 inferred urban populations aged 20-24 in 1985. If we wish to project this group of persons by another five years to 1990, when the survivors will be 25-29 years old, we multiply 2,103,173 by the survival ratio $_5S_{20}$. By using this method, the population can be projected by as many five-year periods as desired, as long as we are willing to assume unchanging mortality.

RELIABILITY AND VALIDITY OF THE RUMM ESTIMATES

The reliability and validity of the RUMM mortality estimates were assessed by performing these tasks: (1) RUMM estimates were compared with alternative sets of estimates obtained through different procedures, and (2) the RUMM estimates were examined for internal consistency.

I. COMPARISONS OF RUMM ESTIMATES TO ALTERNATIVE SETS OF ESTIMATES

In evaluating the performance of a method, we usually compare the estimates generated by this method with other estimates known to be correct and independently established.

A serious obstacle in this technique of reliability assessment is that "reliable" mortality estimates usually do not exist in most Third World countries (Somoza, 1981: 376). If we do not have confidence in the accuracy of the "reliable" estimates, then we cannot judge how well the RUMM estimates perform.

The alternative sets of mortality estimates that were used to evaluate the RUMM estimates were themselves not evaluated for reliability or else the evaluation was also inadequate. The following quote from Somoza (1981: 376) clearly expresses this point:

> - - - In most countries where indirect methods have been applied, presumably with great success, there are not reliable independent fertility and mortality measures to evaluate their performance. On the other hand, the methods have been used in only a few countries with relatively good independent reliable demographic data. In some of these countries, however, the evaluation of the reliability of the independent sources has not been made.

In addition, some of the available alternative sets of estimates are not of the same period or population as those of the RUMM estimates. For example, the available alternative sets of estimates using 1980 data are extremely limited. This is why any available studies on mortality in the three study countries were used for comparative purposes.

However, while one or two alternative mortality estimates are not enough to evaluate the performance of the method, compatibility of the estimates to numerous independent mortality estimates is an indication of reliability. Therefore, this study assessed the reliability of the RUMM estimates by comparing them to as many mortality estimates as possible.

Another way of testing the reliability of the technique is to apply it to a Third World country with rural and urban data. The Life Table estimates for rural and urban areas are then compared to the Life Table estimates for inferred rural and inferred urban. If the difference is negligible, then the estimates produced by the RUMM technique may be deemed reliable.

The U.S. Bureau of the Census (Arriaga, et al., 1976: 237-247) has developed a technique to compare the pattern of mortality in two different Life Tables by using survival rates. This technique calculates two different indices. One index is based on the differences in the survival rates for the same age-group and measures the closeness of the levels of mortality. The second index is based on the differences in the ratios of consecutive survival rates. This index measures the closeness of the patterns of mortality.

The first index is calculated as follows:

$$_5AD_x = {_5S_x}^1 - {_5S_x}^2,$$

where $_5AD_x$ is the difference between the first and the second sets of survival rates for the same age-group; $_5S_x$ is the survival rate from age x to age x+5 from the first set of survival rates; and $_5S_x$ is the survival rate from age x to age x+5 from the second set of survival rates. Then, the mean absolute difference of the two sets of survival rates is:

$$AMD = 1/m \sum_{x=0,5}^{w} |{}_5RD_x|$$

where m is the number of five-year age-groups and w is the lower bound of the last five-year age-groups.

The second index is calculated by first determining the ratios of survival rates for consecutive age-groups. The formulas are:

$${}_5R_x^1 = {}_5S_{x+5}^1 / {}_5S_x^1,$$

$${}_5R_x^2 = {}_5S_{x+5}^2 / {}_5S_x^2.$$

The differences of these ratios for the same age-groups are then determined by:

$${}_5RD_x = {}_5R_x^1 - {}_5R_x^2.$$

Finally, the average of the absolute differences of the ratios is calculated as:

$$RMD = 1/m-1 \sum_{x=0,5}^{w-5} |{}_5RD_x|$$

In applying this technique to survival rates of rural areas versus inferred rural populations and of urban areas versus inferred urban populations of each study country, allow the measurement of the differences in patterns and levels of mortality into two sets of survival rates. If both AMD and RMD values are negligible, then the two sets of survival rates are not significantly different from each other.

II. EXAMINATION FOR INTERNAL CONSISTENCY OF THE RUMM ESTIMATE

There are two ways in which internal consistency of the method can be assessed. The first is to make sure that important assumptions are not violated, and second is to examine all the estimates produced by the technique, i.e., to see to it that all estimates produced by the technique do not contradict each other.

While the second procedure is straightforward, the first is somewhat complicated. Since the RUMM technique is designed by integrating different and independent indirect techniques (Indices of Urbanization and the Brass Growth Balance Equation), conditions set for the operation of these two methods are also the conditions in which the RUMM technique must operate. For example, usefulness of the Brass Growth Balance equation for application to the Philippines, Peninsular Malaysia, and Thailand data depends primarily on the validity of the assumptions of: (1) accurate reporting of age; (2) equal underenumeration for adult age-groups; and (3) population stability.

To assess the degree of the problem of age-misstatements, the U.N. Age-Sex Accuracy Index is computed for each study country. An age-distribution showing a U.N index of twenty or below is considered accurate.

The assumption of population stability probably holds relatively well for the total population of each study country because international migration during the 1960s and the 1970s was negligible, fertility relatively stable, and mortality declined only gradually. However, the assumption of population stability may be violated in sub-national population units. To check whether the assumption of population stability holds for inferred urban and inferred rural populations for each study country, the stable age distributions for the inferred rural and inferred urban populations were generated. These stable population age distributions for inferred rural and inferred urban were then compared to the enumerated census age structures of these areas. The differences between the observed and equivalent stable age structures are expressed in terms of the Index of Dissimilarity and the Index of the Relative Difference (Shryock and Siegel, 1976). If, on the average, the Index of Dissimilarity and the Index of Relative Difference are found to be small, then the age distribution for that area is said to be stable.

The adjustment factors produced by the Brass Growth Balance equation were also compared to other adjustment factors estimated by other independent techniques and sources. These included estimates from the dual-record studies, the country's civil registration system, and the estimates of death registration completeness published by the U.S. Bureau of the Census for each study country.

CHAPTER IV: APPLICATION OF THE RUMM TECHNIQUE TO PHILIPPINE DATA

EVALUATION OF THE CENSUS POPULATION AGE DISTRIBUTION

While the accuracy of age-reporting for census data suggests improvement over time (Kinsella, 1984; Luther, 1983), the problem is not resolved; misreporting and underenumeration continue to be estimated at between three and four percent (Kinsella, 1984; Luther, 1983).

By using the United Nations Age-Sex Accuracy Index, one can examine each specific age-group of the 1980 Philippine census and come up with a summary measure to assess the net age misreporting. Shown on Table 4.1, Table 4.2, and Table 4.3 are the application of the U.N. index to the total country, inferred urban, and inferred rural age-sex distribution.

Examination of these three tables revealed an accurate age-sex distribution. Based on the U.N. Age-Sex Accuracy Index scores of 13.92 for the total country (see Table 4.1), 17.86 for inferred urban (see Table 4.2), and 11.52 for inferred rural (see Table 4.3), the quality of the age-distribution in these populations can then be described as reliable.

The evidence of reliability allowed the study to use these age distributions as base populations for mortality analysis. There were no adjustments nor smoothing performed for these distributions.

Table 4.1. Calculation of the United Nations Age-Sex Accuracy Index, Philippines, 1980

Age	Population*		Analysis of Age Ratios				Analysis of Sex Ratios	
			Male		Female			
	Male (1)	Female (2)	Age Ratio (3)	Deviation from 100 (4)	Age Ratio (5)	Deviation from 100 (6)	Sex Ratio (7)	Successive Differences (8)
0-4	3,932,770	3,733,427					105.3	
5-9	3,396,682	3,208,764	97.5	-2.5	96.5	-3.5	105.9	0.5
10-14	3,036,022	2,913,882	101.8	-1.8	98.8	-1.2	104.2	-1.7
15-19	2,566,848	2,688,793	97.9	-2.1	101.6	1.6	95.5	-8.7
20-24	2,210,308	2,377,916	98.6	-1.4	102.8	2.8	93.0	-2.5
25-29	1,918,288	1,935,876	102.8	2.8	100.4	0.4	99.1	6.1
30-34	1,521,082	1,477,499	96.7	-3.3	94.5	-5.5	102.9	3.9
35-39	1,227,966	1,191,205	95.7	-4.3	95.0	-5.0	103.1	0.1
40-44	1,046,208	1,031,298	101.9	1.9	101.8	1.8	101.4	-1.6
45-49	825,018	835,468	95.4	-4.6	96.3	-3.7	98.7	-2.7
50-54	682,996	703,747	100.9	0.9	100.4	0.4	97.1	-1.7
55-59	528,491	566,069	94.0	-6.0	96.9	-3.1	93.4	-3.7
60-64	441,026	464,470	100.5	0.5	99.3	-0.7	95.0	1.6
65-69	349,270	369,066	106.3	6.3	107.2	7.2	94.6	-0.3
70-74	216,036	224,268						
75+	229,744	247,957						

Average Age Ratio Deviation for Males = 2.97
Average Age Ratio Deviation for Females = 2.84

Average Sex Ratio Difference = 2.71
Age-Sex Accuracy Index = 13.92

$$\text{Age Ratio} = \frac{{}_5P_a}{\frac{1}{2}({}_5P_{a-5} + {}_5P_{a+5})} \times 100$$

Sex Ratio = [(1)/(2)] x 100

*Source: Philippine National Census and Statistics Office, 1980 Population and Housing Census: National Summary, Manila, 1980, Table 3.

Table 4.2. Calculations of the United Nations Age-Sex Accuracy Index, Inferred Urban, Philippines, 1980

Age	Population*		Analysis of Age Ratios				Analysis of Sex Ratios	
			Male		Female			
	Male (1)	Female (2)	Age Ratio (3)	Deviation from 100 (4)	Age Ratio (5)	Deviation from 100 (6)	Sex Ratio (7)	Successive Differences (8)
0-4	1,478,257	1,391,637					106.2	
5-9	1,243,897	1,175,166	95.3	-4.7	94.4	-5.6	105.8	-0.4
10-14	1,132,281	1,098,915	100.5	0.5	96.1	-3.9	103.0	-2.8
15-19	1,008,906	1,112,426	98.2	-1.8	104.0	4.0	90.7	-12.3
20-24	922,857	1,041,163	101.9	1.9	106.4	6.4	88.6	-2.1
25-29	801,822	845,077	102.6	2.6	100.6	0.6	94.9	6.2
30-34	639,822	638,362	99.6	-0.4	96.1	-3.9	100.2	5.3
35-39	483,568	482,999	91.8	-8.2	90.7	-9.3	100.1	-0.1
40-44	414,149	426,595	102.7	2.7	103.4	3.4	97.1	-3.0
45-49	322,718	341,849	94.8	-5.2	95.8	-4.2	94.4	-2.7
50-54	266,667	286,800	101.1	1.1	99.4	-0.6	93.0	-1.4
55-59	204,899	235,093	93.5	-6.5	97.9	-2.1	87.2	-5.8
60-64	171,576	193,548	99.4	-0.6	98.3	-1.7	88.6	1.5
65-69	140,451	158,567	108.7	8.7	109.9	9.9	88.6	-0.1
70-74	86,868	94,935						
75+	91,882	107,864						

Average Age Ratio Deviation for Males = 3.47
Average Age Ratio Deviation for Females = 4.28

Average Sex Ratio Difference = 3.37
Age-Sex Accuracy Index = 17.86

$$\text{Age Ratio} = \frac{{}_5P_a}{\frac{1}{2}({}_5P_{a-5} + {}_5P_{a+5})} \times 100$$

Sex Ratio = [(1)/(2)] x 100

*Source: Philippine National Census and Statistics Office, 1980 Population and Housing Census: National Summary, Manila, 1980, Table 3.

Table 4.3. Calculations of the United Nations Age-Sex Accuracy Index, Inferred Rural, Philippines, 1980

Age	Population*		Analysis of Age Ratios				Analysis of Sex Ratios	
			Male		Female			
	Male (1)	Female (2)	Age Ratio (3)	Deviation from 100 (4)	Age Ratio (5)	Deviation from 100 (6)	Sex Ratio (7)	Successive Differences (8)
0-4	2,454,513	2,341,790					104.8	
5-9	2,152,785	2,033,598	98.8	-1.2	97.8	-2.2	105.9	1.0
10-14	1,903,741	1,814,967	102.6	2.6	100.6	0.6	104.9	-1.0
15-19	1,557,942	1,576,367	97.6	-2.4	100.0	0.0	98.8	-6.1
20-24	1,287,451	1,336,753	96.3	-3.7	100.2	0.2	96.3	-2.5
25-29	1,116,466	1,090,799	103.0	3.0	100.3	0.3	102.4	6.0
30-34	881,260	839,137	94.7	-5.3	93.3	-6.7	105.0	2.7
35-39	744,398	708,206	98.4	-1.6	98.1	-1.9	105.1	0.1
40-44	632,059	604,703	101.4	1.4	100.6	0.6	104.5	-0.6
45-49	502,300	493,619	95.8	-4.2	96.6	-3.4	101.8	-2.8
50-54	416,329	416,947	100.8	0.8	101.1	1.1	99.9	-1.9
55-59	323,592	330,976	94.4	-5.6	96.2	-3.8	97.8	-2.1
60-64	269,450	270,922	101.2	1.2	100.1	0.1	99.5	1.7
65-69	208,819	210,499	104.8	4.8	105.2	5.2	99.2	-0.3
70-74	129,168	129,333						
75+	137,862	140,093						

Average Age Ratio Deviation for Males = 2.91
Average Age Ratio Deviation for Females = 2.00

Average Sex Ratio Difference = 2.21
Age-Sex Accuracy Index = 11.52

$$\text{Age Ratio} = \frac{{}_5P_a}{\frac{1}{2}({}_5P_{a-5} + {}_5P_{a+5})} \times 100$$

Sex Ratio = [(1)/(2)] x 100

*Source: Philippine National Census and Statistics Office, <u>1980 Population and Housing Census: National Summary</u>, Manila, 1980, Table 3.

IDENTIFICATION OF AREAS DESIGNATED AS URBAN AND RURAL

The age distribution of death and population for the 1975 and 1980 vital registrations and censuses were tabulated by region. The Philippines was subdivided into 12 regions in the 1975 census with the National Capital (Metropolitan Manila) included as part of Region 4; in the 1980 census and vital registration, the National Capital became the 13th region. The map for the regional divisions of the Philippines is presented in Appendix B as Figure B1.

Identification of a region into inferred urban or inferred rural population depends on the degree of urbanization of that particular region. The degree of urbanization of a region was assessed by calculating the proportion of urban population, the mean city population size, the total number of cities, and the population density. Each region was assigned a rank based on its score on a particular urbanization index. A lower number rank was assigned to a region which scored higher in that particular index. A higher number rank was assigned to a region which scored low.

Table 4.4 and Table 4.5 show the 1975 and the 1980 scores and ranks of each region according to each index of urbanization. As expected, the separation of the National Capital from Region 4 made this region's score lower in 1980 than for the year 1975. Region 3, on the other hand, showed an increase in scores in almost all categories.

A summary measure for the degree of urbanization for each region was generated by summing the ranks assigned to that region. This sum of the ranks, referred to as Total Rank in Table 4.5 and Table 4.6 served

Table 4.4. Urbanization Index Score and Ranks by Regions, Philippines, 1975

Regions	Proportion of Urban Population (PUP)	Ranks	Mean City Population Size (Uj)	Ranks	Number of Cities	Ranks	Total Rank (TR)	Urban Regions
1	.1873	6	9.26	10	4	6	22	
2	.1144	12	0.00	12	0	12	36	
3	.3166	2	14.03	7	4	5	14	x
4	.6221	1	956.10	1	6	2	4	x
5	.1732	9	6.42	11	3	7	27	
6	.2554	4	36.19	5	7	1	10	x
7	.2835	3	57.22	3	6	3	9	x
8	.1855	8	9.64	9	3	8	25	
9	.1488	11	36.43	4	2	11	26	
10	.1862	7	25.42	6	5	4	17	
11	.2483	5	89.60	2	2	10	17	
12	.1520	10	10.93	8	3	9	22	
Total	.3163		248.94					

Source: Philippine National Census and Statistics Office, 1975 Integrated Census of the Population and Its Economic Activities. Vol. II. National Summary, Phase 1. Manila, 1978, Table 6 and Table 8.

Table 4.5. Urbanization Index Score and Ranks by Regions, Philippines, 1980

Regions	Proportion Urban	Rank	Mean City Population Size in Thousands	Rank	Number of Cities	Rank	Population Density sq. km.	Rank	TR
1	.2377	8	10.98	11	4	5	164.12	6	30
2	.1551	13	0	13	0	8	60.90	13	47
3	.4184	2	18.55	7	4	5	263.40	2	16
4	.3690	3	12.39	9	6	3	130.40	9	24
5	.2146	10	6.51	12	3	6	197.20	5	33
6	.2834	6	39.11	5	7	2	223.80	4	17
7	.3200	5	73.38	3	6	3	253.30	3	14
8	.2177	9	11.74	10	3	6	130.60	8	33
9	.1706	12	52.11	4	4	5	135.30	7	28
10	.2656	7	36.24	6	5	4	97.40	12	29
11	.3359	4	117.81	2	2	7	105.60	10	23
12	.1881	11	16.67	8	3	6	97.50	17	36
13	1.0000	1	782.15	1	11	1	9317.40	1	4
Total	37.31								

Sources: Philippine National Census and Statistics Office, <u>1980 Population and Housing Census: National Summary</u>, Manila, 1980, Table 3 and The National Economic Development Authority, <u>1983 Philippine Statistical Yearbook</u>, Manila, 1983, Table 1.1 and Table 1.2.

Table 4.6. Identification of Inferred Urban Populations, Philippines, 1980

Regions	Total Rank	Population	Cumulative Population	Urban Population of Total Country	Inferred Urban	Inferred Rural
13	4	5,925,884	5,925,884		X	
7	14	3,787,374	9,713,258		X	
3	16	4,802,793	14,516,051		X	
6	17	4,525,615	19,041,666	17,943,897	X	
11	23	3,346,803	22,388,469			X
4	24	6,118,620	28,507,089			X
9	28	2,528,506	31,035,595			X
10	29	2,758,985	33,794,580			X
1	30	3,540,893	37,335,473			X
5	33	3,476,982	40,812,455			X
8	33	2,799,534	43,611,989			X
12	36	2,270,949	45,882,938			X
2	47	2,215,522	48,098,460			X

Proportion of urban population in inferred urban = $\frac{10,429,599}{17,943,897}$ = .5812337

Proportion of urban population in total country = .3730659

Sources: Philippine National Census and Statistics Office, 1980 Population and Housing Census: National Summary, Manila, 1980, Table 3 and The National Economic Development Authority, 1983 Philippine Statistical Yearbook, Manila, 1983, Table 1.1 and Table 1.2.

as the basis of ordering the regions from lower-numbered ranks to the highest. By calculating the cumulative population of these "ordered" regions, one can examine the region with a cumulative population that comes closest to the total number of urban population for the total country. Any region below the "boundary" region was classified as inferred rural. The "boundary" region plus all the other remaining regions was classified as inferred urban. This procedure and assignment of regions to inferred urban or inferred rural populations are shown on Table 4.6.

Comparison of Table 4.6 to Table 4.4 showed the differences in 1975 and 1980 inferred urban and inferred rural classifications. While the 1975 data had regions 3, 4, 6, and 7 as comprising the inferred urban population, the 1980 data had regions 13, 3, 6, and 7 as inferred urban.

Applying the classification presented in Table 4.6, all regions classified as inferred urban for the 1980 data were combined; likewise, all regions classified as inferred urban for the 1975 data were also combined. Their corresponding age distributions and death registrations were added to formulate an inferred urban age and death distribution. Data for the remaining regions were also combined to formulate inferred rural age and death distributions. These distributions are presented in Table 4.7.

ESTIMATING COMPLETENESS OF DEATH REGISTRATION

The first distribution evaluated for underenumeration was the death registration for the total country. Given the tabulation of death and

Table 4.7. Deaths and Population Distribution by Age, for Inferred Urban and Inferred Rural populations, Philippines, 1980

Age*	Inferred Population	Urban Death	Inferred Population	Rural Death
00	0668297	27687	1074615	38013
01	2201597	14101	3721688	21927
05	2419063	03524	4186383	05910
10	2231196	02007	3718708	03253
15	2121332	02845	3134309	04194
20	1964020	03721	2624204	05316
25	1646899	03861	2207265	05355
30	1278234	03744	1720347	04964
35	0966567	03754	1452604	05137
40	0840744	04401	1236762	05673
45	0664567	04511	0995919	05909
50	0553467	05387	0833276	06409
55	0439992	05368	0654568	06534
60	0365124	06624	0540372	07940
65	0299018	07183	0419318	08267
70	0181803	07419	0258501	08747
75	0199746	21656	0277955	25646

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

population age distributions, the Brass Growth Balance equation was applied to estimate the n_x/P_y and d_y'/P_y data points. These data points were plotted against each other and the slope of the line was estimated by the ordinary least-square technique. Table 4.8 shows the n_x/P_y and the d_y'/P_y data points, as well as the corresponding slope of the line for the total country. Slope of the line fitted through age-group 5-9 to age-group 60-64 is shown to be 1.1993, suggesting that death registration for the entire country is 83.34 percent complete.

Since the slope of the line is the estimated ratio between the true number and the reported number of deaths, then the slope of the line is a "correction factor" which can be applied to adjust the number of reported deaths. Application of 1.1993 to the reported deaths for the total country is shown on Table 4.9. Running the least-square regression lines through the n_x/P_y and d_y'/P_y data points, calculated this time on the basis of the "corrected" death figures for the total country, produced a slope which is equal to 1.00.

The next death registration assessed for completeness was the distribution for the inferred urban population. The slope of the line (see Table 4.10) fitted from age-group 5-9 through 60-64 was found to be 1.0624, a figure which was much lower than the slope estimated for the total country. This outcome was expected since in the Philippines, as in the case of most Third World countries, the civil registration system tends to be more accurate in urban populations.

The reported death distribution for the inferred urban population was inflated by 1.0624; this distribution is shown on Table 4.11.

Table 4.8. Application of the Brass Growth Balance Equation to the Philippine Population and Deaths, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	102	7666	298	48098	n/a	n/a	n/a
05	009	6605	196	40432	1427	0.0049	0.0353
10	005	5950	187	33827	1256	0.0055	0.0371
15	007	5256	182	27877	1121	0.0065	0.0402
20	009	4588	175	22621	0984	0.0077	0.0435
25	009	3854	165	18033	0844	0.0092	0.0468
30	009	2999	156	14179	0685	0.0110	0.0483
35	009	2419	148	11180	0542	0.0132	0.0485
40	010	2078	139	08761	0450	0.0158	0.0513
45	010	1661	129	06684	0374	0.0192	0.0559
50	012	1387	118	05023	0305	0.0235	0.0607
55	012	1095	106	03636	0248	0.0293	0.0682
60	015	0905	094	02542	0200	0.0372	0.0787
65	080	1636	080	01636	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.1993

Intercept = 0.0361

Adjusted Crude Death Rates = 0.0074

*00 = below one through four years of age; 05 = five through nine years of age, etc.

Table 4.9. Enumerated Deaths Adjusted by f=1.1993, Philippines, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	122	7666	357	48098	n/a	n/a	n/a
5	011	6605	235	40432	1427	0.0058	0.0353
10	006	5950	224	33827	1256	0.0066	0.0371
15	008	5256	218	27877	1121	0.0078	0.0402
20	011	4588	209	22621	0984	0.0093	0.0435
25	011	3854	198	18033	0844	0.0110	0.0468
30	010	2999	187	14179	0685	0.0132	0.0483
35	011	2419	177	11180	0542	0.0158	0.0485
40	012	2078	166	08761	0450	0.0190	0.0513
45	012	1660	154	06684	0374	0.0231	0.0559
50	014	1387	142	05023	0305	0.0282	0.0607
55	014	1095	128	03636	0248	0.0351	0.0682
60	017	0905	113	02542	0200	0.0446	0.0787
65	096	1636	096	01636	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.0000

Intercept = 0.0329

Adjusted Crude Death Rates = 0.0074

*00 = below one through four years of age; 05 = five through nine years of age, etc.

Table 4.10. Application of the Brass Growth Balance Equation to Inferred Urban Population, Philippines, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	42	2870	128	19042	n/a	n/a	n/a
05	04	2419	087	16172	529	0.0054	0.0327
10	02	2231	083	13753	465	0.0060	0.0338
15	03	2121	081	11522	435	0.0070	0.0378
20	04	1964	078	09400	409	0.0035	0.0435
25	04	1647	075	07436	361	0.0100	0.0486
30	04	1278	071	05789	293	0.0122	0.0505
35	04	0967	067	04511	224	0.0148	0.0498
40	04	0841	063	03544	181	0.0178	0.0510
45	05	0665	059	02704	151	0.0217	0.0557
50	05	0553	054	02039	122	0.0266	0.0597
55	05	0440	049	01486	099	0.0329	0.0669
60	07	0365	044	01046	081	0.0416	0.0770
65	37	0681	037	00681	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.0624

Intercept = 0.0325

Adjusted Crude Death Rates = 0.0072

*00 = below one through four years of age; 05 = five through nine years of age, etc.

Table 4.11. Enumerated Deaths Adjusted by f=1.0624, Inferred Urban Population, Philippines, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	44	2870	136	19042	n/a	n/a	n/a
05	04	2419	092	16172	529	0.0057	0.0327
10	02	2231	088	13753	465	0.0064	0.0338
15	03	2121	086	11522	435	0.0075	0.0378
20	04	1964	083	09400	409	0.0088	0.0435
25	04	1647	079	07436	361	0.0107	0.0486
30	04	1278	075	05789	293	0.0130	0.0505
35	04	0967	071	04511	224	0.0158	0.0498
40	05	0841	067	03544	181	0.0189	0.0510
45	05	0665	062	02704	151	0.0231	0.0557
50	06	0553	058	02039	122	0.0283	0.0597
55	06	0440	052	01486	099	0.0350	0.0669
60	07	0365	046	01046	081	0.0421	0.0770
65	39	0681	039	00681	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.0000

Intercept = 0.0325

Adjusted Crude Death Rates = 0.0072

*00 = below one through four years of age; 05 = five through nine years of age, etc.

While the inferred urban population showed a high completeness rate at 94.12 percent, the inferred rural population showed an underenumeration of 24.16 percent (see Table 4.12). The slope of 1.3185 was used to inflate registered death figures for all age groups (0-1, 1-4, ..., 80+). These adjusted deaths are presented in Table 4.13.

Correction factors for male and female death distributions for the total, the inferred urban and the inferred rural populations were also estimated. In all areas, the death distribution for males was shown to be more complete than the female death distribution. For example, the female distribution for the total country was only 75 percent complete while the male distribution was 91.89 percent complete. In a similar manner, the male and female death distributions for the inferred urban population showed a wide difference. While the female death distribution was found to be 18.45 percent incomplete, the male death distribution was shown to be 7.5 percent overenumerated. The same was true for male and female death distributions for inferred rural populations. The female death distribution showed a low level (70.13 percent) while the male death distribution was higher by 11 percent (81.45 percent).

These discrepancies in the completeness of male and female death distributions were documented by Flieger, et al., (1981). Their estimates for the 1970 male death registration were shown to be 63.7 percent complete while the female was only 53.8 percent complete (see Table 4.14). Flieger, et al., (1981: 11-18) borrowed the hypothesis advanced by Fulton and Hendershot (1975) to explain the discrepancies in male and female death registrations. According to Fulton and Hendershot, death registration is related to the intensity of death participation in social life

Table 4.12. Application of the Brass Growth Balance Equation to Inferred Rural Population, Philippines, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	60	4796	170	29057	n/a	n/a	n/a
05	06	4186	110	24260	898	0.0045	0.0370
10	03	3719	104	20074	791	0.0052	0.0394
15	04	3134	100	16355	685	0.0061	0.0419
20	05	2624	096	13221	576	0.0073	0.0436
25	05	2207	091	10597	483	0.0086	0.0456
30	05	1720	086	08390	393	0.0102	0.0468
35	05	1453	081	06669	317	0.0121	0.0476
40	06	1237	075	05217	269	0.0145	0.0516
45	06	0996	070	03980	223	0.0175	0.0561
50	06	0833	064	02984	183	0.0214	0.0613
55	07	0655	057	02151	149	0.0267	0.0692
60	08	0540	051	01496	119	0.0341	0.0799
65	43	0956	043	00956	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.3185

Intercept = 0.0332

Adjusted Crude Death Rates = 0.0077

*00 = below one through four years of age; 05 = five through nine years of age, etc.

Table 4.13. Enumerated Deaths Adjusted by f=1.3185, Inferred Rural Population, Philippines, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	79	4796	224	29057	n/a	n/a	n/a
05	08	4186	145	24260	898	0.0060	0.0370
10	04	3719	137	20074	791	0.0068	0.0394
15	06	3134	132	16355	685	0.0081	0.0419
20	07	2624	127	13221	576	0.0096	0.0436
25	07	2207	120	10597	483	0.0113	0.0456
30	07	1720	113	08390	393	0.0135	0.0468
35	07	1453	106	06669	317	0.0159	0.0476
40	07	1237	100	05217	269	0.0191	0.0516
45	08	0996	092	03980	223	0.0231	0.0561
50	08	0833	084	02984	183	0.0282	0.0613
55	09	0655	076	02151	149	0.0352	0.0692
60	10	0540	067	01496	119	0.0449	0.0799
65	57	0956	057	00956	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.0000

Intercept = 0.0332

Adjusted Crude Death Rates = 0.0077

*00 = below one through four years of age; 05 = five through nine years of age, etc.

Table 4.14. Levels of Death Registration Estimated by the National Census Dual-Record Survey, by Flieger, Abenoja & Lim, and by RUMM Technique, Philippines (Percent)

Population	Flieger, Abenoja & Lim (1981)	National Census Dual-Record Survey (Mijares, 1979)		Dual-Record Provincial Estimates (Madigan, 1976)	Estimated by the RUMM Technique	
	1970	1971	1973	1976	1975	1980
Total		70.5	77.1	81.5	75.9	83.4
Male	63.7					91.9
Female	53.8					75.0
Inferred Urban					94.6	95.4
Inferred Rural					70.6	74.3

and the therefrom resulting social bonds. Men tend to be more involved in social life than women, particularly when they are heads of households; and their deaths cannot go unnoticed as easily as those of women whose social activities are more likely to take place in smaller social circles.

Table 4.14 shows the levels of death registration estimated in this study for years 1975 and 1980 and those estimated by three other studies, namely: Flieger's provincial estimates (Flieger, et al., 1981), the national dual-record estimates for years 1971 and 1973 (Mijares, 1975), and the dual-record provincial surveys for 1976 (Madigan, et al., 1976). Examination of Table 4.14 revealed that estimates generated by the study were consistent with estimates produced by the dual-record studies. Inasmuch as the dual-record estimates were not affected by migration, age-misstatements, unequal underenumeration of adult age group, unstable population age distribution, census undercounts, changing fertility and mortality, the implication of Table 4.14 suggested that the Brass Growth Balance assumptions were reasonably met by the Philippine data.

Since the 1975 and 1980 classifications of inferred urban and inferred rural populations are not the same, this study produced another set of urban combinations based on the 1975 classification but using the 1980 data. This set of classifications will be referred to as urban and rural regions. While the inferred urban population was composed of Regions 13, 3, 7, and 6, the urban regions were composed of Regions 13, 4, 6, and 7. Table 4.15 shows the levels of death enumeration for inferred urban versus urban regions, and for inferred rural versus rural regions. Despite differences in regional composition, the estimates of the slope shown by inferred urban versus urban regions and inferred rural versus

Table 4.15. Levels of Death Registration for Various Urban and Rural Classification, Philippines, 1980 (Percent)

	URBAN			RURAL		
	Inferred Urban	Urban Regions	Urban Classification	Inferred Rural	Rural Regions	Rural Classification
Total	94.12	95.38	91.01	75.84	74.34	77.47
Male	100.08	100.04		81.45	82.91	
Female	81.55	78.74		70.13	71.73	

rural regions were not substantially different. In fact, the mortality estimates (discussed thoroughly in the next section) for inferred urban and for the urban region were almost identical. The same is true for the mortality estimates of the inferred rural and rural region.

Motivated by this evidence of robustness shown by the technique, another classification of urban and rural population was formed. In this classification, Regions 13, 7, 3, and 4 were classified as urban and the remaining nine regions were classified as rural. This classification is referred to in Table 4.15 as rural and urban classification. Again, the outcome revealed that there was not much difference between inferred urban population and urban classification; and, likewise, between inferred rural population and rural classification. In fact, as will be shown in the next section, this difference disappears when their mortality data are examined.

In reviewing Table 4.6, one can observe that Region 4 is actually the sixth ranked region, or the second region after Region 6 (the last region to qualify as inferred urban). The implication of the findings shown on Table 4.15 indicates that the technique is robust and will produce reliable estimates even if a region is misclassified.

MORTALITY ESTIMATION

Life Tables were generated into two sets for all populations. The first set of Life Tables uses the infant mortality rates as input for age under one and the second set of Life Tables uses the age-specific death rates for age under one. However, this study will present and discuss the first set of Life Tables while the second set will be displayed in Appendix A, Table A1 to Table A3. The explanation for selecting the first set of Life Tables is because census enumeration of age under one is usually very erratic, sometimes grossly overenumerated, but most often grossly underestimated. Using the total number of births in computing rates for age under one minimized the effect of this problem.

Life Tables for the total, inferred urban, and inferred rural populations for 1975 and 1980 data are presented in Table 4.16 through Table 4.21. Comparison of 1975 and 1980 mortality estimates showed a consistent increase in life expectation in almost all age-groups. These increases; however, were consistent with what one would expect if minimum improvement in nutrition, health, and sanitation were to occur in the country within the five-year period.

These increases in life expectations were also exhibited in male and female Life Tables for all types of populations. For example, the 1980 male Life Tables for the total (see Table 4.22), inferred urban (see Table 4.23), and inferred rural (see Table 4.24) populations showed generally higher life expectations than their counterparts in 1975 (see Tables 4.25 through 4.27). Likewise, the 1980 female Life Tables presented in Tables 4.28 through Table 4.30 also reflected similar increases over the 1975 female Life Tables (see Tables 4.31 through 4.33).

Another set of Life Tables was also estimated for urban (composed of Regions 13, 4, 6, and 7) and rural regions as well as for urban (composed of Region 13, 7, 3, and 4) and rural classifications. These Life Tables were compared to the Life Tables generated for inferred urban and inferred rural populations. Table 4.34 shows the closeness of the

Table 4.16. Life Tables for Both Sexes, Philippines, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	55.1	052.2	100000	05224	094787	6397552	63.9
01	07.3	028.4	094776	02695	369673	6302765	66.5
05	01.7	008.6	092081	00793	458424	5933092	64.4
10	01.1	005.3	091288	00483	455235	5474667	60.0
15	01.6	008.0	090806	00728	452209	5019432	55.3
20	02.4	011.7	090078	01057	447747	4567224	50.7
25	02.8	014.3	089021	01268	441934	4119477	46.3
30	03.5	017.3	087753	01514	434979	3677543	41.9
35	04.4	021.8	086239	01881	426493	3242564	37.6
40	05.8	028.7	084358	02420	415742	2816071	33.4
45	07.5	037.0	081939	03028	402123	2400329	29.3
50	10.2	049.7	078911	03924	384742	1998207	25.3
55	13.0	063.1	074986	04735	363094	1613465	21.5
60	19.3	092.0	070251	06464	335097	1250371	17.8
65	27.5	128.4	063787	08193	298455	0915274	14.4
70	44.0	198.3	055595	11026	250410	0616819	11.1
75	70.6	300.1	044569	13377	189405	0366409	08.2
80	176.2	1000.0	031193	31193	177004	0177004	05.6

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.17. Life Tables for Both Sexes, Inferred Urban, Philippines, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	51.2	048.7	100000	04868	095141	6484434	64.8
01	06.8	026.6	095132	02531	371668	6389293	67.2
05	01.6	007.7	092601	00715	461216	6017625	65.0
10	01.0	004.8	091886	00440	458328	5556409	60.5
15	01.4	007.1	091446	00652	455600	5098081	55.8
20	02.0	010.0	090794	00908	451701	4642481	51.1
25	02.5	012.4	089886	01112	446651	4190780	46.6
30	03.1	015.4	088774	01370	440446	3744129	42.2
35	04.1	020.4	087404	01786	432555	3303683	37.8
40	05.6	027.4	085618	02348	422220	2871128	33.5
45	07.2	035.4	083270	02949	408980	2448907	29.4
50	10.3	050.4	080322	04048	391488	2039927	25.4
55	13.0	063.8	076274	04787	369399	1648439	21.6
60	19.3	092.0	071486	06574	340995	1279040	18.0
65	27.8	129.8	064912	08425	303496	0938045	14.5
70	43.4	196.6	056487	11046	254818	0634549	11.2
75	67.7	289.5	045440	13154	194316	0379731	08.4
80	174.1	1000.0	032286	32286	185415	0185415	05.7

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.18. Life Tables for Both Sexes, Inferred Rural, Philippines, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	58.6	055.4	100000	05539	094472	6322548	63.2
01	07.7	029.9	094461	02826	367954	6228076	65.9
05	01.9	009.3	091635	00848	456055	5860122	64.0
10	01.2	005.7	090787	00521	452633	5404066	59.5
15	01.8	008.8	090266	00791	449355	4951433	54.9
20	02.8	013.3	089476	01187	444411	4502078	50.3
25	03.2	015.9	088289	01401	437941	4057666	46.0
30	03.8	018.8	086888	01635	430349	3619725	41.7
35	04.7	023.0	085252	01964	421352	3189376	37.4
40	06.1	029.8	083289	02482	410239	2768023	33.2
45	07.8	038.4	080807	03099	396287	2357784	29.2
50	10.4	049.5	07708	03842	378933	1961498	25.2
55	13.2	063.7	073865	04706	357563	1582565	21.4
60	19.4	092.4	069160	06389	329828	1225001	17.7
65	27.1	127.0	062771	07974	293921	0895174	14.3
70	44.6	200.7	055797	10996	246495	0601253	11.0
75	73.4	309.9	043801	13575	185067	0354758	08.1
80	174.1	1000.0	030226	30226	169691	0169691	05.6

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.19. Life Tables for Both Sexes, Philippines, 1975

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	68.9	065.4	100000	06545	095023	6153566	61.5
01	08.8	034.2	093455	03197	365605	6058543	64.8
05	02.1	010.6	090258	00956	448897	5692938	63.1
10	01.2	005.8	089301	00521	445204	5244041	58.7
15	01.7	008.6	088780	00760	442001	4798837	54.0
20	02.8	013.7	088020	01202	437095	4356836	49.5
25	03.3	016.3	086818	01412	430560	3919741	45.2
30	03.9	019.3	085406	01649	422906	3489181	40.8
35	05.0	024.7	083756	02072	413602	3066275	36.6
40	06.2	030.5	081684	02490	402197	2652673	32.5
45	07.7	038.0	079195	03007	388456	2250476	28.4
50	10.2	049.6	076188	03778	371494	1862020	24.4
55	13.9	067.3	072410	04870	349873	1490526	20.6
60	24.1	113.8	067540	07685	318584	1140653	16.9
65	30.1	139.9	059855	08375	278335	0822168	13.7
70	47.4	211.9	051479	10910	230122	0543833	10.6
75	81.7	339.3	040569	13765	168435	0313711	07.7
80	184.5	1000.0	026805	26805	145276	0145276	05.4

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.20. Life Tables for Both Sexes, Inferred Urban, Philippines, 1975

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	59.0	056.3	100000	05634	095527	6428694	64.3
01	07.7	030.3	094366	02863	370184	6428694	67.1
05	01.7	008.5	091503	00779	455565	5962983	65.1
10	00.9	004.4	090724	00398	452622	5507418	60.7
15	01.3	006.5	090325	00585	450163	5054796	56.0
20	01.9	009.3	089740	00831	446623	4604633	51.3
25	02.3	011.5	088909	01025	441983	4158010	46.8
30	03.0	015.0	087884	01321	436115	3716027	42.3
35	04.0	020.0	086562	01731	428484	3279912	37.9
40	05.2	025.8	084831	02186	418692	2851428	33.6
45	06.9	034.0	082646	02807	406211	2432736	29.4
50	09.4	045.9	079839	03666	390028	2026525	25.4
55	12.6	061.1	076172	04656	369222	1636497	21.5
60	20.6	098.0	071516	07005	340069	1267275	17.7
65	28.4	132.8	064511	08565	301144	0927206	14.4
70	42.5	192.1	055946	10747	252865	0626062	11.2
75	70.7	300.5	045200	13581	192045	0373197	08.3
80	174.5	1000.0	031618	31618	181152	0181152	05.7

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.21. Life Tables for Both Sexes, Inferred Rural, Philippines, 1975

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	73.7	069.5	100000	06946	094801	6024090	60.2
01	09.2	035.9	093054	03338	363607	5929289	63.7
05	02.3	011.5	089716	01030	446003	5565682	62.0
10	01.3	006.5	088686	00575	441991	5119679	57.7
15	02.0	009.7	088111	00855	438417	4677688	53.1
20	03.3	016.4	087256	01432	432699	4239271	48.6
25	03.9	019.2	085824	01645	425006	3806572	44.4
30	04.4	021.6	084179	01819	416346	3381566	40.2
35	05.5	027.2	082359	02238	406202	2965220	36.0
40	06.7	032.9	080121	02636	394016	2559018	31.9
45	08.2	040.0	077485	03098	379681	2165002	27.9
50	10.6	051.4	074387	03827	362368	1785321	24.0
55	14.6	070.2	070560	04956	340411	1422953	20.2
60	25.9	121.5	065604	07973	308086	1082542	16.5
65	31.0	143.6	057631	08278	267459	0774456	13.4
70	49.8	221.3	049353	10920	219463	0506997	10.3
75	87.8	360.1	038432	13840	157561	0287534	07.5
80	189.2	1000.0	024592	24592	129973	0129973	05.3

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.22. Male Life Table, Philippines, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	61.6	058.7	100000	05872	095369	6313078	63.1
01	07.1	027.8	094128	02615	369912	6217709	66.1
05	01.8	008.7	091513	00797	455571	5847797	63.9
10	01.1	005.6	090716	00511	452300	5392226	59.4
15	01.9	009.4	090205	00848	448902	4939926	54.8
20	03.0	014.8	089356	01326	443466	4491024	50.3
25	03.5	017.4	088030	01531	436322	4047559	46.0
30	04.1	020.5	086499	01772	428063	3611237	41.8
35	05.1	025.2	084726	02133	418299	3183174	37.6
40	07.0	034.2	082593	02821	405913	2764875	33.5
45	09.1	044.6	079772	03557	389969	2358962	29.6
50	12.2	059.2	076216	04515	369790	1968993	25.8
55	15.7	075.5	071700	05416	344962	1599204	22.3
60	22.4	105.3	067184	07077	318226	1161370	17.3
65	30.6	142.2	065553	09320	304465	0924648	14.1
70	46.2	207.0	056233	11643	252059	0620184	11.0
75	69.7	296.8	044591	13234	189868	0368125	08.3
80	175.9	1000.0	031357	31357	178256	0178256	05.7

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.23. Male Life Table, Inferred Urban, Philippines, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	51.8	049.7	100000	04967	095954	6345648	63.5
01	06.8	026.8	095033	02542	373788	6249695	65.8
05	01.5	007.5	092492	00691	460731	5875907	63.5
10	01.0	004.9	091801	00449	457881	5415176	59.0
15	01.7	008.4	091352	00836	454849	4957295	54.3
20	02.6	012.7	090588	01148	450069	4502446	49.7
25	03.0	015.0	089440	01340	443849	4052377	45.3
30	03.7	018.1	088100	01598	436504	3608528	41.0
35	04.8	023.5	086502	02030	427434	3172024	36.7
40	06.4	031.5	084472	02661	415707	2744590	32.5
45	08.6	042.1	081811	03440	400456	2328882	28.5
50	12.1	058.5	078371	04587	380388	1928426	24.6
55	15.5	074.4	073784	05491	355191	1548039	21.0
60	22.0	104.1	068293	07111	323684	1192848	17.5
65	30.7	142.4	061181	08711	284128	0869164	14.2
70	44.8	201.3	052470	10563	235941	0585036	11.2
75	65.4	117.7	041907	11774	180099	0349095	08.3
80	178.3	1000.0	030133	30133	168995	0168995	05.6

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.24. Male Life Table, Inferred Rural, Philippines, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	67.3	063.9	100000	06392	095054	6086198	60.9
01	07.8	030.6	093608	02864	367157	5991144	64.0
05	02.0	009.9	090744	00894	451484	5623987	62.0
10	01.3	006.3	089850	00569	447827	5172503	57.6
15	02.1	010.3	089281	00919	444107	4724675	52.9
20	03.4	016.8	088362	01485	438096	4280568	48.4
25	03.9	019.5	086877	01695	430146	3842472	44.2
30	04.6	022.5	085182	01920	421109	3412325	40.1
35	05.4	026.8	083262	02230	410732	2991217	35.9
40	07.4	036.5	081031	02959	397758	2580484	31.9
45	09.6	046.9	078072	03663	381202	2182726	28.0
50	12.4	060.1	074409	04471	360866	1801524	24.2
55	16.0	077.0	069938	05383	336230	1440658	20.6
60	22.6	107.0	064555	06902	305518	1104428	17.1
65	30.5	141.8	057653	08177	267823	0798910	13.9
70	47.4	211.9	049476	10484	221172	0531087	10.7
75	73.6	310.8	038993	12118	164668	0309915	08.0
80	185.0	1000.0	026874	26874	145247	0145247	05.4

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.25. Male Life Table, Philippines, 1975

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	77.1	072.9	100000	07292	094546	5915714	59.2
01	09.1	035.5	092708	03294	362376	5821168	62.8
05	02.3	011.5	089414	01031	444493	5458792	61.0
10	01.3	006.6	088383	00581	440461	5014299	56.7
15	02.1	010.3	087801	00904	436747	4573838	52.1
20	03.5	017.5	086897	01520	430686	4137091	47.6
25	04.1	020.2	085377	01728	422564	3706405	43.2
30	04.6	022.9	083649	01918	413447	3283841	39.3
35	05.9	029.2	081730	02384	402691	2870394	35.1
40	07.4	036.4	079346	02886	389515	2467703	31.1
45	09.5	046.4	076460	03544	373440	2078188	27.2
50	12.4	060.0	072916	04375	353643	1704748	23.4
55	16.8	080.4	068541	05510	328933	1351105	19.7
60	27.4	128.0	063032	08071	294982	1022172	16.2
65	33.1	152.9	054961	08406	253791	0727190	13.2
70	50.1	222.5	046555	10360	206876	0473399	10.2
75	89.1	364.5	036195	13192	147995	0266523	07.4
80	194.1	1000.0	023003	23003	118528	0118528	05.2

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.26. Male Life Table, Inferred Urban, Philippines, 1975

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	65.3	062.1	100000	06210	095163	6223247	62.2
01	07.8	030.4	093790	02851	367935	6128085	65.3
05	01.8	008.9	090939	00806	452679	5760151	63.3
10	01.0	004.9	090133	00445	449552	5307472	58.9
15	01.6	007.8	089688	00701	446685	4857921	54.2
20	02.4	011.7	088986	01044	442322	4411236	49.6
25	02.8	013.7	087943	01206	436698	3968914	45.1
30	03.5	017.5	086737	01518	429889	3532216	40.7
35	04.8	023.8	085219	02025	421032	3102328	36.4
40	06.3	031.0	083194	02576	409531	2681296	32.2
45	08.3	040.8	080618	03285	394878	2271766	28.2
50	11.6	056.6	077333	04373	375732	1876888	24.3
55	14.8	071.4	072960	05206	351783	1501156	20.6
60	23.7	111.9	067753	07583	319810	1149373	20.0
65	32.2	149.2	060170	08976	278412	0895563	13.8
70	45.7	205.0	051194	10492	229740	0551152	10.8
75	76.6	321.3	040702	13078	170816	0321411	07.9
80	183.4	1000.0	027624	27624	150595	0150595	05.5

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.27. Male Life Table, Inferred Rural, Philippines, 1975

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	81.2	076.6	100000	07657	094354	5782156	57.8
01	09.7	037.7	092343	03481	360398	5687803	61.6
05	02.6	012.7	088862	01128	441489	5327405	60.0
10	01.5	007.3	087734	00638	437075	4885917	55.7
15	02.3	011.5	087096	01000	432981	4448842	51.1
20	04.2	020.9	086096	01802	425976	4015862	46.6
25	04.9	024.2	084294	02040	416371	3589887	42.6
30	05.2	025.9	082254	02127	405953	3173516	38.6
35	06.5	031.9	080127	02554	394249	2767563	34.5
40	08.0	039.1	077573	03035	380276	2373314	30.6
45	10.1	049.1	074538	03661	363538	1993038	26.7
50	12.7	061.7	070877	04372	343456	1629500	23.0
55	17.7	084.5	066505	05621	318472	1286045	19.3
60	29.1	135.5	060884	08247	283801	0967573	15.9
65	33.6	154.8	052637	08149	242811	0683772	13.0
70	52.0	230.1	044488	10236	196849	0440960	09.9
75	95.7	386.3	034252	13230	138184	0244111	07.1
80	198.5	1000.0	021002	21002	105927	0105927	05.0

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.28. Female Life Table, Philippines, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	48.0	046.2	100000	04620	096251	6638108	66.4
01	07.5	029.6	095380	02819	374329	6541857	68.6
05	01.7	008.2	092561	00760	460905	6167528	66.6
10	01.0	004.8	091801	00444	457893	5706623	62.2
15	01.3	006.4	091357	00583	455326	5248729	57.5
20	01.7	008.3	090774	00750	451993	4793403	52.8
25	02.1	010.4	090023	00936	447778	4341410	48.2
30	02.6	013.1	089088	01168	442517	3893633	43.7
35	03.5	017.4	087919	01530	435773	3451115	39.3
40	04.4	021.7	086390	02886	427260	3015342	34.9
45	05.6	027.6	084514	02334	416736	2588082	30.6
50	07.8	038.5	082180	03160	403003	2171346	26.4
55	10.1	049.2	079021	03885	385392	1768343	22.4
60	15.9	076.7	075136	05759	361283	1382950	18.4
65	23.9	112.8	069377	07826	327321	1021667	14.7
70	41.6	188.4	061551	11597	278764	0694346	11.3
75	72.4	306.4	049954	15308	211502	0415583	08.3
80	169.8	1000.0	034646	34646	204081	0204081	05.9

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.29. Female Life Table, Inferred Urban, Philippines, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	46.3	044.6	100000	04460	096360	6671159	66.7
01	07.4	029.1	095540	02783	375069	6574799	68.8
05	01.6	007.9	092757	00735	461951	6199730	66.8
10	00.9	004.5	092023	00418	459070	5737779	62.4
15	01.1	005.6	091605	00512	456747	5278708	57.6
20	01.4	007.0	091094	00635	453880	4821961	52.9
25	01.8	009.1	090458	00819	450242	4368082	48.3
30	02.4	011.7	089639	01052	445565	3917839	43.7
35	03.3	014.4	088587	01437	439345	3472274	39.2
40	04.5	022.1	087151	01922	430948	3032930	34.8
45	05.5	027.1	085229	02308	420373	2601982	30.5
50	08.3	040.9	082921	03387	406136	2181609	26.3
55	10.2	049.9	079534	03967	387751	1775473	22.3
60	16.3	078.3	075567	05914	363049	1387723	18.4
65	24.6	115.9	069653	08074	328079	1024673	14.7
70	41.8	189.3	061579	11655	278757	0696595	11.3
75	71.0	301.6	049924	15507	211977	0417838	08.4
80	169.4	1000.0	034867	34867	205861	0205861	05.9

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.30. Female Life Table, Inferred Rural, Philippines, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	49.6	047.7	100000	04769	096152	6376784	63.8
01	07.7	030.1	095231	02869	373597	6280632	66.0
05	01.9	009.3	092362	00855	459671	5907036	64.0
10	01.2	005.7	091507	00525	456222	5447365	59.5
15	01.8	008.8	090982	00797	452917	4991143	54.9
20	02.7	013.3	090185	01196	447934	4538226	50.3
25	03.2	015.9	088989	01413	441413	4090291	46.0
30	03.8	018.8	087576	01648	433761	3648878	41.7
35	04.7	023.0	085928	01979	424693	3215117	37.4
40	06.1	029.8	083949	02502	413491	2790424	33.2
45	07.8	038.4	081447	03124	399428	2376933	29.2
50	10.1	049.5	078324	03873	381937	1977505	25.3
55	13.2	063.7	074451	04743	360398	1595567	21.4
60	19.4	092.4	069708	06439	332442	1235169	17.7
65	27.1	127.0	063269	08037	296251	0902727	14.3
70	44.6	200.7	055231	11083	248449	0606476	11.0
75	73.4	309.9	044148	13683	186534	0358027	08.1
80	177.7	1000.0	030465	30465	171493	0171493	05.6

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.31. Female Life Table, Philippines, 1975

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	60.3	057.6	100000	05760	095523	6406456	64.1
01	08.4	032.8	094240	03096	369002	6310933	67.0
05	01.9	009.6	091144	00880	453521	5941931	65.2
10	01.0	005.0	090264	00455	450185	5488410	60.8
15	01.4	006.8	089810	00609	447526	5038225	56.1
20	02.0	009.8	089201	00870	443830	4590699	51.5
25	02.5	012.2	088331	01080	438955	4146869	47.0
30	03.2	015.6	087291	01363	432847	3707914	42.5
35	04.1	020.3	085888	01743	425081	3275067	38.1
40	05.0	024.6	084145	02065	415560	2849986	33.9
45	06.0	029.7	082079	02438	404302	2434426	29.7
50	08.1	039.7	079641	03161	390303	2030124	25.5
55	11.3	055.0	076480	04202	371893	1639821	21.4
60	21.1	100.4	072277	07256	343247	1267928	17.5
65	27.3	127.8	065021	08308	304335	0924681	14.7
70	45.0	202.1	056713	11463	254906	0620346	10.9
75	75.1	316.2	045250	14310	190473	0365440	08.1
80	176.8	1000.0	030939	30939	174967	0174967	05.7

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.32. Female Life Table, Inferred Urban, Philippines, 1975

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	52.1	050.0	100000	05002	095999	6634621	66.4
01	07.7	030.2	094998	02866	372662	6538623	68.8
05	01.6	008.2	092132	00753	458778	6165961	66.9
10	00.8	003.8	091379	00346	456030	5707184	62.5
15	01.1	005.3	091033	00486	453948	5251155	57.7
20	01.4	007.1	090547	00640	451133	4797207	53.0
25	01.9	009.5	089906	00854	447397	4346075	48.3
30	02.5	012.6	089052	01119	442463	3898679	43.8
35	03.3	016.4	087933	01439	436068	3456217	39.3
40	04.2	020.8	086494	01797	427978	3020150	34.9
45	05.6	027.5	084697	02130	417668	2592173	30.6
50	07.4	036.4	082370	02997	404360	2174506	26.4
55	10.7	052.1	079374	04132	386537	1770147	22.3
60	18.0	085.9	075241	06466	360041	1383610	18.4
65	25.2	118.7	068775	08162	323472	1023570	14.9
70	39.9	181.2	060614	10986	275604	0700098	11.6
75	66.0	283.4	049628	14065	212977	0424494	08.6
80	168.1	1000.0	035563	35568	211517	0211517	06.0

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.33. Female Life Table, Inferred Rural, Philippines, 1975

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	62.9	060.0	100000	06001	095379	6300901	63.0
01	08.7	034.0	093999	03196	367771	6205522	66.0
05	02.1	010.3	090803	00935	451677	5837752	64.3
10	01.1	005.6	089868	00506	448073	5386076	59.9
15	01.6	007.7	089362	00690	445084	4938003	55.3
20	02.3	011.6	088672	01027	440792	4492920	50.7
25	02.8	014.0	087645	01223	435168	4052129	46.2
30	03.5	017.3	086422	01495	428373	3616962	41.9
35	04.5	022.4	084927	01902	419880	3188589	37.5
40	05.4	026.5	083025	02203	409615	2768710	33.4
45	06.3	030.9	080821	02495	397869	2359095	29.2
50	08.5	041.4	078326	03244	383520	1961227	25.0
55	11.6	056.4	075082	04235	364821	1577707	21.0
60	22.8	107.9	070847	07647	335115	1212886	17.1
65	28.5	132.8	063199	08393	295015	0877771	13.9
70	47.6	212.8	054807	11661	244880	0582757	10.6
75	80.5	335.1	043145	14458	179582	0337877	07.8
80	181.3	1000.0	028687	28687	158295	0158295	05.5

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.34. Survival Rates Comparison for Inferred Urban and Urban Regions, Philippines, 1980

Age*	Inferred Urban	Urban Regions	Inferred Urban	Urban Regions	Difference Survival Rates	Difference of Ratios
00	0.9336	0.9291	1.0583	1.0632	0.0045	-.0041
01	0.9880	0.9878	1.0058	1.0060	0.0020	-.0002
05	0.9937	0.9937	1.0004	1.0003	0.0000	0.0001
10	0.9941	0.9940	0.9973	0.9974	0.0001	-.0001
15	0.9914	0.9914	0.9974	0.9974	0.0000	0.0000
20	0.9888	0.9888	0.9973	0.9973	0.0000	0.0000
25	0.9861	0.9861	0.9959	0.9961	0.0000	-.0002
30	0.9821	0.9823	0.9939	0.9899	-.0002	0.0040
35	0.9761	0.9724	0.9923	0.9856	0.0037	0.0067
40	0.9686	0.9584	0.9882	0.9586	0.0102	0.0296
45	0.9572	0.9450	0.9858	0.9779	0.0122	0.0079
50	0.9436	0.9241	0.9783	0.9631	0.0195	0.0152
55	0.9231	0.8900	0.9641	0.9462	0.0331	0.0179
60	0.8900	0.8421	0.9434	0.9221	0.0479	0.0213
65	0.8396	0.7765	0.9083	0.8873	0.0631	0.0210
70	0.7626	0.6890	0.6403	0.6380	0.0736	0.0023
75	0.4883	0.4396	n/a	n/a	0.0487	n/a

Absolute Mean Difference (AMD) = 0.0186

Relative Mean Difference (RMD) = 0.0082

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

mortality levels and patterns between inferred urban and urban regions. The low Absolute and the Relative Mean Differences exhibited by their survival ratios indicated that these estimates are similar. Since Survival ratio is the probability of one age-group to survive to the next age-group, the Absolute and Relative Mean Differences were actually calculated from the differences in probabilities from age-group to age-group of the two survival ratios. Examination of column six of Table 4.34 revealed differences that are very close to zero. These negligible differences in survival ratios are also shown by the comparisons between inferred urban and urban classifications (see Table 4.35), inferred rural and rural regions (see Table 4.36), and between inferred rural and rural classifications (see Table 4.37).

RELIABILITY AND VALIDITY OF THE RUMM ESTIMATES

To assess the validity of mortality estimates in this study, estimates of infant mortality and life expectancies at birth were compared to those obtained from children ever born and children still living data of the 1978 World Fertility Survey and the 1968 and 1973 National Demographic Surveys. The availability of children ever born and children still living data allowed the indirect estimation of infant mortality rate (q_o) and life expectancy at birth through the Brass (1975), Sullivan (1972), and Trussell (1975) techniques.

Since the World Fertility Survey and the National Demographic Surveys follow the census definition of rural and urban areas, the resulting mortality estimates refer to different urban and rural populations. If,

Table 4.35. Survival Rates Comparison of Inferred Urban and Urban Classification, Philippines, 1980

Age*	Inferred Urban	Urban Class.	Inferred Urban	Urban Class.	Difference Survival Rates	Difference of Ratios
00	0.9336	0.9280	1.0583	1.0647	0.0056	-.0064
01	0.9880	0.9880	1.0058	1.0059	0.0000	-.0001
05	0.9937	0.9938	1.0004	1.0002	-.0001	-.0002
10	0.9941	0.9940	0.9973	0.9974	0.0001	0.0000
15	0.9914	0.9913	0.9974	0.9975	0.0001	-.0001
20	0.9888	0.9888	0.9973	0.9975	0.0000	-.0002
25	0.9861	0.9863	0.9959	0.9959	-.0002	0.0000
30	0.9821	0.9823	0.9939	0.9938	-.0002	0.0001
35	0.9761	0.9762	0.9923	0.9919	-.0001	0.0004
40	0.9686	0.9683	0.9882	0.9875	0.0003	0.0007
45	0.9572	0.9568	0.9858	0.9851	0.0004	0.0075
50	0.9436	0.9425	0.9783	0.9772	0.0011	0.0068
55	0.9231	0.9210	0.9641	0.9638	0.0021	0.0003
60	0.8900	0.8877	0.9434	0.9445	0.0023	-.0011
65	0.8396	0.8384	0.9083	0.9117	0.0012	-.0034
70	0.7626	0.7644	0.6403	0.6389	0.0018	0.0014
75	0.4883	0.4884	n/a	n/a	-.0001	n/a

Absolute Mean Difference (AMD) = 0.0009

Relative Mean Difference (RMD) = 0.0014

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.36. Survival Rates Comparison of Inferred Rural and Rural Regions, Philippines, 1980

Age*	Inferred Rural	Rural Regions	Inferred Rural	Rural Regions	Difference Survival Rates	Difference of Ratios
00	0.9249	0.9279	1.0663	1.0628	-.0030	0.0035
01	0.9862	0.9862	1.0064	1.0063	0.0000	0.0001
05	0.9925	0.9924	1.0003	1.0003	0.0001	0.0000
10	0.9928	0.9927	0.9962	0.9962	0.0001	0.0000
15	0.9890	0.9889	0.9964	0.9964	-.0001	0.0000
20	0.9854	0.9853	0.9973	0.9972	0.0001	0.0001
25	0.9827	0.9825	0.9963	0.9961	0.0002	0.0002
30	0.9791	0.9787	0.9944	0.9944	0.0004	0.0000
35	0.9736	0.9732	0.9922	0.9924	0.0004	-.0002
40	0.9660	0.9658	0.9899	0.9890	0.0002	0.0001
45	0.9562	0.9552	0.9868	0.9866	0.0010	0.0002
50	0.9436	0.9424	0.9775	0.9782	0.0012	-.0007
55	0.9224	0.9219	0.9661	0.9625	0.0005	0.0036
60	0.8911	0.8873	0.9412	0.9456	0.0038	-.0044
65	0.8387	0.8390	0.8952	0.9215	0.0063	-.0263
70	0.7508	0.7731	0.6371	0.6355	-.0223	0.0016
75	0.4783	0.4913	n/a	n/a	-.013	n/a

Absolute Mean Difference (AMD) = 0.0031

Relative Mean Difference (RMD) = 0.0026

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 4.37. Survival Rates Comparison of Inferred Rural and Rural Classification, Philippines, 1980

Age*	Inferred Rural	Rural Class.	Inferred Rural	Rural Class.	Difference Survival Rates	Difference of Ratios
00	0.9249	0.9290	1.0663	1.0616	-.0041	0.0047
01	0.9862	0.9862	1.0064	1.0064	0.0000	0.0000
05	0.9925	0.9925	1.0003	1.0003	0.0000	0.0000
10	0.9928	0.9927	0.9962	0.9963	0.0000	-.0001
15	0.9890	0.9891	0.9964	0.9962	-.0001	0.0002
20	0.9854	0.9853	0.9973	0.9971	0.0001	0.0002
25	0.9827	0.9824	0.9963	0.9963	0.0003	0.0000
30	0.9791	0.9788	0.9944	0.9947	0.0003	-.0003
35	0.9736	0.9736	0.9922	0.9925	0.0000	-.0003
40	0.9660	0.9663	0.9899	0.9901	-.0003	-.0002
45	0.9562	0.9567	0.9868	0.9874	-.0005	-.0006
50	0.9436	0.9446	0.9775	0.9785	-.0010	-.0010
55	0.9224	0.9243	0.9661	0.9662	-.0019	-.0001
60	0.8911	0.8931	0.9412	0.9401	-.0020	0.0011
65	0.8387	0.8396	0.8952	0.8923	-.0009	0.0029
70	0.7508	0.7492	0.6371	0.6380	0.0016	0.0009
75	0.4783	0.4780	n/a	n/a	0.0003	n/a

Absolute Mean Difference (AMD) = 0.0008

Relative Mean Difference (RMD) = 0.0008

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

despite all the differences in area classification, the RUMM technique produces mortality estimates that are consistent with the estimates from these surveys, then the technique is not only reliable but also generates valid estimates.

Presented in Table 4.38 are infant mortality rates and their equivalent life expectancies at birth estimated by various techniques from different data sources. While the RUMM estimate for 1975 was clearly consistent with the other estimates, the 1980 estimate was not so clear-cut. This was because the infant mortality estimate for inferred rural population was more than ten deaths lower than the other estimates. However, with the exclusion of the inferred rural infant mortality estimates, all the other RUMM estimates were consistent with the children ever born and children still living estimates.

The RUMM estimates were also compared to some selected provincial and national estimates of adult and infant mortality estimated by various investigators in the Philippines using a wide variety of techniques. These data presented in Table 4.39 also established the trend of mortality experience from the year 1926 to 1980. Again, the RUMM estimates were found to be in keeping with all other mortality estimates in the country.

The next step in assessing the validity and reliability of the RUMM technique was to check its consistency in regards the assumptions set for the method. To check whether the assumption of population stability holds for inferred urban and inferred rural populations, a stable population age distribution for these populations was generated. This stable population age distribution was then compared to the enumerated census age structures and the difference between these age structures was expressed

Table 4.38. Estimates of Infant Mortality Rates and Life Expectancy at Birth for Rural and Urban Areas: 1968-1980

	Urban		Rural	
Year	Implied Infant Mortality	Life Expectancy at Birth	Implied Infant Mortality	Life Expectancy at Birth
1968	65.64	60.75	78.49	58.22
1970	59.46	62.44	68.48	60.43
1973	59.90	62.33	71.01	59.87
1975	56.21	64.24	69.44	60.29
1978	55.25	63.28	68.50	60.30
1980	51.17	64.84	58.63	63.23
1980*	51.00	65.80	63.00	61.70

Notes:

Estimates for 1968, 1970, and 1973 were generated by applying the Brass, Sullivan, and Trussel's child-survivorship technique to children ever born and children surviving data from the 1968 and 1973 National Demographic Surveys and the 1970 Population Census. Estimates are all based upon q(1)-q(35) (see Zelda Zablan, "Trends and Differential in Mortality"), Population of the Philippines, Monograph Series No. 5 (Bangkok, Thailand: Economic and Social Commission for Asia and the Pacific, 1978).

Figures for 1975 and 1980 were generated by segregating rural-urban mortality using 1975 and 1980 regional registered deaths and census data. Urban and rural for 1975 and 1980 refer to implied urban and implied rural populations.

Estimates for 1978 were generated by applying the Brass, Sullivan, Trussel, and Preston and Palloni's child-survivorship technique to children ever born and children surviving data from the 1978 World Fertility Survey. Estimates refer to early 1976.

*Projected Infant Mortality Rates and Life Expectancies at Birth Estimated by Kevin Kinsella, Detailed Statistics on the Urban and Rural Population of the Philippines: 1950-2010 (U.S. Bureau of the Census, Washington, DC, 1984).

Table 4.39. Selected Mortality Estimates for the Philippines: 1926-1978 (Rates per 1,000)

Investigator	Reference Period	Crude Death Rate	Infant Mortality Rate	Life Expectancy at Birth
Disease Intelligence Center (1974)	1926-1930		157.3	
	1931-1935		150.5	
	1936-1940		138.5	
	1946		125.5	
	1947		111.5	
	1948-1952		106.2	
Madigan (1965)	1948-1950	21.6		42.5
Lorimer (1966)	1948-1952	20.0		42.5
Adams (1958)	1948-1957	21.4		
Aromin (1961)	1950	17.3		
Pascual (1962)	1950-1955	16.0		
Disease Intelligence Center (1974)	1953-1957		91.8	
Lorimer (1966)	1953-1958	16.7		47.5
Madigan (1965)	1954-1960	18.5		45.5
Disease Intelligence Center (1974)	1958-1962		73.0	
Lorimer (1966)	1959-1960	13.4		52.5
Flieger, Abenoja & Lim (1981)	1960	12.8	113.0	52.8
U.P.P.I. (1975)	1960	13.7	105.5	52.8
Aromin (1961)	1960	12.9		58.0
Pagtolun-an (1983)	1960	12.9	103.9	57.4
Osteria-Baltazar (1976)	1961	11.7	68.0	58.0
Disease Intelligence Center (1974)	1963-1967		65.5	
U.P.P.I. (1975)	1968	10.1	76.2	58.7
Disease Intelligence Center (1974)	1968-1972		63.7	
Flieger, Abenoja & Lim (1981)	1970	10.8	93.0	55.8
Engracia (1974)	1970	10.4	80.0	58.0
Pagtolun-an (1983)	1970	10.0	85.2	59.0
Osteria-Baltazar (1976)	1971	9.6	64.0	62.0
Mijares (1975)	1973	9.6		
U.P.P.I. (1975)	1973	9.2	67.6	60.6
Flieger, Abenoja & Lim (1981)	1975	8.7	76.0	59.4
RUMM Technique	1975	8.5	68.9	61.5
Gonzaga (1979)	1978		62.0	
RUMM Technique	1980		55.11	63.98

in terms of the Index of Dissimilarity and the Index of Relative Difference. Shown on Table 4.40 are the estimations of the Index of Relative Difference and the Index of Dissimilarity for the 1980 total country. The difference between the total country enumerated age distribution and its equivalent stable population was found to be small. For example, the Index of Dissimilarity was 4.46 which indicates that 4.46 percent of this observed population would have to be shifted to other age-groups in order to make the observed age structure identical to that of its stable population equivalent. According to Keyfitz and Flieger (1971: 60), the index of 4.5 is rather small when compared to similar indices of most other countries, particularly those that have undergone drastic fertility changes in the recent past. Therefore, an Index of Dissimilarity of 4.46 percent signifies a relatively high degree of age-structural stability.

The Index of Dissimilarity between the observed age structure for the inferred urban region and its equivalent stable population was shown to be 7.22 percent while the Index of Relative Difference was found to be 9.25 (see Table 4.41). Again, this figure is small in comparison to similar indices of most other countries.

Examination of the differences between the observed age structure for the inferred rural population (see Table 4.42) and its equivalent stable population revealed a low Index of Relative Difference (3.14) and Index of Dissimilarity (1.71). This high degree of age structural stability exhibited by the inferred rural populations may be indicative of the minimal effect of migration, changing fertility, or changing mortality. On the other hand, the lesser degree of stability shown by the inferred urban population can be attributed to the greater effect of

Table 4.40. Comparison of Reported Age Distribution and Its Stable Population Equivalent, Philippines, 1980

Age*	Stable Population (percent)	Reported Population (percent)	Ratio of Percentages	Differences of percentages
00	15.2	15.9	105.0	0.76
05	13.2	13.7	104.3	0.57
10	11.5	12.4	107.8	0.89
15	10.0	10.9	108.9	0.90
20	08.7	09.5	109.3	0.81
25	07.6	08.0	105.8	0.44
30	06.6	06.2	095.2	-.31
35	05.7	05.0	089.0	-.62
40	04.8	04.3	089.4	-.51
45	04.1	03.5	084.0	-.66
50	03.5	02.9	083.5	-.57
55	02.9	02.3	079.3	-.59
60	02.3	01.9	080.9	-.44
65	01.8	01.5	081.9	-.33
70	01.3	00.9	068.4	-.42
75	00.9	01.0	110.8	0.10

Index of Relative Difference = 6.26

Index of Dissimilarity = 4.46

*00 = below one through four years of age; 05 = five through nine years of age, etc.

Table 4.41. Comparison of Reported Age Distribution and Its Stable Population Equivalent, Inferred Urban, 1980

Age*	Stable Population (percent)	Reported Population (percent)	Ratio of Percentages	Differences of percentages
00	13.6	15.1	110.7	01.46
05	12.1	12.7	105.1	00.62
10	10.8	11.7	108.6	00.93
15	09.6	11.1	115.6	01.50
20	08.6	10.3	119.9	01.71
25	07.6	08.7	113.2	01.00
30	06.8	06.7	099.1	-0.06
35	06.0	05.1	084.9	-0.90
40	05.3	04.4	084.1	-0.83
45	04.6	03.5	076.3	-1.10
50	03.9	02.9	074.0	-1.02
55	03.3	02.3	069.4	-1.02
60	02.8	01.9	069.3	-0.85
65	02.2	01.6	071.0	-0.64
70	01.7	01.0	057.0	-0.72
75	01.1	01.1	092.0	-0.09

Index of Relative Difference = 9.25

Index of Dissimilarity = 7.22

*00 = below one through four years of age; 05 = five through nine years of age, etc.

Table 4.42. Comparison of Reported Age Distribution and Its Stable Population Equivalent, Inferred Rural, Philippines, 1980

Age*	Stable Population (percent)	Reported Population (percent)	Ratio of Percentages	Differences of percentages
00	17.1	16.4	096.7	-0.56
05	14.4	14.4	100.1	00.01
10	12.2	12.8	104.7	00.57
15	10.4	10.8	103.8	00.40
20	08.8	09.0	102.7	00.24
25	07.4	07.6	102.5	00.18
30	06.2	05.9	095.1	-0.31
35	05.2	05.0	095.7	-0.23
40	04.4	04.3	097.8	-0.09
45	03.6	03.4	095.3	-0.17
50	02.9	02.9	097.4	-0.08
55	02.4	02.3	095.0	-0.12
60	01.9	01.9	099.0	-0.02
65	01.4	01.4	101.2	00.02
70	01.0	00.9	086.8	-0.14
75	00.7	01.0	144.3	00.29

Index of Relative Difference = 3.14

Index of Dissimilarity = 1.71

*00 = below one through four years of age; 05 = five through nine years of age, etc.

migration, changing fertility, or changing mortality. However, a seven percent shift in age distribution was not large enough to have a strong effect upon the Brass "adjustment factor" that would bias the estimate of mortality.

In summary, this Chapter presented and discussed the application of the RUMM technique to the Philippine death registration and census data of 1975 and 1980. However, before the application of the technique, Philippine death registration and census age distribution data were evaluated for completeness. While the age distribution showed a fairly accurate age reporting, death registration was, on the average, 25 percent incomplete. As a result, reported deaths had to be inflated to adjust for the high degree of underenumeration.

Comparing the Brass Growth Balance estimates of completeness with those estimated by different surveys revealed that the Brass Growth Balance estimates were consistent with the other estimates. Mortality estimates generated were also consistent with the estimates from children ever born and children still living data from different surveys.

CHAPTER V: APPLICATION OF THE RUMM TECHNIQUE TO THAILAND DATA

Unlike the other Third World countries, Thailand tabulates its deaths and population by rural and urban residence. However, since Thailand stopped publishing its death registration in 1978, there are very few analyses using these distributions. The age-sex distributions on death used in this study were obtained by special request from the Thailand Ministry of Public Health.

The availability of rural and urban tabulations allowed this study to work with two different types of urban and rural classifications. While rural and urban areas were defined and classified by the Thailand Census, inferred urban and inferred rural populations were defined in this study in accordance with several selected indices of urbanization.

Presented in Table 5.1 are the death and population distributions for rural and urban areas. These distributions will be referred to as urban and rural areas throughout this study.

EVALUATION OF THE CENSUS POPULATION AGE DISTRIBUTION

The U.S. Bureau of the Census described the quality of the age-sex distributions for Thailand 1960 and 1970 censuses as reasonably reliable (U.S. Bureau of the Census, 1978). The U.N. Age-Sex Accuracy Index scores were shown to be 19 for 1960 and 18 for 1970. In the 1980 census, the

Table 5.1. Deaths and Population Distribution by Age, for Urban and Rural Areas, Thailand, 1980

Age*	Urban Population	Area Death	Rural Population	Area Death
00	0226292	6585	0917360	07701
01	0844023	2596	3438171	12666
05	1087213	1807	4748165	06783
10	1193654	1373	4710843	04670
15	1386165	2860	4022096	06525
20	1324228	3465	3196801	07718
25	1031799	2861	2522628	06518
30	0737536	2266	1961112	06121
35	0596740	2295	1748080	06508
40	0538995	2891	1628081	08482
45	0444659	3478	1449755	09853
50	0354922	3818	1158459	11071
55	0253166	3496	0858317	10959
60	0203150	4235	0650706	12583
65	0146863	4183	0483223	13294
70	0106916	4386	0353478	14763
75	0118959	9585	0381985	33904

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

index score was shown to be 11.70 (see Table 5.2), indicating a much higher accuracy than in the previous years.

Applying the index to the inferred urban (see Table 5.3) and inferred rural (see Table 5.4) populations also revealed reliable age-sex distributions. Both figures (16.67 for inferred urban and 11.21 for inferred rural), were much lower than the index scores of 20, the minimum scores set by the United Nations as inaccurate.

Evaluation of age-sex distributions for rural and urban areas also revealed accurate data. The urban area showed an index score of 18.56 while the rural area showed a score of 11.31. These scores were lower than the set scores established by the United Nations as inaccurate. The urban and rural areas U.N. Age-Sex Accuracy Index scores are presented in Table 5.5 and Table 5.6, respectively.

The evidence of accuracy of the age distributions allowed this study to use these distributions in the analysis without smoothing or age-adjustment.

IDENTIFICATION OF AREAS DESIGNATED AS URBAN AND RURAL

Besides rural and urban areas, the Kingdom of Thailand is subdivided into four regions, namely: Central, Southern, Northeastern, and Northern regions (see Figure B2 in Appendix B for the map of the administrative divisions of Thailand). In this study, Bangkok Metropolis, which is part of the central region, was treated as a separate region. Separating Bangkok Metropolis from the central region allowed this study to be more flexible especially in classifying regions into inferred urban or

Table 5.2. Calculation of the United Nations Age-Sex Accuracy Index, Thailand, 1980

Age	Population*		Analysis of Age Ratios				Analysis of Sex Ratios	
			Male		Female			
	Male (1)	Female (2)	Age Ratio (3)	Deviation from 100 (4)	Age Ratio (5)	Deviation from 100 (6)	Sex Ratio (7)	Successive Differences (8)
0-4	2,771,779	2,654,067					104.4	
5-9	2,979,485	2,855,893	103.1	3.1	102.9	2.9	104.3	-0.1
10-14	3,006,300	2,898,197	105.9	5.9	104.1	4.1	103.7	-0.6
15-19	2,696,618	2,711,643	102.8	2.8	104.7	4.7	99.4	-4.3
20-24	2,239,837	2,281,192	100.9	0.9	100.9	0.9	98.2	-1.3
25-29	1,743,323	1,811,104	97.6	-2.4	99.3	-0.7	96.3	-1.9
30-34	1,333,155	1,365,493	91.8	-8.2	91.2	-8.8	97.6	1.4
35-39	1,161,496	1,183,324	96.9	-3.1	95.9	-4.1	98.2	0.5
40-44	1,064,541	1,102,535	101.9	1.9	102.5	2.5	96.6	-1.6
45-49	927,227	967,187	102.5	2.5	103.4	3.4	95.9	-0.7
50-54	744,588	768,793	101.2	1.2	100.2	0.2	96.9	1.0
55-59	543,743	567,740	94.1	-5.9	93.7	-6.3	95.8	-1.1
60-64	411,260	442,596	97.9	-2.1	98.2	-1.8	92.9	-2.9
65-69	296,774	333,312	96.3	-3.7	95.5	-4.5	89.0	-3.9
70-74	205,316	255,078						
75+	203,165	297,779						

Average Age Ratio Deviation for Males = 3.38
Average Age Ratio Deviation for Females = 3.44

Average Sex Ratio Difference = 1.63
Age-Sex Accuracy Index = 11.70

$$\text{Age Ratio} = \frac{{}_5P_a}{\frac{1}{2}({}_5P_{a-5} + {}_5P_{a+5})} \times 100$$

$$\text{Sex Ratio} = [(1)/(2)] \times 100$$

*Source: Thailand National Statistical Office, <u>1980 Population and Housing Census for Whole Kingdom</u>, Bangkok, 1980, Table 4.

Table 5.3. Calculation of the United Nations Age-Sex Accuracy Index, Inferred Urban, Thailand, 1980

Age	Population*		Analysis of Age Ratios				Analysis of Sex Ratios	
			Male		Female			
	Male	Female	Age Ratio	Deviation from 100	Age Ratio	Deviation from 100	Sex Ratio	Successive Differences
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0-4	611,682	581,084					105.3	
5-9	619,640	591,920	100.6	0.6	99.3	-0.7	104.7	-0.6
10-14	620,564	610,816	99.1	-0.9	96.7	-3.3	101.6	-3.1
15-19	632,796	671,050	106.8	6.8	120.5	20.5	94.3	-7.3
20-24	564,503	594,141	105.8	5.8	104.4	4.4	95.0	0.7
25-29	434,717	467,114	98.2	-1.8	111.2	11.2	93.1	-19.3
30-34	321,108	337,580	90.6	-9.4	90.2	-9.8	95.1	2.1
35-39	273,859	281,723	95.1	-4.9	93.8	-6.2	97.2	2.1
40-44	255,112	263,179	105.6	5.6	105.9	5.9	96.9	-0.3
45-49	209,206	215,347	98.2	-1.8	98.5	-1.5	97.1	0.2
50-54	171,125	174,216	104.1	4.1	103.3	3.3	98.2	1.1
55-59	119,407	122,011	89.3	-10.7	88.3	-11.7	97.9	-0.4
60-64	96,298	102,268	102.8	2.8	103.6	3.6	94.2	-3.7
65-69	67,856	75,367	92.1	-7.9	91.2	-8.8	90.0	-4.1
70-74	50,999	63,062						
75+	50,396	75,141						

Average Age Ratio Deviation for Males = 4.86
Average Age Ratio Deviation for Females = 5.46

Average Sex Ratio Difference = 2.12
Age-Sex Accuracy Index = 16.67

$$\text{Age Ratio} = \frac{{}_5P_a}{\frac{1}{2}({}_5P_{a-5} + {}_5P_{a+5})} \times 100$$

$$\text{Sex Ratio} = [(1)/(2)] \times 100$$

*Source: Thailand National Statistical Office, 1980 Population and Housing Census for Whole Kingdom, Bangkok, 1980, Table 4.

Table 5.4. Calculation of the United Nations Age-Sex Accuracy Index, Inferred Rural, Thailand, 1980

Age	Population*		Analysis of Age Ratios				Analysis of Sex Ratios	
			Male		Female			
	Male (1)	Female (2)	Age Ratio (3)	Deviation from 100 (4)	Age Ratio (5)	Deviation from 100 (6)	Sex Ratio (7)	Successive Differences (8)
0-4	2,160,097	2,072,983					104.2	
5-9	2,359,845	2,263,973	103.8	3.8	103.8	3.8	104.2	0.0
10-14	2,385,736	2,287,381	107.9	7.9	106.3	6.3	104.3	0.1
15-19	2,063,822	2,040,593	101.6	1.6	100.4	0.4	101.1	-3.2
20-24	1,675,334	1,778,625	99.4	-0.6	105.1	5.1	94.2	-6.9
25-29	1,308,606	1,343,990	97.4	-2.6	95.8	-4.2	97.4	3.2
30-34	1,012,047	1,027,913	92.2	-7.8	91.5	-8.5	98.5	1.1
35-39	887,637	901,601	97.5	-2.5	96.6	-3.4	98.5	0.0
40-44	809,429	839,356	100.8	0.8	101.5	1.5	96.4	-2.0
45-49	718,021	751,840	103.8	3.8	104.9	4.9	95.5	-0.9
50-54	573,463	594,577	100.4	0.4	99.3	-0.7	96.4	0.9
55-59	424,336	445,729	95.5	-4.5	95.4	-4.6	95.2	-1.2
60-64	314,962	340,328	96.4	-3.6	96.7	-3.3	92.5	-2.7
65-69	228,918	257,945	97.6	-2.4	96.9	-3.1	88.7	-3.8
70-74	154,317	192,016						
75+	152,769	222,638						

Average Age Ratio Deviation for Males = 3.27
Average Age Ratio Deviation for Females = 3.83

Average Sex Ratio Difference = 2.01
Age-Sex Accuracy Index = 13.12

$$\text{Age Ratio} = \frac{{}_5P_a}{\frac{1}{2}({}_5P_{a-5} + {}_5P_{a+5})} \times 100$$

Sex Ratio = [(1)/(2)] x 100

*Source: Thailand National Statistical Office, <u>1980 Population and Housing Census for Whole Kingdom</u>, Bangkok, 1980, Table 4.

Table 5.5. Calculation of the United Nations Age-Sex Accuracy Index, Urban Area, Thailand, 1980

Age	Population*		Analysis of Age Ratios				Analysis of Sex Ratios	
			Male		Female			
	Male (1)	Female (2)	Age Ratio (3)	Deviation from 100 (4)	Age Ratio (5)	Deviation from 100 (6)	Sex Ratio (7)	Successive Differences (8)
0-4	550,234	520,081					105.8	
5-9	556,997	530,216	96.8	-3.2	95.3	-4.7	105.1	-0.7
10-14	600,557	593,097	98.0	-2.0	95.0	-5.0	101.3	-3.8
15-19	668,209	717,956	107.4	7.4	112.8	12.8	93.1	-8.2
20-24	644,210	680,018	110.7	10.7	108.4	8.4	94.7	1.7
25-29	495,358	536,441	98.8	-1.2	101.5	1.5	92.3	-2.4
30-34	358,978	376,558	90.9	-9.1	89.8	-10.2	95.3	3.0
35-39	294,123	302,617	94.2	-5.8	93.1	-6.9	97.2	1.9
40-44	265,491	273,504	104.1	4.1	103.0	3.0	97.1	-0.1
45-49	216,019	228,640	98.5	-1.5	100.4	0.4	94.5	-2.6
50-54	173,118	181,804	102.5	2.5	101.0	1.0	95.2	0.7
55-59	121,845	131,321	90.4	-9.6	91.0	-9.0	92.8	-2.4
60-64	96,445	106,705	102.4	2.0	101.2	1.2	90.4	-2.4
65-69	67,258	79,605	94.1	-5.9	95.3	-4.7	84.5	-5.9
70-74	46,576	60,340						
75+	46,090	72,869						

Average Age Ratio Deviation for Males = 5.00
Average Age Ratio Deviation for Females = 5.30

Average Sex Ratio Difference = 2.76
Age-Sex Accuracy Index = 18.56

$$\text{Age Ratio} = \frac{{}_5P_a}{\frac{1}{2}({}_5P_{a-5} + {}_5P_{a+5})} \times 100$$

$$\text{Sex Ratio} = [(1)/(2)] \times 100$$

*Source: Thailand National Statistical Office, <u>1980 Population and Housing Census for Whole Kingdom</u>, Bangkok, 1980, Table 4.

Table 5.6. Calculation of the United Nations Age-Sex Accuracy Index, Rural Area, Thailand, 1980

Age	Population*		Analysis of Age Ratios				Analysis of Sex Ratios	
			Male		Female			
	Male (1)	Female (2)	Age Ratio (3)	Deviation from 100 (4)	Age Ratio (5)	Deviation from 100 (6)	Sex Ratio (7)	Successive Differences (8)
0-4	2,221,545	2,133,986					104.1	
5-9	2,422,488	2,325,677	104.7	4.7	104.8	4.8	104.2	0.1
10-14	2,405,743	2,305,100	108.1	8.1	106.7	6.7	104.4	0.2
15-19	2,028,409	1,993,687	101.4	1.4	102.1	2.1	101.7	-2.6
20-24	1,595,627	1,601,174	97.4	-2.6	98.0	-2.0	99.7	-2.1
25-29	1,247,965	1,274,663	97.1	-2.9	98.4	-1.6	97.9	-1.7
30-34	974,177	988,935	92.1	-7.9	91.8	-8.2	98.5	0.6
35-39	867,373	880,707	97.8	-2.2	96.9	-3.2	98.5	0.0
40-44	799,050	829,031	101.2	1.2	102.4	2.4	96.4	-2.1
45-49	711,208	738,547	103.8	3.8	104.3	4.3	96.3	-0.1
50-54	571,470	586,989	100.9	0.9	99.9	-0.1	97.4	1.1
55-59	421,898	436,419	95.2	-4.8	94.6	-5.4	96.7	-0.7
60-64	314,815	335,891	96.7	-3.3	97.3	-2.7	93.7	-2.9
65-69	229,516	253,707	96.9	-3.1	95.6	-4.4	90.5	-3.3
70-74	158,740	194,738						
75+	157,075	224,910						

Average Age Ratio Deviation for Males = 3.60
Average Age Ratio Deviation for Females = 3.68

Average Sex Ratio Difference = 1.34
Age-Sex Accuracy Index = 11.31

$$\text{Age Ratio} = \frac{{}_5P_a}{\frac{1}{2}({}_5P_{a-5} + {}_5P_{a+5})} \times 100$$

Sex Ratio = [(1)/(2)] x 100

*Source: Thailand National Statistical Office, <u>1980 Population and Housing Census for Whole Kingdom</u>, Bangkok, 1980, Table 4.

inferred rural populations. This is because inclusion of Bangkok Metropolis to any one region will extremely bias the urbanization scores of that region and tremendously reduce the chance of any other region to be classified as inferred urban.

Shown on Table 5.7 are the urbanization index scores of each of the five regions based on four indicators of urbanization. These indicators are: proportion of urban population, the mean city population size, proportion of agricultural population, and the population density. Bangkok Metropolis and Southern regions showed the highest scores in all indicators, making them rank first and second among all five regions. In summing up the population of all top ranked regions (see Table 5.8), the closest figures to the total number of urban populations for the Whole Kingdom were the summed up populations of regions ranked first and second, namely: Bangkok Metropolis and the Southern region. These two regions were classified as inferred urban population while the remaining regions were classified as inferred rural population.

Examination of Table 5.8 revealed that the proportion of the urban population found in the inferred urban population is 52 percent, more than twice the proportion of urban population found in the Whole Kingdom. This result indicates that most of the urban area population reside in inferred urban and that more urban population than rural is found in inferred urban.

Table 5.9 displays the combined distributions of the Bangkok Metropolis and Southern region labeled as inferred urban population. The remaining regions were also combined to compose the distribution for inferred rural populations.

Table 5.7. Urbanization Index Score and Ranks by Regions, Thailand, 1980

Regions	Proportion of Urban Population (1)	Rank (2)	Mean City Population Size (3)	Rank (4)	Proportion of Agricultural Population (5)	Rank (6)	Population Density (7)	Rank (8)	Total Rank (9)
Central	0.1010	3	803	5	.4808	3	94.4	2	13
Bangkok	100.00	1	290,275	1	.0340	1	2965.5	1	4
Northeastern	0.0432	5	1,463	4	.7935	5	92.1	4	14
Northern	0.0714	4	2,118	3	.6923	4	53.2	5	16
Southern	0.1177	2	2,748	2	.4137	2	78.4	3	9

Table 5.8. Identification of Inferred Urban Areas, Thailand, 1980

Regions	Total Rank	Population	Cumulative Population	Urban Population for the Whole Kingdom	Inferred Urban	Inferred Rural
Bangkok	4	4,697,071	4,697,071		X	
Southern	9	5,628,216	10,325,287	10,595,280	X	
Central	13	9,726,272	20,051,559			X
Northeastern	14	15,698,874	35,750,433			X
Northern	16	9,074,103	44,824,540			X

Proportion of Urban Population in Inferred Urban Area = 0.52134

Proportion of Urban Population in the Whole Kingdom = 0.23634

Table 5.9. Deaths and Population Distribution by Age, for Inferred Urban and Inferred Rural, Thailand, 1980

Age*	Inferred Population	Urban Death	Inferred Population	Rural Death
00	0254607	04481	0889045	09805
01	0938159	02752	3344035	12510
05	1211560	01465	4623818	07125
10	1231380	00986	4673117	05057
15	1303846	02068	4104415	07317
20	1158644	02770	3362385	08413
25	0901831	02472	2652596	06907
30	0658688	01983	2039960	06404
35	0555582	02028	1789238	06775
40	0518291	02443	1648785	08930
45	0424553	02798	1469861	10533
50	0345341	02966	1168040	11923
55	0241418	02964	0870065	11491
60	0198566	03701	0655290	13117
65	0143223	03835	0486863	13642
70	0114061	04405	0346333	14744
75	0125537	10348	0375407	33141

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

ESTIMATING COMPLETENESS OF DEATH REGISTRATION

Application of the Brass Growth Balance Equation to the Whole Kingdom of Thailand produced an estimate of completeness of 72 percent. The n_x/P_y and d_y'/P_y data points are shown on Table 5.10. The slope of the line fitted through these data points from age-group 5-9 through age-group 60-64 is shown as 1.3795.

Using the slope of the line as a "correction factor" to adjust the reported deaths resulted in the distribution shown on Table 5.11. Applying the Brass Growth Balance Equation to these corrected deaths produced a slope which is equal to 1.00.

Assessment of the death registration data for the inferred urban population is shown on Table 5.12. As expected, the slope of the line which is 1.2037 was very much lower than that found in the Whole Kingdom. Again, this is an indication that the death registration system tends to work better in urban populations.

Application of 1.2037 to inflate the reported deaths for inferred urban population is shown on Table 5.13. Again, application of the Brass Growth Balance Equation to these corrected deaths generated a slope of 1.00.

The next death registration assessed for completeness was the distribution for inferred rural populations. Table 5.14 shows the slope of the line (1.3718) fitted from age-group 5-9 through age-group 60-64. This slope indicates a completeness which is 10 percent lower than those found in the inferred urban populations.

Table 5.10 Application of the Brass Growth Balance Equation to the Deaths and Population of Thailand, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	30	5426	242	44825	n/a	n/a	n/a
05	09	5835	213	39399	1126	0.0054	0.0286
10	06	5904	204	33563	1174	0.0061	0.0350
15	09	5408	198	27659	1131	0.0072	0.0409
20	11	4521	189	22251	0993	0.0085	0.0446
25	09	3554	178	17730	0808	0.0100	0.0455
30	08	2699	168	14175	0625	0.0119	0.0441
35	09	2345	160	11476	0504	0.0139	0.0440
40	11	2167	151	09132	0451	0.0165	0.0494
45	13	1894	140	06965	0406	0.0200	0.0583
50	15	1513	126	05070	0341	0.0249	0.0672
55	14	1111	111	03557	0262	0.0313	0.0738
60	17	0854	097	02445	0197	0.0396	0.0804
65	80	1591	080	01591	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.3795

Intercept = 0.0285

Adjusted Crude Death Rates = 0.0075

*00 = below one through four years of age; 05 = five through nine years of age, etc.

Table 5.11. Enumerated Deaths Adjusted by f=1.3795, Thailand, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	041	5426	334	44825	n/a	n/a	n/a
05	012	5835	293	39399	1126	0.0074	0.0286
10	008	5904	282	33563	1174	0.0084	0.0350
15	013	5408	273	27659	1131	0.0099	0.0409
20	015	4521	260	22251	0993	0.0117	0.0446
25	013	3554	245	17730	0808	0.0138	0.0455
30	012	2699	232	14175	0625	0.0164	0.0441
35	012	2345	220	11476	0504	0.0192	0.0440
40	016	2167	208	09132	0451	0.0228	0.0494
45	018	1894	193	06965	0406	0.0277	0.0583
50	021	1513	174	05070	0341	0.0344	0.0672
55	020	1111	154	03557	0262	0.0432	0.0738
60	023	0854	134	02445	0197	0.0547	0.0804
65	111	1591	111	01591	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.0000

Intercept = 0.0285

Adjusted Crude Death Rates = 0.0075

*00 = below one through four years of age; 05 = five through nine years of age, etc.

Table 5.12. Application of the Brass Growth Balance Equation to the Death and Population, Inferred Urban, Thailand, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	07	1193	54	10234	n/a	n/a	n/a
05	01	1212	47	09041	240	0.0052	0.0266
10	01	1231	46	07829	244	0.0058	0.0312
15	02	1304	45	06598	254	0.0068	0.0384
20	03	1067	43	05294	237	0.0081	0.0448
25	02	0902	40	04227	197	0.0094	0.0468
30	02	0659	37	03325	0156	0.0113	0.0469
35	02	0556	35	2667	121	0.0133	0.0455
40	02	0518	33	02111	107	0.0159	0.0509
45	03	0425	31	01593	094	0.0195	0.0592
50	03	0345	28	01168	077	0.0242	0.0659
55	03	0241	25	00823	059	0.0307	0.0713
60	04	0199	22	00581	044	0.0383	0.0757
65	19	0383	19	00383	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.2037

Intercept = 0.0335

Adjusted Crude Death Rates = 0.0075

*00 = below one through four years of age; 05 = five through nine years of age, etc.

Table 5.13. Enumerated Deaths Adjusted by f=1.2037, Inferred Urban, Thailand, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	09	1193	66	10234	n/a	n/a	n/a
05	02	1212	57	09041	240	0.0063	0.0266
10	01	1231	55	07829	244	0.0070	0.0312
15	02	1304	54	06598	254	0.0082	0.0384
20	03	1067	51	05294	237	0.0097	0.0448
25	03	0902	48	04227	197	0.0114	0.0468
30	02	0659	45	03325	0156	0.0136	0.0469
35	02	0556	43	2667	121	0.0160	0.0455
40	03	0518	40	02111	107	0.0191	0.0509
45	03	0425	37	01593	094	0.0234	0.0592
50	04	0345	34	01168	077	0.0291	0.0659
55	04	0241	30	00823	059	0.0369	0.0713
60	04	0199	27	00581	044	0.0461	0.0757
65	22	0383	22	00383	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.0000

Intercept = 0.0335

Adjusted Crude Death Rates = 0.0075

*00 = below one through four years of age; 05 = five through nine years of age, etc.

Table 5.14. Application of the Brass Growth Balance Equation to Death and Population, Inferred Rural, Thailand, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	22	4233	188	34591	n/a	n/a	n/a
05	07	4624	166	30358	886	0.0055	0.0292
10	05	4673	158	25734	930	0.0062	0.0361
15	07	4104	153	21061	878	0.0073	0.0417
20	08	3454	146	16956	0756	0.0086	0.0446
25	07	2653	138	13502	611	0.0102	0.0452
30	06	2040	131	10850	469	0.0120	0.0433
35	07	1789	124	08810	383	0.0141	0.0435
40	09	1649	118	07021	344	0.0167	0.0490
45	11	1470	109	05374	312	0.0202	0.0581
50	12	1168	098	03902	264	0.0251	0.0676
55	11	0870	086	02734	204	0.0315	0.0745
60	13	0655	075	01864	153	0.0400	0.0818
65	62	1209	62	01209	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.3718

Intercept = 0.0286

Adjusted Crude Death Rates = 0.0075

*00 = below one through four years of age; 05 = five through nine years of age, etc.

The slope of 1.3718 was used to inflate registered death figures for all age-groups (0-1, 1-4, ..., 80+). These corrected deaths are shown on Table 5.15.

Since Thailand had rural and urban area classifications for death and population, the next distributions assessed were those of rural and urban areas. Table 5.16 shows the n_y/P_y and d_y'/P_y data points and the slope of these data points for urban areas. The slope of 1.1085 indicates a completeness rate of 90 percent which is higher than that shown by the inferred urban population. However, the rural areas (see Table 5.17) showed a completeness rate of 74 percent, which is almost identical to those shown by the inferred rural population. The slope of 1.1085 and the slope of 1.3425 for both urban and rural areas were used to inflate registered death figures in these areas.

Male and female distributions were also assessed for completeness of death enumeration and these assessments are shown in Appendix A, Table A4. Again, like the Philippines, male death distributions were found to be more complete than the female death distributions. On the average, the male death distributions were 10 percent more complete than the female death distributions.

Assessing the reliability of the adjustment factors produced by the Brass Growth Balance Equation, levels of death registration generated in this study were compared to three estimates generated by various techniques. These included: estimates produced by the U.S. Bureau of the Census (1978), estimates by Arnold, Retherford, and Wanglee (1977), estimates produced by the dual-record study conducted by the Thailand National Statistical Office (1976).

Table 5.15. Enumerated Deaths Adjusted by f=1.3718, Inferred Rural, Thailand, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	31	4233	258	34591	n/a	n/a	n/a
05	10	4624	227	30358	886	0.0075	0.0292
10	07	4673	217	25734	930	0.0084	0.0361
15	10	4104	210	21061	878	0.0100	0.0417
20	12	3454	200	16956	0756	0.0118	0.0446
25	09	2653	189	13502	611	0.0140	0.0452
30	09	2040	179	10850	469	0.0165	0.0433
35	09	1789	171	08810	383	0.0194	0.0435
40	12	1649	161	07021	344	0.0230	0.0490
45	14	1470	149	05374	312	0.0277	0.0581
50	16	1168	135	03902	264	0.0345	0.0676
55	16	0870	118	02734	204	0.0432	0.0745
60	18	0655	102	01864	153	0.0549	0.0818
65	84	1209	84	01209	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.0000

Intercept = 0.0286

Adjusted Crude Death Rates = 0.0075

*00 = below one through four years of age; 05 = five through nine years of age, etc.

Table 5.16. Application of the Brass Growth Balance Equation to the Death and Population, Urban Area, Thailand, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	09	1070	62	10595	n/a	n/a	n/a
05	02	1087	53	09525	216	0.0056	0.0227
10	01	1194	51	08438	228	0.0061	0.0270
15	03	1386	50	07244	258	0.0069	0.0356
20	03	1324	47	05858	271	0.0080	0.0463
25	03	1032	43	04534	236	0.0095	0.0520
30	02	0738	41	03502	177	0.0116	0.0505
35	02	0597	38	2764	133	0.0139	0.0483
40	03	0539	36	02168	114	0.0166	0.0524
45	03	0445	33	01629	098	0.0204	0.0604
50	04	0355	30	01184	080	0.0251	0.0675
55	03	0253	25	00829	061	0.0312	0.0733
60	04	0203	22	00576	046	0.0389	0.0792
65	18	0373	18	00373	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.1085

Intercept = 0.03609

Adjusted Crude Death Rates = 0.0065

*00 = below one through four years of age; 05 = five through nine years of age, etc.

Table 5.17. Application of the Brass Growth Balance Equation to the Death and Population, Rural Areas, Thailand, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	20	4356	180	34229	n/a	n/a	n/a
05	07	4748	160	29874	910	0.0053	0.0305
10	05	4711	153	25126	946	0.0061	0.0376
15	07	4202	148	20415	873	0.0073	0.0428
20	08	3197	142	16393	0722	0.0086	0.0440
25	07	2523	134	13196	572	0.0102	0.0433
30	06	1961	130	10673	448	0.0119	0.0420
35	07	1748	121	08712	371	0.0139	0.0426
40	08	1628	115	06964	338	0.0165	0.0450
45	10	1450	106	05336	308	0.0199	0.0577
50	11	1158	097	03886	261	0.0249	0.0671
55	11	0858	086	02728	202	0.0313	0.0740
60	13	0651	075	01869	151	0.0399	0.0807
65	62	1219	62	01219	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.3425

Intercept = 0.0290

Adjusted Crude Death Rates = 0.0071

*00 = below one through four years of age; 05 = five through nine years of age, etc.

Examination of Table 5.18 revealed the extent of underregistration in Thailand. Even the dual-record study showed a death data that is only 59 percent complete. However, very low levels of death registration were consistent with the estimates generated in this study which were also low. Inasmuch as these other estimates were not affected by migration, age misstatements, unequal underenumeration of adult age-groups, unstable population age distribution, census undercounts, changing fertility and changing mortality, the implication of Table 5.18 suggested that the Brass Growth Balance assumptions are reasonably met by the Thailand data.

MORTALITY ESTIMATION

Like the Philippines, two sets of Life Tables were generated for all populations, one set utilizing the age-specific death rate as input for age below one and another set utilizing infant mortality rate. However, the infant mortality estimates for all types of populations were somewhat low when compared with estimates from the World Fertility Survey and the Contraceptive Prevalence Survey of Thailand (see Knodel et al., 1982 and Kamnuansilpa and Chamratrithirong, 1985). For example, Table 5.19 shows how low the RUMM infant mortality estimates are in comparison with the other estimates. Furthermore, the rural figures were much lower than the urban figures. However, it was not only the RUMM estimate that was lower compared to others, nor was it the only estimate whose rural figures were much lower than the urban. The United Nations Demographic Yearbook of 1980 and 1982 estimated infant mortality by using death registration data and came up with the same low infant mortality and the same

Table 5.18. Levels of Death Registration Estimated by Various Studies, Thailand, 1960-1980 (percent)

Population	1960*	1964-65**	1970*	1974-75***	RUMM Technique 1980
Total	65	63	58	59	72
Inferred Urban					83
Inferred Rural					73
Urban Areas					90
Rural Areas					74

*U.S. Bureau of the Census, Country Demographic Profiles of Thailand. Washington, D.C., 1978, p. 1.

**Arnold, Fred, Robert D. Retherford, and Anuri Wanglee, The Demographic Situation in Thailand. Papers of the East-West Population Institute, No. 45. Honolulu, 1977, p. 18.

***Thailand National Statistical Office, The Survey of Population Change: 1974-75. Bangkok, 1976, Table 15.

Table 5.19. Selected Mortality Estimates from Different Sources, Thailand, 1960-1984 (Rates per 1,000)

Investigator or Source	Reference Period	Infant Mortality Rate					Life Expectancy at Birth			Crude Death Rate
		Total	Male	Female	Urban	Rural	Total	Male	Female	
U.S. Bureau of Census (1978)	1960	106					55			12
U.N. Demographic Yearbook 1982 (1984)	1960							53.6	58.7	
Knodel, et al. (1982)	1964-65	84			68	86				
U.S. Bureau of Census (1978)	1964-65	84						56	62	
Knodel, et al. (1982)	1966	70			31	74				
U.S. Bureau of Census (1978)	1970	61			27	65	58	56.5	59.5	10
World Fertility Survey (1984)	1971	65.1								
U.N. Demographic Yearbook 1980 (1982)	1971	22.5	24.6	20.3						
	1972	27.0	30.0	23.8						
	1973	21.8	24.7	18.8						
	1974	26.1								
Knodel et al. (1982)	1974-76	52			20	59				
U.S. Bureau of Census (1983)	1974-75	56					61	58	64	8
U.S. Bureau of Census (1978)	1975	55			26	59				10
U.N. Demographic Yearbook 1980 (1982)	1975	26.3								
	1976	25.5	30.4	20.4						
	1977	25.7								
Knodel, et al. (1982)	1977	52			31	55				
Kamnuansilpa & Chamratri-thirong (1982)	1978	57			23	63				
U.N. Demographic Yearbook 1982 (1984)	1978				25.4	13.3				
	1979				22.5	10.9				
	1975-80	58.9								
RUMM Technique - IMR	1980	16	14.2	12.3	27.5	13.0				7
RUMM Technique - ASDR	1980	17.2	15.4	13.2	21.2	15.1	63.5	64.0	68.9	7
Kamnuansilpa & Chamratri-thirong (1982)	1981	52			31	55				
	1984	45			37	47				

high urban-low rural estimates. Since this study also calculated age-specific death rates for age below one, comparing these figures to estimates of infant mortality revealed almost a similar pattern, low age-specific death rate for age below one, and high urban and low rural mortality patterns.

While it is clear that estimation of infant mortality from registration data results in underestimation (even if it was corrected for incompleteness), there was an important message indicated by these results. Some of the estimates, especially the estimates shown in the U.N. Demographic Yearbooks and the rural and urban areas made in this study, were two different types of urban classifications. Getting an estimate whose patterns (high urban-low rural) were clearly the same indicated that the inferred urban and inferred rural populations represented the urban and rural areas.

The underestimation of infant mortality may have been caused by either one of the following: (1) adjusted deaths for age below 1 was an underestimate; or (2) the total number of births was an overestimate. Examination of these two most possible sources of error indicated that the first reason is more feasible than the second one.

This study has been using one correction factor to adjust deaths of all age-groups (including age under one) to its true levels. Brass (1975: 117) had always emphasized that his Growth Balance Equation was for adult mortality estimation and not for infants or children. Rashad (1981) and Hill (1984) in their evaluation of the Brass Growth Balance Equation classified the technique as an indirect method of adult mortality estimation. The reason they provided was very straightforward, i.e., the registration of child deaths is more deficient than the registration of adult ages and that the proportional omissions of death are constant for ages over childhood. Since the method calculated only one adjustment factor for all ages, the assumption of equal underregistration for adult ages is important. While the method works for adult age groups, using the slope estimated for ages five years old and over to adjust the number of deaths at age below one will possibly underestimate infant mortality rates. In cases where these situations occur, Brass and many others (e.g. Kinsella, 1984; Flieger, et al., 1981; Lingner, 1975) recommended using a reliable estimate of infant mortality as input for age below one. For example, Flieger, et al., (1981: 276-277), in their estimation of the 1970 regional mortality for the Philippines, used the infant mortality estimated by the Brass (1968), Sullivan (1972), and Trussell (1975) techniques from the 1970 census data of children ever born and children surviving. They maintained that the Brass Growth Balance method was not recommended for the estimation of infant and child mortality when "mortality patterns of infants (below age one) and children (below age five) and, probably, also the patterns of underenumeration for children differ from those of adults." However, since there is no way of finding out the exact level of infants' and children's death underenumeration, then getting a comparatively lower infant mortality is an indication of underestimation. Most often, demographers automatically assume that the Brass adjustment factor does not adequately adjust for age below 1 and; therefore, automatically use another estimate of infant mortality as input at age below one.

In this study, these recommendations were followed by using the infant mortality rates estimated by Kamnuansilpa and Chamratrithirong (1982) from the data of the 1981 Contraceptive Prevalence Survey. The estimation procedure used was the Brass, Sullivan, and Trussell survivorship technique.

Table 5.20 through Table 5.24 show Life Tables utilizing infant mortality rates for the following populations: total country, inferred urban, inferred rural, rural area and urban area. Table 5.25 through Table 5.29 present Life Tables that have age-specific death rates as inputs for age below one.

Comparison of these two types of Life Tables indicated that the life expectancy at birth exhibited by those that utilized age-specific death rates for age below one were, on the average, two years longer than those life tables which had infant mortality rates. This result indicated the effect of underenumeration of death at age below one. However, in most cases, life expectancies after age one were virtually the same for both types of Life Tables. Again, this indicates the validity of replacing input at age below one without biasing the adult patterns of mortality.

Male and female Life Tables were also estimated for total country, inferred urban, and inferred rural populations. These tables are presented in Appendix A, as Table A5 through Table A10.

RELIABILITY AND VALIDITY OF THE RUMM ESTIMATES

The availability of mortality estimates for rural and urban areas allowed this study to test the validity and reliability of the RUMM

Table 5.20. Life Tables for Both Sexes, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	52.0	049.4	100000	04943	095066	6142483	61.4
01	04.9	019.4	095057	01839	373790	6047417	63.6
05	02.0	010.1	093218	00941	463734	5673627	60.9
10	01.4	007.0	092276	00648	459760	5209893	56.6
15	02.4	011.9	091628	01088	455418	4750133	51.8
20	03.4	016.9	090539	01531	448870	4294715	47.4
25	03.6	018.0	089009	01605	441030	3845845	43.2
30	04.3	021.2	087403	01855	432380	3404814	39.0
35	05.2	025.6	085549	02187	422274	2972434	34.8
40	07.2	035.6	083361	02964	409396	2550160	30.6
45	09.7	047.4	080397	03811	392459	2140765	26.6
50	13.6	065.6	076586	05026	370367	1748306	22.8
55	17.9	085.9	071560	06143	342444	1377939	19.3
60	27.2	127.2	065417	08322	306281	1035496	15.8
65	38.3	174.6	057095	09969	260555	0729215	12.8
70	57.4	250.9	047127	11824	206072	0468660	09.9
75	86.2	354.4	035302	12512	145231	0262589	07.4
80	194.2	1000.0	022790	22790	117357	0117357	05.2

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 5.21. Life Table for Both Sexes, Inferred Urban, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	31.0	030.1	100000	03007	096999	6561404	65.6
01	03.5	014.0	096993	01353	383237	6464405	66.7
05	01.5	007.3	095640	00696	476462	6081168	63.6
10	01.0	004.8	094945	00455	473586	5604706	59.3
15	01.9	009.5	094490	00898	470204	5131120	54.3
20	02.9	014.3	093592	01338	464614	4660916	49.8
25	03.3	016.4	092254	01510	457494	4196302	45.5
30	03.6	017.9	090744	01628	449651	3738807	41.2
35	04.4	021.7	089116	01935	440744	3289156	36.9
40	05.7	028.0	087181	02437	429814	2848412	32.7
45	07.9	038.9	084744	03295	415485	2418598	28.5
50	10.3	050.4	081450	04105	396986	2003113	24.6
55	14.8	071.3	077345	05512	372943	1606127	20.8
60	22.4	106.2	071833	07631	340084	1233184	17.2
65	32.2	149.1	064201	09575	297069	0893099	13.9
70	46.5	208.2	054627	11374	244699	0596030	10.9
75	72.2	306.0	043253	13233	183182	0351331	08.1
80	178.5	1000.0	030020	30020	168149	0168149	05.6

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 5.22. Life Tables for Both Sexes, Inferred Rural, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	55.0	052.1	100000	05214	094797	6102711	61.0
01	05.1	020.2	094786	01911	372457	6007915	63.4
05	02.1	010.5	092875	00975	461941	5635457	60.7
10	01.5	007.4	091901	00678	457810	5173517	56.3
15	02.5	012.2	091223	01111	453339	4715707	51.7
20	03.4	017.0	090113	01532	446732	4262367	47.3
25	03.6	017.7	088580	01567	438983	3815635	43.1
30	04.3	021.3	087013	01855	430428	3376652	38.8
35	05.2	025.6	085158	02182	420336	2946224	34.6
40	07.4	036.5	082976	03026	407316	2525888	30.4
45	09.8	048.0	079950	03835	390162	2118572	26.5
50	14.0	067.6	076115	05148	367704	1728410	22.7
55	18.1	086.7	070967	06151	339457	1360706	19.2
60	27.5	128.5	064816	08328	303261	1021249	15.8
65	38.4	175.4	056488	09905	257679	0717988	12.7
70	58.4	254.8	046583	11869	203243	0460309	09.9
75	86.7	347.1	0356.4	12371	142641	0257067	07.4
80	195.3	1000.0	022343	22343	114426	0114426	05.1

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 5.23. Life Table for Both Sexes, Urban Area, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	31.0	030.1	100000	03007	096999	6527049	65.3
01	03.4	013.5	096993	01307	383396	6430050	66.3
05	01.8	009.2	095686	00876	476238	6046654	63.2
10	01.3	006.4	094809	00605	472535	5570416	58.8
15	02.3	011.4	094205	01073	468341	5097881	54.1
20	02.9	014.4	093132	01341	462308	4629540	49.7
25	03.1	015.2	091791	01398	455461	4167231	45.4
30	03.4	016.9	090393	01528	448145	3711770	41.1
35	04.3	021.1	088865	01873	439642	3263625	36.7
40	06.0	029.3	086992	02550	428585	2823983	32.5
45	08.7	042.4	084442	03583	413253	2395398	28.4
50	11.9	057.9	080859	04680	392596	1982145	24.5
55	15.3	073.7	076179	05617	366855	1589549	20.9
60	23.1	109.2	070563	07708	333543	1222694	17.3
65	31.6	146.3	062855	09196	291283	0889151	14.2
70	45.5	204.1	056359	10954	240908	0597868	11.1
75	65.3	280.7	042705	11986	183557	0356959	08.4
80	177.2	1000.0	030718	30718	173402	0173402	05.2

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 5.24. Life Table for Both Sexes, Rural Area, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	55.0	052.1	100000	05214	094797	6177952	61.8
01	05.0	019.5	094786	01845	372688	6083156	64.2
05	01.9	009.6	092941	00888	462487	5710468	61.4
10	01.3	006.6	092053	00610	458742	5247981	57.0
15	02.2	010.8	091443	00991	454738	4789239	52.4
20	03.2	016.1	090452	01454	448626	4334501	47.9
25	03.5	017.2	088998	01531	441165	3885875	43.7
30	04.2	020.7	087468	01813	432804	3444710	39.4
35	05.0	024.7	085654	02115	422983	3011906	35.2
40	07.0	034.4	083539	02870	410522	2588923	31.0
45	09.1	044.6	080670	03597	394357	2178401	27.0
50	12.8	062.2	077073	04791	373389	1784044	23.2
55	17.1	082.1	072283	05940	346562	1410655	19.5
60	26.0	121.9	066342	08086	311496	1064092	16.0
65	36.9	169.1	058256	09850	266655	0752596	12.9
70	56.1	245.9	048406	11902	212274	0458941	10.0
75	85.3	351.4	036504	12829	150447	0273668	07.5
80	192.1	1000.0	023675	23675	123221	0123221	05.2

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 5.25. Life Tables for Both Sexes, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	17.2**	016.9	100000	01694	098310	6353610	63.5
01	04.9	019.4	098306	01902	386568	6255300	63.6
05	02.0	010.1	096404	00974	497587	5868732	60.9
10	01.4	007.0	095431	00670	475477	5389145	56.5
15	02.4	011.9	094760	01126	470987	4913668	51.9
20	03.4	016.9	093635	01583	464215	4442681	47.5
25	03.6	018.0	092052	01660	456107	3978466	43.2
30	04.3	021.2	090391	01918	447161	3522358	39.0
35	05.2	025.6	088473	02262	436710	3075197	34.8
40	07.2	035.6	086211	03065	423391	2638488	30.6
45	09.7	047.4	083146	03941	405875	2215097	26.6
50	13.6	065.6	079204	05198	383028	1809222	22.8
55	17.9	085.9	074007	06353	354150	1426193	19.3
60	27.2	127.2	067653	08606	316751	1072043	15.9
65	38.3	174.6	059047	079090	269462	0755292	12.8
70	57.4	250.9	048738	12229	213116	0485830	10.0
75	86.2	354.4	036509	12939	150196	0272713	07.5
80	192.4	1000.0	023570	23570	122517	0122517	05.2

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table 5.26. Life Table for Both Sexes, Inferred Urban, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	21.2**	020.8	100000	02075	097929	6624987	65.6
01	03.5	014.0	097925	01366	386919	6527058	66.7
05	01.5	007.3	096559	00702	481039	6140139	63.6
10	01.0	004.8	095857	00459	478136	5659099	59.0
15	01.9	009.5	095398	00907	474722	5180963	54.3
20	02.9	014.3	094491	01351	469078	4706241	49.8
25	03.3	016.4	093140	01524	461890	4237164	45.5
30	03.6	017.9	091616	01643	453971	3775274	41.2
35	04.4	021.7	089972	01953	444979	3321303	36.9
40	05.7	028.0	088019	02460	433944	2876325	32.7
45	07.9	038.9	085559	03326	419477	2442381	28.6
50	10.3	050.4	082232	04144	400800	2022904	24.6
55	14.8	071.3	078088	05565	376527	1622105	20.8
60	22.4	106.2	072523	07705	343352	1245578	17.2
65	32.2	149.1	064818	09667	299923	0902226	13.9
70	46.5	208.2	055151	11483	247050	0602303	10.9
75	72.2	306.0	043669	13360	184942	0355253	08.1
80	178.0	1000.0	030308	30308	170311	0170311	05.6

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table 5.27. Life Tables for Both Sexes, Inferred Rural, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	15.3**	014.9	100000	01490	098512	6345604	63.5
01	05.1	020.2	098510	01986	387088	6247092	63.4
05	02.1	010.5	096524	01013	480086	5860004	60.7
10	01.5	007.4	095511	00704	475793	5379917	56.3
15	02.5	012.2	094807	01154	471147	4904124	51.7
20	03.3	016.7	093652	01551	464384	4432977	47.3
25	03.6	017.7	092101	01629	456433	3968593	43.1
30	04.3	021.3	090472	01929	447537	3512160	38.8
35	05.2	025.6	088543	02268	437044	3064623	34.6
40	07.4	036.5	086275	03147	423507	2627580	30.5
45	09.8	048.0	083128	03988	405671	2204073	26.5
50	14.0	067.6	079140	05352	382320	1798403	22.7
55	18.1	086.7	073788	06395	352950	1416083	19.2
60	27.5	128.5	067392	08659	315315	1063132	15.8
65	38.4	175.4	058734	10299	267922	0747817	12.7
70	58.4	254.8	048435	12341	211321	0479896	09.9
75	86.7	356.4	036094	12863	148311	0268574	07.4
80	193.2	1000.0	023231	23231	120263	0120263	05.2

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table 5.28. Life Table for Both Sexes, Urban Area, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	32.3**	031.3	100000	03125	096881	6519008	65.2
01	03.4	013.5	096875	01306	382928	6422127	66.3
05	01.8	009.2	095569	00875	475656	6039199	63.2
10	01.3	006.4	094694	00605	471958	5563543	58.8
15	02.3	011.4	094090	01071	467770	5091585	54.1
20	02.9	014.4	093018	01339	461744	4623816	49.7
25	03.1	015.2	091679	01397	454905	4162072	45.4
30	03.4	016.9	090283	01526	447598	3707167	41.1
35	04.3	021.1	088756	01871	439106	3259569	36.7
40	06.0	029.3	086886	02547	428062	2820463	32.5
45	08.7	042.4	084339	03579	412748	2392402	28.4
50	11.9	057.9	080760	04674	392117	1979654	24.5
55	15.3	073.7	076086	05610	366407	1587537	20.9
60	23.1	109.2	070477	07699	333136	1221130	17.3
65	31.6	146.3	062778	09185	290928	0887994	14.2
70	45.5	204.1	053593	10941	240614	0597066	11.1
75	65.3	280.7	042653	11972	183333	0356452	08.4
80	177.2	1000.0	030681	30681	173118	0173118	05.6

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table 5.29. Life Table for Both Sexes, Rural Area, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	11.3**	011.1	100000	01114	098888	6446710	64.5
01	05.0	019.5	098886	01925	388806	6347822	64.2
05	01.9	009.6	096961	00926	482489	5959016	61.4
10	01.3	006.6	096035	00637	478582	5476527	57.0
15	02.2	010.8	095398	01034	474405	4997946	52.4
20	03.2	016.1	094364	01516	468028	4523541	47.9
25	03.5	017.2	092847	01597	460245	4055513	43.7
30	04.2	020.7	091250	01892	451522	3595269	39.4
35	05.0	024.7	089359	02206	441277	3143746	35.2
40	07.0	034.4	087152	02994	428277	2702470	31.0
45	09.1	044.6	084158	03752	411412	2274193	27.0
50	12.8	062.2	080406	04998	389538	1862781	23.2
55	17.1	082.2	075409	06197	361551	1473244	19.5
60	26.0	121.9	069212	08436	324968	1111693	16.1
65	36.9	169.1	060775	10276	278187	0786725	12.9
70	56.1	245.9	050499	12417	221454	0508538	10.1
75	85.3	351.4	038082	13383	156953	0287084	07.5
80	189.8	1000.0	024699	24699	130131	0130131	05.3

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

estimates. By comparing the survival rates of the inferred urban population to those of urban areas, this study assessed the difference between the mortality levels and patterns of these two different types of urban classifications. In a similar manner, survival rates of inferred rural populations were also compared to the survival rates of rural areas.

For comparative purposes, this study utilized the Life Tables that used age-specific death rates as inputs for all ages. Table 5.30 shows the comparison of survival rates for inferred urban populations and urban areas. Survival rates for inferred urban were taken from Table 5.26 while survival rates for urban areas were taken from Table 5.28.

Examination of the Absolute (0.0028) and Relative (0.0024) Mean Difference between these two survival rates revealed a negligible difference. The Absolute Mean Difference (AMD) measured the closeness of the levels of mortality for these two survival rates while the Relative Mean Difference (RMD) measured the closeness of the patterns of mortality. A value which is close to zero indicated no difference. In fact, the urban area and the inferred urban estimates of mortality were identical as clearly shown by the negligible difference in their survival rates for each age-group.

Since the survival rate is the probability of one age-group to survive to the next age-group, the Absolute and Relative Mean Differences were actually calculated from the differences in probabilities from age-group to age-group of the two survival ratios. These differences are presented in columns six and seven of Table 5.30. All of these differences are close to zero.

Table 5.30. Survival Rates Comparison of Inferred Urban and Urban Areas, Thailand, 1980

Age*	Urban Area	Inferred Urban	Urban area	Inferred Urban	Difference Survival Rates	Difference of Ratios
00	0.9608	0.9605	1.0318	1.0329	0.0003	0.0011
01	0.9914	0.9921	1.0008	1.0019	-.0007	0.0011
05	0.9922	0.9940	0.9989	0.9989	-.0018	0.0000
10	0.9911	0.9929	0.9960	0.9960	-.0018	0.0000
15	0.9871	0.9881	0.9981	0.9966	-.0010	0.0015
20	0.9852	0.9847	0.9987	0.9982	0.0005	0.0005
25	0.9839	0.9829	0.9971	0.9973	0.0010	-.0002
30	0.9810	0.9802	0.9938	0.9949	0.0008	-.0011
35	0.9749	0.9752	0.9890	0.9913	-.0003	-.0023
40	0.9642	0.9667	0.9853	0.9884	-.0025	-.0031
45	0.9500	0.9555	0.9836	0.9832	-.0055	0.0004
50	0.9344	0.9394	0.9730	0.9707	-.0050	0.0023
55	0.9092	0.9119	0.9605	0.9579	-.0027	-.0026
60	0.8733	0.8735	0.9471	0.9558	-.0002	-.0087
65	0.8271	0.8237	0.9212	0.9088	0.0034	0.0124
70	0.7619	0.7486	0.6375	0.6393	0.0133	-.0018
75	0.4858	0.4786	n/a	n/a	-.0072	n/a

Absolute Mean Difference (AMD) = 0.0028

Relative Mean Difference (RMD) = 0.0024

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

In a similar manner, survival rate comparisons of inferred rural and rural areas shown on Table 5.31 indicated a negligible difference. The figures for Absolute (.0032) and Relative (.0009) Mean Difference were even closer to zero that those shown by their urban counterparts.

Since urban and rural area classifications are defined by the Thailand Census, the closeness of its mortality level and pattern to those estimated for inferred urban and inferred rural populations not only increased confidence toward the RUMM technique but strengthened the validity and reliability of estimates generated in this study.

Mortality estimates generated by the technique were also assessed by comparing them to other mortality estimates generated by a variety of techniques. However, because the infant mortality estimates used in this study were not generated by the technique but by another independent study (see Kamnuansilpa and Chamratrithirong, 1982), life expectancies at birth of Life Tables which used age-specific death rate as input for age below one were used for comparative purposes. Turning back to Table 5.19, the life expectancies at birth estimated by the RUMM technique versus the life expectancies at birth estimated by other studies, showed that despite the apparent differences in rates used, the life expectancies at birth were consistent with each other. The slight edge in longevity experienced by the 1980 populations were to be expected given the improvement in health, sanitation, nutrition, and economic conditions.

The next step in assessing the validity and reliability of the RUMM technique was to check its consistency in regards the assumptions set for the method. To check whether the assumption of population stability holds for inferred urban and inferred rural populations, stable population age

Table 5.31. Survival Rates Comparison of Inferred Rural and Rural Areas, Thailand, 1980

Age*	Rural Area	Inferred Rural	Rural Area	Inferred Rural	Difference Survival Rates	Difference of Ratios
00	0.9754	0.9712	1.0143	1.0179	0.0042	-.0036
01	0.9893	0.9886	1.0026	1.0025	0.0007	0.0001
05	0.9919	0.9911	0.9994	0.9991	0.0008	0.0003
10	0.9913	0.9902	0.9953	0.9954	0.0011	-.0001
15	0.9866	0.9856	0.9968	0.9973	0.0010	-.0005
20	0.9834	0.9829	0.9977	0.9976	0.0005	0.0001
25	0.9811	0.9805	0.9961	0.9960	0.0006	0.0001
30	0.9773	0.9766	0.9930	0.9922	0.0007	0.0008
35	0.9705	0.9690	0.9898	0.9885	0.0015	0.0013
40	0.9606	0.9579	0.9856	0.9838	0.0027	0.0018
45	0.9468	0.9424	0.9804	0.9796	0.0044	0.0008
50	0.9282	0.9232	0.9683	0.9677	0.0050	0.0006
55	0.8988	0.8934	0.9524	0.9511	0.0054	0.0013
60	0.8560	0.8497	0.9300	0.9282	0.0063	0.0018
65	0.7961	0.7887	0.8902	0.8898	0.0074	0.0004
70	0.7087	0.7018	0.6396	0.6381	0.0069	0.0015
75	0.4533	0.4478	n/a	n/a	0.0055	n/a

Absolute Mean Difference (AMD) = 0.0032

Relative Mean Difference (RMD) = 0.0009

*00 = below one through four years of age; 05 = five through nine years of age, etc.

distributions for these populations were generated. These stable populations' age distribution were then compared to the enumerated census age structures and the differences between these age structures were expressed in terms of the Index of Dissimilarity and the Index of Relative Difference. Shown on Table 5.32 are the estimations of the Index of Relative Difference and the Index of Dissimilarity for the 1980 total populations. The difference between the total country enumerated age distribution and its equivalent stable population was found to be small. For example, the Index of Dissimilarity was 5.3 which indicates that 5.3 percent of this observed population would have to be shifted to other age-groups in order to make the observed age structure identical to that of its stable population equivalent. This index of 5.3 is rather small when compared to similar indices of most other countries, particularly those that have undergone drastic fertility changes in the recent past. Therefore, an Index of Dissimilarity of 5.3 percent signifies a relatively high degree of age-structural stability.

The Index of Dissimilarity between the observed age structure for inferred urban and its equivalent stable population (see Table 5.33) was shown to be 7.59 percent while the Index of Relative Difference was found to be 5.56. Again, these figures are small in comparison to similar indices of most other countries.

Examination of the differences between the observed age structure for the inferred rural population and its equivalent stable population revealed an Index of Relative Difference of 12.94 and an Index of Dissimilarity of 8.44 (see Table 5.34). While the inferred rural populations showed a lesser degree of age-structural stability in comparison with the

Table 5.32. Comparison of Reported Age Distribution And Its Stable Population Equivalent, Thailand, 1980

Age*	Stable Population (percent)	Reported Population (percent)	Ratio of Percentages	Differences of percentages
00	15.4	12.1	078.5	-3.31
05	13.4	13.0	097.2	-0.38
10	11.7	13.2	112.8	01.50
15	10.2	12.1	118.7	01.90
20	08.8	10.1	114.6	01.28
25	07.6	07.9	104.3	00.33
30	06.6	06.0	091.9	-0.53
35	05.6	05.2	093.1	-0.39
40	04.8	04.8	100.9	00.04
45	04.0	04.2	104.6	00.19
50	03.4	03.4	100.8	00.03
55	02.6	02.5	096.1	-0.10
60	02.1	01.9	089.0	-0.24
65	01.6	01.4	087.8	-0.19
70	01.1	01.0	092.5	-0.08
75	00.7	00.6	088.8	-0.08
80	00.5	00.5	107.3	00.03

Index of Relative Difference = 4.39

Index of Dissimilarity = 5.30

*00 = below one through four years of age; 05 = five through nine years of age, etc.

Table 5.33. Comparison of Reported Age Distribution and Its Stable Population Equivalent, Inferred Urban, Thailand, 1980

Age*	Stable Population (percent)	Reported Population (percent)	Ratio of Percentages	Differences of percentages
00	16.6	11.7	070.1	-4.97
05	14.2	11.8	083.5	-2.34
10	12.1	12.0	099.3	-0.08
15	10.3	12.7	123.3	02.41
20	08.4	10.4	123.8	02.00
25	07.4	08.8	118.4	01.37
30	06.3	06.4	102.0	00.13
35	05.3	05.4	101.9	00.10
40	04.5	05.1	113.5	00.60
45	03.7	04.2	111.8	00.44
50	03.0	03.4	111.4	00.35
55	02.5	02.4	094.8	-0.13
60	01.9	01.9	101.8	00.03
65	01.0	01.1	097.6	-0.03
70	01.0	01.1	108.9	00.09
75	00.7	00.7	096.2	-0.03
80	00.5	00.6	113.5	00.07

Index of Relative Difference = 5.56

Index of Dissimilarity = 7.59

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

Table 5.34. Comparison of Reported Age Distribution and Its Stable Population Equivalent, Inferred Rural, Thailand, 1980

Age*	Stable Population (percent)	Reported Population (percent)	Ratio of Percentages	Differences of percentages
00	18.6	12.2	065.9	-6.33
05	15.4	13.4	086.8	-2.03
10	12.8	13.5	105.5	00.70
15	10.7	11.9	111.4	01.22
20	08.8	10.0	113.4	01.18
25	07.3	07.7	105.5	00.40
30	06.0	05.9	098.6	-0.08
35	04.9	05.2	105.4	00.26
40	04.0	04.8	119.5	00.78
45	03.2	04.3	132.4	01.04
50	02.5	03.4	133.0	00.84
55	02.0	02.5	127.7	00.55
60	01.5	01.9	128.0	00.41
65	01.1	01.4	134.1	00.36
70	00.7	01.0	143.1	00.30
75	00.4	00.6	147.2	00.19
80	00.3	00.5	147.2	00.19

Index of Relative Difference = 12.94

Index of Dissimilarity = 8.44

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

total and inferred urban populations, an 8.44 percent shift in age distribution was not large enough to bias the "correction factor" generated by the Brass Growth Balance Equation and, therefore, had very minimal effect upon the estimates of mortality.

In this chapter, we discussed the application of the RUMM technique to the Thailand death registration and population data of 1980. Evaluation of the accuracy of the age distribution as well as the level of underregistration of deaths was performed. However, while the age distribution for the census of 1980 showed a reliable and accurate data, the death registration for all types of populations showed a high degree of inaccuracy. In fact, on the average, Thailand death registration was shown to be 30 percent incomplete.

The level of registration estimated by the Brass Growth Balance technique was compared with those levels estimated by different techniques. The levels of registration estimated in this study were found to be consistent with the other estimates.

The availability of rural and urban area classifications of death and population allowed this study to produce alternative mortality estimates for comparison. These alternative mortality estimates when compared to the inferred urban and inferred rural mortality estimates displayed a negligible difference, a difference which is closer to zero. This result clearly showed that despite great differences in the definition of urban and rural complexes, the levels and patterns of mortality in these populations (inferred urban versus urban area, and inferred rural versus rural area) were still found to be statistically identical.

CHAPTER VI: APPLICATION OF THE RUMM TECHNIQUE TO PENINSULAR MALAYSIA

Malaysia is composed of two regions, Peninsular and East Malaysia. Peninsular Malaysia has 11 states while East Malaysia has two. The 1980 census enumerated 13.7 million persons in Malaysia and 83 percent of these reside in Peninsular Malaysia and only 17 percent in East Malaysia.

Since Peninsular and East Malaysia have been united only for such a short time, few sources of Demographic data actually cover the entire country (Finch and Sweetser, 1979). Due to this coverage problem and to the difference in the quality of data for the two areas, most of the analysis have been done separately for Peninsular and East Malaysia.

While for more than a decade now, death registration in Peninsular Malaysia has been found to be as high as 96.5 percent complete, death registration for East Malaysia has been found to be inadequate. For example, Finch and Sweetser estimate a 70 percent underregistration of deaths in East Malaysia.

The unavailability and inadequacy of the data on deaths in East Malaysia result in this study's analysis of Peninsular Malaysia only and not of the total country. In addition, most demographic estimates, whether mortality or fertility, always separate Peninsular Malaysia and East Malaysia. This is because for quite sometime, Sabah and Sarawak, the two states comprising East Malaysia have had no available census and other demographic data. For comparative analysis, these two regions have been treated as separate. In fact, most studies in mortality levels and patterns have been only for Peninsular Malaysia and not for total Malaysia. This is because even in the analysis stage, the findings of most investigators for East Malaysia have usually been unrealistic and most often end up being rejected. For example, Finch and Sweetser (1979), in their attempt to produce a demographic profile for total Malaysia, estimated mortality for East Malaysia by utilizing various techniques. The first four estimates were rejected on the account that they were inconsistent when considering the mortality estimates of Peninsular Malaysia, the social and economic differences between Peninsular Malaysia and East Malaysia, and when considering the levels of life expectancy estimated for other countries in the region (Finch and Sweetser, 1979).

An additional advantage for concentrating analysis on Peninsular Malaysia was the availability of tabulations of deaths and population by rural and urban residence. These distributions, which are referred to in this study as rural and urban areas, allowed the estimation of an alternative estimate of mortality which can be compared to the RUMM estimate for inferred urban and inferred rural populations. These death and population distributions for rural and urban areas are presented in Table 6.1.

EVALUATION OF THE CENSUS POPULATION AGE DISTRIBUTION

The 1980 population age distribution for Peninsular Malaysia has already been adjusted for underenumeration. The Census General Report

Table 6.1. Deaths and Population Distribution by Age, for Urban and Rural Areas, Peninsular Malaysia, 1980

Age*	Urban Population	Area Death	Rural Population	Area Death
00	118079	1832	178565	6483
01	499796	0443	748419	2110
05	588620	0236	914189	0934
10	563777	0192	841640	0653
15	598409	0307	718283	0921
20	543400	0453	576854	0969
25	451750	0448	477213	0924
30	370463	0446	402388	0919
35	261385	0411	317447	0877
40	238373	0616	311432	1231
45	171751	0822	235993	1383
50	148758	1093	215372	2096
55	109971	1360	168178	2622
60	095992	1852	142083	3700
65	076734	2272	092513	3947
70	060235	2451	074407	5107
75	059565	4579	070052	8658

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

(Department of Statistics Malaysia, 1983) specifies that the post-enumeration survey (PES) suggests that the population of Peninsular Malaysia has been underenumerated by 4.2 percent and that the age distributions were adjusted using this level of underenumeration.

However, despite the correction that was made on the population distribution, the U.N. Age-Sex Accuracy Index scores for all types of populations (Peninsular Malaysia, inferred urban, inferred rural, urban and rural areas) exceeded 20, the minimum limit set by the United Nations for inaccuracy. While all the scores were in their low 20's (21.23 for Peninsular Malaysia, 23.06 for urban area, 22.34 for rural area, 20.87 for inferred urban, and 23.88 for inferred rural), they all indicate a low level of accuracy.

If the population used had not already been corrected for underenumeration, the most appropriate step would have been to estimate the level of underenumeration by using the Forward Derivation technique proposed by the U.S. Bureau of the Census. However, since adjustments had already been made, this study tried to smooth the population by using the method proposed by the United Nations for cases where U.N. Age-Sex Accuracy Index scores were higher than 20. Applying the U.N. Age-Sex Accuracy Index procedure to the smoothed age distributions showed scores that were much lower than the original age distributions. The smoothed age distributions for Peninsular Malaysia showed an index score of 12.18 (see Table 6.2). This index score indicates a high degree of accuracy. The inferred urban and inferred rural populations showed index scores of 12.02 (see Table 6.3) and 15.10 (see Table 6.4) respectively. Again, these

Table 6.2. Calculation of the United Nations Age-Sex Accuracy Index, Peninsular Malaysia, 1980

Age	Population* (smoothed)		Analysis of Age Ratios: Male		Analysis of Age Ratios: Female		Analysis of Sex Ratios	
	Male (1)	Female (2)	Age Ratio (3)	Deviation from 100 (4)	Age Ratio (5)	Deviation from 100 (6)	Sex Ratio (7)	Successive Differences (8)
0-4	791,760	753,099					105.1	
5-9	766,132	736,677	101.4	1.4	101.6	1.6	104.0	-1.1
10-14	719,777	696,915	101.8	1.8	102.2	0.2	103.3	-0.7
15-19	647,902	654,462	102.3	2.3	102.6	2.6	99.0	-4.3
20-24	546,823	578,608	98.9	-1.1	102.2	2.2	94.5	-4.5
25-29	457,597	477,811	98.7	-1.3	100.2	0.2	95.8	1.3
30-34	380,407	375,195	98.9	-1.1	96.8	-3.2	101.4	5.6
35-39	311,550	297,340	96.7	-3.3	94.3	-5.7	104.8	3.4
40-44	263,654	255,557	100.3	0.3	99.7	-0.3	103.2	-1.6
45-49	214,441	215,322	98.2	-1.8	99.6	-0.4	99.6	-3.6
50-54	172,978	176,834	97.3	-2.7	97.6	-2.4	97.8	-1.8
55-59	141,164	147,168	99.2	-0.8	99.9	-0.1	95.9	-1.9
60-64	111,677	117,796	99.1	-0.9	101.5	1.5	94.8	-1.1
65-69	84,209	85,038	94.6	-5.4	91.4	-8.6	99.0	4.2
70-74	66,411	68,231						
75+	61,550	68,067						

Average Age Ratio Deviation for Males = 1.85
Average Age Ratio Deviation for Females = 2.23

Average Sex Ratio Difference = 2.70
Age-Sex Accuracy Index = 12.18

$$\text{Age Ratio} = \frac{{}_5P_a}{\frac{1}{2}({}_5P_{a-5} + {}_5P_{a+5})} \times 100$$

Sex Ratio = [(1)/(2)] x 100

*Source: Department of Statistics Malaysia, 1980 Population and Housing Census of Malaysia: Kuala Lumpur, 1983, Table 2.5.

Table 6.3. Calculation of the United Nations Age-Sex Accuracy Index, Inferred Urban, Peninsular Malaysia, 1980

Age	Population* (smoothed)		Analysis of Age Ratios				Analysis of Sex Ratios	
			Male		Female			
	Male (1)	Female (2)	Age Ratio (3)	Deviation from 100 (4)	Age Ratio (5)	Deviation from 100 (6)	Sex Ratio (7)	Successive Differences (8)
0-4	340,093	329,723					103.1	
5-9	331,861	318,627	101.0	1.0	100.3	0.3	104.2	1.0
10-14	316,821	305,770	100.1	0.1	98.5	-1.5	103.6	-0.5
15-19	300,883	301,986	102.1	2.1	102.5	2.5	99.6	-4.0
20-24	272,410	283,671	102.2	2.2	104.8	4.8	96.0	-3.6
25-29	232,045	239,186	100.9	0.9	102.3	2.3	97.0	1.0
30-34	187,331	184,127	98.8	-1.2	97.3	-2.7	101.7	4.7
35-39	147,165	139,433	95.2	-4.8	92.7	-7.3	105.5	3.8
40-44	121,698	116,629	98.1	-1.9	97.3	-2.7	104.3	-1.2
45-49	100,938	100,318	99.5	-0.5	101.2	1.2	100.6	-3.7
50-54	81,290	81,546	98.6	-1.4	98.5	-1.5	99.7	-0.9
55-59	63,892	65,296	97.5	-2.5	97.3	-2.7	97.8	-1.8
60-64	49,788	52,676	97.7	-2.3	100.7	0.7	94.5	-3.3
65-69	38,028	39,362	95.9	-4.1	94.3	-5.7	96.6	2.1
70-74	29,522	30,784						
75+	25,987	30,548						

Average Age Ratio Deviation for Males = 1.94
Average Age Ratio Deviation for Females = 2.76

Average Sex Ratio Difference = 2.44
Age-Sex Accuracy Index = 12.02

$$\text{Age Ratio} = \frac{{}_5P_a}{\frac{1}{2}({}_5P_{a-5} + {}_5P_{a+5})} \times 100$$

$$\text{Sex Ratio} = [(1)/(2)] \times 100$$

*Source: Department of Statistics Malaysia, 1980 Population and Housing Census of Malaysia: Kuala Lumpur, 1983, Table 2.5.

Table 6.4. Calculation of the United Nations Age-Sex Accuracy Index, Inferred Rural, Peninsular Malaysia, 1980

Age	Population* (smoothed)		Analysis of Age Ratios: Male		Analysis of Age Ratios: Female		Analysis of Sex Ratios	
	Male (1)	Female (2)	Age Ratio (3)	Deviation from 100 (4)	Age Ratio (5)	Deviation from 100 (6)	Sex Ratio (7)	Successive Differences (8)
0-4	451,667	423,376					106.7	
5-9	434,271	418,050	101.6	1.6	102.6	2.6	103.9	-2.8
10-14	402,956	391,144	103.2	3.2	101.5	1.5	103.0	-0.9
15-19	347,020	352,477	102.5	2.5	102.8	2.8	98.5	-4.6
20-24	274,413	294,937	95.9	-4.1	99.8	-0.2	93.0	-5.4
25-29	225,552	238,625	96.5	-3.5	98.2	-1.8	94.5	1.5
30-34	193,077	191,067	99.0	-1.0	96.4	-3.6	101.1	6.5
35-39	164,385	157,906	98.1	-1.9	95.7	-4.3	104.1	3.1
40-44	141,956	138,928	102.2	2.2	101.8	1.8	102.2	-1.9
45-49	113,503	115,004	97.2	-2.8	98.2	-1.8	98.7	-3.5
50-54	91,688	95,287	96.1	-3.9	96.8	-3.2	96.2	-2.5
55-59	77,272	81,872	100.6	0.6	102.1	2.1	94.4	-1.8
60-64	61,889	65,120	100.3	0.3	102.1	2.1	95.0	0.7
65-69	46,181	45,676	93.5	-6.5	89.1	-10.9	101.1	6.1
70-74	36,889	37,447						
75+	35,563	37,519						

Average Age Ratio Deviation for Males = 2.62
Average Age Ratio Deviation for Females = 2.98

Average Sex Ratio Difference = 3.17
Age-Sex Accuracy Index = 15.10

$$\text{Age Ratio} = \frac{{}_5P_a}{\frac{1}{2}({}_5P_{a-5} + {}_5P_{a+5})} \times 100$$

$$\text{Sex Ratio} = [(1)/(2)] \times 100$$

*Source: Department of Statistics Malaysia, 1980 Population and Housing Census of Malaysia: Kuala Lumpur, 1983, Table 2.5.

scores indicate a high degree of reliability and accuracy of age-sex distributions. Table 6.5 and Table 6.6 display the scores for urban and rural areas. The urban area had a score of 15.38 and the rural had an index score of 13.0.

All the scores which were lower than 20 indicated accuracy and reliability of age-sex distributions. Given this indication of accuracy, the smoothed population age-sex distributions were used as base population in the estimation of mortality for all types of populations.

IDENTIFICATION OF AREAS DESIGNATED AS URBAN AND RURAL

Peninsular Malaysia is subdivided into 11 states (a map showing these administrative divisions are presented in Figure B3, Appendix B) The 1980 census provided a separate tabulation for the Federal Territory (sometimes referred to as Wilayah Persekutuan, its Malaysian name) which belonged to the state of Selangor in the 1970 census.

Assessment of the degree of urbanization of each state followed the same procedure as those applied to the Philippines and Thailand. Four indices of urbanization were applied to each state and their urbanization scores were calculated and ranked. These indices of urbanization are: the proportion of the urban population, the mean city population size, the total number of cities, and the population density. Table 6.7 shows the urbanization index scores and the rank of each state. As expected, Federal Territory, the region which was recorded by the census as 100 percent urban, is ranked first. It was followed by Pulao Pinang,

Table 6.5. Calculation of the United Nations Age-Sex Accuracy Index, Urban Area, Peninsular Malaysia, 1980

Age	Population* (smoothed)		Analysis of Age Ratios				Analysis of Sex Ratios	
			Male		Female			
	Male (1)	Female (2)	Age Ratio (3)	Deviation from 100 (4)	Age Ratio (5)	Deviation from 100 (6)	Sex Ratio (7)	Successive Differences (8)
0-4	317,715	300,160					105.8	
5-9	301,443	287,177	98.7	-1.3	98.4	-1.6	105.0	-0.9
10-14	292,959	283,579	99.2	-0.8	97.1	-2.9	103.3	-1.7
15-19	289,035	296,742	104.1	4.1	105.0	5.0	97.4	-5.9
20-24	262,096	281,679	102.4	2.4	106.1	6.1	93.0	-4.4
25-29	223,031	234,042	100.5	0.5	101.6	1.6	95.3	2.2
30-34	181,909	179,053	99.6	-0.4	97.2	-2.8	101.6	6.3
35-39	142,344	134,262	95.8	-4.2	93.0	-7.0	106.0	4.4
40-44	115,251	109,565	98.7	-1.3	97.8	-2.2	105.2	-0.8
45-49	91,126	89,791	98.0	-2.0	99.0	-1.0	101.5	-3.7
50-54	70,640	71,867	96.6	-3.4	96.5	-3.5	98.3	-3.2
55-59	55,187	59,202	96.2	-3.8	97.6	-2.4	93.2	-5.1
60-64	44,150	49,459	96.2	-3.8	99.6	-0.4	89.3	-4.0
65-69	36,639	40,095	100.6	0.6	99.0	-1.0	91.4	2.1
70-74	28,692	31,543						
75+	26,863	32,703						

Average Age Ratio Deviation for Males = 2.20
Average Age Ratio Deviation for Females = 2.88

Average Sex Ratio Difference = 3.43
Age-Sex Accuracy Index = 15.38

$$\text{Age Ratio} = \frac{{}_5P_a}{\frac{1}{2}({}_5P_{a-5} + {}_5P_{a+5})} \times 100$$

$$\text{Sex Ratio} = [(1)/(2)] \times 100$$

*Source: Department of Statistics Malaysia, 1980 Population and Housing Census of Malaysia: Kuala Lumpur, 1983, Table 2.5.

Table 6.6. Calculation of the United Nations Age-Sex Accuracy Index, Rural Area, Peninsular Malaysia, 1980

Age	Population* (smoothed)		Analysis of Age Ratios				Analysis of Sex Ratios	
			Male		Female			
	Male (1)	Female (2)	Age Ratio (3)	Deviation from 100 (4)	Age Ratio (5)	Deviation from 100 (6)	Sex Ratio (7)	Successive Differences (8)
0-4	474,045	452,939					104.7	
5-9	464,689	449,500	103.2	3.2	103.8	3.8	103.4	-1.3
10-14	426,818	413,335	103.7	3.7	102.4	2.4	103.3	-0.1
15-19	358,867	357,721	100.9	0.9	100.7	0.7	100.3	-2.9
20-24	284,727	296,929	96.0	-4.0	98.7	-1.3	95.9	-4.4
25-29	234,566	243,769	97.1	-2.9	98.9	-1.1	96.2	0.3
30-34	198,499	196,141	98.3	-1.7	96.4	-3.6	101.2	5.0
35-39	169,206	163,078	97.6	-2.4	95.3	-4.7	103.8	2.6
40-44	148,403	145,992	101.5	1.5	101.2	1.2	101.7	-2.1
45-49	123,314	125,531	98.4	-1.6	100.0	0.0	98.2	-3.4
50-54	102,339	104,967	97.8	-2.2	98.3	-1.7	97.5	-0.7
55-59	85,977	87,966	101.2	1.2	101.5	1.5	97.7	0.2
60-64	67,527	68,337	101.1	1.1	102.8	2.8	98.8	1.1
65-69	47,570	44,943	90.4	-9.6	85.6	-14.4	105.8	7.0
70-74	37,719	36,688						
75+	34,687	35,365						

Average Age Ratio Deviation for Males = 2.77
Average Age Ratio Deviation for Females = 3.02

Average Sex Ratio Difference = 2.40
Age-Sex Accuracy Index = 13.00

$$\text{Age Ratio} = \frac{{}_5P_a}{\frac{1}{2}({}_5P_{a-5} + {}_5P_{a+5})} \times 100$$

Sex Ratio = [(1)/(2)] x 100

*Source: Department of Statistics Malaysia, 1980 Population and Housing Census of Malaysia: Kuala Lumpur, 1983, Table 2.5.

Table 6.7. Urbanization Index Score and Ranks by State, Peninsular Malaysia, 1980

State	Proportion of Urban Population	Rank	Mean City Population Size in Thousands	Rank	Number of Cities	Rank	Population Density sq. km.	Rank	Total Rank
Johore	.2600	5	15.73	5	3	1	83	7	18
Kedah	.1200	9	3.78	9	1	3	114	6	27
Kelantan	.1500	10	3.38	10	1	3	57	8	31
Melaka	.2500	6	15.53	6	1	3	271	3	18
Negeri Sembilan	.2100	7	12.58	7	1	3	83	7	24
Pahang	.1800	8	0	11	0	4	21	10	32
Pulau Pinang	.5000	2	80.48	3	2	2	872	2	9
Perak	.2700	4	35.69	4	2	2	83	7	17
Perlis	0	11	0	11	0	4	182	4	30
Selangor	.4400	3	147.89	2	3	1	179	5	11
Terengganu	.2700	4	5.86	8	1	3	40	9	24
Wilayah Persekutuan	1.0000	1	978.33	1	3	1	3,784	1	4

Source: Department of Statistics Malaysia, 1980 Population and Housing Census of Malaysia: Kuala Lumpur, 1983, Table M2.1 and Table 2.5.

Selangor, Perak, Johore, and others. Selangor, the state where Federal Territory belonged to prior to the 1980 census remains highly urbanized as indicated by its being ranked third. This is probably because Kuala Lumpur, the capital city of Malaysia remains part of the state of Selangor.

Table 6.8 shows the states ordered from the first ranked to the last. Cumulating the total population of these ranked-ordered states resulted in a cumulative population shown in column four. Comparison of column four with the urban population of Peninsular Malaysia entered at column five showed that the closest cumulative population to the total urban population for Peninsular Malaysia is that of Perak. Therefore, all states that were ranked higher (first, second, and third) than Perak were classified as inferred urban population. These states are Federal Territory, Pulao Pinang, and Selangor. Perak, being the "boundary" state, was also classified as inferred urban. The remaining eight states were classified as inferred rural populations.

The next step was to combine the population or deaths of the states that were classified as inferred urban and/or inferred rural. This summation of the population and/or deaths provided the distribution presented in Table 6.9. However, when these distributions were assessed for age and sex accuracy, the result indicated that the distributions were somewhat inaccurate. Therefore, this study utilized the smoothed population distribution as the base population for the analysis.

Table 6.8. Identification of Inferred Urban Population, Peninsular Malaysia, 1980

State	Total Rank	Population	Cumulative Population	Urban Population Peninsular Malaysia	Inferred Urban	Inferred Rural
Wilayah Persekutuan	04	0978326	00978326		x	
Pulao Pinang	09	0955618	01933944		x	
Selangor	11	1517504	03451448		x	
Perak	17	1807423	05258871	4957058	x	
Johore	18	1640488	06899359			x
Melaka	18	0465346	07364705			x
Negeri Sembilan	24	0574327	07939032			x
Terengganu	24	0541608	08480640			x
Kedah	27	1117610	09598250			x
Perlis	30	0148448	09746698			x
Kelantan	31	0895354	10642052			x
Pahang	32	0800034	11442086			x

Proportion of urban population in inferred Urban = 0.4967

Proportion of urban population in Peninsular Malaysia = 0.4332

Table 6.9. Death and Population Distribution by Age, for Inferred Urban and Inferred Rural, Peninsular Malaysia, 1980

Age*	Inferred Population	Urban Death	Inferred Population	Rural Death
00	127281	2967	169363	5348
01	542535	0891	705680	1662
05	650488	0414	852321	0756
10	617487	0335	787930	0510
15	604172	0556	712520	0672
20	562234	0627	558020	0795
25	464224	0670	464739	0702
30	381136	0649	391715	0716
35	271856	0559	306976	0729
40	250116	0868	299689	0979
45	193772	1094	213972	1111
50	169310	1592	194820	1597
55	123468	1837	154681	2145
60	106561	2614	131514	2938
65	077390	2908	091857	3311
70	060306	3418	074336	4140
75	056535	6016	073082	7221

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

ESTIMATING COMPLETENESS OF DEATH REGISTRATION

For more than a decade, Peninsular Malaysia's vital registration system had shown excellent coverage of births and deaths. Based on the results of the 1973-74 Household Expenditure Survey in Peninsular Malaysia (see Finch and Sweetser, 1979), the registrations of births and deaths were estimated to be 96.5 and 93.0 percent complete. The United Nations (1982) noted that Malaysia is one of only five Third World countries that claimed to have "complete" (90 percent or more recording of deaths) vital registration in 1975.

Bearing these previous results in mind, it was somewhat surprising to find a slope that was below 1.00 which indicated overenumeration. In fact, among all populations for both sexes combined, only the urban area showed a slope of 1.1085 or an underenumeration of 10.8 percent (see Table 6.10) whereas the rural area showed a slope of 0.8442 or an overenumeration of 18 percent (see Table 6.11). In a similar pattern, the inferred urban (see Table 6.12) showed a very low overenumeration of 3 percent whereas the inferred rural (see Table 6.13) showed a 10.5 percent overenumeration. Table 6.14 which shows the calculation of the slope for Peninsular Malaysia also indicates a 7 percent overenumeration. However, most of these populations (except for the urban and rural areas) had slopes that were close to 1.00 or 100 percent enumeration.

Examination of the male and female distributions showed a pattern of slight underenumeration for females and overenumeration for males. For example, the male distribution for Peninsular Malaysia (see Table

Table 6.10 Application of the Brass Growth Balance Equation to the Deaths and Population, Urban Area, Peninsular Malaysia, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	2275	618	20	4960	n/a	n/a	n/a
05	0236	589	18	4342	121	0.0040	0.0278
10	0192	577	17	3754	117	0.0046	0.0310
15	0307	586	17	31777	116	0.0054	0.0366
20	0453	544	17	2591	113	0.0065	0.0436
25	0448	457	16	2047	100	0.0080	0.0489
30	0446	361	16	15902	082	0.0100	0.0514
35	0411	277	15	1229	064	0.0126	0.0519
40	0616	225	15	0956	050	0.0158	0.0526
45	0822	181	14	0728	032	0.0198	0.0557
50	1093	143	14	0547	030	0.0249	0.0591
55	1360	114	13	0405	026	0.0309	0.0635
60	1852	094	11	0290	021	0.0384	0.0717
65	9302	197	09	0197	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.1085

Intercept = 0.0328

Adjusted Crude Death Rates = 0.0044

*00 = under one through four years of age; 05 = five through nine years of age, etc.

Table 6.11 Application of the Brass Growth Balance Equation to the Deaths and Population, Rural Area, Peninsular Malaysia, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	8593	927	44	6482	n/a	n/a	n/a
05	0934	914	35	5555	184	0.0063	0.0331
10	0653	840	34	4641	175	0.0073	0.0378
15	0921	717	33	3801	156	0.0088	0.0410
20	0969	582	32	3084	130	0.0105	0.0421
25	0924	478	31	2503	106	0.0126	0.0424
30	0919	395	31	2024	087	0.0151	0.0431
35	0877	332	30	1630	073	0.0182	0.0446
40	1231	294	29	1297	063	0.0222	0.0483
45	1383	249	28	1003	054	0.0274	0.0542
50	2096	207	26	0754	046	0.0347	0.0605
55	2622	174	24	0547	038	0.0440	0.0697
60	3700	136	21	0373	031	0.0574	0.0831
65	7712	237	18	0237	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 0.8442

Intercept = 0.0314

Adjusted Crude Death Rates = 0.0057

*00 = under one through four years of age; 05 = five through nine years of age, etc.

Table 6.12 Application of the Brass Growth Balance Equation to the Deaths and Population, Inferred Urban, Peninsular Malaysia, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	3858	670	28	5259	n/a	n/a	n/a
05	0414	651	24	4590	132	0.0053	0.0288
10	0335	623	24	3939	127	0.0060	0.0323
15	0556	603	23	3317	123	0.0071	0.0370
20	0627	556	23	2714	116	0.0084	0.0427
25	0670	471	22	2158	103	0.0103	0.0476
30	0649	371	22	1686	084	0.0128	0.0500
35	0559	287	21	1315	066	0.0159	0.0500
40	0868	238	20	1028	052	0.0198	0.0510
45	1094	201	19	0790	044	0.0247	0.0556
50	1592	163	18	0589	036	0.0312	0.0618
55	1837	129	17	0426	029	0.0394	0.0686
60	2614	102	15	0297	023	0.0504	0.0708
65	12342	194	12	0194	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 0.9646

Intercept = 0.0317

Adjusted Crude Death Rates = 0.0051

*00 = under one through four years of age; 05 = five through nine years of age, etc.

Table 6.13 Application of the Brass Growth Balance Equation to the Deaths and Population, Inferred Rural, Peninsular Malaysia, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	7010	875	35	6183	n/a	n/a	n/a
05	0756	852	28	5308	173	0.0054	0.0325
10	0510	794	28	4455	165	0.0062	0.0370
15	0672	699	27	3661	149	0.0074	0.0408
20	0795	569	26	2962	127	0.0089	0.0428
25	0702	464	26	2392	103	0.0107	0.0432
30	0716	384	25	1928	085	0.0129	0.0440
35	0729	322	24	1544	071	0.0157	0.0458
40	0979	281	23	01222	060	0.0192	0.0494
45	1111	229	22	0941	051	0.0239	0.0541
50	1597	187	21	0712	042	0.0300	0.0583
55	2145	159	20	0525	035	0.0376	0.0659
60	2938	127	18	0366	029	0.0481	0.0781
65	14672	239	15	0239	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 0.9049

Intercept = 0.0323

Adjusted Crude Death Rates = 0.0052

*00 = under one through four years of age; 05 = five through nine years of age, etc.

Table 6.14 Application of the Brass Growth Balance Equation to the Deaths and Population, Peninsular Malaysia, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	10868	1545	63	11442	n/a	n/a	n/a
05	01170	1503	52	09897	305	0.0053	0.0308
10	00845	1417	51	08394	292	0.0061	0.0348
15	1228	1302	50	06978	272	0.0072	0.0390
20	01422	1125	49	5675	243	0.0087	0.0428
25	01372	0935	48	04550	206	0.0105	0.0453
30	01365	0756	46	03615	169	0.0128	0.0468
35	01288	0609	45	02859	136	0.0158	0.0477
40	01847	0519	44	02250	112	0.0195	0.0501
45	02205	0430	42	01731	095	0.0242	0.0548
50	03189	350	40	01301	078	0.0305	0.0599
55	03982	288	37	0951	064	0.0384	0.0671
60	05552	0229	33	0663	052	0.0491	0.0781
65	27014	434	27	0434	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 0.9333

Intercept = 0.0320

Adjusted Crude Death Rates = 0.0052

*00 = under one through four years of age; 05 = five through nine years of age, etc.

6.15 showed a slope of 0.8508 or a 17 percent overenumeration, while its female counterpart (see Table 6.16) showed a slope of 1.0354 or a 3 percent underenumeration.

While these outcomes are somewhat baffling, it can be explained by the fact that the analysis was done only for Peninsular Malaysia, the region where most urban centers are located and; therefore, the location of most hospitals and clinics in Malaysia. The seriously ill residents of East Malaysia (Sabah and Sarawak) might have flocked to Peninsular Malaysia for treatment. Majority of these visitors may have died in the hospital or in the house of relatives and some of them may have been erroneously recorded as residents. However, since the unavailability of data limited the ability of this study to assess the accuracy of the speculations advanced above, both the corrected and the uncorrected distributions of deaths were utilized in the estimation of mortality. This is because if we follow what most studies had indicated, that is, complete enumeration of deaths for Peninsular Malaysia, then the death registration data should not be corrected. However, if we follow the result of the Brass Growth Balance Equation, then deaths should be adjusted by the factor (f) which the method generates. There are several reasons for doing this step. First, the Brass Growth Balance Equation assumes stability of the age distributions. If in the next stage, this study finds that the age distributions for all populations or any of the populations are not stable, then this study will have reservations about the estimates produced by the deaths that have been corrected with the Brass Growth

Table 6.15 Application of the Brass Growth Balance Equation to Male Deaths and Population, Peninsular Malaysia, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	6074	792	36	5738	n/a	n/a	n/a
05	0652	766	30	4946	156	0.0061	0.0315
10	0510	720	29	4180	149	0.0070	0.0355
15	0786	648	29	3460	137	0.0084	0.0395
20	0965	547	28	2812	119	0.0100	0.0425
25	0885	458	27	2266	100	0.0120	0.0443
30	0751	380	26	1808	084	0.0145	0.0463
35	0734	312	26	1428	069	0.0179	0.0485
40	1119	264	25	1116	058	0.0222	0.0515
45	1335	214	24	0852	048	0.0278	0.0561
50	1950	173	22	0640	039	0.0350	0.0607
55	2424	141	20	0465	031	0.0439	0.0676
60	3221	112	18	0324	025	0.0555	0.0781
65	14748	212	15	0212	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 0.8508

Intercept = 0.0317

Adjusted Crude Death Rates = 0.0054

*00 = under one through four years of age; 05 = five through nine years of age, etc.

Table 6.16 Application of the Brass Growth Balance Equation to Female Deaths and Population, Peninsular Malaysia, 1980

Age*	Deaths	Population	d_y'	P_y	n_x	d_y'/P_y	n_x/P_y
00	4794	753	27	5704	n/a	n/a	n/a
05	0518	737	22	4951	149	0.0045	0.0301
10	0335	697	22	4214	143	0.0052	0.0340
15	0442	654	22	3517	135	0.0061	0.0384
20	0457	579	21	2863	123	0.0074	0.0431
25	0487	478	21	2284	106	0.0090	0.0462
30	0614	375	20	1807	085	0.0112	0.0472
35	0554	297	20	1431	067	0.0137	0.0470
40	0728	256	19	1134	055	0.0167	0.0488
45	0870	215	18	0878	047	0.0208	0.0536
50	1239	177	17	0663	039	0.0262	0.0591
55	1558	147	16	0486	032	0.0332	0.0666
60	2331	118	15	0339	026	0.0430	0.0781
65	12266	221	12	0221	n/a	n/a	n/a

Slope (line fitted from age group 5-9 to age group 60-64) = 1.0354

Intercept = 0.0324

Adjusted Crude Death Rates = 0.0049

*00 = under one through four years of age; 05 = five through nine years of age, etc.

Balance factor. In this instance, it is advisable to utilize the uncorrected death distributions.

MORTALITY ESTIMATION

Like the analysis of mortality for the Philippines and Thailand, infant mortality rates were also estimated to be utilized as input for age below one. However, the estimated infant mortality rates (see Table 6.17) for both the adjusted and the unadjusted deaths, were found to be somewhat lower in comparison to infant mortality rates estimated by other studies. For example, the infant mortality rates for corrected deaths, especially for total, urban area and inferred rural populations were inconsistent with the estimates generated by the U.S. Bureau of the Census and the United Nations. These figures were too low in comparison to other estimates of infant mortality. In a similar pattern, the figures for the unadjusted deaths also showed very low total (24.0) and urban area (12.6) infant mortality rates. These estimates are about seven deaths per thousand births lower than the figures shown by the U.N. Demographic Yearbook of 1979. In fact, the figures that were most consistent with the other infant mortality estimates were the age-specific death rates for age below one calculated for the corrected deaths. The rate was 26.2 per thousand population for Peninsular Malaysia, 30.6 for rural, 17.2 for urban, 28.6 for inferred rural and 22.5 for inferred urban. These figures are very close to the estimates of infant mortality of other

Table 6.17. Selected Mortality Estimates from Different Sources, Peninsular Malaysia, 1957-1980 (Rates per 1,000)

Investigator or Source	Reference Period	Infant Mortality Rates					Life Expectancy at Birth			Crude Death Rate
		Total	Male	Female	Rural	Urban	Total	Rural	Urban	
U.N. Demographic Yearbook 1967	1957	75.0								12
	1958	80.0								11
	1959	66.0								10
	1960	69.0								10
	1961	60.0								9
	1962	59.0								10
	1963	57.0								9
	1964	48.0								8
U.N. Demographic Yearbook 1975	1965	50.0								8
	1966	48.0								8
	1967	45.0								8
	1968	42.0								8
	1969	43.0								8
	1970	41.0								7
World Fertility Survey (1984)	1970	36.1								7
U.S. Bureau of Census (1979)	1970*	42.0					64			8
	1971	39.0								7
	1971*	41.0								
U.N. Demographic Yearbook 1980	1971	38.5	43.6	33.2						
	1972	37.9	42.9	32.7						
U.S. Bureau of Census (1979)	1972	38.0								7
	1972*	40.0	45.0	34.0						7
	1973	38.0								
	1973*	39.0	43.0	34.0						
U.N. Demographic Yearbook 1980	1973	38.5	43.1	33.6						
	1974	35.4	39.4	31.3						
U.S. Bureau of Census (1979)	1974	35.0								7
	1974*	37.0	41.0	33.0						
	1975	33.0								6
	1975*	35.0	39.0	30.0						
U.N. Demographic Yearbook 1980	1975	33.3	37.3	29.0						
	1976	30.8	34.7	26.6						6
U.S. Bureau of Census (1979)	1976	31.0								8
U.N. Demographic Yearbook 1980	1977	31.8	35.7	27.7						
U.S. Bureau of Census (1979)	1978	29.0								
U.N. Demographic Yearbook 1980	1978	28.1	31.5	24.6	29.8	19.9				
	1979				29.2	19.1				
RUMM (IMR) Adjusted Deaths	1980	22.4		21.9	27.3	13.9	67.8	68.2	71.4	5
Inferred Urban/Rural	1980				24.1	19.6		69.7	69.2	
Unadjusted Deaths	1980	24.0			32.3	12.6	68.5		72.6	
Inferred Urban/Rural	1980				26.7	20.3		68.4	68.8	6
RUMM (ASDR) Adjusted Deaths	1980	26.2			30.6	17.2		68.0	71.2	
Inferred Urban/Rural	1980				28.6	22.5		69.4	69.0	
Unadjusted Deaths	1980	28.0			36.3	15.5	68.3	62.6	72.3	
Inferred Urban/Rural	1980				31.6	23.3		68.1	68.6	

*Estimated through cohort analysis of registered deaths and infant deaths.

studies. For this reason, Life Tables for the adjusted deaths were calculated by using the age-specific death rates for all ages.

Table 6.18 shows the Life Table for Peninsular Malaysia. The very low age-specific death rates and the high expectation of life indicate a longevity that is somewhat unique among Third World nations. However, it must be kept in mind that the study population, by concentrating on Peninsular Malaysia, may have excluded representation from the most rural and the least privileged of Malaysia's population. For example, Table 6.19 and Table 6.20 show the Life Tables for urban and rural areas rural areas exhibiting life expectancies at birth of 71.2 and 68.0 years respectively. The same is true for inferred urban and inferred rural populations which both show life expectancies at birth of 69 years (see Table 6.21 and Table 6.22).

RELIABILITY AND VALIDITY OF THE RUMM ESTIMATES

Comparison of the inferred urban and inferred rural estimates to that of urban and rural, allowed this study to assess the validity and reliability of the RUMM estimates. By comparing the survival rates of the inferred urban population to that of the urban area and those of inferred rural to rural area, this study provided a demographic test of difference between the mortality levels and patterns of these different population classifications.

Table 6.23 shows the calculation of the Absolute and Relative Mean Difference between the survival rates of the inferred urban population

Table 6.18. Life Table for Both Sexes, Peninsular Malaysia, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	26.2**	025.4	100000	02549	097456	6757694	67.6
01	01.9	007.6	097451	00740	387214	6660239	68.3
05	00.7	003.6	096711	00352	482674	6273025	64.9
10	00.6	002.8	096359	00269	481120	5790351	60.1
15	00.9	004.4	096089	00422	479391	5309232	55.3
20	01.2	005.9	095667	00563	476930	4829840	50.5
25	01.4	006.8	095105	00649	473900	4352911	45.8
30	01.7	008.4	094455	00795	470290	3879011	41.1
35	02.0	009.8	093661	00918	466008	3408722	36.4
40	03.3	016.5	092743	01527	459895	2942714	31.7
45	04.8	023.7	091216	02159	450681	2482819	27.2
50	08.5	041.7	089057	03710	436008	2032137	22.8
55	12.9	062.4	085346	05329	413410	1596129	18.7
60	22.6	106.8	080018	08551	378710	1182719	14.8
65	52.4	231.6	071466	16553	315950	0804009	11.3
70	75.3	316.8	054914	17394	231084	0488059	08.9
75	108.1	425.6	037520	15970	147675	0256975	06.9
80	197.2	1000.0	021550	21550	109299	0109299	05.1

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table 6.19. Life Tables for Both Sexes, Urban Area, Peninsular Malaysia, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	17.2**	016.9	100000	01691	098312	7115779	71.2
01	00.9	003.7	098309	00361	391974	7017467	71.4
05	00.5	002.3	097948	00220	489192	6625493	67.6
10	00.4	001.9	097728	00181	488190	6136301	62.8
15	00.6	002.9	097548	00282	487032	5648111	57.9
20	00.9	004.6	097265	00446	485210	5161079	53.1
25	01.1	005.4	096819	00526	482778	4675869	48.3
30	01.4	006.8	096293	00657	479819	4193091	43.6
35	01.7	008.2	095635	00786	476212	3713271	38.8
40	03.0	015.1	094849	01431	470670	3237060	34.1
45	05.0	024.9	093419	02325	461281	2766389	29.6
50	08.5	041.6	091094	03791	445991	2305108	25.3
55	13.2	063.8	087303	05570	422590	1859117	21.3
60	21.9	104.0	081733	08496	387425	1436527	17.6
65	32.8	151.7	073237	11110	338409	1049102	14.3
70	045.1	202.7	062127	12593	279153	0710693	11.4
75	062.0	268.3	049534	13292	214442	0431540	08.7
80	166.9	1000.0	036242	36242	217098	0217098	06.0

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table 6.20. Life Tables for Both Sexes, Rural Area, Peninsular Malaysia, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	30.7**	029.7	100000	02974	097032	6795786	68.0
01	02.4	009.4	097026	00916	384898	6698754	69.0
05	00.9	004.3	096110	00412	479519	6313857	65.7
10	00.7	003.3	095698	00315	477699	5834338	61.0
15	01.1	005.4	095382	00514	475627	5356639	56.2
20	01.4	007.0	094869	00666	472677	4881012	51.5
25	01.6	008.1	094202	00765	469099	4408335	46.8
30	02.0	009.8	093437	00916	464898	3939236	42.2
35	02.2	011.1	092522	01026	460043	3474338	37.6
40	03.5	017.5	091496	01601	453477	3014295	32.9
45	04.7	023.2	089895	02084	444266	2560818	28.5
50	08.5	041.8	087811	03667	429889	2116553	24.1
55	12.7	061.6	084144	05187	407755	1686663	20.0
60	23.0	108.7	078958	0108.7	373331	1278908	16.2
65	36.0	165.2	070375	11627	322806	0905577	12.9
70	57.9	253.1	058747	14866	256572	0582771	09.9
75	93.2	377.9	043882	16585	177947	0326199	07.4
80	184.1	1000.0	027297	27297	148252	0148252	05.4

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table 6.21. Life Tables for Both Sexes, Inferred Urban, Peninsular Malaysia, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	22.5**	022.0	100000	02200	097805	6904395	68.0
01	01.6	006.3	097800	00615	389050	6806590	69.6
05	00.6	003.1	097186	00296	4485188	6417540	66.0
10	00.5	002.6	096890	00252	483820	5932351	61.2
15	00.9	004.4	096638	00429	482118	5448532	56.4
20	01.1	005.4	096209	00523	479738	4966414	51.6
25	01.4	006.8	095686	00653	476798	4486676	46.9
30	01.7	008.4	095033	00800	473165	4009878	42.2
35	01.9	009.4	094233	00882	468962	3536713	37.5
40	03.5	017.4	093352	01624	462698	3067751	32.9
45	05.2	025.9	091728	02372	452707	2605053	28.4
50	09.4	046.1	089355	04116	436487	2152345	24.1
55	13.7	066.3	085239	05654	412063	1715859	20.1
60	24.6	115.9	079586	09222	374874	1303796	16.4
65	36.2	166.2	070364	11691	322593	0928922	13.0
70	54.6	240.2	058673	14094	258131	0606330	10.3
75	82.3	341.2	044579	15208	184876	0348199	07.8
80	179.8	1000.0	029371	29371	163323	0163323	05.6

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table 6.22. Life Table for Both Sexes, Inferred Rural, Peninsular Malaysia, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	28.6**	027.8	100000	02778	097228	6934971	69.4
01	02.1	008.5	097222	00822	386011	6837743	70.3
05	00.8	004.0	096400	00385	4485188	6451732	66.9
10	00.6	002.9	096015	00278	479381	5970694	62.2
15	00.9	004.3	095737	00416	477647	5491313	57.4
20	01.3	006.3	095322	00599	475111	5013666	52.6
25	01.4	006.8	094723	00647	471998	4538555	47.9
30	01.7	008.4	094076	00792	468403	4066557	43.2
35	02.1	010.2	093285	00951	464045	3598154	38.6
40	03.2	015.6	092333	01443	458060	3134109	33.9
45	04.4	021.8	090891	02176	449508	2676049	29.4
50	07.7	037.9	088913	03371	436135	2226541	25.0
55	12.2	059.2	085541	05064	415048	1790406	20.9
60	20.9	099.5	080478	08007	382372	1375358	17.1
65	32.6	150.8	072471	10929	335033	0992987	13.7
70	50.4	223.8	061542	13773	273278	0657954	10.7
75	77.9	325.9	047769	15568	199924	0384676	08.1
80	174.3	1000.0	032201	32201	184752	0184752	05.7

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table 6.23. Survival Rates Comparison of Inferred Urban and Urban Areas, Peninsular Malaysia, 1980

Age*	Urban Area	Inferred Urban	Urban Area	Inferred Urban	Difference Survival Rates	Difference of Ratios
00	0.9806	0.9737	1.0175	1.0235	0.0069	-.0060
01	0.9978	0.9966	1.0002	1.0006	0.0012	-.0004
05	0.9980	0.9972	0.9996	0.9993	0.0008	0.0003
10	0.9976	0.9965	0.9987	0.9986	0.0011	0.0001
15	0.9963	0.9951	0.9987	0.9986	0.0012	0.0001
20	0.9950	0.9939	0.9989	0.9985	0.0011	0.0004
25	0.9839	0.9924	0.9986	0.9987	0.0015	-.0004
30	0.9925	0.9911	0.9959	0.9955	0.0014	0.0004
35	0.9884	0.9866	0.9916	0.9917	0.0018	-.0001
40	0.9801	0.9784	0.9865	0.9855	0.0017	0.0010
45	0.9669	0.9642	0.9799	0.9790	0.0027	0.0009
50	0.9475	0.9440	0.9676	0.9638	0.0035	0.0038
55	0.9168	0.9098	0.9528	0.9458	0.0070	0.0070
60	0.8735	0.8605	0.9444	0.9299	0.0130	0.0145
65	0.8249	0.8002	0.9313	0.8950	0.0247	0.0363
70	0.7682	0.7162	0.6549	0.6550	0.0523	-.0001
75	0.5031	0.4691	n/a	n/a	0.0340	n/a

Absolute Mean Difference (AMD) = 0.0092

Relative Mean Difference (RMD) = 0.0045

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

and urban area. Contrary to what the Life Table values indicate, the Absolute (0.0092) and Relative (0.0045) Mean Differences between the two survival rates were close to zero. Since survival ratios are the probabilities of one age-group to survive to the next age-group, the Absolute Mean Difference and the Relative Mean Difference were actually taken from the differences in probabilities from age-group to age-group of the two survival ratios. If we examine closely the sixth column of Table 6.23, the differences in these probabilities are very small. The lowest difference was 0.0008 (the difference in the probabilities of age-group 1-4 to survive to age-group 5-9) and the highest difference was 0.052 (the difference in the probabilities of age-group 65-69 to survive to age-group 70-74). One thing that should be noted, however, is that all these differences shown in column six are positive, therefore, indicating that the urban area has a slight edge over the inferred urban population.

Repeating the same assessment procedure for the survival ratios of the rural area and the inferred rural population also resulted in a negligible difference. Table 6.24, for example, shows very small Absolute (0.007) and Relative (0.0033) Mean Differences. Again, examination of age-group to age-group differences of these two survival ratios shown in column six indicated very close mortality levels. The lowest difference was -0.0004 and the highest was only -0.038. Since the inferred urban populations were shown to be lower in all age-groups to that of the urban area, then it was to be expected that inferred rural survival ratios must be higher than those of the rural area. As expected, the differences in column six of Table 6.24 were all negative.

Table 6.24. Survival Rates Comparison of Inferred Rural and Rural Areas, Peninsular Malaysia, 1980

Age*	Rural Area	Inferred Rural	Rural Area	Inferred Rural	Difference Survival Rates	Difference of Ratios
00	0.9639	0.9665	1.0323	1.0300	-.0026	0.0023
01	0.9950	0.9955	1.0012	1.0011	-.0005	0.0001
05	0.9962	0.9966	0.9995	0.9998	-.0004	-.0003
10	0.9957	0.9964	0.9981	0.9983	-.0007	-.0002
15	0.9938	0.9947	0.9986	0.9988	-.0004	-.0002
20	0.9924	0.9935	0.9986	0.9989	-.0011	-.0003
25	0.9910	0.9924	0.9986	0.9983	-.0014	-.0003
30	0.9896	0.9907	0.9961	0.9964	-.0011	-.0003
35	0.9857	0.9871	0.9939	0.9941	-.0014	-.0002
40	0.9797	0.9813	0.9876	0.9888	-.0016	-.0012
45	0.9676	0.9703	0.9803	0.9808	-.0027	-.0005
50	0.9485	0.9517	0.9653	0.9681	-.0032	-.0028
55	0.9156	0.9213	0.9444	0.9510	-.0057	-.0066
60	0.8647	0.8762	0.9192	0.9310	-.0115	-.0118
65	0.7948	0.8157	0.8727	0.8969	-.0209	-.0242
70	0.6936	0.7316	0.6553	0.6565	-.0380	-.0012
75	0.4545	0.4803	n/a	n/a	-.0258	n/a

Absolute Mean Difference (AMD) = 0.0070

Relative Mean Difference (RMD) = 0.0033

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

One of the main assumptions of the Brass Growth Balance Equation is the stability of the age distributions that are used in the calculation of the "adjustment factor." If the true age distribution is shifted by a very large proportion because of the effect of high migration, or changing fertility, or changing mortality, or by the high degree of age-misstatement, census undercounts, or by the combination of all of them, then estimates generated by the Brass Growth Balance Equation are affected by these violations of the assumption. Since availability of data limited the capacity of this study to assess which of the above caused the shifting (if ever) of the age distribution, this study assessed the stability of the age distribution by calculating equivalent stable populations utilizing the estimated empirical life tables generated from deaths adjusted by the Brass adjustment factors. Comparing these two age distributions (actual and generated stable age distributions) allowed us to assess the difference. This difference of the actual from that of the stable age distribution indicated a deviation from stability.

Equivalent stable populations for Peninsular Malaysia, inferred urban, and inferred rural populations are presented in Table 6.25, Table 6.26, and Table 6.27. Mortality inputs were taken from Life Tables for Peninsular Malaysia (from Table 6.18), inferred urban (from Table 6.19), and inferred rural (from Table 6.20). Since each of these Life Tables has been adjusted by the Brass Growth Balance "adjustment factors," if we compare the resulting stable population to its actual census-enumerated population, the difference will indicate the deviation of the reported age structures from stability. These deviations are expressed

Table 6.25. Comparison of Reported Age Distribution and Its Stable Population Equivalent, Peninsular Malaysia, 1980

Age*	Stable Population (percent)	Reported Population (percent)	Ratio of Percentages	Differences of percentages
00	12.4	13.5	108.8	01.09
05	11.2	13.1	116.9	01.90
10	10.2	12.4	121.5	02.19
15	09.2	11.4	123.2	02.20
20	08.4	09.8	117.6	01.50
25	07.6	08.2	108.1	00.61
30	06.8	06.6	096.7	-0.22
35	06.2	05.3	086.5	-0.83
40	05.5	04.5	082.1	-0.99
45	04.9	03.8	076.3	-1.17
50	04.3	03.1	070.4	-1.28
55	03.8	02.5	067.3	-1.23
60	03.1	02.0	064.3	-1.12
65	02.4	01.5	062.5	-0.89
70	01.6	01.2	074.7	-0.40
75	00.9	01.1	124.3	00.22
80	01.5	00.0	000.5	-1.51

Index of Relative Difference = 12.92

Index of Dissimilarity = 9.64 *00 = under one through four years of age; 05 = five through nine years of age, etc.

Table 6.26. Comparison of Reported Age Distribution and Its Stable Population Equivalent, Inferred Urban, Peninsular Malaysia, 1980

Age*	Stable Population (percent)	Reported Population (percent)	Ratio of Percentages	Differences of percentages
00	8.6	12.7	147.5	04.10
05	7.7	12.4	161.3	04.70
10	7.5	11.8	158.2	04.35
15	7.3	11.5	156.9	04.15
20	7.1	10.6	148.4	03.45
25	6.9	09.0	129.1	02.02
30	6.7	07.1	104.7	00.32
35	6.6	05.5	083.2	-1.10
40	6.3	04.5	071.5	-1.81
45	6.1	03.8	063.0	-2.25
50	5.7	03.1	054.0	-2.64
55	5.3	02.5	046.3	-2.85
60	4.7	02.0	041.2	-2.82
65	4.0	01.5	036.9	-2.52
70	3.1	01.2	036.7	-1.98
75	02.2	01.1	049.0	-1.12
80	4.1	00.0	000.4	-4.06

Index of Relative Difference = 24.23

Index of Dissimilarity = 23.09

*00 = under one through four years of age; 05 = five through nine years of age, etc.

Table 6.27. Comparison of Reported Age Distribution and Its Stable Population Equivalent, Inferred Rural, Peninsular Malaysia, 1980

Age*	Stable Population (percent)	Reported Population (percent)	Ratio of Percentages	Differences of percentages
00	15.4	14.2	091.6	-1.30
05	13.3	13.8	103.4	00.46
10	11.5	12.8	111.5	01.32
15	10.0	11.3	113.7	01.36
20	08.6	09.2	107.3	00.62
25	07.4	07.5	101.6	00.11
30	06.4	06.2	097.7	-0.15
35	05.5	05.2	095.3	-0.26
40	04.7	04.5	097.0	-0.14
45	04.0	03.7	092.9	-0.28
50	03.4	03.0	090.2	-0.33
55	02.8	02.6	093.0	-0.19
60	02.2	02.1	092.8	-0.16
65	01.7	01.5	088.6	-0.19
70	01.2	01.2	101.0	00.01
75	00.8	01.2	156.7	00.43
80	01.3	00.0	001.1	-1.32

Index of Relative Difference = 7.50

Index of Dissimilarity = 4.32

*00 = under one through four years of age; 05 = five through nine years of age, etc.

in terms of the Index of Dissimilarity and the Index of Relative Difference.

Table 6.25 shows the comparison between Peninsular Malaysia's reported age structures and its stable equivalent. The Index of Dissimilarity was found to be 9.64 and the Index of Relative Difference was shown to be 12.92. While these values are not low, they are small when compared to that of inferred urban (see Table 6.26). The Index of Dissimilarity was 23.09 while the Index of Relative Difference was 24.23. This indicates that 23.09 percent of the observed population would have to be shifted to other age-groups in order to make the observed age structure identical to that of its stable population equivalent. In contrast to these two age distributions, the inferred rural population showed a high degree of age structural stability (see Table 6.27). The Index of Dissimilarity was shown to be 4.32 and the Index of Relative Difference was 7.50.

One may presume that the inferred urban age distribution may have been the population that was affected by either high migration, changing fertility, changing mortality, and/or the combination of all these three factors. For example, Table 6.28 shows that two of the states classified as inferred urban show high annual growth rates of 3.7 (Selangor) and 3.5 (Federal Territory) percent. While some of the states that were classified inferred rural also showed high annual growth rates, their effect on the total inferred rural population was somewhat balanced out by the other states. This is because while inferred rural is composed of eight states, inferred urban is composed only of four states.

Table 6.28. Population Size and Rates of Change by State, Peninsular Malaysia, 1970 and 1980

Area	Population (thousands) 1970	Population (thousands) 1980	Average Annual Growth Rate (percent) 1970-1980
Johore	1277.2	1580.4	2.1
Kedah	0954.9	1077.8	1.2
Kelantan	0684.7	0859.3	2.3
Malacca	0404.1	0446.8	1.0
Negeri Sembilan	0481.6	0551.4	1.3
Pahang	0504.9	0768.8	4.2
Penang	0776.1	900.8	1.5
Perak	1569.1	1743.6	1.1
Perlis	0121.1	0144.8	1.8
Selangor	0982.1	1426.2	3.7
trengganu	0405.4	0525.3	2.6
Wilayah Persekutuan	0648.3	0919.6	3.5
Peninsular Malaysia	8809.5	10944.8	2.2

Source: Department of Statistics Malaysia, 1980 Population & Housing Census of Malaysia: General Report of the Population Census. Kuala Lumpur, 1983, Table 3.2

Since age-structural stability is the requirement of the Brass Growth Balance equation, the indication of instability on the part of the inferred urban population will put doubts on the mortality estimates generated for this population. This study, therefore, strongly recommends that the life table generated for the inferred urban population be rejected and replaced by the estimates generated without adjusting the deaths. This Life Table is presented in Table 6.29.

If we turn our attention back to Table 6.12 which presented the application of the Brass Growth Balance Equation to the inferred urban population, the slope was shown to be 0.9646 or a 3.7 percent overenumeration. Since in not adjusting deaths, one automatically assumed that the slope is 1.00, a difference of 0.037 was not large enough to make a difference in the mortality analysis. For example, Table 6.30 shows that the adjusted and unadjusted Life Tables for inferred urban populations were actually identical. The Absolute and Relative Mean Differences at 0.0021 and 0.0008 respectively, were very close to zero.

In summary, this chapter discussed the application of the RUMM technique to Peninsular Malaysia. While more treatments were done on the age distributions for both population and death, basically the procedures used in this chapter were similar to that of the Philippines and Thailand.

Since the technique was applied only to a sub-national population (Peninsular Malaysia and not the total country), this may have contributed to the failure of the Brass Growth Balance technique to produce reliable estimates of completeness. Some of the estimates, however, were very

Table 6.29. Unadjusted Life Table for Both Sexes, Inferred Urban, Peninsular Malaysia, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	23.3**	022.8	100000	02278	097727	6858897	68.6
01	01.6	006.5	097722	00637	388657	6761171	69.2
05	00.6	003.2	097085	00310	484648	6372514	65.6
10	00.5	002.7	096774	00261	483220	5887866	60.8
15	00.9	004.6	096513	00443	481460	5404647	56.0
20	01.1	005.6	096071	00541	479000	4923187	51.3
25	01.4	007.1	095529	00676	475957	4444187	46.5
30	01.8	008.7	094853	00826	472201	3968231	41.8
35	02.0	009.7	094027	00912	467855	3496029	37.2
40	03.6	018.0	093115	01679	461375	3028175	32.5
45	05.4	026.8	091435	02454	451043	2566800	28.1
50	09.8	047.7	088982	04247	434290	2115757	23.8
55	14.2	068.7	084734	05818	409127	1681467	19.8
60	25.5	119.9	078917	09462	370927	1272340	16.1
65	37.6	171.8	069454	11930	317447	0901413	13.0
70	56.6	248.0	057525	14264	251964	0583966	10.2
75	085.3	351.5	043261	15204	178294	0332003	07.7
80	182.5	1000.0	028057	28057	153709	0153709	05.5

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table 6.30. Survival Rates Comparison of the Adjusted and Unadjusted Mortality for Inferred Urban, Peninsular Malaysia, 1980

Age*	Adjusted Deaths	Unadjusted Deaths	adjusted Deaths	Unadjusted Deaths	Difference Survival Rates	Difference of Ratios
00	0.9737	0.9728	1.0235	1.0243	0.0009	-.0008
01	0.9966	0.9964	1.0006	1.0007	0.0002	-.0001
05	0.9972	0.9971	0.9993	0.9993	0.0001	0.0000
10	0.9965	0.9964	0.9986	0.9985	0.0001	0.0001
15	0.9951	0.9949	0.9987	0.9988	0.0002	-.0001
20	0.9938	0.9937	0.9986	0.9984	0.0001	0.0002
25	0.9924	0.9921	0.9987	0.9987	0.0003	0.0000
30	0.9911	0.9908	0.9955	0.9954	0.0003	0.0001
35	0.9866	0.9862	0.9917	0.9913	0.0004	0.0004
40	0.9784	0.9776	0.9855	0.9850	0.0008	0.0005
45	0.9642	0.9629	0.9790	0.9784	0.0013	0.0006
50	0.9440	0.9421	0.9638	0.9623	0.0019	0.0015
55	0.9098	0.9066	0.9458	0.9440	0.0032	0.0018
60	0.8605	0.8558	0.9299	0.9274	0.0047	0.0025
65	0.8002	0.7937	0.8950	0.8915	0.0065	0.0035
70	0.7162	0.7076	0.6550	0.6543	0.0086	0.0007
75	0.4691	0.4630	n/a	n/a	0.0061	n/a

Absolute Mean Difference (AMD) = 0.0021

Relative Mean Difference (RMD) = 0.0008

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

close to 1.00 which would indicate consistency with other studies' estimates. In such cases, using the adjusted or unadjusted mortality estimates would not make any difference because these two estimates are identical. In addition, the fact that the unadjusted Life Tables were not, in any way, influenced by the Brass Growth Balance adjustment factor or any indirect techniques, then there were no assumptions that doubted its reliability. When age-specific death rates are directly estimated by using the registered deaths and the population age-distributions, then that estimation of mortality ceases to be indirect.

CHAPTER VII: SUMMARY, CONCLUSION, AND IMPLICATIONS

SUMMARY

This study involved the design and testing of the Rural Urban Mortality Measurement (RUMM) technique. The RUMM technique was designed to segregate death registration data into inferred urban and inferred rural areas. It has the computational advantage of being simple to calculate and does not require intricate mathematical theory to understand the process. It involves minimum data requirements, which are flexible and if necessary, can be replaced by alternative data. Finally, the technique's main contribution to the field of mortality analysis is its being the only technique to attempt to estimate rural and urban mortality in countries where tabulations for rural and urban deaths do not exist.

In most Third World countries, the only available rural and urban estimates of mortality are for infants and children. These estimates were calculated by applying the Brass, Sullivan, and Trussell technique to children ever born and children still living. While the technique estimates infant and childhood mortality, Brass, Sullivan, Trussell, and many other demographers are in agreement that the method produces more reliable estimates of infant mortality and less reliable estimates of childhood mortality.

The Brass, Sullivan, and Trussell child-survivorship technique does not estimate adult mortality. As a consequence, an apparent neglect of adult mortality exists in Third World nations. Since planning and implementation of programs for health, sanitation, nutrition, education, and economic development benefit from complete mortality information, the absence of childhood and adult mortality estimates hinders development planning in Third World nations.

The RUMM technique was designed to overcome deficiencies evident in earlier approaches. It generated estimates of mortality for inferred urban and inferred rural populations and was tested on whether these estimates were different from the mortality estimates generated for urban and rural areas. As illustrated by the application of the RUMM technique to the three study countries, the inferred urban and inferred rural mortality estimates were found to be valid and reliable. The estimates, besides being consistent with estimates of mortality from other studies, also showed clear similarities with urban and rural area mortality estimates.

Like most indirect techniques, the RUMM technique was designed to have general applicability. However, the difference in availability and adequacy of data from one country to the next, made each application to a particular country unique. For example, if we begin by examining each step of the RUMM technique as applied to a given country, we can see each unique twist that is only true to a specific country and not in others. When we evaluated the population and death age-sex distributions of each study country, Thailand and the Philippines showed reliable and accurate data while Peninsular Malaysia indicated inaccuracy. These findings necessitated the use of a smoothed population distribution in the analysis of Peninsular Malaysia.

In the next step, the identification of areas into inferred urban or inferred rural showed Thailand to be different. While the total number of cities was found to be a good indicator of urbanization in the Philippines and Peninsular Malaysia, it was found to be unreliable for Thailand. The evident cause of this unreliability is that all regions in Thailand, with the exception of Bangkok Metropolis, have the same number of cities of size 50,000 or more inhabitants. In the case of Thailand, the number of cities was replaced by the proportion of the agricultural population. This situation points to one important aspect of the RUMM technique which needs to be emphasized, and that is its non-reliance on any particular indicator of urbanization. While the four indices selected in this study were good indicators, other indicators can also be used. As long as there are at least three indicators of urbanization that allow reasonable assessment of the degree of urbanization of a unit, then the technique will work. However, the more indicators used to assess the urbanization of a unit, the closer one gets to the true urbanization index of a unit.

Another important point which the application of the RUMM technique to two time-periods in the Philippines demonstrates is the possibility that the classification of a unit into urban or rural may vary from year to year. In fact, this occurred in the Philippines. The 1975 inferred urban population was composed of a different combination of regions than that of 1980. However, when the 1975 inferred urban classification was applied to the 1980 data so as to produce a new set of urban and rural regions for 1980, the resulting estimates of the levels of registration as well as the estimates of mortality for this new classification were found to be identical to that of the 1980 inferred urban and inferred rural populations.

Encouraged by this indication of robustness of the technique, this study tried to test other urban and rural combinations, which this study referred to as urban and rural classifications in Table 4.15. Again, the outcome revealed no difference between inferred urban and urban classifications, nor was there a difference found between inferred rural and rural classifications. The evidence of two different classifications providing estimates that are identical to that of inferred urban and inferred rural populations led to the conclusion that the technique is robust and will produce reliable estimates even if a region or a unit is misclassified.

The application of the Brass Growth Balance Equation to each of the study countries showed interesting patterns. Thailand and the Philippines showed high degrees of underenumeration, while Peninsular Malaysia showed over-enumeration.

While the Philippines and Thailand showed levels of registration which are consistent with estimates from other studies, Peninsular Malaysia showed somewhat misleading findings. The urban area showed underenumeration while the others showed overenumeration. However, the total and inferred urban populations which indicated a slight degree of overenumeration were actually close to being 100 percent complete. Because of these misleading results for Peninsular Malaysia, both the adjusted and unadjusted Life Tables were generated. The adjusted Life Tables were generated after deaths were adjusted by the Brass Growth

Balance "correction factor." The unadjusted Life Tables were estimated directly from registered deaths.

These results seem to indicate that the Brass Growth Balance Equation works better if applied to the rural and urban populations of the whole country and not for the sub-section of a country.

Another illustration of the uniqueness of the technique when applied to a particular country was shown in the estimation of infant mortality. For example, in both the 1975 and 1980 Philippine data, infant mortality rates estimated by the RUMM technique were consistent with estimates from other studies. Thailand and Peninsular Malaysia, although showing similarities with many other estimates, were actually lower when compared to the estimates generated by the World Fertility Survey and other surveys. Because the infant mortality estimates from the World Fertility Survey and other surveys were more reliable than other estimates, this study rejected its own estimate of infant mortality for Thailand and replaced it with the infant mortality generated from the children ever born and children still living data of the Contraceptive Prevalence Survey of 1981. For Peninsular Malaysia, infant mortality rates were not used for the life tables. These infant mortality rates were replaced by the age-specific death rates for age below one because they were more consistent with estimates from other studies.

The availability of rural and urban classifications for Thailand and Peninsular Malaysia provided this study with alternative estimates of mortality by which the inferred urban and inferred rural estimates were evaluated. Survival rates of inferred urban population were compared to survival rates of urban areas and similarly, inferred rural with rural areas. These comparisons for both Thailand and Peninsular Malaysia indicated that the estimates for these two types of urban and rural classifications are identical. This result led this study to conclude that inferred urban and inferred rural are reliable and valid representations of urban and rural estimates when the latter are absent.

With the exception of the inferred urban population of Peninsular Malaysia, generally, these three study countries showed age-structural stability. However, the inferred urban deaths of Peninsular Malaysia were so close to 100 percent complete that adjusting the deaths would not make any difference in mortality estimates. In fact, this study showed that the adjusted and the unadjusted Life Tables are identical. Their Absolute and Relative Mean Differences are very close to zero.

CONCLUSION

This study assessed the reliability and validity of the RUMM technique in relation to the five hypotheses described in the first chapter of this study. The first hypothesis referred to the Brass Growth Balance "correction factors" (f's) for each study country. These correction factors must be consistent with existing estimates of death registration completeness for each country.

Levels of death registration estimated in this study for both Thailand and the Philippines were found to be consistent with the estimates of other studies. For example, both the 1975 and 1980 estimates for the Philippines were shown to be consistent with estimates from the National Dual-Record Study (Mijares, 1979), with estimates by Flieger, et al., (1981), and with the Provincial Dual-Record Study (Madigan, et al., 1976). In a similar manner, estimates for Thailand were also shown to be consistent with estimates from the Dual-Record Study (Thailand National Statistics Office, 1976), with estimates by Arnold, Retherford, and Wanglee (1977), and with estimates by the U.S. Bureau of the Census (1978).

Since these alternative estimates were not bound by the assumptions of the Brass Growth Balance technique, then these results strongly supported the reliability and validity of the RUMM estimates.

While the Brass estimates for Thailand and the Philippines were shown to be reliable, the opposite seemed to be true for Peninsular Malaysia. Only the slopes of Peninsular Malaysia and inferred urban showed a closeness to 1.00, the slope which most previous studies associated with the death registration of Peninsular Malaysia.

The second hypothesis which was tested referred to Thailand and Peninsular Malaysia. Both countries had urban and rural tabulations of population and deaths which allowed this study to estimate rural and urban Life Tables. These Life Tables for rural and urban areas were compared to the Life Tables estimated for inferred urban and inferred rural populations. If the difference between inferred urban and urban areas as well as the difference between inferred rural and rural areas are negligible, then the RUMM estimates are valid.

The estimates of mortality for inferred urban and urban areas for Thailand were found to be identical. Their Absolute Mean Difference and Relative Mean Difference were very close to zero. This negligible difference was also shown by inferred rural and rural area comparisons.

Likewise, mortality estimates for Peninsular Malaysia's inferred urban and urban areas as well as inferred rural and rural areas showed the same closeness. The difference in their survival ratios was negligible.

These findings on both Thailand and Peninsular Malaysia clearly showed that in cases where urban and rural tabulations of deaths are unavailable or inadequate, the RUMM technique could be used to segregate the population into inferred urban and inferred rural and their mortality estimated to represent urban and rural areas of that country.

The third hypothesis which referred to the Philippines states that estimates of mortality for inferred urban and inferred rural populations for 1975 must be consistent with estimates of mortality for the 1980 period.

Life Tables for both 1975 and 1980 of total, inferred urban, and inferred rural populations of the Philippines were shown to be consistent with each other. While life expectancies for the 1980 period were higher, these were what one would expect if minimum improvement in nutrition, health, and sanitation were to occur in the country within the five-year period. These estimates would have been inconsistent if the 1980 and 1975 life expectancies were the same or if the 1980 figures were lower.

Comparison of mortality estimates generated by the RUMM technique to adult and infant mortality estimates generated by other studies were the goals addressed by the fourth and fifth hypotheses.

Except for the infant mortality rates for Thailand and Peninsular Malaysia, mortality estimates generated by the RUMM technique for all types of populations were consistent with estimates from other studies.

For example, infant and adult mortalities for both 1975 and 1980 data of the Philippines were shown to be consistent with mortality estimates from other studies. The same was true for estimates of adult mortality for Thailand and Peninsular Malaysia.

In conclusion, the application of the RUMM technique to three different Third World countries clearly showed that the mortality estimates for inferred urban and inferred rural populations were reliable and valid substitutes for urban and rural mortality estimates. Since in most Third World countries, rural and urban tabulations of deaths are absent, then a technique that could provide alternative estimates of rural and urban mortality is necessary.

IMPLICATIONS

Almost all indirect techniques were designed with data limitations and inadequacies in mind. Since all of them began with a premise that data which allow direct calculations of rates do not exist, their data requirement are few and that these required input data are not definite, they can be replaced by alternative data if the ones needed are not available in that particular country.

Since there were no two countries that had exactly the same data, the application of indirect techniques varied from country to country depending on the availability of data. Such was the case of the RUMM technique when applied to the Philippines, Thailand, and Peninsular Malaysia.

While the application of the RUMM technique in these three study countries used specific indices of urbanization and the Brass Growth Balance equation to evaluate death registration, this does not mean that the RUMM technique is dependent on these techniques. Depending on whatever data is available in a specific country, one may use other techniques of evaluating death registration or maybe one might use levels of death registration estimated by other studies. There is no necessity to calculate the death registration adjustment factor if reliable estimates already exist.

Indices of urbanization used in this study are also not definite. They can be replaced by other indicators of urbanization. Again, the RUMM technique is not dependent on whatever technique was used in a specific step.

The RUMM technique in this study was specifically applied to mortality. However, one should remember that it has broader applicability. For example, one can segregate rural and urban births, rural and urban occupations, rural and urban incomes, rural and urban data on health, rural and urban data on nutrition, and many other types of data. Let us take the case of income, for example. In most Third World countries, data on income are not tabulated by rural and urban residence. One may apply the RUMM technique and establish inferred urban and inferred rural incomes. Here, application of the RUMM technique does not require the Brass Growth Balance Equation or any technique to evaluate death registration.

One of the comments this investigator received when part of this paper was presented in a meeting was that this technique can be applied to a sub-national population such as estimation of inferred urban and inferred rural mortality of a province, or a state, or a region. At the time, the investigator agreed that the technique could also segregate rural and urban populations of sub-areas in a country. However, some of the misleading outcomes shown by the Brass Growth Balance Equation for Peninsular Malaysia, may have been the result of its application to a sub-national population. There might have been too much movement between small units within a country. The effects of this movement may not be felt just by looking at the inferred urban or inferred rural populations of a whole country, but may become more magnified or emphasized or focused in smaller units.

Therefore, while one can apply this technique to a sub-national population, one must take into account the stability of the age distribution of that sub-national population; otherwise, the Brass Growth Balance Equation will provide misleading "correction factors." The safest way is not to use any indirect techniques of estimating levels of under-enumeration if the RUMM technique is to be applied to sub-national populations. Levels estimated by the dual-record studies and other surveys are more appropriate because they are not bound by the assumptions of the Brass Growth Balance Equation.

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APPENDIX A

Table A1. Life Tables for Both Sexes, Philippines, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	45.2**	043.3	100000	04326	095683	6459322	64.6
01	07.3	028.4	095674	02720	373175	6363639	66.5
05	01.7	008.5	092954	00791	462790	5900464	64.5
10	01.1	005.3	092162	00487	459594	5527674	60.0
15	01.6	008.0	091675	00735	456538	5068080	55.3
20	02.4	0011.7	090940	01067	452034	4611541	50.7
25	02.9	014.3	089873	01280	446166	4159507	46.3
30	03.5	017.3	088593	01528	439144	3713342	41.9
35	04.4	021.8	087065	01899	430576	3274198	37.6
40	05.8	028.7	085166	02443	419722	2843622	33.4
45	07.5	037.0	082723	03057	405973	2423899	29.3
50	10.2	049.7	079666	03962	388425	2017927	25.3
55	13.0	063.1	075704	04780	366570	1629501	21.5
60	19.3	092.0	070924	06526	338305	1262931	17.8
65	27.5	128.4	064398	08271	301313	0924625	14.4
70	44.0	198.3	056127	11131	252808	0623312	11.1
75	070.6	300.1	044996	13505	191218	0370505	08.2
80	175.7	1000.0	031491	31491	179286	0179286	05.7

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table A2. Life Table for Both Sexes, Inferred Urban, Philippines, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	44.4**	042.6	100000	04255	095753	6545947	65.5
01	07.0	027.2	095745	02606	373859	6450194	67.4
05	01.6	007.8	093139	00724	463885	6076335	65.2
10	01.0	004.7	092415	00438	460982	5612450	60.7
15	01.5	007.3	091977	00669	458214	5151468	56.01
20	02.0	010.0	091308	00909	454270	4693254	51.4
25	02.5	011.3	090400	01127	449180	4238984	46.9
30	03.1	015.4	089272	01373	442929	3789803	42.5
35	04.0	020.4	087899	01758	435102	3346874	37.1
40	05.5	027.2	086141	02341	424855	2911772	33.8
45	07.2	035.3	083801	02959	411604	2486917	29.7
50	10.0	048.1	080841	03890	394482	2075313	25.7
55	12.8	062.2	076952	04783	372800	1680832	21.8
60	19.0	090.7	072168	06542	344488	1308032	18.1
65	28.1	131.3	065627	08617	306590	0963544	14.7
70	41.6	188.4	057009	10741	258192	0656954	11.5
75	61.6	266.8	046268	12345	200476	0398762	08.6
80	171.1	1000.0	033923	33923	198286	0198286	05.9

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table A3. Life Table for Both Sexes, Inferred Rural, Philippines, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	46.3**	044.2	100000	04422	095587	6404262	64.0
01	07.7	029.9	095578	02856	372318	6308675	66.0
05	01.9	009.3	092722	00863	461455	5936358	64.0
10	01.2	005.8	091860	00536	457958	5474903	59.6
15	01.8	008.7	091324	00175	454630	5016945	54.9
20	02.7	013.5	090528	01223	449584	4562315	50.4
25	03.2	016.0	089305	01426	442960	4112731	46.1
30	03.9	016.8	087879	01676	435206	3669771	41.8
35	04.8	020.3	086203	02028	425948	3234565	37.5
40	06.1	030.1	084176	02533	414547	2808617	33.4
45	07.9	038.5	081643	03143	400358	2394070	29.3
50	10.5	051.4	078500	04031	382424	1993712	25.4
55	13.3	064.1	074469	04775	360409	1611288	21.6
60	19.5	093.1	069694	06489	332248	1250879	18.0
65	28.8	134.3	063205	08487	294810	0918631	14.5
70	42.4	191.8	054719	10495	247355	0623821	11.4
75	62.5	270.4	044223	11959	191219	0376466	08.5
80	174.2	1000.0	032264	32264	185247	0185247	05.7

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table A4. Levels of Death Registration for Total Country, Inferred Urban, and Inferred Rural Populations, by Sex, Thailand, 1980 (percent)

Population	Male	Female
Thailand	92.54	80.91
Inferred urban	88.99	76.38
Inferred Rural	77.71	68.20

Table A5. Male Life Table, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	15.4**	015.1	100000	01514	098616	6402279	64.0
01	04.1	016.3	098486	01603	390109	6303662	64.0
05	01.7	008.7	096883	00839	4823168	5913554	61.0
10	01.3	006.2	096044	00598	478722	5431237	56.6
15	02.3	011.7	095445	01115	474439	4952515	51.9
20	03.8	0018.7	094330	01762	467248	4478076	47.5
25	04.0	019.6	092569	01815	458307	4010828	43.3
30	04.5	022.1	090754	02006	448755	3552521	39.1
35	05.3	026.0	088748	02308	437970	3103766	35.0
40	07.3	035.6	086440	03078	424505	2665797	30.8
45	09.7	047.5	083362	03959	406913	2241291	26.9
50	13.4	064.6	079403	05133	384183	1834379	23.1
55	17.4	083.5	074270	06199	355854	1450196	19.5
60	26.5	124.1	068071	08444	319246	1094342	16.1
65	37.5	171.6	059627	10229	272563	0775095	13.0
70	55.1	242.2	049398	11963	217081	0502533	10.2
75	082.0	340.3	037435	12737	155330	0285451	07.6
80	189.8	1000.0	024698	24698	130121	0130121	05.3

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table A6. Female Life Table, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	13.2**	013.1	100000	01307	098809	6887356	68.9
01	04.1	016.2	098693	01598	390780	6788546	68.9
05	01.6	008.2	097094	00793	483490	6397767	65.9
10	01.1	005.5	096302	00528	480187	5914277	61.4
15	01.6	007.8	095773	00749	476994	5434090	56.7
20	01.9	0009.7	095024	00917	472829	4957095	52.2
25	02.0	010.2	094107	00955	468148	4484266	47.7
30	02.6	012.9	093152	01203	462753	4016118	43.1
35	03.3	016.3	091949	01496	456006	3553365	38.6
40	04.7	023.4	090453	02119	446970	3097359	34.2
45	06.4	031.4	088335	02769	434750	2650390	30.0
50	09.1	044.7	085565	03823	418269	2215640	25.9
55	12.4	060.0	081742	06004	396442	1797371	22.0
60	18.4	087.7	076834	06740	367321	1400929	18.2
65	26.6	124.7	070094	08738	328625	1033608	14.8
70	42.1	190.3	061356	11673	277597	0704983	11.5
75	064.9	279.0	049683	13862	213759	0427386	08.6
80	167.7	1000.0	035821	35821	213627	0213627	06.0

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table A7. Male Life Table, Inferred Urban, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	21.8**	021.4	100000	02142	098081	6372953	63.7
01	03.6	014.3	097858	01397	388063	6274872	64.1
05	01.5	007.5	096461	00721	480503	5886810	61.0
10	01.2	005.4	095740	00539	477412	5406307	56.5
15	02.4	011.5	095225	01145	473259	4928896	51.8
20	04.1	0020.1	094079	01891	465670	4455636	47.4
25	04.5	022.4	092189	02065	455781	3989967	43.3
30	04.9	024.0	090124	02164	445210	3534185	39.2
35	05.4	026.8	087960	02356	433911	3088975	35.1
40	06.9	034.0	085604	02912	420742	2655064	31.0
45	09.8	047.8	082693	03951	403585	2234323	27.0
50	12.0	058.4	078741	04598	382212	1830738	23.3
55	17.0	081.4	074143	06035	355630	1448525	19.5
60	26.7	124.9	068108	08509	319271	1092896	16.1
65	38.1	173.9	059600	10361	272096	0773625	13.0
70	54.1	238.3	049228	11732	216862	0501529	10.2
75	083.2	344.3	037506	12912	155251	0284668	07.6
80	190.0	1000.0	024594	24594	129417	0129417	05.3

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table A8. Female Life Table, Inferred Urban, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	20.2**	019.9	100000	01985	098232	6928341	69.3
01	03.4	013.6	098015	01329	388724	6830109	69.7
05	01.4	006.9	096685	00670	481752	6441385	66.6
10	00.8	004.1	096016	00393	479096	5959632	62.1
15	01.3	006.7	095623	00639	476518	5480536	57.3
20	01.8	009.2	094984	00870	472747	5004019	52.7
25	02.0	010.0	094114	00918	468278	4531272	48.2
30	02.3	011.2	093197	01043	463377	4062994	43.6
35	03.2	014.7	092154	01592	457102	3599618	39.1
40	04.3	021.0	090687	01907	448666	3142516	34.7
45	05.8	028.6	088780	02542	437544	2693850	30.3
50	08.4	041.0	086238	03535	422351	2256306	26.2
55	12.3	059.4	082703	04915	401226	1833955	22.2
60	17.8	085.3	077788	06635	372350	1432729	18.4
65	26.2	123.1	071152	08757	333868	1060379	14.9
70	39.9	181.4	062395	11319	283678	0726510	11.6
75	064.3	276.9	051076	14145	220019	0442832	08.7
80	165.8	1000.0	036931	36931	222814	0222814	06.0

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table A9. Male Life Table, Inferred Rural, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	16.3**	016.0	100000	01602	098540	6129472	61.3
01	05.1	020.2	098398	01983	388841	6030932	61.3
05	02.2	010.7	096415	01036	479484	5642091	58.5
10	01.6	007.7	095379	00636	475054	5162607	54.1
15	02.8	013.9	094643	01311	469935	4687553	49.5
20	04.3	021.1	093332	01967	461740	4217618	45.2
25	04.6	022.5	091365	02055	451685	3755878	41.1
30	05.2	025.8	089309	02305	440783	3304193	37.0
35	06.3	030.9	087004	02685	428307	2863410	32.9
40	08.8	036.4	084319	03642	412487	2435103	28.9
45	11.7	056.7	080676	04570	391956	2022616	25.1
50	16.5	079.2	076106	06030	365455	1630660	221.4
55	21.1	100.0	070076	07010	332856	1265204	18.1
60	31.7	146.9	063066	09262	292176	0932349	14.8
65	44.9	201.7	053804	10851	241893	0640173	11.9
70	66.6	285.5	042953	12263	184106	0398280	09.3
75	098.1	393.8	0306.9	12085	123236	0214174	07.0
80	204.6	1000.0	018605	18605	090938	0090938	04.9

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

Table A10. Female Life Table, Inferred Rural, Thailand, 1980

Age*	1000 $_nm_x$	1000 $_nq_x$	$_nl_x$	$_nd_x$	$_nL_x$	T_x	e_x
00	13.7**	013.6	100000	01356	098767	6603070	66.0
01	05.2	020.3	098644	02006	389564	6504303	65.9
05	02.1	010.2	096638	00985	480725	6114739	63.3
10	01.4	007.0	095652	00667	476593	5634015	58.9
15	02.0	010.2	094985	00964	472515	5157422	54.3
20	02.4	0011.8	094021	01108	467336	4684907	49.8
25	02.5	012.4	092913	01154	461682	4217571	45.4
30	03.3	016.2	091759	01484	455087	3755889	40.9
35	04.0	019.7	090276	01779	446931	3300802	36.6
40	05.9	029.1	088497	02573	436053	2853870	32.3
45	07.9	038.5	085924	03312	421341	2417818	28.1
50	11.3	054.8	082612	04528	401743	1996476	24.2
55	15.0	072.1	078085	05630	376348	1594733	20.4
60	23.1	109.2	072455	07908	342502	1218385	16.8
65	32.2	148.9	064546	09612	298701	0875883	13.6
70	51.6	228.5	054934	12551	243292	0577182	10.5
75	078.5	328.1	042383	13908	177144	0333890	07.9
80	182.7	1000.0	028475	28475	156746	0156746	05.5

*00 = under one year of age; 01 = one through four years of age; 05 = five through nine years of age, etc.

**Age-specific death rate.

APPENDIX B

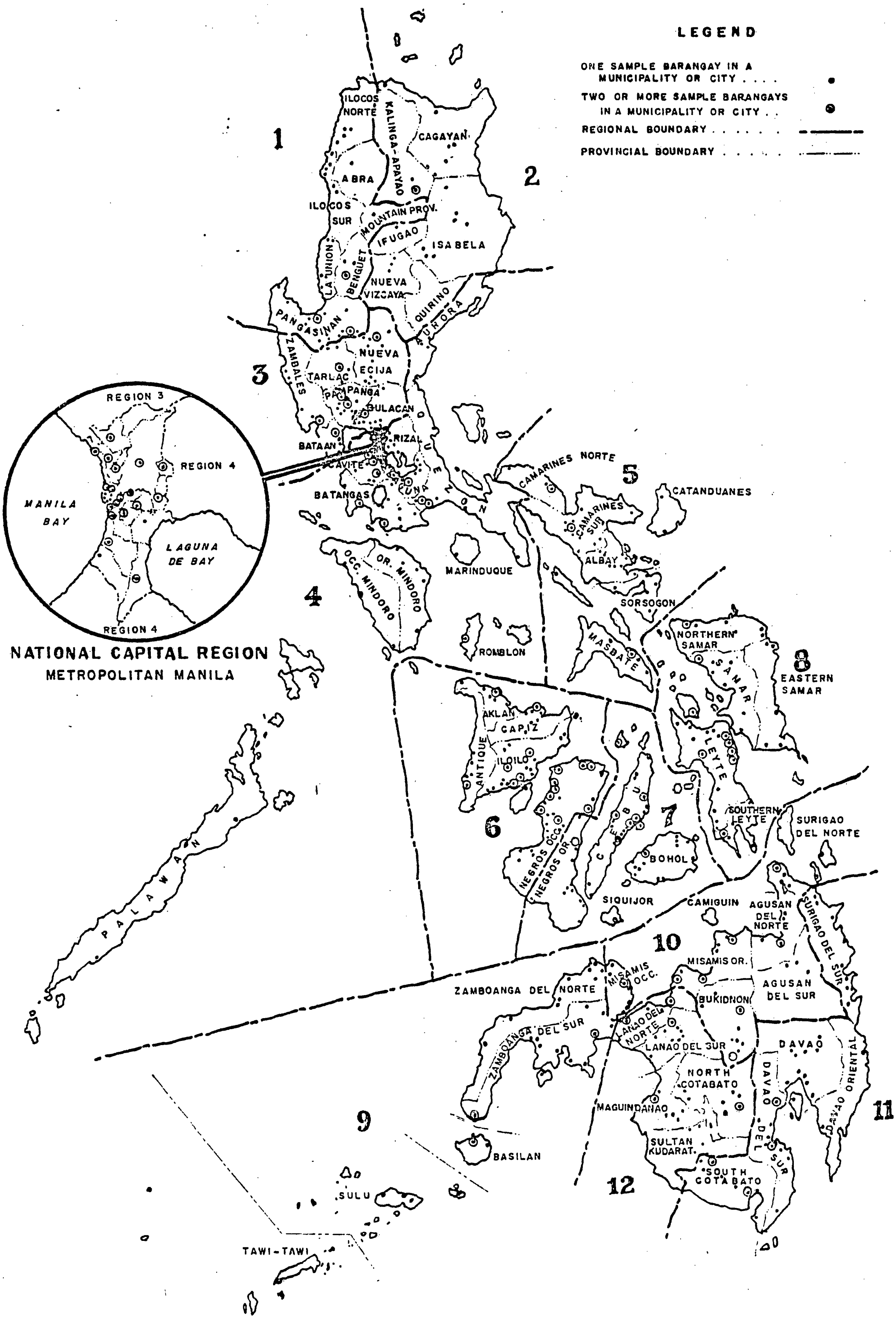

Figure B1. Regional Divisions of the Philippines

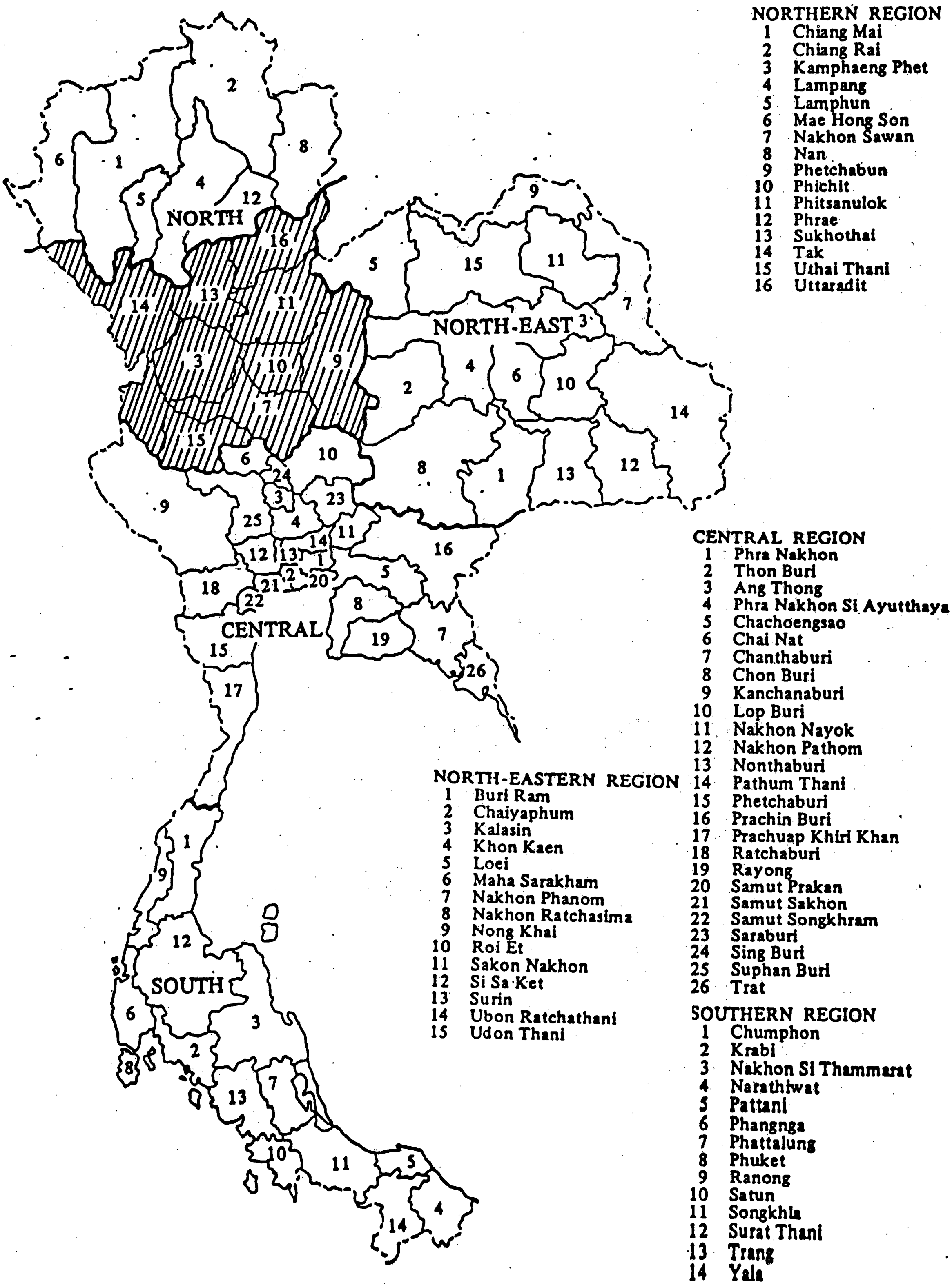

Figure B2. Regional Divisions of Thailand

Figure B3. Administrative Divisions of Peninsular Malaysia

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