**A Multiple Decrement Life Table Analysis of Respiratory
Related Mortality in Ontario
for the Periods 1975-77, 1985-87 & 1995-97**

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**A Thesis Submitted to the Faculty of Graduate Studies
in Partial Fulfillment for
the Degree of Master of Arts**

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Abstract

This exploratory study examines structural variations in respiratory related mortality for the province of Ontario between 1976 and 1996. Multiple decrement life tables containing approximations of continuous hazard and density functions are the main analytical tools. Males experienced declines in respiratory related mortality hazards over the 20 year period. Conversely, females experienced large increases in respiratory related mortality hazards, especially with respiratory related cancers. A common pattern among males and females regarding respiratory related deaths was that the relative frequency of death declined throughout middle and early late adulthood, but increased at the advanced age groups. Consequently, deaths due to respiratory related diseases were occurring at higher ages over time. It was also found that the data on bronchitis, emphysema and asthma for [1976] and [1996] were not comparable. A change in coding practices among physicians was the probable reason for lack of comparability over time and between ICDA revisions.

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Chapter 1

Introduction

1.1 Purpose of the Study

The purpose of the study is to model the structural variations of respiratory related mortality in Ontario over a 20 year period. There are two primary objectives of the mortality analysis. The first objective is to construct single decrement and multiple decrement life tables of Ontario by gender for the periods 1975-77, 1985-87 and 1995-97. The choice of the time span was an arbitrary decision. At this point, my concern is to develop an effective method to analyze structural variations in mortality over time. Second, the main analytical tools will consist mainly of the hazard rate and probability density functions. Graphical applications of the hazard and density functions will be used to provide a detailed description of the structural variation in respiratory related mortality over the 20 year period. Thus, all of the necessary tools needed are available to provide the framework for a detailed analysis of respiratory diseases mortality in Ontario. This life table analysis is exploratory in nature because there are no comparisons available regarding structural variations of mortality using the hazard and density functions in the province of Ontario or Canada.

1.2 Multiple Decrement Life Tables

The multiple decrement life table (MDLT) is a statistical tool used by demographers, actuaries, biostatisticians and many others. Traditionally, the MDLT is used for measuring such events as cause specific probabilities of death, the expected proportion of deaths for each cause and so forth. Essentially, the MDLT allows the researcher to follow a synthetic cohort from birth to death by subjecting this cohort to the

observed population mortality rates for a specific period. However, the MDLT is a multifunctional tool because of its many possible applications in the analysis of cause specific mortality. The key here is that the MDLT can be used to model the structure of cause specific mortality through graphical applications of the various life table functions. These visual aids will create a concrete and visible model of an intangible structure operating in social reality. In turn, the model will allow for an easier understanding of the mortality process because we can visualize the operation of the mortality process throughout the life span.

Multiple decrement life tables can play an important role in aiding the understanding of old age mortality. Particularly, my interests concern the mortality patterns of respiratory related diseases over time. The Canadian population is growing older, as do most populations in almost all 'developed nations'. This aging effect means that as the aggregate entering late adulthood increases, the chances also increase of individuals dying from degenerative diseases, such as respiratory related ones. I feel it is necessary to gain an understanding of the changes in the structural components of respiratory related mortality over time. This task should be done before we embark on analyses of social conditions or possible cohort effects, which contribute to the mortality patterns of respiratory related diseases. Examination of the structural changes over the life span will give insight and direction, which will lead to ideas and questions concerning the social conditions contributing to mortality patterns. However, the social conditions or cohort effects contributing to increases or decreases in respiratory related mortality will be dealt with in subsequent studies. The first step is to expand a set of

methods that measure the risk and structure of death throughout the life span. The MDLT seems to be well suited for this task.

1.3 Outline of Subsequent Chapters

In Chapter 2, I discuss the literature on respiratory related mortality in sociology and demography. It should be noted that there are very few pertinent sources found in these disciplines. I will also discuss the methodological literature, which is relevant to my topic. In Chapter 3, I identify the sources of data and address the issues of comparing mortality between revisions of the International Classification of Diseases (ICD). There is also the introduction of a method to extend the open-ended age group. In Chapter 4, I give the methods and assumptions used to construct single and multiple decrement life tables with a special emphasis on the hazard rate and probability density functions. In Chapter 5, I show the results of the structural variation in respiratory related mortality in Ontario over the 20 year period. I also discuss a problem in regards to making accurate comparisons of bronchitis, emphysema and asthma between ICD revisions. In chapter 6, I give a summary of the results and problems associated with the data, namely the inability to compare bronchitis, emphysema and asthma over time. In addition, I outline my future research directions and go over some practical limitations of the MDLT method.

Chapter 2

Literature Review

2.1 Trends in Respiratory Disease Mortality

I could not locate any relevant Canadian studies in the sociological or demographic literature pertaining to the structure of respiratory disease mortality. The limited amount of information on the Canadian trends of respiratory disease mortality was obtained from Health Canada and the Ontario Lung Association. Health Canada recently produced a report on the trends of respiratory diseases in Canada between 1987 and 1998 (Health Canada 2001). This report included some general trends of mortality for the main types of respiratory diseases. The diseases of interest include lung cancer, pneumonia, influenza, and chronic obstructive pulmonary disease (COPD). The trends discussed here apply to all of Canada. Nevertheless, these patterns will provide an insight into the trends that occurred in Ontario because they should be similar to all of Canada.

Lung cancer is the leading type of cancer death among males and females. It accounted for approximately 30% of all cancer deaths among males and 20% among females by 1998 (2001: 57). Females had stable lung cancer mortality rates in the 45 to 64 age group between 1987 and 1998. However, the mortality rates of lung cancer increased among females over the age of 65 during the same period. Conversely, males experienced declines in lung cancer mortality rates between 1987 and 1998. Levi et al. (2001) found similar mortality patterns occurring between the ages of 65 and 84 in the United States and Western Europe. It appears that lung cancer has become an increasingly large health problem among females in the highly industrialized nations.

Nevertheless, the mortality rates of lung cancer remained considerably higher among males over all age groups

Pneumonia and influenza are the leading infectious cause of death and the sixth leading cause of death overall in Canada (Health Canada 2001: 70). Generally, pneumonia and influenza mortality rates increase rapidly with age. The Health Canada report indicated that mortality rates of pneumonia and influenza increased for both sexes over 85 years of age and remained stable over all other age groups between 1987 and 1998. However, males continued to have higher mortality rates than females beyond 65 years of age over the 11 year span.

Chronic Obstructive Pulmonary Disease (COPD) includes a range of lower respiratory diseases primarily composed of chronic bronchitis, emphysema and sometimes asthma. In recent times, COPD is mainly composed of chronic bronchitis and emphysema. COPD is the fourth leading cause of death among males and the seventh among females in Canada. The numbers of deaths attributed to COPD have quadrupled since 1971 (Ontario Lung Association). Generally, mortality rates of COPD increase sharply beyond 70 years of age. The mortality rates of females increased between 1987 and 1998. Males also experienced an increase in mortality rates beyond 80 years of age and a decrease in the preceding age groups over the 11 year span. Overall, lung cancer is a major cause of death in the 45 to 64 age groups, COPD in the 65 to 84 age group and pneumonia and influenza contribute a high proportion of deaths beyond 85 years of age (Health Canada 2001: 6)

The report produced by Health Canada provides a basic insight into the trends of mortality from respiratory diseases. An important aspect of this report is that it indicates

that the number of deaths from respiratory diseases will increase as the population ages because these diseases primarily affect the older segment of the Canadian population (with the exception of lung cancer). Thus, I feel it is very important to monitor the structural variations in respiratory diseases mortality over time. In this way, it will be easier to identify the specific segments of a population that are at the greatest risk of dying from each of the particular respiratory diseases. Furthermore, analyzing the changes in the structure of mortality over time will allow for some insight into the degree of progress in regards to the reduction of mortality from these causes.

2.2 A Neglected Method

An effective method for analyzing the structure of disease categories in detail and the mortality experience of a population as a whole is a multiple decrement life table (MDLT). There are a number of books on demographic methods that contain chapters on the methods of MDLT construction (Preston et al. 2001, Hinde 1998, Namboodiri & Suchindran 1987, Manton & Stallard 1984, Elandt-Johnson & Johnson 1980). The methods of MDLT construction outlined in the textbooks adequately show various approaches to constructing a multiple decrement life table. However, the life table functions and the graphs produced from the functions remain at the stage of construction. In other words, the various functions of MDLTs are defined to give their general meanings, but these texts lack a detailed interpretation or description of the functions and corresponding graphs. The life table functions and corresponding graphical applications contain valuable information, which must be materialized through a detailed description of the mortality experience of a population. Thus, there is not much help in terms of a

definitive method, which provides a procedure of conducting a detailed interpretation of the life table functions and corresponding graphical applications.

Unfortunately, there are not many cause specific mortality studies found in the sociological or demographic literature that apply the use of multiple decrement life tables. I could not locate any Canadian studies that dealt specifically with multiple decrement life tables. However, I located a multinational study and a study conducted on the United States. Preston et al. (1972) conducted the multinational study of 180 nations using multiple decrement life tables. This study consisted of a conglomeration of time series MDLTs for ‘various national populations’ with 12 underlying causes of death (e.g. cardiovascular, respiratory tuberculosis, neoplasms, motor vehicle accidents etc.). It contained MDLTs for Canada through the periods of 1921 to 1964. Note that *Statistics Canada* has produced single decrement life tables for Canada and the provinces since 1921. Nevertheless, I chose to construct my own life tables for the learning experience. Simply, I feel that constructing life tables from scratch will enable a better understanding of the various life table functions.

The methods texts and the Preston et al. study provide the framework for a detailed analysis of the mortality experience a population from various causes of death. However, I had one main concern with the methods texts and the study. The cause of death categories in the methods textbooks (with the exception of Manton & Stallard 1984) and some of the categories in the Preston et al. study (e.g. cardiovascular diseases, neoplasms etc.) remained in their general groupings. The construction of MDLTs with general categories is fine when one wishes to compare the overall population effect of different categories of death (e.g. heart disease, neoplasms, respiratory diseases etc.).

However, each cause of death category contains a number of other causes of death that make up the general category. For instance, the category of respiratory diseases includes pneumonia, influenza, emphysema, bronchitis, asthma, chronic airways obstruction and many other minor causes of death that make up the total number of respiratory disease deaths. The general cause of death categories creates the problem of overly generalized information on the overall mortality structure on the age and gender composition of a population. The reason for the overly general information is that each cause of death within a general category may act differently (i.e. exposure to the risk or transition rate) on the population than the other causes within the same category. In order to account for these differential population effects, we need to break a particular disease category into its component parts and study the effects of each of the contributing causes of death independently. Thus, I want to use the multiple decrement life tables to analyze specific types of respiratory related deaths by dividing the general respiratory diseases category into the major causes of death contained within that category. The MDLT is a well suited tool because an assumption of the MDLT is that each cause of death is acting independently of one another.

The study conducted on the United States by Manton & Stallard (1980) is more detailed and complex because it included the contributory causes as well as the underlying cause of death indicated on the death certificate. Their methods textbook also uses a similar approach and contains a more detailed division of various types of cardiovascular diseases (Manton & Stallard 1984). In their study, Manton & Stallard (1980: 189) analyzed the effects of 'diabetes and generalized atherosclerosis on death due to ischemic heart disease or stroke'. I can only construct MDLTs that include the

underlying cause of death because data on the contributing causes of death are not available in Canada.

A limitation of Manton and Stallards' study was that it focused exclusively on the cause specific life expectancies. Manton & Stallard (1980: 191) defined the cause specific life expectancies as the 'mean age at death from a specific cause'. Preston et al. (2001:72) indicate that cause specific life expectancies do not provide a straightforward interpretation because the proportion of the cohort that will eventually die from cause i , cannot be identified at age x . The individuals can only be known after deaths from various causes have occurred. They indicate that it is 'pointless to calculate the expectation of life for unidentifiable individuals'. Moreover, using the life expectancy function does not give a representation of a population's mortality structure. It only can give an average age at which a person will die from a specific cause of death. I feel that graphical applications of various life table functions will produce an adequate approximation of a population's mortality structure.

There have been some developments with the methods of life table construction in biostatistics (Elandt-Johnson & Johnson 1980, Manton & Stallard 1984) and to some extent in demography (Namboodiri & Suchindran 1987, Hinde 1998). The life table is a 'discrete-time model' because age is measured in completed years (Manton & Stallard 1984). The way that vital statistics are recorded and published makes it seem that death does occur in a discrete fashion (Hinde 1998: 35, Preston et al. 2001: 59). For instance, the ages at death are commonly published in discrete age groups (e.g. the number of deaths in 5 year age intervals). The discrete assumption also means that all deaths are assumed to occur at mid-year because the population is a mid-year estimate. Thus, it

seems that deaths can occur throughout a limited number of finite or countable age groups and only during one time of the year. However, death is theoretically considered a continuous process where it occurs at an instantaneous rate throughout the age span. In other words, death or the transition from the alive to the dead state can occur at any time throughout the age span. Hence, the concept of death as a continuous process is actually more consistent with the way that death operates in reality.

Note that the concept of a continuous process is a mathematical idealization because continuous processes cannot be observed directly in reality. The approximations of any event are always discrete because we only have the capacity to handle “finite numbers of real things” (Hays & Winkler 1971: 120). Nevertheless, approximations can be made to model the underlying continuous processes occurring in reality. The risk of death and the actual event of death within the life span are assumed to be continuously increasing with age, regardless if age is measured in discrete intervals. For instance, let us assume that a person dies and the physician records the age at death as 50 years old. However, in reality that person may be 50 years, 3 months and 13 days old. A condition of a continuous process is that there is zero probability of dying at an exact age. In reality, individuals probably hardly ever die at exact age x . Thus, death is considered to be occurring continuously throughout the age span and should be modeled as a continuous process.

Elandt-Johnson & Johnson (1980) and Manton & Stallard (1984) presented some functions that can be used in the life table to make it approximate a ‘continuous time model’. Essentially, the underlying process that governs the life table functions is considered to be continuously increasing with age (Elandt- Johnson & Johnson 1980,

Manton & Stallard 1984). This continuously increasing rate of change is referred to as the *hazard function* or in demography the *force of mortality* (see section 4.2). The hazard function is simply the transition rate from the alive to the dead state (i.e. the person years of exposure to the risk of death or the instantaneous (relative) death rate). These concepts are also accepted and discussed fully in the demographic methods of life table construction (Preston et al. 1972, Namboodiri & Suchindran 1987, Hinde 1998, Preston et al. 2001). However, the continuous approximation of the hazard function is not usually included in multiple decrement life tables and is approximated with a slightly different approach (see section 4.2).

Generally, measures commonly used in survival analysis are incorporated into the life table to be used in conjunction with the traditional discrete measures. Kleinbaum (1996: 4) defines survival analysis as the statistical modeling of data where the variable of interest is the time (e.g. age at death) until the event (e.g. death) occurs. Essentially, it is a close relative of the life table, but models the age of death as a continuous random variable and allows for inference about the distribution of this random variable. Survival analysis is based on three mathematically related functions. The measures are the **hazard function** (probability of failure at time x , given survival until time x), the **survivor function** (survival until time x) and the **probability density function** (probability of failure at time x). My concern is with the hazard and density functions. Note that Namboodiri & Suchindran (1987) include the probability density function for the construction of multiple decrement life tables.

Manton & Stallard (1984: 80) indicate that it is useful to include the hazard function in the MDLT even if there is no concern with modeling death as a continuous

process. The reason is that the proportional hazards contain additive properties. Simply, the additive property of the hazard function makes it compatible with the additive nature of the multiple decrement life tables. The probability density function does not contain additive properties. Nevertheless, it is a very useful function to include in the life table. Moreover, some of the traditional life table functions have unintuitive meanings when they are used to measure multiple causes of decrement (Preston et al. 2001). The meanings associated with the hazard and density functions remain straightforward. Thus, these functions are easy to interpret and are effective measures for modeling the structural variations in cause specific mortality over time. In addition, incorporating these measures into the life table will enable an examination of the variation in the exposure to the relative risk and the relative frequency of death that a synthetic cohort experiences throughout a lifetime.

Chapter 3

Data

3.1 Data Sources

The underlying causes of death by age and gender for Ontario during the periods of 1975-77 and 1985-87 are from the annual publications of *Ontario Vital Statistics*. The definition of the underlying cause of death is “the disease or injury, which initiated the train of morbid conditions leading directly to death” (Elandt-Johnson & Johnson 1980: 270). The Ontario mortality data for the periods of 1995-97 have been taken from the *University of Ottawa Data Services* web site. The data are located in the *Health Statistics at a Glance-Health Indicators 1999* database, which included the deaths by underlying cause, age, gender, Canada, provinces and territories between 1991 and 1998. Population estimates for the defined periods are located in the same database. Note that I used mid-year population estimates to construct the multiple decrement life tables. The population estimates of 1975-77, 1985-87 and 1995-97 are postcensal estimates and adjusted with the population estimates of the 1996 census (Refer to Appendix A, Tables 1.1 through 4.6 for the population estimates and mortality data).

3.2 Development of Multiple Decrement Life Table Categories

The 8th revision of the *International Classification of Diseases, Adapted* (ICDA-8) was the standard classification system used by Canadian medical certifiers to determine the underlying causes of death in 1975-77. Conversely, the ICDA-9 was the classification system used to determine the underlying causes of death during the 1985-87 and 1995-97 periods. ICDA means that the International Classification of Diseases was adapted (or changed) for use in the United States. Canadian medical certifiers began

using the ICDA in 1969. The fact that the ICDA is revised approximately every 10 years and I had to use two different revisions posed some problems in regards to making accurate comparisons of the mortality experience over time. The World Health Organization (WHO) indicates that mortality data cannot be directly converted between ICD revisions. There may be large differences between the revisions due to changes in the methods used to classify certain diseases. In addition, there may be modifications in the selection rules for determining an underlying cause of death when multiple causes are indicated on a death certificate.

A way to deal with the changes in coding procedures is to use an approach called 'bridge coding' or 'comparability studies'. The principle of this method is to use both ICD revisions to code all deaths or a sample of deaths during a single year in order to make comparability ratios for each of the causes. A comparability ratio of 1.00 indicates that equal numbers of deaths were classified to a particular cause in both revisions. A ratio of less than 1.00 could mean a decrease in the assignment of deaths in the 9th revision as compared with the 8th revision and/or the categories are different in the 9th as compared to the 8th revision. Conversely, a ratio greater than 1.00 indicates an increase in the number of deaths in the 9th revision as compared with the 8th or the classifications encompass a broader range of diseases than the 8th revision (National Centre for Health Statistics 1980: 2). Essentially, the comparability ratio is an estimate of the discontinuity or congruence between the classifications of deaths using both revisions of the ICDA (National Centre for Health Statistics 1980). Section 1.2 in Appendix A shows the comparability ratios between the 8th and 9th revisions of the ICDA. It also gives a detailed account of the changes made to the classification system between the revisions.

No studies on this subject have been conducted using Canadian mortality data. However, the National Centre for Health Statistics (NCHS) in the USA conducts comparability studies when the WHO produces new revisions of the ICD. Since Canada and the USA are both member states of the World Health Organization, the comparability ratios should be similar between the two countries. Furthermore, Canada uses the ICDA, which was first adopted for use in the USA. Thus, the coding schemes of both nations should be similar because the same guidelines are followed for determining the underlying causes of death. Therefore, it should be acceptable to take these comparability ratios at face value with Canadian mortality data.

In 1976, the NCHS conducted a comparability study with a sample of 137,292 records and coded the underlying causes of death with both the 8th and 9th revisions of the ICDA. The NCHS study suggests that the modifications between the 8th and 9th revisions of the ICDA will create problems with direct comparisons over time. Malignant neoplasms of the respiratory organs are exempt from these problems. On the other hand, diseases of the respiratory system need adjustments because of the differences between the revisions and corresponding comparability ratios.

A further problem is that Ontario Vital Statistics publishes the causes of death with the intermediate ("A" List) or in abbreviated form (the intermediate list of diseases of the respiratory system consists of ICDA-8: A89-A96, ICDA-9: A163-A178). The intermediate ICDA-8 list contains less detail than the "A" list of ICDA-9. Fortunately, the intermediate list of ICDA-9 gives the diseases transferred to other classifications between the 8th and 9th revisions. Hence, the only conceivable solution to make the

alternatively coded periods comparable would be to convert the classification system of the 9th revision into the classifications of the 8th revision.

The exception is with the category of pneumonia and influenza. Pneumonia and influenza will be kept the way it was classified in ICDA-9. The reason is that the ICDA-8 had pneumonia and influenza under separate classifications. I feel that they should be combined because Health Canada et al. had them combined in their report. There is one minor problem associated with the pneumonia and influenza category. *Pneumonotosis due to solids and liquids* was removed from the category of pneumonia in ICDA-9 and transferred under a separate classification (ICDA-9: 507). This category cannot be distinguished in ICDA-9 because the intermediate list has that classification combined with other classifications not related to pneumonia. However, there are a small number of deaths attributed to this cause in any given year. Thus, the absence of this category should only cause minor problems in regards to making accurate comparisons of mortality trends between the ICDA revisions.

COPD is measured using a combination of ICDA-8: 490-493 & 519.3 or ICDA-9: 490-492 & 496. Unfortunately, I will not be able to directly measure the structural variations of COPD over the 20 year period. The reason is that the abbreviated list of ICDA-8 does not provide distinguishable properties, which would allow COLD or 519.3 to be isolated. The intermediate list of ICDA-8 has COLD or 519.3 grouped with other respiratory related deaths under the *other* classification (ICDA-8: A96). *Chronic Airways Obstruction, not else classified* (ICDA-9: 496, which was formerly ICDA-8: 519.3) will be moved into other respiratory diseases category of the MDLTs to make it consistent with ICDA-8. A limitation is that a great level of detail is lost because chronic airways

obstruction is a major cause of death within the respiratory diseases classification. The only solution here is to examine the major diseases that make up COPD. These are chronic bronchitis, emphysema and sometimes asthma. The intermediate list of ICDA-8 has bronchitis, emphysema and asthma combined under a single classification. These diseases will be combined in the periods coded under ICDA-9 to make them comparable with ICDA-8. This procedure should negate the linkage change between ICDA-8 and ICDA-9 that resulted in an increase in the number of asthma deaths and a decrease in the number of emphysema and bronchitis deaths.

Table 3.1 Categories used for the Multiple Decrement Life Tables

Category	Abbreviation	Definition
<i>All Respiratory Related Diseases (ICDA-8: 460-519, 160-163)</i>	<i>all_res</i>	<i>n/a</i>
<i>Malignant Neoplasms of the Respiratory Organs (ICDA-8: 160-163)</i>	<i>neo</i>	<i>Occurs as a primary tumor originating in the respiratory organs or metastasis from cancer in other body tissues.</i>
<i>Pneumonia & Influenza (ICDA-9: 480-487)</i>	<i>pneu</i>	<i>Infection of the lung parenchyma that may be caused by bacterial, viral or fungal organisms.</i>
<i>COPD (Bronchitis, Emphysema, Asthma) (ICDA-8: 490-493)</i>	<i>bea</i>	<i><u>Bronchitis</u>: a persistent cough for at least 3 months of the year for 2 consecutive years ...leading to a progressive decrease in airflow.</i> <i><u>Emphysema</u>: abnormal dilatation of the distal air spaces.</i> <i><u>Asthma</u>: diffuse airway inflammation and Bronchospasm that may occur in response to various stimuli...a reversible airway obstruction.</i>
<i>Other Respiratory Diseases (ICDA-8: 460-466, 500-519)</i>	<i>oth_res</i>	<i>n/a</i>
<i>All Other Causes (All except those defined above)</i>	<i>residual</i>	<i>n/a</i>

Source: Wilkins et al. 2001, pp. 19, 49, 67, 87, 115

The other respiratory diseases category of the multiple decrement life tables will consist of the classifications that did not relate to the ones defined above and the

classifications that were not distinguishable due to the intermediate or “A” list. Table 3.1 gives a general description of the categories used in the multiple decrement life tables.

3.3 Other Issues with the Data

When analyzing respiratory diseases mortality it becomes apparent that the majority of respiratory related deaths occur during late adulthood. The data for the periods of 1976 and 1986 have an open-ended age interval of 85+, while 1996 has an open-ended age interval of 90+. This leads to an issue of consistent comparability over the 20 year period. There are two options to be able to have consistent comparisons over time. The first and easier option would be to make all periods have an open-ended interval of 85+. A problem here is that I would lose a considerable amount of detail in the analysis.

The second option is to estimate the 85 to 89 age group for the periods of 1976 and 1986. This option would extend the open-ended age interval to 90+ for all periods. I decided to extend the open-ended age interval during these periods. There were two main reasons for this decision. First, the majority of respiratory related deaths occur during the older age groups. Thus, an effective and detailed analysis of respiratory related mortality requires an age span that is as complete as possible. Second, the cause specific probability density functions cannot equal unity because the age span is not complete. However, extending the open-ended age interval will give a more complete age span and thus, more complete probability distributions. Simply, the density function is one of the main analytical tools. Thus, I need a larger age span to show the majority of the distribution of age at death to provide meaningful interpretation. Refer to Appendix B for the method of extending the open-ended age interval for the periods of 1976 and 1986.

Chapter 4

Methods

4.1 Median Number of Deaths and Mid-Period Population Estimates

I decided to use the median number of deaths by age group, per 3 year periods and the mid-period populations (the census years) to construct the life tables. The fluctuation of the age specific number of deaths for each cause was my primary reason for choosing the median number of deaths over the mean number of deaths. It becomes apparent that the number of deaths by certain age groups tend to fluctuate over the 3 year periods when examining the cause specific death categories (refer to Appendix A, Tables 1.2 through 1.6). Simply, the median is the “most serviceable measure” for descriptive statistics (in the absence of inference on population parameters). The median contains the property of “representing the typical value”, which make it a better estimator than the mean value for descriptive purposes (Hays & Winkler 1972: 150-151).

The reason for the advantage of the median is that the mean is sensitive to extreme values and large fluctuations in the number of deaths may increase the chance of potential bias in the estimates. However, erratic shifts in the number of deaths (for all causes) tend to be improbable in nations with “complete” death registration or where there tend to be no sudden occurrences of uncontrollable or detrimental events (e.g. wars, famines etc.). Thus, the mean number of deaths may be more suited for all cause mortality. Nevertheless, I decided to use the median number of deaths to construct both the single and multiple decrement life tables for purposes of consistency. Furthermore, if the population is growing at a linear rate, then the age specific death rates (${}_n m_x$) and life expectancies (e_x) computed with either method should be identical within a few decimal

places. For instance, Shryock et al. (1976: 225) indicate that using the mid-period (census year) population should be equivalent to the average population when there are “no sharp fluctuations” in the population size. Appendix B gives a comparison of single decrement life tables calculated with the median and mean number of deaths for the period of 1995-1997. Generally, Appendix B shows that the property (constant rate of occurrence) seems to hold true for the number of deaths and population size because either of the methods produces identical estimates within a few decimal places.

4.2 Single Decrement Life Tables

A period life table estimates the probability of survival or death throughout the lifespan of a hypothetical cohort (Keyfitz & Frauenthal 1975: 889, Shryock et al. 1976: 249, Preston et al. 2001: 38). Generally, the life table shows the mortality experience of a synthetic cohort ‘subjected’ to a stationary pattern of age specific mortality rates. The mortality experience of the synthetic cohort can be generalized to the actual population for the period(s) of interest. The reason for the generalization is that the age specific death rates (${}_n m_x$) of the life table are assumed to be the actual death rates (${}_n M_x$) observed in the population (there may be some bias between the two estimates). Simply, the age specific mortality rates are estimated from vital statistics and census based population estimates (Shryock et al. 1976). Thus, the mortality experience of an actual population can be approximated through an examination of a synthetic life table cohort (${}_n M_x = {}_n m_x$).

There are many different methods available to construct life tables. The methods of life table construction in this analysis are derived from a variety of sources. I assume that none of the available methods are superior to the others. I only chose this particular

method because it seemed to be the most straightforward way of constructing a life table. The objective here is to go quickly through the methods of construction in discrete notation. For more detailed analyses of the methods and theory of life tables, refer to Preston et al. (2001) pp.38-91, Namboodiri and Suchindran (1987) pp. 93-136, Elandt-Johnson & Johnson (1980) pp. 83-149, Manton & Stallard (1984) pp. 70-182, Keyfitz & Frauenthal (1975), Keyfitz (1966) and for overall methods refer to Shryock et al. 1976 pp.249-272.

Computation of the age specific mortality rates or ${}_n m_x$ is the first step in the construction of a life table. The age specific mortality rate is defined as the death rate in the age interval x to $x+n$ and obtained from:

$${}_n m_x = \frac{{}_n D_x}{{}_n P_x} \quad [4.2.1]$$

where ${}_n D_x$ is the age specific median number of deaths and ${}_n P_x$ is the age specific mid-period (census year) population. Next, the age specific mortality rates are ‘converted’ into age specific probabilities of death (${}_n q_x$). The probability of death function becomes the basis of all other life table functions and is defined as the probability of dying within age interval x to $x+n$, given survival until age x . The ${}_n q_x$ values are computed with the formula (Keyfitz 1966:307, Preston et al. 2001:47):

$${}_n q_x = \frac{{}_n m_x}{1 + ({}_n a_x) {}_n m_x} \quad [4.2.2]$$

where n is the length of the age interval and ${}_n m_x$ is the age specific mortality rate.

The ${}_n a_x$ values represent the average person years lived in the age interval x to $x+n$, for persons dying in the interval. A quadratic function of ${}_n d_x$ is used to compute ${}_5 a_5$ to ${}_5 a_{85}$ (Keyfitz 1966:307):

$${}_n a_x = \frac{n}{2} + \frac{n}{24} \left(\frac{{}_n d_{x+n} - {}_n d_{x-n}}{{}_n d_x} \right) \quad [4.2.3]$$

where n is the length of the age interval and ${}_n d_x$ is the number of life table deaths in the age interval x to $x+n$. Here it is assumed that the distribution of deaths follows a quadratic function in the interval $x-n, x+2n$ and the ${}_n m_x$ values are consistent. This assumption was proven at the beginning of the section (see section 4.1). The ${}_n d_x$ values are required for the calculation of the ${}_n a_x$ values. Thus, ${}_n q_x$ and the corresponding ${}_n d_x$ values are first computed by having ${}_n a_x = 2.5$ years ($n/2$) in the ${}_n q_x$ equation. Next, these preliminary ${}_n d_x$ values were used in the above formula to compute the corrected values of ${}_n a_x$. Ultimately, the corrected ${}_n a_x$ values were used in the ${}_n q_x$ equation and all other life table functions were recomputed. This procedure was repeated to twice “stabilize” the estimates of the ${}_n a_x$ values (Preston et al. 2001: 45). Chiang (1972: 539) indicates that the ${}_n a_x$ values should be calculated every 10 years. Hence, ${}_n a_x$ values were computed for each of the periods and separately for both males and females.

Since male and female infant mortality rates (${}_1 m_0$) in Ontario was less than .107 (${}_1 m_0 < \text{criteria for selection}$), the ${}_n a_x$ values at infancy (${}_1 a_0$) and the 1 to 4 age group (${}_4 a_1$) are computed with (Preston et al. 2001: 48):

$$\textbf{Males} \quad {}_1 a_0 = .045 + 2.684 \cdot {}_1 m_0 \quad \text{and} \quad {}_4 a_1 = 1.651 - 2.816 \cdot {}_1 m_0 \quad [4.2.4]$$

$$\textbf{Females} \quad {}_1 a_0 = .053 + 2.800 \cdot {}_1 m_0 \quad \text{and} \quad {}_4 a_1 = 1.522 - 1.518 \cdot {}_1 m_0 \quad [4.2.5]$$

where ${}_1m_0$ is the age specific mortality rate at infancy. As the complement of ${}_nq_x$, the probability of survival between ages x and $x+n$ or ${}_np_x$ is obtained by:

$${}_np_x = 1 - {}_nq_x \quad [4.2.3]$$

where ${}_nq_x$ is the probability of dying within age interval x to $x+n$. Next, the number of life table survivors at age x or l_x is obtained with:

$$l_0 = 100,000 \text{ and } l_{x+n} = l_x \cdot {}_np_x \quad [4.2.6]$$

$${}_nd_x = l_x - l_{x+n} \quad [4.2.7]$$

where l_x is the number of survivors and ${}_np_x$ is the survival probability in the preceding age interval. It is customary to have the initial cohort or the radix (l_0) equal 100,000. Now the number of life table deaths in age interval x to $x+n$ or ${}_nd_x$ can be easily derived, where $l_x - l_{x+n}$ are the number of survivors minus the number of survivors to the end of the next age interval.

These next two formulas describe the stationary population. These functions are important in the formulation of survival probabilities for specific age ranges and the life expectancy function. The number of person years lived between ages x to $x+n$ or ${}_nL_x$ was calculated with the formula:

$${}_nL_x = n \cdot l_{x+n} + {}_na_x \cdot {}_nd_x \text{ and } {}_\infty L_x = \frac{l_x}{{}_\infty m_x} \quad [4.2.8]$$

$$T_x = \sum_{a=x}^{\infty} {}_nL_a \quad [4.2.9]$$

where l_{x+n} is the number of survivors in the proceeding age interval, ${}_na_x$ is the average number of person years lived and ${}_nd_x$ is the number of deaths in the age interval. In the

open-ended age interval, l_x represents the number of survivors and ${}_x m_x$ is the age specific mortality rate of that interval. In turn, the number of person years lived past age x or T_x can be estimated by taking the cumulative sum of the ${}_n L_x$ values beginning with the open-ended age interval. Life expectancy is the average remaining lifetime for a person that is alive at age x or e_x and is calculated by:

$$e_x = \frac{T_x}{l_x} \quad [4.2.10]$$

where T_x is the person years lived past age x and l_x is the number of survivors at the beginning of the age interval.

The next two life table functions deserve special attention because they are the main analytical tools used to examine the structural variations in mortality over the 20 year period. The first function is the *hazard rate function* (${}_n h_x$) or in demographic terms, the *force of mortality* (u_x). Elandt-Johnson & Johnson (1980) and Manton & Stallard (1984) apply this function to make the life table approximate a ‘continuous time model’ because mortality and the exposure to the risk of death are continuous processes. The hazard function is defined as the probability of dying between ages x to $x+n$, given that the individual has survived until age x (Elandt-Johnson & Johnson: 51). Notice, that this definition is similar to the definition of the ${}_n q_x$ function. The difference is that ${}_n q_x$ gives the *average* probability of death *within* the age interval and ${}_n h_x$ gives the instantaneous death rate exerted *over* the age interval x to $x+n$. Furthermore, the values of ${}_n q_x$ are bounded by the range 0 to 1 whereas the values of ${}_n h_x$ are not bounded by any range (Smith 1948, Manton & Stallard 1984).

The above definition seems rather confusing because the hazard rate function is not a true probability. A hazard function is actually a *conditional failure rate*. The division of the conditional probability (numerator) by a *unit of time* (denominator) makes the hazard function a measure of the *probability per unit of time* (Kleinbaum 1996: 11). Simply, this division makes the hazard function a rate. In theory, a characteristic of this rate is that the values can range from 0 to infinity $(0, \infty)$. In my case, the values of ${}_n h_x$ would probably not exceed 1 because the unit of time is quite large (i.e. 5 year age intervals). Nevertheless, a more precise definition of the hazard rate function is the instantaneous potential per year for death to occur, given that the individual has survived until age x (Kleinbaum 1996: 10). In life table terms, the hazard rate function is defined as the *instantaneous* death rate or the number of person years of exposure to the risk of death in the age interval x to $x+n$, given survival until age x (Lawless 1982, Preston et al. 2001). Essentially, the hazard rate function measures the rate of change (or rate of decrease) in the survival function or in life table terminology, the ${}_n p_x$ function.

My concern is with the *cumulative hazard function* or *cumulative force of mortality*. I decided to use the cumulative hazard function because the life tables are abridged or age is divided in 5 year intervals. Thus, there is no way of knowing the approximate hazard rates in terms of single years or what each hazard rate would equal within the interval x to $x+n$. Of general interest, the formula for the hazard rate function is ${}_n h_x = -\frac{1}{n} \ln({}_n p_x)$. This formula gives an approximation of the average hazard function exerted over the interval x to $x+n$. On the other hand, the *cumulative hazard function* (H_x) is the integral over time of the hazard rate function. Think of the cumulative hazard

function as the sum of all the hazard rates in the age interval x to $x+n$. In other words, H_x is the sum of the exposure to the risk of death that an individual faces going from ages x to $x+n$. Essentially, the formulas will produce graphs that are identical, but only in a different scale.

The cumulative hazard function exerted over the age interval x to $x+n$ can be approximated at the midpoints of each age interval $x+1/2n$ (0.5, 3.0, 7.5 ... 87.5) by taking the negative logarithm of the survival function (estimated as ${}_n p_x$):

$$H_x = -\ln({}_n p_x) \quad [4.2.11]$$

where ${}_n p_x$ (${}_n p_x = \exp(-H_x)$) is the probability of surviving between ages x to $x+n$ (Manton & Stallard 1984: 146). This formula gives the assumption that the force of mortality is not constant over the age interval. If one assumed the force of mortality was constant over the age interval, then the ${}_n m_x$ values can be used as approximations of the force of mortality. (${}_n m_x = u_x$). This is a common assumption in the demographic methods textbooks (Preston et al. 2001).

I am not concerned with the individual values of the H_x function. When plotted by age, the cumulative hazard function will show the intensity of the mortality hazards throughout the lifespan of the synthetic cohort. The point here is to plot the values of the H_x function for an examination of the variation in the exposure to the risk of death, as the synthetic cohort ages. In addition, there will also be an examination of the variations in the intensity of the mortality hazards over time. A *bathtub* shaped hazard is a typical pattern observed when plotting the values of the hazard function by age. The exposure to the risk of death is moderate during infancy, low during childhood, starts to increase

during the late teens and then starts increasing rapidly during late adulthood. Generally, the hazard function is mainly considered a function of age or time. However, the construction of life tables by gender also creates the assumption that the force of mortality must be a function of gender (Namboodiri & Suchindran 1987). That is, males and females each have instantaneous death rates that are acting independently of one another.

The second function of interest is the *probability density function* (${}_n f_x$) or the *curve of death*. The probability density function can be defined as the unconditional probability that an individual will die in the age interval x to $x+n$. More specifically, the height of the area under the curve that lies between the ages of x and $x+n$ is the probability that death will occur in that age interval. Elandt-Johnson & Johnson (1980), Manton and Stallard (1984) treat the distribution of age at death as a random variable and apply the continuous ${}_n f_x$ to approximate the ages at death (x of X) or relative frequency of death throughout the life span (random variable X). Here the life span can equal any value between 0 years and 110 years (arbitrary decision). As with all probability distributions, the life span contains a cumulative distribution function (F_x or proportion dying at age x) that can be derived from the life table with $F_x = 1 - (l_{x+n}/l_0)$, which is the complement of the cumulative survival function (or proportion surviving at age x) $S_x = l_{x+n}/l_0$. Note that these functions are not used in this particular mortality analysis. I only wanted to show that they could be derived from the life table.

The main concern here is to plot the ${}_n f_x$ values by age and period. These plots will show the structure of mortality in terms of the relative frequency of death over the age span. This will also enable an examination of the structural variations of mortality

over time. Note that the plotted values of ${}_nf_x$ will not form a legitimate probability distribution because the area under the curve cannot equal unity (a requirement of a probability distribution). The reason is that the open-ended age interval makes the potential maximum limit (here it assumed at 110 years) of the life span unobtainable because the ages at death are not known in the open-ended age group. However, most deaths should occur in the defined age groups making the distribution of age at death an acceptable model of estimation.

The probability density function or distribution of age at death can be approximated at the midpoints of each age interval $x + 1/2n$ (0.5, 3.0, 7.5 ... 87.5) with the formula (Namboodiri & Suchindran 1987: 102):

$${}_nf_x = \frac{{}_nd_x}{n \cdot l_0} \text{ and } \frac{{}_\infty d_x}{20 \cdot l_0} \quad [4.2.12]$$

where ${}_nd_x$ is the number of survivors at the beginning of interval x to $x+n$, n is the length of the interval and l_0 is the radix. The denominator gives the assumption that deaths are distributed evenly between ages x and $x+n$. Values of ${}_nf_x$ are not known in the open-ended age interval, but were ‘arbitrarily’ closed for aesthetic purposes (when plotted) by assuming no person lives beyond 110 years of age (Namboodiri & Suchindran 1987). The peak of the probability distribution is denoted by the modal age (highest ${}_nf_x$). The modal age gives the age group with the highest relative frequency of death.

Another component of the probability distribution is that it can give an approximation of the *variability of age at death*. The variability of age at death is simply the area under the curve or the age range where the majority of deaths take place (Wilmoth & Horiuchi 1999). These graphs can only give a rough approximation (through

visual inspection) of variability of age at death. There are more precise measures (e.g. interquartile range) for estimating the variability (in studies of mortality compression), but the methods are beyond the nature and scope of this study. The reader is referred to Wilmoth & Horiuchi (1999) for more precise measurements of variability of the age at death. These components of the probability distribution will also aid in the examination of structural variations in mortality over time.

4.3 Multiple Decrement Life Tables

The single and multiple decrement life tables are similar in their purposes except that a multiple decrement life table (MDLT) contains more than one mode of exit from a given state (Hinde 1996: 49, Preston et al. 2001: 71). Methods of MDLT construction are slightly different from that of single decrement life tables. The difference is that the ${}_nq_x$, ${}_nl_x$, ${}_nd_x$ and H_x functions are partitioned to measure specific causes of death. The partitioning of these functions for each cause i is a straightforward procedure because the functions contain additive properties. For instance, the cause specific probabilities of dying can be added together to equal all causes combined or ${}_nq_x = {}_nq_x^{neo} + {}_nq_x^{pneu} + {}_nq_x^{bea} + {}_nq_x^{oth-res} + {}_nq_x^{residual}$ and so forth for each function defined above (with the exception of ${}_nf_x$).

The additive properties hold because the cause of death categories are defined as mutually exclusive and exhaustive (i.e. all decrements are included and none have been counted more than once). Essentially, this means that the cause of death categories are independent of one another or there are no “overlapping” of the categories (Preston et al. 2001: 79). However, in reality it is known that this is not the case because an individual

may have more than one disease that is affecting multiple organ systems, which ultimately will contribute to their death. On the other hand, we can also argue that the categories are entirely independent of one another. The reason is that only data on the underlying causes of death are available in Ontario. This means that when individuals die their causes of death are recorded and published with a single underlying cause, in which there can be no overlapping of the categories. In other words, the exclusive availability of only the underlying causes of death creates the illusion of independence. Primarily, there is no way of knowing the contributory causes of the death that were also stated on the death certificate. Hence, based on these premises we can assume that the categories of the MDLT are mutually exclusive and exhaustive.

This assumed independence of each of the causes of death also implies that the force of mortality is a function of each cause and thus, each cause i will be occurring at an independent ‘instantaneous’ rate (Namboodiri 1987). In addition, the construction of life tables differentiated by gender also gives the assumption that the force of mortality is a function of gender. Hence, males and females will have independent instantaneous death rates for each cause i .

Age specific mortality rates are not required to begin the construction of the multiple decrement life tables. Instead, the probability of dying from cause i in the age interval x to $x+n$ for the aggregate surviving until age x or ${}_nq_x^i$ can be directly partitioned with:

$${}_nq_x^i = {}_nq_x \cdot \frac{{}_nD_x^i}{{}_nD_x} \quad [4.3.1]$$

where ${}_nq_x$ is the age specific probability of death for all causes, ${}_nD_x^i$ is the number of deaths from cause i between ages x to $x+n$ and ${}_nD_x$ is the age specific number of deaths from all causes. Number of decrements (or life table deaths) from cause i in the age interval x to $x+n$ or ${}_nd_x^i$ were computed with the formula:

$${}_nd_x^i = {}_nq_x^i \cdot l_x \quad [4.3.2]$$

$$l_x^i = \sum_{a=x}^{\infty} {}_nd_a^i \quad [4.3.3]$$

where ${}_nq_x^i$ is the probability of death from cause i and l_x is the number of life table survivors between ages x to $x+n$ for all causes. Next, the number of persons surviving until age x , that will eventually die from cause i or l_x^i can be computed by taking the cumulative sum of the life table deaths from cause i beginning at the open-ended age interval.

Once the ${}_nd_x^i$ and l_x^i values are computed for each cause i , it becomes possible to compute the ‘approximated’ cause specific density and cumulative hazard functions. The unconditional probability (or relative frequency) that death from cause i occurs in the age interval x to $x+n$ or ${}_nf_x^i$ can be approximated at the midpoint $x + \frac{1}{2}n$ with:

$${}_nf_x^i = \frac{{}_nd_x^i}{n \cdot l_0^i} \quad [4.3.4]$$

where ${}_nd_x^i$ is the age specific life table deaths from cause i , n is the length of the interval and l_0^i is the number of individuals that will eventually die from cause i (radix of cause i). Notice, the difference in the denominator from the all causes formula (see 4.29). This makes the cause specific density function not have additive properties. Lastly, the

cumulative instantaneous death rate from cause i in the age interval x to $x+n$, for those surviving until age x or H_x^i can be approximated at the midpoints of each age interval $x + \frac{1}{2}n$ by:

$$H_x^i = H_x \cdot \frac{{}_n d_x^i}{{}_n d_x} \quad [4.3.5]$$

where H_x is the age specific hazard function for all causes, ${}_n d_x^i$ is the age specific number of deaths from cause i and ${}_n d_x$ is the age specific number of deaths for all causes. The H_x^i function is sometimes referred to as the cumulative proportional hazard.

The ${}_n a_x$, ${}_n L_x$, T_x and e_x functions were not computed for the multiple decrement life tables. The main reason for not including these functions is that the interpretations are unintuitive (Preston et al. 2001: 72). However, Manton & Stallard (1984: 157) use the e_x^i function in their analyses. They define this function as expected number of years lived for a person that will eventually die from cause i (see section 2.2). Even the l_x^i function contains this particular problem, but it is usually included to compute the conditional probability of eventually dying from cause i (Namboodiri & Suchindran 1987, Preston et al. 2001). The probability an individual will eventually die from cause i , for those surviving at age x or ${}_n c_x^i$ is obtained by:

$${}_n c_x^i = l_x^i / l_x \quad [4.3.6]$$

where l_x^i is the expected number of deaths at age x from cause i and l_x is the number of survivors at age x . When the proportions are multiplied by 100, the ${}_n c_x^i$ function gives

the expected percentage of deaths from cause i at age x . This function will give a general impression of the impact that a specific cause of death has on the population.

Chapter 5

Results

5.1 Introduction

I must elaborate on some issues before beginning the single decrement and multiple decrement life table analyses. First, I will assume that my hypothetical cohorts had the same observed age specific mortality rates as the Ontario population over all periods (${}_nM_x = {}_nm_x$). Thus, the life table rates and probabilities will be applied to the Ontario population because they would be the observed rates of the actual population over the 20 year span. Second, the life table periods of 1975-77, 1985-87 and 1995-97 are addressed as 1976, 1986 and 1996 to increase the flow of the descriptive process. Third, I will sometimes use the terms infancy (0 to 1), childhood/adolescence (2 to 19), early adulthood (20 to 39), middle adulthood (40 to 64) and late adulthood (65 and over) interchangeably with the actual age groups. Fourth, I also constructed life tables for the rest of Canada. The original idea was to provide a basis of comparison with the mortality experience of Ontario. However, the mortality patterns were very similar between Ontario and the rest of Canada. Thus, I have excluded the rest of Canada from this analysis to avoid being overly repetitive. I will include any major differences in footnotes where appropriate.

The last issue to be addressed is the utilization of the cumulative hazard (H_x) and probability density functions (${}_nf_x$) in place of the more traditional ${}_nq_x$, ${}_np_x$, ${}_nd_x$ and l_x functions. This does not mean that the other life table functions are being replaced. Remember, the life table functions are mathematically related and hold the same increasing or decreasing properties as the other functions. Furthermore, I think it is

important to include the force of mortality because theoretically this function is the underlying stochastic component of the mortality process. Simply, the H_x function will determine the number of deaths or survivors and probability of death or survival within any given age group. For example, if the H_x values are elevated, then the values of ${}_nq_x$, ${}_nf_x$ and the analogue ${}_nd_x$ will be larger in any given age group. Alternatively, if the values of the H_x function are small, then values of the ${}_np_x$ and ${}_nl_x$ functions will be larger in any given age group. The reader should refer to Appendix D, Tables 4.1 to 4.8 throughout the results section to view the relatedness of the functions and as complements to the graphical displays.

5.2 Single Decrement Life Tables

In this section, I will briefly examine the changes in the life expectancy among Ontario males and females between 1976 and 1996. In addition, I will use graphical applications of the cumulative hazard and probability density functions to explore the structural variations in all cause mortality over the 20 year period. The hazard and density functions will also be used to examine the probable reasons for the trends observed among male and female life expectancies. This section will set the stage for the subsequent sections of the analysis, namely the structural variations in respiratory diseases mortality.

5.3 Changes in Life Expectancy

Table 5.1 shows the increases in the life expectancies at birth (e_0) and at age 65 (e_{65}) by gender and period (refer to formula 4.2.10). Generally, female newborns could expect to live longer than male newborns over all periods. However, males experienced a larger gain in the life expectancy at birth between 1976 and 1996. The male e_0 increased

from 70.79 years to 75.91 years by 1996. This equaled a total gain of 5.12 years (or an increase of 7.23%) over the 20 year span. Conversely, the female e_0 increased from 77.97 years to 81.33 years between 1976 and 1996. Females gained a total of 3.36 years (or an increase of 4.31%) in the average expectation of life during the 20 year period.

Table 5.1 Increases (Years & %) in Male and Female Life Expectancies at Birth and Age 65 by Period

<i>Gender</i>	<i>Period</i>	e_0	<i>Gain</i>	%	e_{65}	<i>Gain</i>	%
<i>Males</i>	1976	70.79	-	-	13.89	-	-
	1986	73.71	2.92	4.13	15.00	1.11	7.99
	1996	75.91	2.19	2.98	16.17	1.18	7.84
	<i>Total</i>		5.12	7.23		2.28	16.45
<i>Females</i>	1976	77.97	-	-	18.22	-	-
	1986	80.03	2.06	2.64	19.21	0.99	5.44
	1996	81.33	1.30	1.62	19.89	0.68	3.56
	<i>Total</i>		3.36	4.31		1.67	9.19

The largest male and female gains in the life expectancy occurred between 1976 and 1986. Males experienced a gain of 2.92 years (or an increase of 4.13%) and females had a gain of 2.06 years (or an increase of 2.64%) during that period. The absolute change in life expectancy declined for both sexes (most notably for females) between 1986 and 1996. There were still gains in life expectancy, but these gains were not as large as the ones observed between 1976 and 1986. For instance, males experienced a gain of 2.19 years (or an increase of 2.98%) and females had a gain of 1.30 years (or an increase of 1.62%) between 1986 and 1996.

Males also experienced a slightly larger gain than females in the life expectancy at 65 years of age. The male e_{65} increased from 13.89 years to 16.17 years between 1976 and 1996. This equaled a total gain of 2.28 years (or an increase of 16.45%) during the 20

year span. Conversely, the female e_{65} increased from 18.22 years to 19.89 years by 1996. Females experienced a total gain of 1.67 years (or an increase of 9.19%). The absolute gain in the life expectancy decreased slightly for females between 1986 and 1996 and remained stable for males over all periods. Despite the larger gains in the male life expectancy, a large gap continued to exist between the male and female life expectancies.

Table 5.2 Gender Differentials in Life Expectancies at Birth and Age 65

<i>Period</i>	e_0		<i>Gap</i>	e_{65}		<i>Gap</i>
	<i>Females</i>	<i>Males</i>		<i>Females</i>	<i>Males</i>	
1976	77.97	70.79	7.18	18.22	13.89	4.33
1986	80.03	73.71	6.32	19.21	15.00	4.21
1996	81.33	75.91	5.42	19.89	16.17	3.72

Table 5.2 shows the gap between the male and female life expectancies at birth and 65 years of age by period. The gap is simply the difference between the male and female life expectancies. In 1976, females could expect to live on average 7.18 years longer than males. The gap in the male and female life expectancies decreased to 5.42 years by 1996. These decreases in the gap were a result of males experiencing larger gains in the expectation of life than females over the 20 year period. The gap between males and females also continued to decrease as age increased over the 20 year span. For example, the gap at 65 years of age decreased from 4.33 years to 3.72 years between 1976 and 1996. It was apparent that males and females experienced increases in the expectation of life and a decreasing gap between the sexes.

5.4 Male and Female Cumulative Hazard Functions

Figures 5.1 and 5.2 show the cumulative forces of mortality (H_x) approximated at the midpoints of each age group by period (refer to formula 4.2.11). Generally, males and females had similar mortality hazards from infancy until approximately 14 years of age. The similarities in the exposure to the risk of death remained over the entire 20 year period. A divergence among the male and female mortality hazards occurred at approximately 15 years of age. This divergence remained where males were exposed to a greater a risk of death throughout the age span over all periods.

Nevertheless, males experienced continuous declines in the exposure to the risk of death over the age span with the largest declines occurring throughout late adulthood. Alternatively, this meant that the number of male survivors (l_x) were also increasing at the advanced age groups over the 20 year period. Concurrently, there was also an increase in the number of life table deaths (${}_nd_x$) at the advanced age groups (between the ages of 80 and 89). However, the number of survivors must have increased at a higher rate than the number of deaths. Sequentially, this resulted in mortality rates that were lower than in the past. Hence, the conversion of the mortality rates into probabilities of death (${}_nm_x \rightarrow {}_nq_x$) would result in increasing survival probabilities and decreasing mortality hazards at the advanced age groups between 1976 and 1996.

Females also experienced declines in the exposure to the risk of death throughout the age span. However, the rate of decline in the intensity of the mortality hazards was lower among females. Most of the decline in the female mortality hazards occurred between 1976 and 1986. Here, we can see that the female mortality risk may have reached a degree of stabilization between 1986 and 1996. This meant that there was a

**Figure 5.1 Cumulative Hazard Functions of All Causes by Period
(Ontario Males)**

**Figure 5.2 Cumulative Hazard Functions of All Causes by Period
(Ontario Females)**

deceleration in the decline of the mortality hazards because the number of deaths and survivors were increasing at an almost equal rate between 1986 and 1996.

Note that over time the number of deaths may decline or increase in any given age group, but the mortality hazards may continuously decrease. This fundamental process will occur throughout the results section. In most cases, deaths will actually decline until around 74 years of age and then increase throughout the rest of the age span (a common pattern observed in respiratory related diseases). The reason for the declines in the mortality hazards is that the number of survivors kept increasing at a greater rate than the number of deaths (a more common occurrence for males). Alternatively, if the number of deaths increased at a greater rate than the number of survivors, then the mortality hazards would also increase (a more common occurrence for females).

The patterns observed among the male and female mortality hazards explain the changes associated with the life expectancies. Simply, females had a lower risk of death than males throughout the entire age span. Thus, females would also have a greater probability of survival than males into the advanced age groups. On the other hand, males had a higher risk of death throughout the age span, which makes the male aggregate have a lower probability of survival into the advanced age groups. Given that, the life expectancy function is an average approximation of the length of life. The higher male risk of death and consequently, the lower number of survivors within each age group causes the average to be lower than that of females. In addition, the larger declines that males experienced in the intensity of the mortality hazards would also explain the larger gains observed in the male life expectancy and hence, the decreasing gender gap.

5.5 Male and Female Probability Density Functions (Curves of Death)

Figures 5.3 and 5.4 give the probability density functions of the life span approximated at the midpoints of each age group by period (refer to formula 4.2.12). Generally, the probability distributions were bimodal with major peaks at infancy and late adulthood. Males and females experienced a moderate decline in the peak at infancy between 1976 and 1996. These declines coincide with the declines in the intensity of the infant mortality hazard over the 20 year span. The trends in the male and female probability distributions become notably heterogenic beyond childhood and must be examined on an individual basis.

The male probability distributions went through a large transformation over the 20 year period. Males experienced declines in the relative frequency of death throughout young, middle and early late adulthood. The largest declines in the densities occurred between the ages of 40 and 79. Yet, the relative frequency of death increased between the ages of 80 and 89 over the 20 year span. The declining mortality hazards throughout infancy and early late adulthood led to a higher concentration of deaths and hence, increased densities at the advanced age groups. Accordingly, the modal age of the male distributions at late adulthood increased from between the ages of 75 and 79 to the ages of 80 and 84 by 1996. Simultaneously, the approximate majority of male deaths decreased from between the ages of 65 and 89 to the ages of 70 and 89 over the 20 year period. Thus, the variability of age at death (refer to section 4.2, pg. 28) decreased from covering an area of around 25 years to 20 years of the age span. These patterns mean that the highest relative frequency of death among males increased progressively into the

**Figure 5.3 Probability Density Functions of All Causes by Period
(Ontario Males)**

**Figure 5.4 Probability Density Functions of All Causes by Period
(Ontario Females)**

older age groups and the majority of deaths were becoming concentrated within a smaller area of the age span over the 20 year period. The shifting peaks of the probability distributions further into late adulthood also account for the increases observed in the male life expectancy between 1976 and 1996.

Conversely, the female probability density functions went through a smaller transformation than that of males. The lesser degree of structural variation in all cause mortality reflects the lower declines observed among the female mortality hazards. Nonetheless, females experienced declines in the relative frequency of death throughout the age span until around 84 years of age and moderate increase in the density over the 85 to 89 age group. Consequently, the modal age of the distributions at late adulthood increased slightly from between 80 and 89 to the ages of 85 and 89 over the 20 year span. There was also minor change associated with the variability of age at death. The approximate majority of female deaths remained constant over the 20 year period and occurred roughly between the ages of 75 and 89 (this excludes life table deaths beyond 90 years of age). Note that the female variability may extend beyond 90 years of age. In 1996, 26.91% of female life table deaths occurred past 90 years of age. Thus, the variability may have actually occurred between the ages of 80 and somewhere past 90 years of age by 1996. However, I cannot make any assumptions beyond 90 years of age because the formula used to estimate the open-ended age group (refer to formula 4.2.12) is only used for aesthetic purposes. Nevertheless, the highest densities among females were also becoming increasingly concentrated in a smaller area of the age span between 1976 and 1996. This is evident in the continually increasing peakedness of the female probability distributions over the 20 year period.

5.6 Multiple Decrement Life Tables

It is now time to change the focus of the analysis to an examination of the structural variation in respiratory related mortality between 1976 and 1996. There are two assumptions that must be made before I continue with the multiple decrement life table analysis. First, when I am discussing a particular cause of death it is assumed to be acting simultaneously in the presence of all other causes. I state this here so that I do not have to repeat myself throughout the remainder of the analysis. Second, I will also assume that the hypothetical cohorts were subjected to the same mortality rates in the Ontario population. This assumption is the same as the one concerning the single decrement life tables (see section 5.1)

In addition, the number of deaths for each cause was estimated at the 85 to 89 age group for the periods of 1976 and 1986 (see section 3.3 and Appendix C). There is a possibility that the estimations may distort the findings associated with this age group. Simply, there is no way of knowing the accuracy of these estimates. However, I feel that the estimations provide an adequate approximation of the mortality experienced at the 85 to 89 age group over those periods. Nevertheless, the mortality patterns observed at this age group should be accepted with caution.

I will begin this section with an examination of the varying mortality patterns concerning the expected proportion of respiratory related deaths. Next, I will conduct an examination of the structural variation (in terms of relative risk and frequency of death) in respiratory related mortality through graphical applications of the cumulative proportional hazards and cause specific probability density functions.

5.7 Expected Percentage of Deaths for Each Cause i

Table 5.3 gives a partial list of the conditional probabilities or proportions (c_x^i) that individuals surviving at age x , will eventually die from cause i (refer to Appendix D, Table 4.8 for the complete age specific conditional probabilities for each cause and period). There is no need to explain each of the probabilities because the interpretations are self-explanatory. The percentage of male newborns that could expect to die from all respiratory related diseases (*ICDA-8: 160-163, 460-519*) increased from 14.7% to 18.0% between 1976 and 1996. Conversely, the percentage of female newborns that would eventually die from all respiratory related diseases almost doubled from 7.9% to 13.6% over the 20 year span. Generally, females experienced a greater rate of increase than males in the expected proportion of respiratory related deaths. The male/female ratio of all respiratory related deaths decreased from 1.9 to 1.3 over the 20 year period.

Table 5.3 Conditional Probabilities of Individuals Surviving at Age x , that will Eventually Die from Cause i by Period & Gender

<i>Period</i>	x	<i>all res</i>		<i>neo</i>		<i>pneu</i>		<i>bea</i>		<i>oth res</i>	
		<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>	<i>M</i>	<i>F</i>
1976	00-01	0.147	0.079	0.064	0.015	0.040	0.047	0.021	0.007	0.022	0.010
	50-54	0.156	0.080	0.068	0.015	0.042	0.048	0.022	0.007	0.023	0.010
	80-84	0.144	0.082	0.029	0.005	0.072	0.065	0.019	0.005	0.023	0.007
1986	00-01	0.175	0.111	0.080	0.033	0.038	0.046	0.013	0.007	0.045	0.026
	50-54	0.183	0.112	0.083	0.032	0.040	0.047	0.013	0.006	0.047	0.026
	80-84	0.179	0.102	0.042	0.010	0.068	0.065	0.014	0.004	0.055	0.023
1996	00-01	0.180	0.136	0.076	0.042	0.042	0.049	0.008	0.007	0.054	0.038
	50-54	0.188	0.138	0.079	0.042	0.044	0.051	0.008	0.007	0.057	0.038
	80-84	0.184	0.123	0.041	0.016	0.066	0.065	0.009	0.006	0.068	0.036

The percentage of male newborns that could expect to die from respiratory related cancers (*ICDA-8: 160-163*) increased from 6.4% to 8.0% between 1976 and 1986

and then declined slightly to 7.6% by 1996¹. Conversely, the expected percentage of female respiratory related cancer deaths nearly tripled from 1.5% to 4.2% over the 20 year span. The male/ female ratio of respiratory related cancer deaths decreased from 4.3 to 1.8 between 1976 and 1996. This diminishing gender ratio reflects the large increases in the number of female cancer deaths and the stabilization in the number of male cancer deaths over the 20 year period.

The percentage of male newborns that could expect to die from pneumonia and influenza (*ICDA-8: 470-474, 480-486*) decreased slightly from 4.0% to 3.8% between 1976 and 1986 and then increased to 4.2% by 1996. Ontario females followed the same pattern as males, but had slightly higher percentages of expected pneumonia and influenza deaths. The expected percentage of female deaths decreased slightly between 1976 and 1986 from 4.7% to 4.6% and then increased to 4.9% by 1996. Note that there may be potential bias in these estimates over the 20 year span. As I mentioned in the data section (see section 3.2), *pneumonitis due to solids and liquids* was removed from the pneumonia classification and transferred under a separate classification (*ICDA-9: 507*) in *ICDA-9*. However, this particular cause of death accounts for a very small number of deaths in a given year. For example, there were 53 male deaths and 52 female deaths in Ontario for the year of 1987. Thus, I would assume that the comparisons should be accurate over the 20 year period. Overall, the male and female conditional probabilities of dying from pneumonia and influenza remained almost constant over the 20 year period.

¹ Male newborns in the rest of Canada had a slightly lower percentage of expected deaths at 6.20% in 1976. This increased to a noticeably higher percentage than Ontario at 9.11% by 1996.

I discovered a potential problem in terms of the comparability with the next cause of death categories between 1976 and 1996. The percentage of male newborns that could expect to die of bronchitis, emphysema or asthma (*ICDA-8: 490-493*) declined from 2.1% to 0.8% between 1976 and 1996. Female newborns that could expect to die from bronchitis, emphysema or asthma remained constant at 0.7% over the 20 year period. On the other hand, the percentage of expected male deaths from other respiratory diseases (*ICDA-8: 460- 466, 500-519*) increased from 2.2% to 5.4% between 1976 and 1996. Female newborns that would eventually die from other respiratory diseases increased from 0.1% to 3.8% over the 20 year period.

These mortality patterns seem questionable because there was quite an abrupt change in the expected percentage of deaths between 1976 and 1996. I suspect that the NCHS comparability ratio study between *ICDA-8* & 9 contained ratios close to 1.00 for a specific reason (refer to Appendix A, section 1.2). The reason was that medical certifiers in the United States already had a tendency to code emphysema and bronchitis deaths under the *COLD* classification as early as the late 1960s (NCHS 1975). Thus, it was probably a normative practice among medical certifiers to code these deaths under the more general classification when the NCHS conducted the study. Thus, the tendencies of the certifiers would go unnoticed by an examination of the comparability ratios. Hence, it seems that Ontario and probably all of Canada had the same coding practices as the United States. This is evident in the increasing and decreasing patterns observed in the expected proportion of deaths from these categories.

5.8 Cumulative Proportional Hazards

In this section, I will examine the variation in the intensity of the respiratory related mortality hazards over the 20 year period. In addition, I will also demonstrate that the cumulative hazard function is a useful tool for examining discrepancies in the data. This will be done with an examination of the inherent problems associated with the bronchitis, emphysema or asthma and other respiratory diseases categories. The reader is once again encouraged to refer to Appendix D, Tables 4.1 through 4.7 as a complement to the graphs.

5.8.1 *Bronchitis, Emphysema, Asthma and Other Respiratory Diseases*

The mortality hazards of bronchitis, emphysema or asthma (H_x^{bea}) and other respiratory ($H_x^{oth-res}$) diseases were analyzed together because of the inherent problem with these particular categories. Figures 5.5 through 5.8 show the cumulative proportional hazards of bronchitis, emphysema or asthma and other respiratory diseases. There was a large decrease in the male mortality hazards of bronchitis, emphysema or asthma between 1976 and 1996. On the other hand, there was a large increase in the male mortality hazards of other respiratory diseases over the 20 year span. Note that the ‘other respiratory diseases’ category of the multiple decrement life tables is composed of other causes of death besides COLD (*ICDA-8: 519.3*) or CAO (*ICDA-9: 496*). However, the COLD or CAO classifications make up the majority of deaths in the category. Thus, the trend and shape of the cumulative proportional hazard should generally reflect these causes of death.

I suspect that the declines in the male mortality hazards of bronchitis, emphysema or asthma and the increases in the other respiratory diseases category were

Figure 5.5 Cumulative Hazard Functions of Bronchitis, Emphysema & Asthma by Period (Ontario Males)

Figure 5.6 Cumulative Hazard Functions of Bronchitis, Emphysema & Asthma by Period (Ontario Females)

**Figure 5.7 Cumulative Hazard Function of Other Respiratory Diseases
by Period (Ontario Males)**

**Figure 5.8 Cumulative Hazard Function of Other Respiratory Diseases
by Period (Ontario Females)**

illusory. Any decreases or increases in the mortality hazards of that magnitude with classifications that are highly related (COPD is measured with *ICDA-9: 490-492 & 496*) seems improbable. Therefore, I believe that these mortality hazards reflect the tendency of medical professionals in Ontario to attribute fewer deaths to bronchitis and emphysema as time progressed. These hazard plots also confirm that there was an increasing tendency of medical professionals to code potential emphysema or bronchitis deaths under the more general classification of *Chronic Airways Obstruction* over the 20 year period. Hence, there is no way of knowing the actual mortality hazards or any rates for that matter of bronchitis or emphysema with the data in its current state.

These trends are not obvious in the female mortality hazards. This is probably due to the small number of asthma, bronchitis or emphysema deaths among females during 1976. The trend of generalizing these diseases was already occurring for quite some time when female mortality rates from these causes began to increase. Thus, it was probable that most deaths would be coded under the more general classification, thereby hiding the problem among female deaths. I will leave these issues at the present and elaborate on them further in the discussion section (see section 6.2).

5.8.2 Cumulative Proportional Hazards of All Respiratory Related Diseases:

Figures 5.9 and 5.10 show the cumulative proportional hazards of all respiratory related diseases ($H_x^{all-res}$) approximated at the midpoints of each age group by period (refer to formula 4.3.5). You can see that the male and female mortality hazards of all respiratory related diseases ($H_x^{neo} + H_x^{pneu} + H_x^{bea} + H_x^{oth-res} = H_x^{all-res}$) made a moderate contribution to the total force of mortality (see figures 5.1 & 5.2). Generally, males and

Figure 5.9 Cumulative Hazard Function of All Respiratory Related Diseases by Period (Ontario Males)

Figure 5.10 Cumulative Hazard Function of All Respiratory Related Diseases by Period (Ontario Females)

females had a low risk of death from all respiratory related diseases until middle adulthood.

Males experienced a continuous decline in the mortality hazards until around 79 years of age. Most of the decline in the intensity of the mortality hazards throughout middle and early late adulthood occurred between 1986 and 1996. Alternatively, males experienced an increase in the exposure to the risk of death beyond 80 years of age between 1976 and 1986 and then slight declines in the mortality hazards at the advanced age groups by 1996. Overall, males were beginning to experience declines in the risk of death from respiratory related diseases throughout the entire age span by 1996.

In contrast, females experienced a slightly different trend concerning the exposure to the risk of death from respiratory related diseases. They had declines in the risk of death until around 39 years of age and then an increase in the hazards throughout the rest of the age span between 1976 and 1986. There were further declines in the intensity of the mortality hazard from the ages of 40 to 59 between 1986 and 1996. However, the remaining age groups throughout middle and late adulthood experienced large increases in the intensities of the mortality hazards by 1996. Overall, while males were experiencing declines in the intensity of the mortality hazards throughout the age span, females were experiencing large increases in the risk of death, especially during late adulthood by 1996. Nevertheless, males continued to have a much greater risk than females of dying from respiratory related diseases over all periods.

5.8.3 Cumulative Proportional Hazard of Respiratory Related Cancers

Figures 5.11 and 5.12 show the cumulative proportional hazards of respiratory related cancers (H_x^{neo}) approximated at the midpoints of each age group by period.

Figure 5.11 Cumulative Hazard Functions of Respiratory Related Cancers by Period (Ontario Males)

Figure 5.12 Cumulative Hazard Functions of Respiratory Related Cancers by Period (Ontario Females)

Generally, males and females experienced little exposure to the risk of death from respiratory related cancers until around 30 years of age over all periods. This also indicates that the probabilities of death (q_x^{neo}) were at or near zero during this stage of the age span for both sexes. Respiratory related cancers made the largest contribution to the total force of respiratory related diseases mortality among males over all periods and were second among females by 1996.

The male respiratory related cancer hazards do not have the appearance of the bathtub hazard. These mortality hazards are actually more consistent with an inverse bathtub hazard. Generally, the inverse bathtub hazard will increase to a maximum and then decrease throughout the remainder of the age span (Lawless 1982). Notice the way that the male cancer hazards changed over time. In 1976, there was a steady inclining intensity of the mortality hazards between the ages of 40 and 74 and then a rapid decline of the mortality hazards over the remaining age span. By 1986, the force of mortality continuously increased until around 84 years of age and then declined. The reason for the continuously increasing hazards was the large increases in the intensity of mortality throughout late adulthood between 1976 and 1986. However, males then experienced moderate declines in the risk of death from respiratory related cancers throughout the age span by 1996. Overall, these trends mean that males were increasingly at a greater risk of dying from respiratory related cancers at later ages than in the past. Yet, it appeared that the risk of death from respiratory related cancers was on the decline throughout the age span by 1996.

In 1976, the female hazard curve of respiratory related cancers was a monotone increasing function of age. There was a small increase in the risk of death between the

ages of 35 and 59 and then a constant mortality hazard throughout the rest of middle and late adulthood. The shape of the hazard curve reflects the low risk and small number of cancer related deaths among females during that period.

Notice that the female mortality hazard curve showed the full features of an inverse bathtub by 1996. The reason for the changing mortality hazard was that females experienced a continual increase in the exposure to the risk of death from respiratory related cancers. This coincided with the large increases in the number of respiratory related cancer deaths between 1976 and 1996. Respiratory cancer deaths were increasing at a greater rate than the number of survivors throughout middle and late adulthood, which resulted in the increased mortality hazards at those age groups. The intensity of the female mortality hazards approximately doubled during late adulthood between 1976 and 1986 and made another large increase by 1996. The only decline that females experienced was a moderate one throughout middle adulthood between 1986 and 1996. Overall, males continued to have a greater risk than females of dying from respiratory related cancers even with the major increases in the intensity of the female mortality hazards.

5.8.4 Cumulative Proportional Hazards of Pneumonia & Influenza

Figures 5.13 and 5.14 show the cumulative proportional hazards of pneumonia and influenza (H_x^{pneu}) approximated at the midpoint of each age group by period. The mortality hazards of pneumonia and influenza retain the shape of the bathtub. Generally, pneumonia and influenza made the largest contribution to the total force of respiratory related mortality for females and the third largest contribution among males by 1996 (COPD would be second among males and third among females by 1996). Males and

Figure 5.13 Cumulative Hazard Functions of Pneumonia & Influenza by Period (Ontario Males)

Figure 5.14 Cumulative Hazard Functions of Pneumonia & Influenza by Period (Ontario Females)

females both had noticeable decreases in the risk of death from pneumonia and influenza at infancy between 1976 and 1996. The hazards at infancy became comparable to the intensity of risk throughout childhood and young adulthood by 1996. In other words, there was little exposure to the risk of death from pneumonia and influenza throughout infancy and young adulthood by 1996.

Males experienced some noticeable variation in the exposure to the risk of death from pneumonia and influenza over the 20 year span. There were moderate declines in the intensity of the mortality hazards throughout middle and late adulthood with the largest declines taking place between the ages of 70 and 84. Notice that the majority of decline in the mortality hazards occurred between 1976 and 1986. This trend would point to a degree of stabilization in the exposure to the risk of death from pneumonia and influenza between 1986 and 1996. The declines throughout middle and late adulthood caused the highest mortality hazards to be shifted further into the advanced age groups by 1996. This meant that most deaths and the greatest probabilities of death were increasingly becoming concentrated within the advanced age groups. However, the advanced age groups also experienced lower mortality hazards over time because the number of survivors at these age groups increased at a higher rate than the number of pneumonia and influenza deaths.

Conversely, females had a slightly different trend occurring in the risk associated with dying from pneumonia and influenza between 1976 and 1996. Females also experienced declines in the risk of death between 1976 and 1986. However, there was actually a slight increase in the intensity of risk between the ages of 75 and 89 by 1996. This trend indicates that the number of pneumonia and influenza deaths increased at a

slightly greater rate than the number of survivors in those age groups. Thus, the intensity of the mortality hazard would also increase at the advanced age groups over time.

Overall, males experienced larger declines in the intensity of the mortality hazards than females. Nevertheless, males still had a much higher risk of dying from pneumonia and influenza over all periods. Notice that the intensity of the mortality hazards from respiratory related cancers lost momentum as age increased. Alternatively, the intensity of mortality from pneumonia and influenza gained momentum as age increased. This means that respiratory related cancers made a larger contribution to the total force of respiratory related mortality during early part of late adulthood. Alternatively, pneumonia and influenza made a greater contribution to the total force of respiratory related mortality at the advanced age groups. In other words, the aggregate that survived past early late adulthood would be at a lower risk of dying from respiratory related cancers and a greater risk of dying from pneumonia and influenza and vice versa.

5.9 Cause Specific Probability Density Functions (Curves of Death)

The categories of bronchitis, emphysema or asthma and the other respiratory diseases are not comparable over the 20 year period. I constructed graphs of the distributions of the age at death for these causes, but they will not be included in this section of the analysis. There is no reason to include the probability density functions of these categories because the distributions will not portray an accurate representation over the 20 year period. I discovered the problems associated with the coding of these deaths in the middle of the analysis and it was too late to make any changes to the MDLT categories. However, the other MDLT categories should be accurate and I will examine the probability distributions of these causes of death.

5.9.1 Probability Density Function of All Respiratory Related Diseases

Figures 5.15 and 5.16 give the probability density functions of all respiratory related diseases (${}_n f_x^{all-res}$) approximated at the midpoints of each age group by period (refer to formula 4.3.4). Male and female curves of death for respiratory related diseases are bimodal with peaks at infancy and late adulthood. The density at infancy declined to a level that was only slightly greater than the densities throughout childhood and young adulthood by 1996. Males and females also experienced slight declines in densities throughout adolescence and young adulthood. These densities were already low during that area of the age span making the declines less obvious.

The largest declines in the male densities occurred between the ages of 40 and 79. However, there was a large increase in the relative frequency of death between the ages of 80 and 89 years over the 20 year period. Consequently, the modal ages of the male probability distributions also increased from between the ages of 75 and 79 to the ages of 80 and 84. In addition, the occurrence of the majority of deaths increased from approximately between the ages of 65 and 84 to 70 and 89 by 1996. The variability of the age at death never changed and highest probabilities of death from respiratory related diseases continued to cover an area of approximately 20 years of the age span. The difference was that the highest densities were progressively shifting further into late adulthood between 1976 and 1996. Notice the sharp peak of the probability distribution at the more advanced age groups by 1996.

Conversely, there was minimal variation in the female probability distributions considering the large increases associated with the risk of respiratory related deaths. As time progressed, there were declines in the relative frequency of death between the ages

Figure 5.15 Probability Density Functions of All Respiratory Related Diseases by Period (Ontario Males)

Figure 5.16 Probability Density Function of All Respiratory Related Diseases by Period (Ontario Females)

of 60 and 74 and increases throughout the remaining age span. In turn, the modal ages increased from between the ages of 80 and 84 to the ages of 80 and 89. The variability in the age at death remained stable, covering an area of approximately 20 years with most deaths occurring between the ages of 70 and 89. Notice that the female probability distributions appear incomplete. The reason is that many respiratory related deaths occur past the age of 90 for females. However, I cannot make any assumptions beyond 90 years of age because there are no data available for these age groups.

Overall, the major transformation that occurred with the male and female probability distributions was that the highest relative frequencies of death were becoming increasingly concentrated in the older age groups, as time progressed. Notice the increasing peakedness of the probability distributions over the 20 year period. This also means that males and females had a greater probability of dying from respiratory related diseases at the later age groups than in the past. Alternatively, males and females that would die from respiratory related diseases had a greater probability of surviving into the older age groups over time.

5.9.2 Probability Density Functions of Respiratory Related Cancers

Figures 5.17 and 5.18 give the probability density functions of respiratory related cancers (${}_nf_x^{neo}$) approximated at the midpoint of each age group by period. Constant male and female cancer hazards throughout infancy, childhood and much of young adulthood led to the appearance of normal probability distributions. Generally, the male and female densities of respiratory related cancers do not start making noticeable increases until around 35 years of age.

Figure 5.17 Probability Density Functions of Respiratory Related Cancers by Period (Ontario Males)

Figure 5.18 Probability Density Functions of Respiratory Related Cancers by Period (Ontario Females)

A moderate transformation occurred to the structure of the male probability distributions over the 20 year period. The transformation that occurred was the expansion of the probability distribution into the older age groups. The reasons for the change were that males experienced a moderate decline in the relative frequency of death from ages 35 to 69 and an increase in the densities beyond 70 years of age. Consequently, the modal age of the male distributions increased from between the ages of 65 and 74 to the ages of 70 and 74 by 1996. Additionally, the majority of deaths shifted from between the ages of 60 and 79 shifted to 65 and 84 by 1996. Variability in the age of death remained constant and continued to cover an area of approximately 20 years over all periods. The difference was that the highest probabilities of death were progressively occurring at the later age groups than previously. Respiratory related cancers were increasingly becoming a large killer of males throughout late adulthood by 1996.

Conversely, the female probability distributions went through a large transformation over the 20 year period. Notice that the female curves of death were asymmetrical in 1976 and 1986. The low risk and small number of respiratory related cancer deaths during those periods would account for that type of probability distribution. Over time, the female probability distributions became more symmetrical. This was due to the large increases in the risk and number of respiratory related cancer deaths over the 20 year period. Nevertheless, females also experienced large declines in the relative frequency of death between the ages of 35 and 74 and a large increase in the densities beyond 75 years of age.

Accordingly, the modal age of the distributions increased from between the ages of 65 and 69 to the ages of 70 and 74 by 1996. The female variability in the age at death

shifted from between the ages of 55 and 79 to the ages of 60 and 84 by 1996. Notice that the female variability covered a slightly larger area of the age span than that of males. The female variable also remained static and covered an area of approximately 25 years of the age span. Nonetheless, females were also experiencing a greater relative frequency of death at the older age groups as time progressed. Notice the increasing peakedness of the probability distributions over the 20 year period.

Notice the more gradually inclining slopes of the female probability distributions. The reason for the more gradually inclining slopes was the slightly higher female densities throughout middle adulthood (approximately between the ages of 35 and 64) over all periods. This occurrence is interesting because the cumulative hazard function (H_x^{neo}) and probabilities of death (${}_nq_x^{neo}$) cannot account for this pattern. Overall, males were exposed to a greater risk and probability of death throughout the age span over all periods. However, these functions are conditional and depend on the individual surviving, until age x . The probability density function is an unconditional probability that is independent of any preceding event. Thus, females had a slightly greater unconditional probability of death than males between the ages of 35 and 64. In other words, females had a slightly greater possibility than males of dying throughout middle adulthood from respiratory related cancers over the 20 year period.

5.9.3 Probability Density Functions of Pneumonia & Influenza

Figures 5.19 and 5.20 show the probability density functions of pneumonia and influenza (${}_nf_x^{pneu}$) approximated at the midpoint of each age group by period. The male and female probability distributions went through similar transformations throughout the age span over the 20 year period. Generally, there were large declines in the densities at

Figure 5.19 Probability Density Functions of Pneumonia & Influenza by Period (Ontario Males)

Figure 5.20 Probability Density Functions of Pneumonia & Influenza by Period (Ontario Females)

infancy that coincided with the declining risk of death for both males and females. There was also a decline in the relative frequency of death throughout childhood and young adulthood. The decreases in the intensity of the mortality hazards over the younger age groups led to densities that were constant over that part of the age span.

The male probability density functions went through a moderate transformation throughout middle and late adulthood over the 20 year period. Males experienced moderate declines in the relative frequency of death between the ages of 35 and 79 and a large increase in the densities beyond 80 years of age. The distributions became very sharply peaked because of the increasing concentration of deaths at the advanced age groups by 1996. This concentration of deaths was also evident in the changes associated in the variability of age at death. The variability of age at death decreased from between the ages of 75 and 89 to the ages of 80 and 89 by 1996. Thus, the variability decreased to cover an area from approximately 15 to 10 years of the age span over the 20 year period. Accordingly, the modal age of the probability distributions increased from between the ages of 80 and 84 to the ages of 85 and 89 by 1996.

Females experienced similar patterns to males in the structural variation of the distribution of age at death. However, there was a lesser degree of increases and declines in the female densities throughout the age span. Females experienced a decline in the relative frequency of death between the ages of 35 and 84 and a large increase in the density over the 85 to 89 age group. Consequently, the modal age of the probability distributions increased slightly from between the ages of 80 and 89 to the ages of 85 and 89 by 1996. In 1976, the approximate majority of deaths occurred between the ages of 80 and 90. I cannot make any accurate assumptions about the variability of age at death

beyond 1976. However, I assume that the majority of pneumonia and influenza deaths occurred somewhere between the ages of 85 and beyond by 1996. Notice, that the density of the open-ended age group was quite large given, that I closed out the probability distributions with formula 4.2.12. Furthermore, 45.29% of female and 28.01% of male pneumonia and influenza deaths occurred beyond 90 years of age by 1996. Thus, I assume that the female variability of age at death extended past the visible portion of the age span. This may also be true for males, but to less of an extent than females. Remember, these assumptions are only speculative because I did not have any data for age groups beyond 90 years of age. Overall, males and females had an increasing probability of dying from pneumonia and influenza at the more advanced age groups between 1976 and 1996. This mortality pattern is evident in the increasing peakedness of the probability distributions over the 20 year period.

Chapter 6

Discussion & Conclusions

6.1 Summary of the Results

Overall, some notable mortality trends occurred in Ontario over the 20 year period. Males experienced larger increases than females in life expectancy at birth and at age 65. There was an increase of 5.12 years among males and an increase of 3.36 years among females. Consequently, the gender gap in the life expectancy at birth decreased from 7.18 to 5.42 years by 1996. The decreases in the gender gap continued throughout the age groups over the 20 year period. The larger male declines in the intensity of the mortality hazards would account for the larger increases observed among the male life expectancy and the decreasing gender gap in the life expectancies. The number of male and female survivors increased at a greater rate than the number of deaths at the older age groups over time. Thus, the intensity of the mortality hazards at the older age groups also declined over the 20 year period. Males had a more rapid rate of increasing survival and hence, experienced larger declines than females in the exposure to the risk of death. Nevertheless, males remained exposed to a much larger risk of death throughout the age span and this would reflect the lower overall life expectancy of males.

A common pattern among males and females for all causes and respiratory related deaths was that the relative frequency of death was declining throughout middle and early late adulthood, but increasing at the advanced age groups. This meant that males and females dying from all causes and respiratory related diseases were surviving longer or dying at a greater relative frequency in progressively older age groups over time. The commonly occurring pattern was evident in the shifting density peaks (modal ages)

further into late adulthood as time progressed. It was also evident in the increasing peakedness (concentration of deaths) of the probability distributions during late adulthood over the 20 year period. However, each of the causes of death categories had some unique characteristics. I will address these separately.

All respiratory related diseases made a moderate contribution to the total force of mortality over the 20 year span. The percentage of all respiratory related deaths among males increased from 14.7% to 18.0% of all deaths by 1996. Females had a larger increase than males in the percentage of all respiratory related deaths. The percentage of female deaths almost doubled from 7.9% to 13.6% between 1976 and 1996. Over time, the number of male survivors increased at a greater rate than the number of male respiratory related deaths. This meant that males were experiencing an overall decline in the intensity of the mortality hazards throughout the age span by 1996. Yet, the male exposure to the risk of death from respiratory related diseases remained quite high over all periods. Females experienced an opposite trend concerning the intensity of the mortality hazards. The number of respiratory related deaths increased at a greater rate than the number of female survivors throughout much of late adulthood. Thus, females experienced a considerable increase in the exposure to the risk of death from respiratory related diseases, especially between 1986 and 1996.

Respiratory related cancers made the largest contribution to the total force of respiratory related diseases mortality among males and the second largest among females. Male cancer deaths were on the declining trend with the percentage of deaths decreasing slightly from 8.0% to 7.64% between 1986 and 1996. The percentage of female respiratory related cancer deaths continually increased. It nearly tripled from 1.5% to

4.2% between 1976 and 1996. Males were beginning to experience declines in the intensity of the mortality hazards throughout the age span by 1996. Nevertheless, males remained at a considerably high risk of death from respiratory related cancers throughout much of late adulthood regardless of the declining trend. The declines that males experienced were only moderate at best. Conversely, females had large increases in exposure to the risk of death from respiratory related cancers. Yet, males remained at a much greater risk of death than females even with the large increases that females experienced.

Two plausible explanations possibly account for the patterns observed with respiratory related cancer mortality over the 20 year period. The first is the *gender-equality hypothesis*. This hypothesis predicts that the female advantage in terms of lung cancer mortality will diminish because of changes in the independence of females. That is, females will begin to participate in behaviors and roles (e.g. work roles, smoking etc.) that were traditionally occupied by males (Pampel 2003: 47). For instance, the societal changes that influenced females to smoke 30 to 40 years ago are reflected in the current mortality patterns of respiratory related cancers (Health Canada 2001: 63).

The other concept is that cigarette smoking diffuses throughout the population at different times by gender. Pampel (2003: 48) suggests that the differential adoption of smoking by males and females can account for the declining gender differential in mortality rates. The initial lag created by differential adoption causes the gender differential to increase. Once males reached their peak and female rates began increasing, the gap stopped increasing. When males rates are declining and the rates of females are steadily increasing the gender mortality differential also begins to decline. I will not

dwell any further into these concepts. However, these are important explanations concerning the patterns observed in the mortality hazards. The concepts will be examined fully in future studies.

The majority of cancer deaths occurred throughout a considerably younger portion of the age span compared to the other types of respiratory diseases. The highest male and female relative frequency of death occurred between the ages of 70 and 74 by 1996. This modal age is very premature considering that the highest relative frequency of death from pneumonia and influenza was between 85 and 89 years of age by 1996. A surprising trend was that females had a slightly higher relative frequency of respiratory related cancer death than males throughout middle adulthood over all periods.

Pneumonia & influenza hazards made the largest contribution to the total force of respiratory related diseases mortality among females and the third largest among males. The proportion of pneumonia and influenza deaths remained almost stable among males and females over the 20 year period. However, males and females experienced a slight increase in the proportion of pneumonia and influenza deaths by 1996. There were moderate declines in the intensity of the male mortality hazards between 1976 and 1996. Most of the decline in the exposure to the risk of death occurred between 1976 and 1986. The number of deaths and survivors were increasing at an almost equal rate and thus, the mortality hazards stabilized between 1986 and 1996.

Conversely, females experienced a decline in the mortality hazards between 1976 and 1986, followed by a slight increase in the mortality hazards at the advanced age groups by 1996. The female mortality hazards also appeared to have stabilized to some extent. Males remained at greater risk of dying from pneumonia and influenza than

females throughout late adulthood. This is even considering that females had a higher number of pneumonia and influenza deaths than males over all periods. The categories of bronchitis, emphysema or asthma and the other respiratory diseases were not comparable over the 20 year period. The problem was accidentally discovered in the middle of the analysis and will form a major topic in the following area of the discussion.

6.2 Problems with the Data

I suppose that my strategy of changing the ICDA-9 classifications to be consistent with ICDA-8 coding scheme (with the exception of pneumonia and influenza) was not completely successful. This was evident in the discovery of the problems associated with the categories of bronchitis, emphysema or asthma (*bea*) and other respiratory diseases (*oth_res*). In future studies, it would be advisable to perform a thorough search concerning changes in the coding practices by medical certifiers, which would impede accurate comparisons over time. Note that the study done by the NCHS (1980) on the comparability ratios between the 8th and 9th revisions of the ICDA made no mention of the changes in the coding practices associated with these classifications.

I accidentally found mention of these changes in a study on the comparability ratios between the 7th and 8th revisions (NCHS 1975). This study indicated that during the late 1960s there were an increasing number of deaths classified as COLD on the death certificate. In 1969, the NCHS introduced an independent classification for *COLD* (ICDA-8: 519.3) because they wanted to isolate the COLD deaths from the previous category of *Other Diseases of the Lung* (ICDA-8: 519.2). The number of deaths attributed to COLD continued to increase “rapidly” and in 1971/1972, the NCHS again changed the ‘coding procedures’ of this classification. They added a new definition to

prevent the increasing trend of COLD and instructed certifiers to code the cause of death as chronic bronchitis, emphysema or asthma when a “specific diagnosis” was possible. However, the changes made to the coding procedures did not stop the increasing number of deaths assigned to that classification. There was a belief that medical certifiers used the general classification when it was not known if the underlying cause of death was emphysema or chronic bronchitis (NCHS 1975: 45-47).

I found that the independent category of COLD (ICDA-8: 519.3) first appeared in the Canadian data by 1973. There was no mention that they included this new classification, nor of any reasons for the inclusion when it first appeared. Generally, I could not find any Canadian information that made any indication of an increasing number of deaths being attributed to the COLD classification. Nonetheless, I strongly believe that this practice was occurring throughout Canada for many reasons. First, Canada uses the same classification system that was originally adopted for use in the USA (ICDA). Second, there were large increases in the number of COPD deaths throughout Canada since the 1970s. Note that COPD is not an actual cause of death. It is a combination of lower respiratory diseases primarily composed of emphysema and chronic bronchitis. Hence, the number of bronchitis and emphysema deaths should also be increasing because they are the main diseases that make up COPD.

It is possible that this trend could go unnoticed because in the early 1970s the NCHS was already giving instructions to combine ICDA-8: 490-493 & 519.3 to measure the full effects of mortality from these deaths. It appeared that the difference between these causes of death was already indistinguishable in the USA and probably in Canada as well. Health Canada (2001) measured COPD mortality using ICDA-9: 490-492 & 496

(this is equivalent to ICDA-8 490-493 & 519.3) in their report on *Respiratory Diseases in Canada*. Thus, medical certifiers in Canada must have been influenced by the trends that were occurring in the United States because the same measures are used to analyze mortality from lower respiratory diseases.

This trend is interesting because it provides an example of the development of a normative practice. The NCHS (1975: 46) indicated that it became “fashionable” among American physicians to assign deaths to COLD or COPD in the late 1960s and early 1970s. As it became a more common occurrence among medical certifiers to conform to this practice and continuously assign deaths to the more general classification, it then also developed into a norm. In a sense, we also witness the social construction of a new disease. The norm became so deeply ingrained among the practices of physicians that the only way to measure bronchitis or emphysema mortality was through the combination of the classifications ICDA-8:490-A93, 519.3 or ICDA-9:490-492, 496 or what is commonly referred to as Chronic Obstructive Pulmonary Disease. Asthma (ICDA-8 & 9: 493) was removed from the general category in the 9th revision of the ICDA. Thus, the distinction between the specific categories of emphysema and chronic bronchitis became less viable as time progressed. The number deaths assigned to these specific classifications decreased and the number of assignments in to the more general classifications of COLD or CAO (depending on the ICDA revision) increased. Hence, differences between the diseases become less apparent over time and the result was a general category that covered a range of indistinguishable diseases. It would seem that the medical community has the ability to eradicate a group of diseases by changing the procedures of classification.

I do not have any problem with the way in which physicians determine a particular cause of death. The problem is concerning the lack of information that is available in Canada on these types of issues regarding mortality data. It would make the research process easier if there were reports on the changes in coding practices among Canadian physicians. A positive aspect that came out of these findings was that I was able to demonstrate that the cumulative hazard function is an effective tool for analyzing problems or changes in coding practices over time. The downside is that you have to know what you are looking for, in able to make sound judgments about any changes that may have taken place. Fortunately, the NCHS conducts many studies on these issues and contain a large number of historical documents that are freely accessible on the NCHS website. The studies concern American mortality data, but the trends observed are probably similar to the ones in Canada.

This issue also brings up some other problems with the Ontario data produced by the Office of the Registrar General. As I indicated in the data section, I could not include the category of COPD in the multiple decrement life tables. The reason was that Ontario death statistics are only published with the ‘intermediate’ or “A” list causes of death. It was possible to isolate CAO from ICDA-9, but not COLD from ICDA-8. The latter was grouped under the *other* category. Simply, there is a need for Ontario Vital Statistics to be published with the ‘detailed list of causes’. This would allow particular causes of death to be effectively analyzed over time and between the ICD revisions.

There is an *Ontario Mortality Database* in existence and it may contain the detailed list on the causes of death (I am not sure, because I have never had access to the database). With several attempts, I could not gain free access (without paying money) to

the Ontario Mortality Database. The *Eastern Health Information Partnerships* have access to the database, but only release the data (if the *Office of the Registrar General* approves the release) to their partner affiliations (some universities and other groups). These organizations distribute data to a limited number of groups or individuals. Thus, the Health Information Partnerships are only beneficial to a select group of institutions or individuals. The other way to gain access is directly through the *Office of the Registrar General* (they handle and produce vital statistics). However, it can be very expensive to gain access to the data (if they decide to release it), which are not published in their annual reports. Residents of Ontario pay for the generation of the data, but when they want to gain access to the data, they have to pay more to possibly have a chance to analyze the data. Generally, the Health Information Partnerships and the Office of the Registrar General are not very helpful to researchers outside of their organizations.

There is one last problem with the data. The problem concerns the length of the published age groups. Analyzing old age mortality and respiratory related diseases requires that the open-ended age group be extended to a 100 years of age. Notice that throughout the results section the female probability density functions appeared incomplete. The reason was that a large number of female deaths were occurring beyond 90 years of age (with the exception of respiratory related cancers). Simply, the majority of deaths occur during late adulthood and to analyze the structure of old age mortality you need a more complete age span. The open-ended age group was extended in the Ontario Vital Statistics from 85+ years to 90+ years between 1976 and 1996. Nevertheless, the current age span is still not adequate to analyze respiratory related diseases (except for respiratory related cancers).

In a sense, the current published age span is more suited to studying male mortality or the causes of death that primarily occur before the advanced age groups. A positive aspect emerging from the data deficiencies mentioned above was that I developed a crude method that extends the open-end age group to make compatible comparisons over time. A limitation of that method was that there is now way of knowing the accuracy of the estimation technique. However, the estimated deaths in the 85 to 89 age groups appeared to be adequate throughout the analysis. Hence, I would conclude that they gave reasonable approximation of respiratory related mortality at the 85 to 89 age group.

6.3 Future Directions

I am now at a point where I have a general understanding of the structure of respiratory diseases mortality on the population of Ontario over a short time span. I have also identified the segments of the Ontario population that are at the greatest risk of dying from respiratory related diseases. A future research model would be to examine the changes in the structure of respiratory related diseases mortality throughout the history of Canada, the provinces and possibly major cities. That is, I would conduct a closer examination concerning regional variations of cause specific mortality over a considerably longer time span. This of course, depends on the availability or access to these types of data. It proved difficult to conduct a detailed mortality analysis on a single province over a short time span.

Nevertheless, a primary objective would be to continue to achieve a greater of level of detail in the structural variation of mortality over time using the multiple decrement life table method. Of course, there would have to be considerable historical

research concerning the changes that occurred in the coding practices of the underlying causes of death between the revisions of the International Classification of Diseases.

I will also develop indirect estimation techniques to model the course of a particular cause of death when it is not comparable over time due to changes in coding procedures. Another objective of future research would be to model earlier periods of history containing insufficient data by developing indirect estimation methods and linking them with later periods estimated with direct methods allowing for comparisons that are more accurate over time. A third part of the research model would be to examine the concurrent social events or conditions that may have had or are having a direct impact of on the structural variation of respiratory related diseases mortality (e.g. vaccinations, industrial pollution, prevalence of smoking, medical knowledge and technology, social change etc.).

6.4 General and Concluding Remarks

I feel that the multiple decrement life tables were an adequate tool for analyzing the changes in the structure of respiratory diseases mortality over time. In addition, the MDLTs showed a large potential for being able to analyze specific causes of death that are normally contained within the general category. This aspect was proven even despite the limitations imposed by the problems with the mortality data.

I also found that using the hazard and density functions in place of the more traditional life table functions provided an adequate portrayal of the structural variation in mortality over time. This was primarily due to the straightforward interpretation associated with these functions. The aid of graphical applications to portray these continuous functions of the age span made the mortality experience easier to describe and

understand. The reason was that I was able to model intangible structures that operate in social reality into concrete and visible structures. The detailed description of the structural variation observed in the graphical displays also makes the visual models come alive with meaning. Thus, the MDLT method contains the possibility to influence the comprehension of the mortality experience through visualization and detailed description.

There are a few practical limitations when using this demographic method. First, the MDLT can prove very cumbersome by the large amount of numerical values produced for each of the functions. I feel that the best way that to handle the numerical colossus is with the production of graphical applications of the key functions that one wishes to analyze. In this way, the graphical approach makes the life table functions visible and easily understandable. Second, when a particular disease category has a small number of deaths, the graphs (especially, the probability density function) tend to fluctuate erratically throughout the age span. Thus, it would be best to analyze specific causes of death that have a large number of deaths occurring at any given time. This aspect imposes a limit on the degree of detail achievable when analyzing a specific disease category. You cannot divide a category into overly specific sub-categories because many values of the life table functions will equal zero. Other than that, the MDLT proved to be a useful tool for modeling the intangible structure of respiratory related diseases mortality and making it into a comprehensive concrete structure.

This exploratory study has also given the expectations that one faces with the changes in the coding procedures, which may impose limitations on comparisons when conducting historical mortality studies. In addition, there was the strong underlying message that you cannot take the quality of any data for granted. There are likely to be

many problems associated with the data or a lack of access to the data that may impede the research process. However, with these problems, there comes the ability of innovation and determination to work around the problems. No research is without constant setbacks, problems, disappointments and so forth. However, when you figure out a way to work around those problems, in a somewhat successful way, all of those negatives disappear and then you can say that it is not perfect, but it is finished.

Appendix A

1.1 Population Estimates & Mortality Data

Table 1.1 Population Estimates of Ontario for the Periods 1975-1977, 1985-1987 & 1995-1997

<i>e) Males</i>				
<i>x</i>	1995	1996	1997	mean
00-01	75,110	71,761	68,243	71,705
01-04	313,548	315,869	314,950	314,789
05-09	383,526	390,095	397,941	390,521
10-14	372,646	379,923	387,388	379,986
15-19	366,070	371,156	374,859	370,695
20-24	385,176	378,230	378,553	380,653
25-29	422,165	412,042	409,724	414,644
30-34	507,036	500,647	490,299	499,327
35-39	469,991	484,809	498,202	484,334
40-44	413,766	425,651	441,284	426,900
45-49	379,031	391,668	392,893	387,864
50-54	289,893	301,935	325,621	305,816
55-59	242,604	247,139	254,250	247,998
60-64	225,772	225,080	225,285	225,379
65-69	201,836	205,114	207,968	204,973
70-74	161,849	164,342	166,869	164,353
75-79	99,609	105,385	112,118	105,704
80-84	61,136	62,541	63,577	62,418
85-89	25,640	26,909	28,450	27,000
90+	10,074	9,976	10,290	10,113
Total	5,406,478	5,470,272	5,548,764	5,475,171

<i>c) Males</i>				
<i>x</i>	1985	1986	1987	mean
00-01	67,715	68,699	68,884	68,433
01-04	259,412	262,335	270,831	264,193
05-09	316,323	320,381	327,451	321,385
10-14	336,173	328,604	328,514	331,097
15-19	374,374	370,864	368,625	371,288
20-24	461,668	459,749	451,508	457,642
25-29	423,870	440,998	461,493	442,120
30-34	383,825	394,968	413,543	397,445
35-39	363,830	374,356	377,341	371,842
40-44	292,154	305,016	328,475	308,548
45-49	246,909	251,214	260,633	252,919
50-54	237,104	235,683	235,748	236,178
55-59	228,783	231,769	233,347	231,300
60-64	201,823	204,730	208,305	204,953
65-69	147,215	154,380	163,354	154,983
70-74	117,449	119,620	120,964	119,344
75-79	73,791	76,579	80,032	76,801
80-84	40,788	41,921	43,306	42,005
85-89	17,122	17,739	18,907	17,923
90+	6,897	7,063	7,347	7,102
Total	4,597,225	4,666,668	4,768,608	4,677,500

<i>a) Males</i>				
<i>x</i>	1975	1976	1977	mean
00-01	64,419	62,615	63,055	63,363
01-04	258,226	252,747	249,710	253,561
05-09	348,834	345,310	341,454	345,199
10-14	420,630	411,347	401,002	410,993
15-19	410,699	421,284	425,731	419,238
20-24	382,630	391,308	397,255	390,398
25-29	362,508	370,454	367,515	366,826
30-34	296,195	307,033	327,540	310,256
35-39	249,554	253,230	261,535	254,773
40-44	246,767	244,907	243,665	245,113
45-49	241,237	241,923	243,392	242,184
50-54	225,777	228,895	229,550	228,074
55-59	174,226	181,399	191,148	182,258
60-64	156,867	158,855	159,018	158,247
65-69	117,367	122,015	127,311	122,231
70-74	85,214	87,242	89,146	87,201
75-79	53,008	54,990	57,178	55,059
80-84	29,498	29,977	30,594	30,023
85-89	13,635	13,648	13,879	13,721
90+	5,591	5,958	6,110	5,886
Total	4,142,882	4,185,137	4,225,788	4,184,602

Source: Health Statistics at a Glance- Health Indicators 1999

<i>f) Females</i>				
<i>x</i>	1995	1996	1997	mean
00-01	71,153	68,251	64,761	68,055
01-04	297,222	300,172	299,705	299,033
05-09	364,090	370,243	377,957	370,763
10-14	353,460	360,157	366,356	359,991
15-19	345,631	350,240	354,696	350,189
20-24	375,031	368,944	367,841	370,605
25-29	421,250	414,384	411,638	415,757
30-34	500,616	494,189	486,164	493,656
35-39	475,628	488,432	499,798	487,953
40-44	427,199	439,668	454,730	440,532
45-49	384,650	398,600	401,174	394,808
50-54	293,503	306,701	331,416	310,540
55-59	247,977	254,078	262,319	254,791
60-64	234,259	234,284	235,063	234,535
65-69	225,662	226,109	226,891	226,221
70-74	207,319	209,905	210,611	209,278
75-79	142,564	150,369	159,881	150,938
80-84	102,973	104,954	106,555	104,827
85-89	57,026	58,676	60,572	58,758
90+	31,234	32,248	33,527	32,336
Total	5,558,447	5,630,604	5,711,655	5,633,569

<i>d) Females</i>				
<i>x</i>	1985	1986	1987	mean
00-01	64,493	65,183	65,733	65,136
01-04	245,289	249,687	258,462	251,146
05-09	300,650	303,366	310,649	304,888
10-14	319,129	313,308	313,942	315,460
15-19	352,286	349,393	348,223	349,967
20-24	441,915	436,604	426,642	435,054
25-29	424,056	435,789	451,024	436,956
30-34	394,691	406,401	421,587	407,560
35-39	363,200	375,147	380,752	373,033
40-44	286,006	299,425	324,095	303,175
45-49	241,993	246,806	256,677	248,492
50-54	233,407	233,121	233,529	233,352
55-59	234,286	234,479	235,786	234,850
60-64	228,410	230,920	232,776	230,702
65-69	175,583	185,225	196,657	185,822
70-74	149,685	153,007	156,044	152,912
75-79	110,232	113,530	117,832	113,865
80-84	73,253	75,664	78,842	75,920
85-89	40,353	41,807	43,497	41,886
90+	21,355	22,305	23,524	22,395
Total	4,700,272	4,771,167	4,876,273	4,782,571

<i>b) Females</i>				
<i>x</i>	1975	1976	1977	mean
00-01	61,356	60,085	59,702	60,381
01-04	244,394	239,053	237,504	240,317
05-09	332,306	328,596	323,495	328,132
10-14	400,773	391,589	381,066	391,143
15-19	395,179	403,264	407,745	402,063
20-24	383,390	393,397	399,532	392,106
25-29	358,213	367,752	368,413	364,793
30-34	286,481	298,048	319,453	301,327
35-39	240,917	245,329	253,760	246,669
40-44	235,430	235,472	234,880	235,261
45-49	236,031	234,215	234,176	234,807
50-54	235,279	238,902	237,521	237,234
55-59	182,900	192,132	204,130	193,054
60-64	166,970	169,589	172,004	169,521
65-69	136,170	141,292	146,533	141,332
70-74	108,810	111,534	115,525	111,956
75-79	80,556	83,074	85,187	82,939
80-84	51,940	53,605	55,710	53,752
85-89	27,268	28,203	29,360	28,277
90+	12,493	13,540	14,228	13,420
Total	4,176,856	4,228,671	4,279,924	4,228,484

Table 1.2 All Causes: Ontario Males and Females for the Periods 1975-77, 1985-87 & 1995-1997

a) Males						b) Females					
x	1995	1996	1997	mean	median	x	1995	1996	1997	mean	median
00-01	482	461	412	452	461	00-01	388	341	316	348	341
01-04	82	95	89	89	89	01-04	62	74	64	67	64
05-09	46	43	49	46	46	05-09	49	46	35	43	46
10-14	58	69	68	65	68	10-14	67	43	50	53	50
15-19	212	193	234	213	212	15-19	100	86	96	94	96
20-24	316	285	260	287	285	20-24	99	105	99	101	99
25-29	358	340	284	327	340	25-29	162	134	133	143	134
30-34	601	535	473	536	535	30-34	243	236	195	225	236
35-39	729	718	657	701	718	35-39	323	356	312	330	323
40-44	891	867	834	864	867	40-44	496	504	482	494	496
45-49	1,167	1,100	1,083	1,117	1,100	45-49	739	731	703	724	731
50-54	1,479	1,441	1,476	1,465	1,476	50-54	951	906	901	919	906
55-59	1,921	1,967	1,998	1,962	1,967	55-59	1,210	1,300	1,193	1,234	1,210
60-64	3,162	2,979	2,904	3,015	2,979	60-64	1,919	1,807	1,833	1,853	1,833
65-69	4,671	4,593	4,499	4,588	4,593	65-69	2,871	2,772	2,717	2,787	2,772
70-74	5,960	6,119	5,904	5,994	5,960	70-74	4,231	4,242	4,234	4,236	4,234
75-79	5,927	6,054	6,450	6,144	6,054	75-79	4,957	5,245	5,354	5,185	5,245
80-84	5,941	6,031	6,090	6,021	6,031	80-84	6,389	6,478	6,515	6,461	6,478
85-89	4,007	4,171	4,251	4,143	4,171	85-89	6,150	6,244	6,481	6,292	6,244
90+	2,569	2,612	2,651	2,611	2,612	90+	6,494	6,776	7,162	6,811	6,776
Total	40,579	40,673	40,666	40,639	40,666	Total	37,900	38,426	38,875	38,400	38,426

c) Males						d) Females					
x	1985	1986	1987	mean	median	x	1985	1986	1987	mean	median
00-01	546	543	484	524	543	00-01	415	426	404	415	415
01-04	112	109	101	107	109	01-04	89	92	99	93	92
05-09	77	77	57	70	77	05-09	45	44	50	46	45
10-14	91	76	90	86	90	10-14	68	42	46	52	46
15-19	290	298	302	297	298	15-19	135	118	116	123	118
20-24	507	422	452	460	452	20-24	167	151	129	149	151
25-29	399	428	467	431	428	25-29	164	160	179	168	164
30-34	437	440	477	451	440	30-34	224	204	187	205	204
35-39	483	547	526	519	526	35-39	279	275	292	282	279
40-44	668	625	674	656	668	40-44	388	372	449	403	388
45-49	895	880	872	882	880	45-49	560	582	549	564	560
50-54	1,550	1,546	1,374	1,490	1,546	50-54	863	899	876	879	876
55-59	2,451	2,486	2,393	2,443	2,451	55-59	1,396	1,279	1,329	1,335	1,329
60-64	3,559	3,668	3,542	3,590	3,559	60-64	2,080	2,070	2,060	2,070	2,070
65-69	4,219	4,326	4,419	4,321	4,326	65-69	2,628	2,679	2,730	2,679	2,679
70-74	5,353	5,086	5,272	5,237	5,272	70-74	3,537	3,657	3,539	3,578	3,539
75-79	5,132	5,241	5,389	5,254	5,241	75-79	4,385	4,434	4,530	4,450	4,434
80-84	4,347	4,470	4,547	4,455	4,470	80-84	4,699	5,047	4,938	4,895	4,938
85-89	2,798	2,892	2,890	2,860	2,890	85-89	4,483	4,621	4,655	4,586	4,621
90+	1,828	1,848	1,865	1,847	1,848	90+	4,398	4,701	4,766	4,622	4,701
Total	35,742	36,008	36,193	35,981	36,114	Total	31,003	31,853	31,923	31,593	31,649

e) Males						f) Females					
x	1975	1976	1977	mean	median	x	1975	1976	1977	mean	median
00-01	926	858	752	845	858	00-01	688	657	632	659	657
01-04	155	171	141	156	155	01-04	118	128	113	120	118
05-09	140	116	143	133	140	05-09	88	84	73	82	84
10-14	158	129	143	143	143	10-14	102	75	98	92	98
15-19	585	487	485	519	487	15-19	165	168	172	168	168
20-24	551	548	613	571	551	20-24	181	163	166	170	166
25-29	443	444	439	442	443	25-29	192	171	189	184	189
30-34	395	376	383	385	383	30-34	196	186	199	194	196
35-39	494	459	483	479	483	35-39	266	272	265	268	266
40-44	759	736	697	731	736	40-44	426	376	445	416	426
45-49	1,277	1,274	1,319	1,290	1,277	45-49	731	668	690	696	690
50-54	2,045	2,041	1,955	2,014	2,041	50-54	1,077	1,054	1,055	1,062	1,055
55-59	2,509	2,510	2,666	2,562	2,510	55-59	1,285	1,289	1,436	1,337	1,289
60-64	3,467	3,448	3,507	3,474	3,467	60-64	1,745	1,765	1,782	1,764	1,765
65-69	4,016	4,166	4,280	4,154	4,166	65-69	2,360	2,248	2,424	2,344	2,360
70-74	4,455	4,627	4,617	4,566	4,617	70-74	2,992	2,931	3,023	2,982	2,992
75-79	4,205	4,320	4,395	4,307	4,320	75-79	3,725	3,661	3,583	3,656	3,661
80-84	3,630	3,658	3,522	3,603	3,630	80-84	3,978	4,131	4,194	4,101	4,131
85-89	2,503	2,424	2,393	2,440	2,424	85-89	3,511	3,561	3,696	3,589	3,561
90+	1,391	1,428	1,344	1,388	1,391	90+	2,668	2,829	2,904	2,800	2,829
Total	34,104	34,220	34,277	34,200	34,222	Total	26,494	26,417	27,139	26,683	26,701

Source: Province of Ontario, Vital Statistics for 1975 & 1976, 1977, 1985, 1986, 1987, Health Indicators at a Glance 1999

Notes: The residual category (*residual*) was obtained by subtracting the median values of all causes from the values of all respiratory related diseases (*all_res*).

Table 1.3 Diseases of the Respiratory System (ICDA-8 & 9: 460-519): Ontario Males and Females for the Periods 1975-1977, 1985-1987 & 1995-1997

a) Males						b) Females					
x	1995	1996	1997	mean	median	x	1995	1996	1997	mean	median
00-01	11	3	4	6	4	00-01	4	8	2	5	4
01-04	5	8	4	6	5	01-04	5	5	3	4	5
05-09	2	2	0	1	2	05-09	5	0	3	3	3
10-14	1	2	0	1	1	10-14	4	2	1	2	2
15-19	6	3	8	6	6	15-19	2	1	0	1	1
20-24	9	5	4	6	5	20-24	3	4	7	5	4
25-29	2	9	2	4	2	25-29	5	4	1	3	4
30-34	12	5	6	8	6	30-34	7	2	7	5	7
35-39	7	10	10	9	10	35-39	8	7	4	6	7
40-44	9	10	11	10	10	40-44	15	16	8	13	15
45-49	22	35	23	27	23	45-49	21	17	25	21	21
50-54	52	43	35	43	43	50-54	32	42	31	35	32
55-59	58	75	66	66	66	55-59	63	61	53	59	61
60-64	132	144	125	134	132	60-64	87	106	101	98	101
65-69	338	292	278	303	292	65-69	204	194	167	188	194
70-74	513	505	516	511	513	70-74	327	321	335	328	327
75-79	598	642	648	629	642	75-79	490	472	466	476	472
80-84	766	781	726	758	766	80-84	666	607	650	641	650
85-89	588	585	624	599	588	85-89	594	627	641	621	627
90+	441	424	437	434	437	90+	762	789	832	794	789
Total	3,572	3,583	3,527	3,561	3,572	Total	3,304	3,285	3,337	3,309	3,304

c) Males						d) Females					
x	1985	1986	1987	mean	median	x	1985	1986	1987	mean	median
00-01	10	15	7	11	10	00-01	7	10	10	9	10
01-04	8	6	6	7	6	01-04	5	7	9	7	7
05-09	3	3	2	3	3	05-09	1	1	1	1	1
10-14	3	9	0	4	3	10-14	1	3	3	2	3
15-19	4	3	5	4	4	15-19	7	3	3	4	3
20-24	9	5	6	7	6	20-24	7	6	6	6	6
25-29	7	7	7	7	7	25-29	4	6	3	4	4
30-34	7	8	13	9	8	30-34	6	3	4	4	4
35-39	16	13	8	12	13	35-39	4	4	4	4	4
40-44	15	13	5	11	13	40-44	12	9	13	11	12
45-49	23	21	20	21	21	45-49	17	15	11	14	15
50-54	43	52	44	46	44	50-54	23	26	26	25	26
55-59	80	107	81	89	81	55-59	53	46	60	53	53
60-64	152	170	179	167	170	60-64	97	101	99	99	99
65-69	287	272	315	291	287	65-69	161	147	160	156	160
70-74	477	422	446	448	446	70-74	201	262	242	235	242
75-79	531	577	552	553	552	75-79	273	308	300	294	300
80-84	517	616	516	550	517	80-84	289	385	358	344	358
85+	663	714	718	698	714	85+	775	927	907	870	907
Total	2,855	3,033	2,930	2,939	2,905	Total	1,943	2,269	2,219	2,144	2,219

e) Males						f) Females					
x	1975	1976	1977	mean	median	x	1975	1976	1977	mean	median
00-01	50	41	26	39	41	00-01	33	21	23	26	23
01-04	12	19	8	13	12	01-04	11	9	8	9	9
05-09	8	4	8	7	8	05-09	8	5	5	6	5
10-14	6	4	5	5	5	10-14	6	8	7	7	7
15-19	7	8	8	8	8	15-19	4	6	5	5	5
20-24	10	11	8	10	10	20-24	5	5	5	5	5
25-29	6	8	13	9	8	25-29	6	4	4	5	4
30-34	8	5	15	9	8	30-34	9	8	4	7	8
35-39	17	15	14	15	15	35-39	10	11	12	11	11
40-44	19	17	30	22	19	40-44	12	14	13	13	13
45-49	38	42	43	41	42	45-49	24	20	27	24	24
50-54	73	73	70	72	73	50-54	47	32	34	38	34
55-59	125	111	110	115	111	55-59	61	56	63	60	61
60-64	210	213	168	197	210	60-64	77	69	82	76	77
65-69	313	277	288	293	288	65-69	119	114	102	112	114
70-74	358	403	344	368	358	70-74	161	153	154	156	154
75-79	453	437	394	428	437	75-79	216	193	195	201	195
80-84	378	386	391	385	386	80-84	254	263	239	252	254
85+	462	465	405	444	462	85+	456	522	517	498	517
Total	2,553	2,539	2,348	2,480	2,501	Total	1,519	1,513	1,499	1,510	1,520

Source: Province of Ontario, Vital Statistics for 1975 & 1976, 1977, 1985, 1986, 1987, Health Indicators at a Glance 1999

Notes: The other respiratory diseases category (*oth_res*) was obtained by subtracting the median values of the diseases of the respiratory system (*res*) from pneumonia & influenza (*pneu*) and bronchitis, emphysema & asthma (*bea*).
The all respiratory related diseases category (*all_res*) was obtained by adding the median values of diseases of the respiratory system (*res*) to the median values of neoplasms of the respiratory organs (*neo*).

**Table 1.4 Neoplasms of the Respiratory Organs (ICDA-8: 160-163, ICDA-9: 160-165):
Ontario Males and Females for the Periods 1975-1977, 1985-1987 & 1995-1997**

<i>a) Males</i>						<i>b) Females</i>					
<i>x</i>	1995	1996	1997	mean	median	<i>x</i>	1995	1996	1997	mean	median
00-01	0	0	0	0	0	00-01	0	0	0	0	0
01-04	0	0	0	0	0	01-04	0	0	0	0	0
05-09	0	0	0	0	0	05-09	0	0	0	0	0
10-14	0	0	0	0	0	10-14	0	0	0	0	0
15-19	1	0	0	0	0	15-19	0	0	0	0	0
20-24	1	0	0	0	0	20-24	0	1	1	1	1
25-29	0	1	3	1	1	25-29	2	2	1	2	2
30-34	5	6	5	5	5	30-34	6	3	1	3	3
35-39	16	16	12	15	16	35-39	16	10	8	11	10
40-44	32	29	33	31	32	40-44	36	40	30	35	36
45-49	92	71	74	79	74	45-49	72	75	51	66	72
50-54	159	149	143	150	149	50-54	115	107	89	104	107
55-59	278	256	241	258	256	55-59	151	173	150	158	151
60-64	424	459	412	432	424	60-64	240	268	249	252	249
65-69	633	651	615	633	633	65-69	325	349	315	330	325
70-74	724	735	688	716	724	70-74	377	387	397	387	387
75-79	512	549	527	529	527	75-79	280	314	329	308	314
80-84	379	362	345	362	362	80-84	206	202	222	210	206
85-89	144	152	168	155	152	85-89	90	93	101	95	93
90+	55	44	61	53	55	90+	35	45	47	42	45
Total	3,455	3,480	3,327	3,421	3,410	Total	1,951	2,069	1,991	2,004	2,001

<i>c) Males</i>						<i>d) Females</i>					
<i>x</i>	1985	1986	1987	mean	median	<i>x</i>	1985	1986	1987	mean	median
00-01	0	0	0	0	0	00-01	0	0	0	0	0
01-04	0	0	0	0	0	01-04	0	0	0	0	0
05-09	0	0	0	0	0	05-09	0	0	0	0	0
10-14	0	0	0	0	0	10-14	0	0	0	0	0
15-19	1	0	1	1	1	15-19	1	1	0	1	1
20-24	3	1	0	1	1	20-24	1	0	0	0	0
25-29	1	2	2	2	2	25-29	1	1	2	1	1
30-34	6	2	1	3	2	30-34	5	6	3	5	5
35-39	18	19	14	17	18	35-39	8	5	15	9	8
40-44	29	34	46	36	34	40-44	42	29	32	34	32
45-49	69	89	80	79	80	45-49	49	49	66	55	49
50-54	186	170	192	183	186	50-54	92	104	104	100	104
55-59	370	357	355	361	357	55-59	151	144	165	153	151
60-64	503	545	511	520	511	60-64	211	194	230	212	211
65-69	541	561	600	567	561	65-69	248	240	225	238	240
70-74	542	537	564	548	542	70-74	203	206	218	209	206
75-79	424	398	467	430	424	75-79	150	169	184	168	169
80-84	238	269	279	262	269	80-84	96	91	108	98	96
85+	142	155	137	145	142	85+	73	64	60	66	64
Total	3,073	3,139	3,249	3,154	3,130	Total	1,331	1,303	1,412	1,349	1,337

<i>e) Males</i>						<i>f) Females</i>					
<i>x</i>	1975	1976	1977	mean	median	<i>x</i>	1975	1976	1977	mean	median
00-01	0	0	0	0	0	00-01	0	0	0	0	0
01-04	0	0	0	0	0	01-04	0	1	0	0	0
05-09	0	0	0	0	0	05-09	0	0	0	0	0
10-14	0	0	0	0	0	10-14	0	0	0	0	0
15-19	1	0	1	1	1	15-19	0	0	0	0	0
20-24	1	1	0	1	1	20-24	0	0	1	0	0
25-29	1	2	1	1	1	25-29	3	2	1	2	2
30-34	9	3	5	6	5	30-34	7	2	1	3	2
35-39	9	7	6	7	7	35-39	5	4	10	6	5
40-44	42	33	30	35	33	40-44	20	13	25	19	20
45-49	92	92	85	90	92	45-49	34	25	38	32	34
50-54	172	186	170	176	172	50-54	62	69	59	63	62
55-59	256	253	266	258	256	55-59	65	71	91	76	71
60-64	334	402	371	369	371	60-64	83	93	90	89	90
65-69	364	438	452	418	438	65-69	83	61	99	81	83
70-74	374	415	391	393	391	70-74	59	52	75	62	59
75-79	258	282	287	276	282	75-79	48	52	49	50	49
80-84	150	148	158	152	150	80-84	35	30	46	37	35
85+	74	52	79	68	74	85+	26	20	23	23	23
Total	2,137	2,314	2,302	2,251	2,274	Total	530	495	608	544	535

Source: Province of Ontario, Vital Statistics for 1975 & 1976, 1977, 1985, 1986, 1987, Health Indicators at a Glance 1999

**Table 1.5 Pneumonia and Influenza (ICDA-8: 470-474 & 480-486, ICDA-9: 480-487):
Ontario Males and Females for the Periods 1975-1977, 1985-198 & 1995-1997**

a) Males

x	1995	1996	1997	mean	median
00-01	7	1	0	3	1
01-04	1	3	2	2	2
05-09	1	1	0	1	1
10-14	0	1	0	0	0
15-19	3	2	5	3	3
20-24	5	2	0	2	2
25-29	1	6	1	3	1
30-34	6	2	5	4	5
35-39	2	9	5	5	5
40-44	6	5	6	6	6
45-49	8	16	12	12	12
50-54	21	24	17	21	21
55-59	23	26	23	24	23
60-64	34	49	36	40	36
65-69	80	55	75	70	75
70-74	138	133	131	134	133
75-79	170	214	215	200	214
80-84	287	302	276	288	287
85-89	264	270	308	281	270
90+	252	226	244	241	244
Total	1,309	1,347	1,361	1,339	1,341

b) Females

x	1995	1996	1997	mean	median
00-01	1	4	1	2	1
01-04	4	5	1	3	4
05-09	0	0	2	1	0
10-14	3	0	0	1	0
15-19	1	1	0	1	1
20-24	1	3	2	2	2
25-29	2	1	1	1	1
30-34	2	1	6	3	2
35-39	4	3	0	2	3
40-44	8	6	2	5	6
45-49	7	6	10	8	7
50-54	12	14	7	11	12
55-59	16	20	16	17	16
60-64	20	27	27	25	27
65-69	49	49	43	47	49
70-74	102	85	72	86	85
75-79	158	149	163	157	158
80-84	312	267	304	294	304
85-89	358	338	384	360	358
90+	551	563	590	568	563
Total	1,611	1,542	1,631	1,595	1,599

c) Males

x	1985	1986	1987	mean	median
00-01	5	10	3	6	5
01-04	4	2	3	3	3
05-09	2	1	1	1	1
10-14	0	1	0	0	0
15-19	1	1	2	1	1
20-24	2	2	3	2	2
25-29	1	2	2	2	2
30-34	3	2	8	4	3
35-39	7	4	3	5	4
40-44	5	7	3	5	5
45-49	10	11	9	10	10
50-54	16	12	18	15	16
55-59	22	39	26	29	26
60-64	36	57	38	44	38
65-69	64	50	85	66	64
70-74	135	120	109	121	120
75-79	175	181	159	172	175
80-84	200	257	202	220	202
85+	348	393	390	377	390
Total	1,036	1,152	1,064	1,084	1,067

d) Females

x	1985	1986	1987	mean	median
00-01	5	7	6	6	6
01-04	3	6	5	5	5
05-09	0	1	0	0	0
10-14	0	1	1	1	1
15-19	2	1	2	2	2
20-24	2	3	1	2	2
25-29	1	3	1	2	1
30-34	1	0	2	1	1
35-39	1	0	2	1	1
40-44	4	2	3	3	3
45-49	3	5	7	5	5
50-54	4	8	5	6	5
55-59	14	16	17	16	16
60-64	27	22	22	24	22
65-69	40	40	43	41	40
70-74	65	75	61	67	65
75-79	110	131	116	119	116
80-84	168	236	206	203	206
85+	592	699	669	653	669
Total	1,042	1,256	1,169	1,156	1,166

e) Males

x	1975	1976	1977	mean	median
00-01	38	33	17	29	33
01-04	6	10	4	7	6
05-09	7	1	5	4	5
10-14	1	3	2	2	2
15-19	5	4	3	4	4
20-24	7	2	4	4	4
25-29	4	6	7	6	6
30-34	5	2	6	4	5
35-39	10	6	6	7	6
40-44	13	9	16	13	13
45-49	21	20	22	21	21
50-54	35	28	25	29	28
55-59	51	33	34	39	34
60-64	45	70	47	54	47
65-69	103	74	89	89	89
70-74	126	146	123	132	126
75-79	219	199	164	194	199
80-84	206	211	188	202	206
85+	325	318	278	307	318
Total	1,227	1,175	1,040	1,147	1,152

f) Females

x	1975	1976	1977	mean	median
00-01	26	16	18	20	18
01-04	9	4	4	6	4
05-09	5	2	2	3	2
10-14	4	5	4	4	4
15-19	3	2	2	2	2
20-24	2	1	2	2	2
25-29	4	2	3	3	3
30-34	5	3	2	3	3
35-39	6	6	6	6	6
40-44	8	8	6	7	8
45-49	13	8	10	10	10
50-54	25	14	10	16	14
55-59	22	23	20	22	22
60-64	39	31	34	35	34
65-69	65	38	39	47	39
70-74	89	82	84	85	84
75-79	152	129	126	136	129
80-84	209	213	181	201	209
85+	397	462	440	433	440
Total	1,083	1,049	993	1,042	1,033

Source: Province of Ontario, Vital Statistics for 1975 & 1976, 1977, 1985, 1986, 1987, Health Indicators at a Glance 1999

Table 1.6 Bronchitis, Emphysema & Asthma (ICDA-8 & 9: 490-493): Ontario Males and Females for the Periods 1975-1977, 1985-1987 & 1995-1997

a) Males

x	1995	1996	1997	mean	median
00-01	0	1	0	0	0
01-04	0	0	0	0	0
05-09	0	0	0	0	0
10-14	0	0	0	0	0
15-19	2	1	3	2	2
20-24	2	3	3	3	3
25-29	1	0	1	1	1
30-34	3	0	1	1	1
35-39	2	0	2	1	2
40-44	0	3	1	1	1
45-49	3	7	4	5	4
50-54	4	5	4	4	4
55-59	9	8	7	8	8
60-64	16	19	17	17	17
65-69	43	32	39	38	39
70-74	47	59	53	53	53
75-79	64	54	52	57	54
80-84	67	66	58	64	66
85-89	32	34	27	31	32
90+	12	20	21	18	20
Total	307	312	293	304	307

b) Females

x	1995	1996	1997	mean	median
00-01	0	1	0	0	0
01-04	0	0	1	0	0
05-09	1	0	0	0	0
10-14	1	2	1	1	1
15-19	0	0	0	0	0
20-24	2	1	3	2	2
25-29	2	2	0	1	2
30-34	3	0	0	1	0
35-39	1	2	2	2	2
40-44	1	1	1	1	1
45-49	10	4	8	7	8
50-54	5	5	7	6	5
55-59	11	9	6	9	9
60-64	13	20	19	17	19
65-69	25	29	14	23	25
70-74	33	47	42	41	42
75-79	47	48	48	48	48
80-84	47	49	48	48	48
85-89	25	39	36	33	36
90+	34	28	38	33	34
Total	261	287	274	274	282

c) Males

x	1985	1986	1987	mean	median
00-01	0	0	0	0	0
01-04	0	0	1	0	0
05-09	1	2	1	1	1
10-14	1	5	0	2	1
15-19	3	1	1	2	1
20-24	5	2	2	3	2
25-29	4	0	3	2	3
30-34	4	6	4	5	4
35-39	1	6	2	3	2
40-44	3	2	0	2	2
45-49	3	6	2	4	3
50-54	9	14	10	11	10
55-59	24	22	18	21	22
60-64	34	32	29	32	32
65-69	58	47	58	54	58
70-74	73	78	72	74	73
75-79	87	83	78	83	83
80-84	75	73	66	71	73
85+	56	57	54	56	56
Total	441	436	401	426	426

d) Females

x	1985	1986	1987	mean	median
00-01	0	1	0	0	0
01-04	0	0	0	0	0
05-09	1	0	1	1	1
10-14	0	1	1	1	1
15-19	5	1	1	2	1
20-24	2	3	2	2	2
25-29	2	2	0	1	2
30-34	3	1	1	2	1
35-39	2	1	2	2	2
40-44	3	4	4	4	4
45-49	7	5	1	4	5
50-54	8	10	7	8	8
55-59	11	16	16	14	16
60-64	18	22	23	21	22
65-69	30	24	29	28	29
70-74	39	51	47	46	47
75-79	40	48	36	41	40
80-84	28	23	24	25	24
85+	33	30	42	35	33
Total	232	243	237	237	238

e) Males

x	1975	1976	1977	mean	median
00-01	0	0	0	0	0
01-04	1	1	0	1	1
05-09	0	1	1	1	1
10-14	5	0	2	2	2
15-19	1	3	2	2	2
20-24	0	6	1	2	1
25-29	1	1	4	2	1
30-34	2	2	1	2	2
35-39	2	3	2	2	2
40-44	5	6	5	5	5
45-49	9	13	9	10	9
50-54	15	26	21	21	21
55-59	48	45	31	41	45
60-64	86	65	52	68	65
65-69	123	104	82	103	104
70-74	140	132	109	127	132
75-79	136	121	101	119	121
80-84	79	69	82	77	79
85+	79	67	48	65	67
Total	732	665	553	650	660

f) Females

x	1975	1976	1977	mean	median
00-01	0	0	0	0	0
01-04	0	0	0	0	0
05-09	1	0	0	0	0
10-14	2	3	2	2	2
15-19	1	2	2	2	2
20-24	1	2	3	2	2
25-29	1	1	1	1	1
30-34	2	2	1	2	2
35-39	2	0	4	2	2
40-44	4	4	3	4	4
45-49	5	7	6	6	6
50-54	13	10	10	11	10
55-59	19	16	21	19	19
60-64	23	28	24	25	24
65-69	25	36	24	28	25
70-74	42	34	30	35	34
75-79	28	20	29	26	28
80-84	23	18	25	22	23
85+	32	24	28	28	28
Total	224	207	213	215	212

Source: Province of Ontario, Vital Statistics for 1975 & 1976, 1977, 1985, 1986, 1987, Health Indicators at a Glance 1999

Appendix A

1.2 Comparability Ratios of Respiratory Diseases from NCHS (1980)

Table 1.7 Comparability Ratios of Respiratory Diseases

<i>Cause of Death (ICD-9)</i>	<i>Comparability Ratio</i>
<i>Malignant Neoplasm of the Respiratory Organs (160-165)</i>	1.0007
<i>Pneumonia & Influenza (480-487)</i>	0.9284
<i>Pneumonia (480-486)</i>	0.9199
<i>Influenza (487)</i>	0.9714
<i>COPD & Allied Conditions (490-496)</i>	1.8846
<i>Bronchitis (490-491)</i>	0.9383
<i>Emphysema (492)</i>	0.9770
<i>Asthma (493)</i>	1.3544
<i>Other COPD & Allied Conditions (494-496)</i>	1.0054

Source: National Centre for Health Statistics 1980

Table 1.7 shows the comparability ratios between the 8th and 9th revisions from the NCHS study. Generally, there were some modifications in the classification of the diseases of the respiratory system (ICDA-8 & 9: 460-519) that would result in comparability ratios being greater or less than 1.00. First, *chronic obstructive lung disease* (ICDA-8: 519.3) was changed to *chronic airways obstruction, not else classified* (ICDA-9: 496) in the 9th revision was included under the category of *Chronic obstructive pulmonary diseases (COPD) and allied conditions* (ICDA-8: 490-493, ICDA-9: 490-496). In addition, *bronchiectasis* (ICDA-8: 518) was also ‘transferred’ to the same category (ICDA-9: 494). This resulted in a ratio greater than 1.00 because more deaths were attributed to the new classification of COPD and allied conditions. *Asthma* (ICDA-8 & 9: 493) deaths had a ratio greater than 1.00 because this disease was ‘linked’ with bronchitis and emphysema in the 8th revision and there was no link between these diseases in the 9th revision. This change led to an increase in the number of asthma deaths and a decrease in the number of deaths attributed to bronchitis and emphysema. *Pneumonitis due to solids and liquids* was taken from the *pneumonia, unspecified*

classification (ICDA-8: 486) and placed in a separate classification under *other respiratory diseases* (ICDA-9: 507). This led to a ratio less than 1.00 and a corresponding decrease in the number of deaths attributed to pneumonia. Lastly, there were minimal changes in the category *neoplasms of respiratory organs* (ICDA-8:160-163, ICDA-9:160-165) between the revisions resulting in a ratio of 1.007 (NCHS 1980: 6-7).

Appendix B

2.1 Comparison of Median & Mean Life Tables

Figure 2.1 shows the median and mean age specific mortality rates (${}_n m_x$) by age and gender (refer to Tables 2.1 through 2.4 for the median and mean life tables). The plotted ${}_n m_x$ values of males overlap almost perfectly except in the 85 to 89 age group and the open-ended age interval. Here, you can see that there are only slight deviations between the two estimates. Refer to tables 2.5 for all age specific differences between the median and mean ${}_n m_x$ values. The median ${}_5 m_{85}$ value of .1550 is slightly greater than the mean ${}_5 m_{85}$ value of .1534 (difference of 0.0016). In addition, the median ${}_{\infty} m_{90}$ value of .2618 is greater than the mean ${}_{\infty} m_{90}$ value of .2579 (difference of 0.0039). The differences between the female median and mean ${}_n m_x$ values are even smaller than the male values. For example, the median ${}_{\infty} m_{90}$ value of .2101 was only slightly less than the mean ${}_{\infty} m_{90}$ of .2106 (difference of 0.0005). Overall, the differences are small between the mean and median estimates. Hence, the utilization of either method will not lead to large differences in the values of the other life table functions. Refer to tables 1.1 through 1.4 for the mean and median single decrement life tables.

Figure 2.2 shows the median and mean life expectancies (e_x) by age and gender. You can see that the differences between the median and mean life expectancies are quite diminutive. The median and mean values overlap more or less perfectly for both sexes. However, there were slight differences between the median and mean e_x values. Refer to table 2.6 for all age specific differences between the median and mean e_x values. For example, males had a median e_0 of 75.91 years and a mean e_0 of 75.92 years (difference

of .013 years). The median e_{∞} for males was 3.82 years and the mean e_{∞} was 3.88 years (difference of .058 years). Conversely, females had median e_0 of 81.33 years and a mean e_0 of 81.30 years (a difference of .030 years), which was slightly larger than the difference for males. The median e_{∞} was 4.76 years and the mean was e_{∞} 4.75 years (difference of .011 years). Note that the method I used to estimate the life expectancy is comparable to the estimates produced by *Statistics Canada* (Statistics Canada uses Greville's method). For instance, Statistics Canada estimated a male e_0 of 75.86 years and a female e_0 of 81.2 years for the period 1995-97.

The use of either method to construct the life tables will not cause serious problems in terms of precision because the differences in the estimates derived from either method are negligible. Note, that the estimates are almost identical despite the fact that ${}_na_x$ values were computed separately for the median and mean life tables. Furthermore, the median ${}_nm_x$ values were computed by dividing the median deaths from the midpoint population (1996). Conversely, the mean ${}_nm_x$ values were computed by dividing the mean deaths from the mean population of 1995 through 1997.

The similarity between the median and mean estimates also extends to the multiple decrement life tables. Tables 2.7 and 2.8 give median and mean differentials of the cumulative hazard functions for the period 1995-97 by gender and cause. Notice that the median and mean estimates among males and females produce differences that are identical within a few decimal places. Hence, it seems acceptable to use either method to construct the life tables.

Appendix B

Table 2.1 Ontario Males: Median Deaths & Midpoint Population by Age (1995-1997)

<i>x</i>	<i>nD_x</i>	<i>nP_x(%)</i>	<i>nax</i>	<i>nm_x</i>	<i>nq_x</i>	<i>np_x</i>	<i>lx</i>	<i>nd_x</i>	<i>nL_x</i>	<i>T_x</i>	<i>ex</i>
00-01	461	71,761	0.06	0.00642	0.00639	0.99361	100,000	639	99,401	7,590,702	75.91
01-04	89	315,869	1.63	0.00028	0.00113	0.99887	99,361	112	397,181	7,491,301	75.39
05-09	46	390,095	2.42	0.00012	0.00059	0.99941	99,250	58	496,097	7,094,120	71.48
10-14	68	379,923	3.03	0.00018	0.00089	0.99911	99,191	89	495,780	6,598,024	66.52
15-19	212	371,156	2.71	0.00057	0.00285	0.99715	99,102	283	494,864	6,102,244	61.58
20-24	285	378,230	2.57	0.00075	0.00376	0.99624	98,820	372	493,195	5,607,380	56.74
25-29	340	412,042	2.58	0.00083	0.00412	0.99588	98,448	405	491,258	5,114,185	51.95
30-34	535	500,647	2.63	0.00107	0.00533	0.99467	98,043	523	488,972	4,622,927	47.15
35-39	718	484,809	2.63	0.00148	0.00738	0.99262	97,520	720	485,897	4,133,955	42.39
40-44	867	425,651	2.63	0.00204	0.01014	0.98986	96,801	981	481,678	3,648,058	37.69
45-49	1,100	391,668	2.70	0.00281	0.01395	0.98605	95,819	1,337	476,026	3,166,380	33.05
50-54	1,476	301,935	2.71	0.00489	0.02417	0.97583	94,482	2,284	467,175	2,690,354	28.47
55-59	1,967	247,139	2.70	0.00796	0.03908	0.96092	92,199	3,603	452,695	2,223,179	24.11
60-64	2,979	225,080	2.69	0.01324	0.06421	0.93579	88,596	5,689	429,842	1,770,483	19.98
65-69	4,593	205,114	2.66	0.02239	0.10638	0.89362	82,907	8,820	393,874	1,340,641	16.17
70-74	5,960	164,342	2.61	0.03627	0.16689	0.83311	74,087	12,364	340,928	946,767	12.78
75-79	6,054	105,385	2.57	0.05745	0.25211	0.74789	61,723	15,561	270,873	605,839	9.82
80-84	6,031	62,541	2.50	0.09643	0.38853	0.61147	46,162	17,935	185,988	334,966	7.26
85-89	4,171	26,909	2.43	0.15500	0.55415	0.44585	28,227	15,642	100,913	148,978	5.28
90+	2,612	9,976		0.26183	1.00000	0.00000	12,585	12,585	48,065	48,065	3.82

Table 2.2 Ontario Males: Mean Deaths & Population by Age (1995-1997)

<i>x</i>	<i>nD_x</i>	<i>nP_x(%)</i>	<i>nax</i>	<i>nm_x</i>	<i>nq_x</i>	<i>np_x</i>	<i>lx</i>	<i>nd_x</i>	<i>nL_x</i>	<i>T_x</i>	<i>ex</i>
00-01	452	71,705	0.06	0.00630	0.00626	0.99374	100,000	626	99,413	7,592,051	75.92
01-04	89	314,789	1.63	0.00028	0.00113	0.99887	99,374	112	397,230	7,492,638	75.40
05-09	46	390,521	2.40	0.00012	0.00059	0.99941	99,262	58	496,158	7,095,408	71.48
10-14	65	379,986	3.05	0.00017	0.00086	0.99914	99,203	85	495,852	6,599,250	66.52
15-19	213	370,695	2.71	0.00057	0.00287	0.99713	99,119	284	494,942	6,103,397	61.58
20-24	287	380,653	2.56	0.00075	0.00376	0.99624	98,834	372	493,263	5,608,455	56.75
25-29	327	414,644	2.58	0.00079	0.00394	0.99606	98,462	388	491,374	5,115,192	51.95
30-34	536	499,327	2.63	0.00107	0.00536	0.99464	98,074	525	489,125	4,623,818	47.15
35-39	701	484,334	2.63	0.00145	0.00722	0.99278	97,549	704	486,079	4,134,694	42.39
40-44	864	426,900	2.64	0.00202	0.01007	0.98993	96,845	975	481,927	3,648,614	37.67
45-49	1,117	387,864	2.69	0.00288	0.01430	0.98570	95,870	1,371	476,185	3,166,688	33.03
50-54	1,465	305,816	2.71	0.00479	0.02370	0.97630	94,499	2,239	467,357	2,690,502	28.47
55-59	1,962	247,998	2.70	0.00791	0.03885	0.96115	92,260	3,584	453,069	2,223,145	24.10
60-64	3,015	225,379	2.69	0.01338	0.06488	0.93512	88,675	5,753	430,082	1,770,076	19.96
65-69	4,588	204,973	2.66	0.02238	0.10633	0.89367	82,922	8,817	393,956	1,339,994	16.16
70-74	5,994	164,353	2.62	0.03647	0.16777	0.83223	74,104	12,432	340,875	946,037	12.77
75-79	6,144	105,704	2.57	0.05812	0.25467	0.74533	61,672	15,706	270,225	605,162	9.81
80-84	6,021	62,418	2.50	0.09646	0.38850	0.61150	45,966	17,858	185,135	334,937	7.29
85-89	4,143	27,000	2.43	0.15345	0.55022	0.44978	28,108	15,466	100,790	149,803	5.33
90+	2,609	10,113		0.25794	1.00000	0.00000	12,643	12,643	49,013	49,013	3.88

Table 2.3 Ontario Females: Median Deaths & Midpoint Population by Age (1995-1997)

<i>x</i>	<i>nD_x</i>	<i>nP_x(%)</i>	<i>nax</i>	<i>nm_x</i>	<i>nq_x</i>	<i>np_x</i>	<i>lx</i>	<i>nd_x</i>	<i>nL_x</i>	<i>T_x</i>	<i>ex</i>
00-01	341	68,251	0.07	0.00500	0.00497	0.99503	100,000	497	99,536	8,132,843	81.33
01-04	64	300,172	1.51	0.00021	0.00085	0.99915	99,503	85	397,800	8,033,307	80.73
05-09	46	370,243	2.45	0.00012	0.00062	0.99938	99,418	62	496,932	7,635,507	76.80
10-14	50	360,157	2.72	0.00014	0.00069	0.99931	99,356	69	496,624	7,138,576	71.85
15-19	96	350,240	2.60	0.00027	0.00137	0.99863	99,287	136	496,109	6,641,952	66.90
20-24	99	368,944	2.54	0.00027	0.00134	0.99866	99,151	133	495,429	6,145,842	61.98
25-29	134	414,384	2.63	0.00032	0.00162	0.99838	99,018	160	494,713	5,650,414	57.06
30-34	236	494,189	2.65	0.00048	0.00239	0.99761	98,858	236	493,737	5,155,701	52.15
35-39	323	488,432	2.70	0.00066	0.00330	0.99670	98,623	326	492,365	4,661,964	47.27
40-44	496	439,668	2.71	0.00113	0.00563	0.99437	98,297	553	490,220	4,169,600	42.42
45-49	731	398,600	2.70	0.00183	0.00913	0.99087	97,744	893	486,669	3,679,380	37.64
50-54	906	306,701	2.70	0.00295	0.01467	0.98533	96,851	1,421	480,987	3,192,711	32.97
55-59	1,210	254,078	2.70	0.00476	0.02355	0.97645	95,431	2,248	471,983	2,711,724	28.42
60-64	1,833	234,284	2.68	0.00782	0.03842	0.96158	93,183	3,580	457,608	2,239,741	24.04
65-69	2,772	226,109	2.68	0.01226	0.05960	0.94040	89,603	5,340	435,607	1,782,133	19.89
70-74	4,234	209,905	2.68	0.02017	0.09634	0.90366	84,262	8,118	402,461	1,346,526	15.98
75-79	5,245	150,369	2.65	0.03488	0.16121	0.83879	76,144	12,275	351,916	944,065	12.40
80-84	6,478	104,954	2.59	0.06172	0.26867	0.73133	63,869	17,160	278,015	592,149	9.27
85-89	6,244	58,676	2.60	0.10641	0.42392	0.57608	46,709	19,801	186,073	314,134	6.73
90+	6,776	32,248		0.21012	1.00000	0.00000	26,908	26,908	128,061	128,061	4.76

Table 2.4 Ontario Females: Mean Deaths & Population by Age (1995-1997)

<i>x</i>	<i>nD_x</i>	<i>nP_x(%)</i>	<i>nax</i>	<i>nm_x</i>	<i>nq_x</i>	<i>np_x</i>	<i>lx</i>	<i>nd_x</i>	<i>nL_x</i>	<i>T_x</i>	<i>ex</i>
00-01	348	68,055	0.07	0.00512	0.00509	0.99491	100,000	509	99,525	8,129,811	81.30
01-04	67	299,033	1.51	0.00022	0.00089	0.99911	99,491	89	397,742	8,030,286	80.71
05-09	43	370,763	2.45	0.00012	0.00058	0.99942	99,402	58	496,861	7,632,544	76.78
10-14	53	359,991	2.71	0.00015	0.00074	0.99926	99,344	74	496,551	7,135,683	71.83
15-19	94	350,189	2.60	0.00027	0.00134	0.99866	99,270	133	496,031	6,639,132	66.88
20-24	101	370,605	2.56	0.00027	0.00136	0.99864	99,137	135	495,356	6,143,100	61.97
25-29	143	415,757	2.61	0.00034	0.00172	0.99828	99,002	170	494,604	5,647,744	57.05
30-34	225	493,656	2.65	0.00046	0.00227	0.99773	98,832	225	493,632	5,153,140	52.14
35-39	330	487,953	2.70	0.00068	0.00338	0.99662	98,607	333	492,271	4,659,508	47.25
40-44	494	440,532	2.71	0.00112	0.00559	0.99441	98,274	550	490,113	4,167,237	42.40
45-49	724	394,808	2.70	0.00183	0.00913	0.99087	97,725	893	486,573	3,677,124	37.63
50-54	919	310,540	2.70	0.00296	0.01470	0.98530	96,832	1,424	480,890	3,190,551	32.95
55-59	1,234	254,791	2.70	0.00484	0.02396	0.97604	95,408	2,286	471,783	2,709,661	28.40
60-64	1,853	234,535	2.68	0.00790	0.03879	0.96121	93,123	3,612	457,223	2,237,878	24.03
65-69	2,787	226,221	2.68	0.01232	0.05988	0.94012	89,510	5,360	435,094	1,780,655	19.89
70-74	4,236	209,278	2.67	0.02024	0.09664	0.90336	84,151	8,133	401,822	1,345,561	15.99
75-79	5,185	150,938	2.66	0.03435	0.15897	0.84103	76,018	12,084	351,759	943,739	12.41
80-84	6,461	104,827	2.60	0.06163	0.26838	0.73162	63,934	17,159	278,406	591,980	9.26
85-89	6,292	58,758	2.60	0.10708	0.42597	0.57403	46,775	19,925	186,080	313,573	6.70
90+	6,810	32,336		0.21060	1.00000	0.00000	26,850	26,850	127,494	127,494	4.75

Figure 2.1 Median & Mean Age Specific Mortality Rates by Age & Gender

Figure 2.2 Median & Mean Life Expectancies by Age & Gender

Table 2.5 Differences Between Median & Mean Age Specific Mortality Rates (1995-1997)

<i>a) Males</i>				<i>b) Females</i>			
<i>x</i>	<i>n m x(med)</i>	<i>n m x(mean)</i>	<i>loss</i>	<i>x</i>	<i>n m x(med)</i>	<i>n m x(mean)</i>	<i>loss</i>
00-01	0.0064	0.0063	0.0001	00-01	0.0050	0.0051	-0.0001
01-04	0.0003	0.0003	0.0000	01-04	0.0002	0.0002	0.0000
05-09	0.0001	0.0001	0.0000	05-09	0.0001	0.0001	0.0000
10-14	0.0002	0.0002	0.0000	10-14	0.0001	0.0001	0.0000
15-19	0.0006	0.0006	0.0000	15-19	0.0003	0.0003	0.0000
20-24	0.0008	0.0008	0.0000	20-24	0.0003	0.0003	0.0000
25-29	0.0008	0.0008	0.0000	25-29	0.0003	0.0003	0.0000
30-34	0.0011	0.0011	0.0000	30-34	0.0005	0.0005	0.0000
35-39	0.0015	0.0014	0.0000	35-39	0.0007	0.0007	0.0000
40-44	0.0020	0.0020	0.0000	40-44	0.0011	0.0011	0.0000
45-49	0.0028	0.0029	-0.0001	45-49	0.0018	0.0018	0.0000
50-54	0.0049	0.0048	0.0001	50-54	0.0030	0.0030	0.0000
55-59	0.0080	0.0079	0.0000	55-59	0.0048	0.0048	-0.0001
60-64	0.0132	0.0134	-0.0001	60-64	0.0078	0.0079	-0.0001
65-69	0.0224	0.0224	0.0000	65-69	0.0123	0.0123	-0.0001
70-74	0.0363	0.0365	-0.0002	70-74	0.0202	0.0202	-0.0001
75-79	0.0574	0.0581	-0.0007	75-79	0.0349	0.0344	0.0005
80-84	0.0964	0.0965	0.0000	80-84	0.0617	0.0616	0.0001
85-89	0.1550	0.1534	0.0016	85-89	0.1064	0.1071	-0.0007
90+	0.2618	0.2579	0.0039	90+	0.2101	0.2106	-0.0005

Table 2.6 Ontario: Loss Between Median and Mean Life Expectancies (1995-1997)

<i>a) Males</i>				<i>b) Females</i>			
<i>x</i>	<i>e x(med)</i>	<i>e x(mean)</i>	<i>loss</i>	<i>x</i>	<i>e x(med)</i>	<i>e x(mean)</i>	<i>loss</i>
00-01	75.91	75.92	-0.013	00-01	81.33	81.30	0.030
01-04	75.39	75.40	-0.004	01-04	80.73	80.71	0.021
05-09	71.48	71.48	-0.004	05-09	76.80	76.78	0.017
10-14	66.52	66.52	-0.004	10-14	71.85	71.83	0.020
15-19	61.58	61.58	-0.001	15-19	66.90	66.88	0.017
20-24	56.74	56.75	-0.002	20-24	61.98	61.97	0.019
25-29	51.95	51.95	-0.003	25-29	57.06	57.05	0.018
30-34	47.15	47.15	0.006	30-34	52.15	52.14	0.012
35-39	42.39	42.39	0.005	35-39	47.27	47.25	0.018
40-44	37.69	37.67	0.012	40-44	42.42	42.40	0.014
45-49	33.05	33.03	0.014	45-49	37.64	37.63	0.016
50-54	28.47	28.47	0.003	50-54	32.97	32.95	0.016
55-59	24.11	24.10	0.016	55-59	28.42	28.40	0.015
60-64	19.98	19.96	0.023	60-64	24.04	24.03	0.004
65-69	16.17	16.16	0.011	65-69	19.89	19.89	-0.004
70-74	12.78	12.77	0.013	70-74	15.98	15.99	-0.010
75-79	9.82	9.81	0.003	75-79	12.40	12.41	-0.016
80-84	7.26	7.29	-0.030	80-84	9.27	9.26	0.012
85-89	5.28	5.33	-0.052	85-89	6.73	6.70	0.021
90+	3.82	3.88	-0.058	90+	4.76	4.75	0.011

Table 2.7 Median & Mean Cumulative Hazard Functions in Ontario for the Period 1995-1997

a) Males (Median)							
x	Hz	Hz(all_res)	Hz(nes)	Hz(pnes)	Hz(hea)	Hz(oth_res)	Hz(residual)
00-01	0.0064	0.0001	0.0000	0.0000	0.0000	0.0000	0.0064
01-04	0.0011	0.0001	0.0000	0.0000	0.0000	0.0000	0.0011
05-09	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0006
10-14	0.0009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009
15-19	0.0029	0.0001	0.0000	0.0000	0.0000	0.0000	0.0028
20-24	0.0038	0.0001	0.0000	0.0000	0.0000	0.0000	0.0037
25-29	0.0041	0.0000	0.0000	0.0000	0.0000	0.0000	0.0041
30-34	0.0053	0.0001	0.0000	0.0000	0.0000	0.0000	0.0052
35-39	0.0074	0.0003	0.0002	0.0001	0.0000	0.0000	0.0071
40-44	0.0102	0.0005	0.0004	0.0001	0.0000	0.0000	0.0097
45-49	0.0141	0.0012	0.0009	0.0002	0.0001	0.0001	0.0128
50-54	0.0245	0.0032	0.0025	0.0003	0.0001	0.0003	0.0213
55-59	0.0399	0.0065	0.0052	0.0005	0.0002	0.0007	0.0333
60-64	0.0664	0.0124	0.0094	0.0008	0.0004	0.0018	0.0540
65-69	0.1125	0.0227	0.0155	0.0018	0.0010	0.0044	0.0898
70-74	0.1826	0.0379	0.0222	0.0041	0.0016	0.0100	0.1447
75-79	0.2905	0.0561	0.0253	0.0103	0.0026	0.0179	0.2344
80-84	0.4919	0.0920	0.0295	0.0234	0.0054	0.0337	0.3999
85-89	0.8078	0.1433	0.0294	0.0523	0.0062	0.0554	0.6645
90+	-	-	-	-	-	-	-

b) Males (Mean)							
x	Hz	Hz(all_res)	Hz(nes)	Hz(pnes)	Hz(hea)	Hz(oth_res)	Hz(residual)
00-01	0.0063	0.0001	0.0000	0.0000	0.0000	0.0000	0.0062
01-04	0.0011	0.0001	0.0000	0.0000	0.0000	0.0000	0.0011
05-09	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0006
10-14	0.0009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0008
15-19	0.0029	0.0001	0.0000	0.0000	0.0000	0.0000	0.0028
20-24	0.0038	0.0001	0.0000	0.0000	0.0000	0.0000	0.0037
25-29	0.0039	0.0001	0.0000	0.0000	0.0000	0.0000	0.0039
30-34	0.0054	0.0001	0.0001	0.0000	0.0000	0.0000	0.0052
35-39	0.0072	0.0002	0.0002	0.0001	0.0000	0.0000	0.0070
40-44	0.0101	0.0005	0.0004	0.0001	0.0000	0.0000	0.0096
45-49	0.0144	0.0014	0.0010	0.0002	0.0001	0.0001	0.0130
50-54	0.0240	0.0032	0.0025	0.0003	0.0001	0.0003	0.0208
55-59	0.0396	0.0066	0.0052	0.0005	0.0002	0.0007	0.0331
60-64	0.0671	0.0126	0.0096	0.0009	0.0004	0.0017	0.0545
65-69	0.1124	0.0229	0.0155	0.0017	0.0009	0.0048	0.0895
70-74	0.1836	0.0376	0.0219	0.0041	0.0016	0.0099	0.1461
75-79	0.2939	0.0554	0.0253	0.0096	0.0027	0.0178	0.2385
80-84	0.4918	0.0915	0.0296	0.0236	0.0052	0.0331	0.4004
85-89	0.7990	0.1453	0.0298	0.0541	0.0060	0.0554	0.6537
90+	-	-	-	-	-	-	-

c) Females (Median)							
x	Hz	Hz(all_res)	Hz(nes)	Hz(pnes)	Hz(hea)	Hz(oth_res)	Hz(residual)
00-01	0.0050	0.0001	0.0000	0.0000	0.0000	0.0000	0.0049
01-04	0.0009	0.0001	0.0000	0.0001	0.0000	0.0000	0.0008
05-09	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0006
10-14	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007
15-19	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0014
20-24	0.0013	0.0001	0.0000	0.0000	0.0000	0.0000	0.0013
25-29	0.0016	0.0001	0.0000	0.0000	0.0000	0.0000	0.0015
30-34	0.0024	0.0001	0.0000	0.0000	0.0000	0.0001	0.0023
35-39	0.0033	0.0002	0.0001	0.0000	0.0000	0.0000	0.0031
40-44	0.0056	0.0006	0.0004	0.0001	0.0000	0.0001	0.0051
45-49	0.0092	0.0012	0.0009	0.0001	0.0001	0.0001	0.0080
50-54	0.0148	0.0023	0.0017	0.0002	0.0001	0.0002	0.0125
55-59	0.0238	0.0042	0.0030	0.0003	0.0002	0.0007	0.0197
60-64	0.0392	0.0075	0.0053	0.0006	0.0004	0.0012	0.0317
65-69	0.0615	0.0115	0.0072	0.0011	0.0006	0.0027	0.0499
70-74	0.1013	0.0171	0.0093	0.0020	0.0010	0.0048	0.0842
75-79	0.1758	0.0263	0.0105	0.0053	0.0016	0.0089	0.1495
80-84	0.3129	0.0413	0.0099	0.0147	0.0023	0.0144	0.2715
85-89	0.5515	0.0636	0.0082	0.0316	0.0032	0.0206	0.4879
90+	-	-	-	-	-	-	-

d) Females (Mean)							
x	Hz	Hz(all_res)	Hz(nes)	Hz(pnes)	Hz(hea)	Hz(oth_res)	Hz(residual)
00-01	0.0051	0.0001	0.0000	0.0000	0.0000	0.0000	0.0050
01-04	0.0009	0.0001	0.0000	0.0000	0.0000	0.0000	0.0008
05-09	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0005
10-14	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007
15-19	0.0013	0.0000	0.0000	0.0000	0.0000	0.0000	0.0013
20-24	0.0014	0.0001	0.0000	0.0000	0.0000	0.0000	0.0013
25-29	0.0017	0.0001	0.0000	0.0000	0.0000	0.0000	0.0017
30-34	0.0023	0.0001	0.0000	0.0000	0.0000	0.0000	0.0022
35-39	0.0034	0.0002	0.0001	0.0000	0.0000	0.0000	0.0032
40-44	0.0056	0.0005	0.0004	0.0001	0.0000	0.0001	0.0051
45-49	0.0092	0.0011	0.0008	0.0001	0.0001	0.0001	0.0081
50-54	0.0148	0.0022	0.0017	0.0002	0.0001	0.0003	0.0126
55-59	0.0242	0.0043	0.0031	0.0003	0.0002	0.0006	0.0200
60-64	0.0396	0.0075	0.0054	0.0005	0.0004	0.0012	0.0321
65-69	0.0617	0.0115	0.0073	0.0010	0.0005	0.0026	0.0503
70-74	0.1016	0.0171	0.0093	0.0021	0.0010	0.0048	0.0845
75-79	0.1731	0.0262	0.0103	0.0052	0.0016	0.0091	0.1470
80-84	0.3125	0.0412	0.0102	0.0142	0.0023	0.0144	0.2713
85-89	0.5551	0.0631	0.0084	0.0318	0.0029	0.0201	0.4920
90+	-	-	-	-	-	-	-

Table 2.8 Median & Mean Cumulative Hazard Function Differentials in Ontario for the Period 1995-1997

a) Male Median & Mean Cumulative Hazard Function Differentials							
x	Hz	Hz(all_res)	Hz(nes)	Hz(pnes)	Hz(hea)	Hz(oth_res)	Hz(residual)
00-01	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002
01-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
05-09	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10-14	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15-19	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20-24	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25-29	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002
30-34	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
35-39	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
40-44	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
45-49	-0.0004	-0.0001	-0.0001	0.0000	0.0000	0.0000	-0.0002
50-54	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0005
55-59	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003
60-64	-0.0007	-0.0002	-0.0002	-0.0001	0.0000	0.0001	-0.0005
65-69	0.0001	-0.0003	0.0000	0.0001	0.0000	-0.0004	0.0003
70-74	-0.0011	0.0003	0.0003	0.0000	0.0000	0.0001	-0.0014
75-79	-0.0034	0.0007	0.0000	0.0007	-0.0001	0.0001	-0.0041
80-84	0.0001	0.0005	0.0000	-0.0001	0.0002	0.0005	-0.0005
85-89	0.0088	-0.0020	-0.0004	-0.0018	0.0002	0.0000	0.0108
90+	-	-	-	-	-	-	-

b) Female Median & Mean Cumulative Hazard Function Differentials							
x	Hz	Hz(all_res)	Hz(nes)	Hz(pnes)	Hz(hea)	Hz(oth_res)	Hz(residual)
00-01	-0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0001
01-04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
05-09	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10-14	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15-19	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20-24	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25-29	-0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0001
30-34	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
35-39	-0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0001
40-44	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
45-49	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	-0.0001
50-54	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	-0.0001
55-59	-0.0004	-0.0001	-0.0001	0.0000	0.0000	0.0000	-0.0003
60-64	-0.0004	0.0000	-0.0001	0.0001	0.0000	0.0000	-0.0004
65-69	-0.0003	0.0000	-0.0001	0.0000	0.0001	0.0000	-0.0003
70-74	-0.0003	-0.0001	0.0000	0.0000	0.0000	0.0000	-0.0003
75-79	0.0027	0.0002	0.0003	0.0001	0.0000	-0.0002	0.0025
80-84	0.0004	0.0002	-0.0002	0.0004	0.0000	-0.0001	0.0002
85-89	-0.0036	0.0005	-0.0001	-0.0001	0.0002	0.0005	-0.0041
90+	-	-	-	-	-	-	-

Appendix C

3.1 Estimation of ${}_nD_x^i$ in the 85 to 89 Age Group for the Periods of 1976 & 1986

The method that I used to estimate the age intervals qualifies as an indirect method that would probably be suited to use on developing nations with insufficient or unavailable data. Ontario is comparable to a developing nation because it is difficult and expensive to obtain certain types of data. However, some available data make the estimations simpler to achieve. First, I had the number of deaths for all causes combined in the 85 to 89 and 90+ age groups for both periods. I used median number of deaths in each of the age groups. Second, I also had the population estimates of the age groups for both periods.

The point of this method is to obtain a reasonable approximation so that the estimates for the age groups are close to the actual numbers of deaths observed in the population. Thus, it does not matter whether the numbers of deaths are slightly over or underestimated. It only matters that the values of the hazard and probability density function of X (life span) for the 85 to 89 age group do not have extreme values that cause a distortion in the graphs. A slight under or overestimation of the number of deaths should still provide me with values of ${}_5H_{85}^i$ and ${}_5f_{85}^i$ that are a close approximation of the actual hazard and density functions in the population. In other words, minor deviations in the estimated number of deaths would not cause the values of the hazard and density functions to be that much different from the actual values.

This method is based primarily on trial and error. I decided to plot the number of deaths by age for each cause to estimate the number of deaths in the interval. Figures 3.1 through 3.8 show the number of deaths for cause i by age and period. The dotted lines are

the estimated number of deaths in the 85 to 89 age group for each cause. These lines of estimation were roughly based on the patterns observed for each of the causes during the 1996 period. The numbers of deaths in the 90+ interval are simply derived by subtracting the number of deaths estimated in the 85-89 age groups by the total number of deaths that previously made up the 85+ interval (${}_{\infty}D_{90}^i = {}_{\infty}D_{85}^i - {}_5D_{85}^i$). Deaths needed be estimated for ${}_5D_{85}^{neo}$, ${}_5D_{85}^{pneu}$, ${}_5D_{85}^{bea}$ and ${}_5D_{85}^{oth-res}$. Next, ${}_5D_{85}^{all-res}$ was obtained by taking the sum of the four causes mentioned above and ${}_5D_{85}^{residual}$ was obtained by subtracting all causes from all respiratory related diseases (${}_5D_{85}^{residual} = {}_5D_{85} - {}_5D_{85}^{all-res}$).

The percentage of deaths for each cause (${}_nD_x^i / {}_nD_x \cdot 100$) were also calculated to aid in the estimation of the age intervals. Tables 3.1 through 3.6 show the percentage of deaths by cause, age, gender and period. Notice that the percentages follow a consistent pattern. This increasing or decreasing trend of the percentages of each cause as age increases was helpful in the estimation of the age intervals. It aids in the estimation by making sure that the estimated number of deaths using the graphs follow the patterns observed in the percentages. I also included the respiratory diseases (ICDA-8: 460-519) category (${}_nD_x^{res}$) to make sure that these percentages were also following a consistent pattern. The percentages of the 85 to 89 age groups to be estimated were also roughly based on the patterns observed in 1996. The largest difficulty was with the pneumonia and influenza deaths of females. The peak (highest number of deaths) in 1976 was placed in the 80 to 84 age group, while the peak is in the 85 to 89 age group for 1986. I assumed that this was correct because the percentages followed a consistent pattern with this estimate. Notice that all of the percentages follow a consistent pattern for each of the

causes. Therefore, I assume that these estimations will provide an adequate approximation of the actual number of deaths that occurred in the population during those periods.

Figure 3.1 Respiratory Related Cancer Deaths by Age & Period (Ontario Males)

Figure 3.2 Respiratory Related Cancer Deaths by Age & Period (Ontario Females)

Figure 3.3 Pneumonia & Influenza Deaths by Age & Period (Ontario Males)

Figure 3.4 Pneumonia & Influenza Deaths by Age & Period (Ontario Females)

Figure 3.5 Bronchitis, Emphysema & Asthma Deaths by Age & Period (Ontario Males)

Figure 3.6 Bronchitis, Emphysema & Asthma Deaths by Age & Period (Ontario Females)

Figure 3.7 Other Respiratory Diseases Deaths by Age & Period (Ontario Males)

Figure 3.8 Other Respiratory Diseases Deaths by Age & Period (Ontario Females)

Appendix C

Table 3.1 Number & Percentage of Deaths 1995-1997 (Ontario Males)

<i>x</i>	<i>nD_x</i>	<i>nD_x(all_res)</i>	<i>nD_x(neo)</i>	<i>nD_x(pneu)</i>	<i>nD_x(bea)</i>	<i>nD_x(oth_res)</i>	<i>nD_x(residual)</i>	<i>nD_x(res)</i>
60-64	2,979	556	424	36	17	79	2,423	132
65-69	4,593	925	633	75	39	178	3,668	292
70-74	5,960	1,237	724	133	53	327	4,723	513
75-79	6,054	1,169	527	214	54	374	4,885	642
80-84	6,031	1,128	362	287	66	413	4,903	766
85-89	4,171	740	152	270	32	286	3,431	588
90+	2,612	492	55	244	20	173	2,120	437
	%	%	%	%	%	%	%	%
60-64	2,979	18.66	14.23	1.21	0.57	2.65	81.34	4.43
65-69	4,593	20.14	13.78	1.63	0.85	3.88	79.86	6.36
70-74	5,960	20.76	12.15	2.23	0.89	5.49	79.24	8.61
75-79	6,054	19.31	8.70	3.53	0.89	6.18	80.69	10.60
80-84	6,031	18.70	6.00	4.76	1.09	6.85	81.30	12.70
85-89	4,171	17.74	3.64	6.47	0.77	6.86	82.26	14.10
90+	2,612	18.84	2.11	9.34	0.77	6.62	81.16	16.73

Table 3.2 Number & Percentage of Deaths 1985-1987 (Ontario Males)

<i>x</i>	<i>nD_x</i>	<i>nD_x(all_res)</i>	<i>nD_x(neo)</i>	<i>nD_x(pneu)</i>	<i>nD_x(bea)</i>	<i>nD_x(oth_res)</i>	<i>nD_x(residual)</i>	<i>nD_x(res)</i>
60-64	3,559	681	511	38	32	100	2,878	170
65-69	4,326	848	561	64	58	165	3,478	287
70-74	5,272	988	542	120	73	253	4,284	446
75-79	5,241	976	424	175	83	294	4,265	552
80-84	4,470	786	269	202	73	242	3,684	517
85+	4,738	856	142	390	56	268	3,882	714
85-89	2,890	491	101	186	37	167	2,399	390
90+	1,848	365	41	204	19	101	1,483	324
	%	%	%	%	%	%	%	%
60-64	3,559	19.13	14.36	1.07	0.90	2.81	80.87	4.78
65-69	4,326	19.60	12.97	1.48	1.34	3.81	80.40	6.63
70-74	5,272	18.74	10.28	2.28	1.38	4.80	81.26	8.46
75-79	5,241	18.62	8.09	3.34	1.58	5.61	81.38	10.53
80-84	4,470	17.58	6.02	4.52	1.63	5.41	82.42	11.57
85+	4,738	18.07	3.00	8.23	1.18	5.66	81.93	15.07
85-89	2,890	16.99	3.49	6.44	1.28	5.78	83.01	13.49
90+	1,848	19.75	2.22	11.04	1.03	5.47	80.25	17.53

Table 3.3 Number & Percentage of Deaths 1975-1977 (Ontario Males)

<i>x</i>	<i>nD_x</i>	<i>nD_x(all_res)</i>	<i>nD_x(neo)</i>	<i>nD_x(pneu)</i>	<i>nD_x(bea)</i>	<i>nD_x(oth_res)</i>	<i>nD_x(residual)</i>	<i>nD_x(res)</i>
60-64	3,467	581	371	47	65	98	2,886	210
65-69	4,166	726	438	89	104	95	3,440	288
70-74	4,617	749	391	126	132	100	3,868	358
75-79	4,320	719	282	199	121	117	3,601	437
80-84	3,630	536	150	206	79	101	3,094	386
85+	3,815	536	74	318	67	77	3,279	462
85-89	2,424	319	50	163	44	62	2,105	269
90+	1,391	217	24	155	23	15	1,174	193
	%	%	%	%	%	%	%	%
60-64	3,467	16.76	10.70	1.36	1.87	2.83	83.24	6.06
65-69	4,166	17.43	10.51	2.14	2.50	2.28	82.57	6.91
70-74	4,617	16.22	8.47	2.73	2.86	2.17	83.78	7.75
75-79	4,320	16.64	6.53	4.61	2.80	2.71	83.36	10.12
80-84	3,630	14.77	4.13	5.67	2.18	2.78	85.23	10.63
85+	3,815	14.05	1.94	8.34	1.76	2.02	85.95	12.11
85-89	2,424	13.16	2.06	6.72	1.82	2.56	86.84	11.10
90+	1,391	15.60	1.73	11.14	1.65	1.08	84.40	13.87

Table 3.4 Number & Percentage of Deaths 1995-1997 (Ontario Females)

<i>x</i>	<i>nD_x</i>	<i>nD_x(all_res)</i>	<i>nD_x(neo)</i>	<i>nD_x(pneu)</i>	<i>nD_x(bea)</i>	<i>nD_x(oth_res)</i>	<i>nD_x(residual)</i>	<i>nD_x(res)</i>
60-64	1,833	350	249	27	19	55	1,483	101
65-69	2,772	519	325	49	25	120	2,253	194
70-74	4,234	714	387	85	42	200	3,520	327
75-79	5,245	786	314	158	48	266	4,459	472
80-84	6,478	856	206	304	48	298	5,622	650
85-89	6,244	720	93	358	36	233	5,524	627
90+	6,776	834	45	563	34	192	5,942	789
	%	%	%	%	%	%	%	%
60-64	1,833	19.09	13.58	1.47	1.04	3.00	80.91	5.51
65-69	2,772	18.72	11.72	1.77	0.90	4.33	81.28	7.00
70-74	4,234	16.86	9.14	2.01	0.99	4.72	83.14	7.72
75-79	5,245	14.99	5.99	3.01	0.92	5.07	85.01	9.00
80-84	6,478	13.21	3.18	4.69	0.74	4.60	86.79	10.03
85-89	6,244	11.53	1.49	5.73	0.58	3.73	88.47	10.04
90+	6,776	12.31	0.66	8.31	0.50	2.83	87.69	11.64

Table 3.5 Number & Percentage of Deaths 1985-1987 (Ontario Females)

<i>x</i>	<i>nD_x</i>	<i>nD_x(all_res)</i>	<i>nD_x(neo)</i>	<i>nD_x(pneu)</i>	<i>nD_x(bea)</i>	<i>nD_x(oth_res)</i>	<i>nD_x(residual)</i>	<i>nD_x(res)</i>
60-64	2,070	310	211	22	22	55	1,760	99
65-69	2,679	400	240	40	29	91	2,279	160
70-74	3,539	448	206	65	47	130	3,091	242
75-79	4,434	469	169	116	40	144	3,965	300
80-84	4,938	454	96	206	24	128	4,484	358
85+	9,322	971	64	669	33	205	8,351	907
85-89	4,621	392	45	237	19	91	4,229	343
90+	4,701	579	19	432	14	114	4,122	564
	%	%	%	%	%	%	%	%
60-64	2,070	14.98	10.19	1.06	1.06	2.66	85.02	4.78
65-69	2,679	14.93	8.96	1.49	1.08	3.40	85.07	5.97
70-74	3,539	12.66	5.82	1.84	1.33	3.67	87.34	6.84
75-79	4,434	10.58	3.81	2.62	0.90	3.25	89.42	6.77
80-84	4,938	9.19	1.94	4.17	0.49	2.59	90.81	7.25
85+	9,322	10.42	0.69	7.18	0.35	2.20	89.58	9.73
85-89	4,621	8.48	0.97	5.13	0.41	1.97	91.52	7.42
90+	4,701	12.32	0.40	9.19	0.30	2.43	87.68	12.00

Table 3.6 Number & Percentage of Deaths 1975-1977 (Ontario Females)

<i>x</i>	<i>nD_x</i>	<i>nD_x(all_res)</i>	<i>nD_x(neo)</i>	<i>nD_x(pneu)</i>	<i>nD_x(bea)</i>	<i>nD_x(oth_res)</i>	<i>nD_x(residual)</i>	<i>nD_x(res)</i>
60-64	1,765	167	90	34	24	19	1,598	77
65-69	2,360	197	83	39	25	50	2,163	114
70-74	2,992	213	59	84	34	36	2,779	154
75-79	3,661	244	49	129	28	38	3,417	195
80-84	4,131	289	35	209	23	22	3,842	254
85+	6,390	540	23	440	28	49	5,850	517
85-89	3,561	239	16	187	18	18	3,322	223
90+	2,829	301	7	253	10	31	2,528	294
	%	%	%	%	%	%	%	%
60-64	1,765	9.46	5.10	1.93	1.36	1.08	90.54	4.36
65-69	2,360	8.35	3.52	1.65	1.06	2.12	91.65	4.83
70-74	2,992	7.12	1.97	2.81	1.14	1.20	92.88	5.15
75-79	3,661	6.66	1.34	3.52	0.76	1.04	93.34	5.33
80-84	4,131	7.00	0.85	5.06	0.56	0.53	93.00	6.15
85+	6,390	8.45	0.36	6.89	0.44	0.77	91.55	8.09
85-89	3,561	6.71	0.45	5.25	0.51	0.51	93.29	6.26
90+	2,829	10.64	0.25	8.94	0.35	1.10	89.36	10.39

Appendix D

4.1 Multiple Decrement Life Tables

Table 4.1 Males: Median Number of Deaths by Specified Cause i , Mid-Period Population & Single Decrement Life Table Functions by Period

a) Ontario: Median Multiple Decrement Life Table for Males (1995-1997)

x	nD_x	$nD_x(\text{all_res})$	$nD_x(\text{neo})$	$nD_x(\text{pneu})$	$nD_x(\text{hea})$	$nD_x(\text{oth_res})$	$nD_x(\text{residual})$	$nPx(96)$	nm_x	na_x	np_x	nL_x	T_x	ex
00-01	461	4	0	1	0	3	457	71,761	0.0064	0.06	0.9936	99,401	7,590,702	75.91
01-04	89	5	0	2	0	3	84	315,869	0.0003	1.63	0.9989	397,181	7,491,301	75.39
05-09	46	2	0	1	0	1	44	390,095	0.0001	2.42	0.9994	496,097	7,094,120	71.48
10-14	68	1	0	0	0	1	67	379,923	0.0002	3.03	0.9991	495,780	6,598,024	66.52
15-19	212	6	0	3	2	1	206	371,156	0.0006	2.71	0.9971	494,864	6,102,244	61.58
20-24	285	5	0	2	3	0	280	378,230	0.0008	2.57	0.9962	493,195	5,607,380	56.74
25-29	340	3	1	1	1	0	337	412,042	0.0008	2.58	0.9959	491,258	5,114,185	51.95
30-34	535	11	5	5	1	0	524	500,647	0.0011	2.63	0.9947	488,972	4,622,927	47.15
35-39	718	26	16	5	2	3	692	484,809	0.0015	2.63	0.9926	485,897	4,133,955	42.39
40-44	867	42	32	6	1	3	825	425,651	0.0020	2.63	0.9899	481,678	3,648,058	37.69
45-49	1,100	97	74	12	4	7	1,003	391,668	0.0028	2.70	0.9860	476,026	3,166,380	33.05
50-54	1,476	192	149	21	4	18	1,284	301,935	0.0049	2.71	0.9758	467,175	2,690,354	28.47
55-59	1,967	322	256	23	8	35	1,645	247,139	0.0080	2.70	0.9609	452,695	2,223,179	24.11
60-64	2,979	556	424	36	17	79	2,423	225,080	0.0132	2.69	0.9358	429,842	1,770,483	19.98
65-69	4,593	925	633	75	39	178	3,668	205,114	0.0224	2.66	0.8936	393,874	1,340,641	16.17
70-74	5,960	1,237	724	133	53	327	4,723	164,342	0.0363	2.61	0.8331	340,928	946,767	12.78
75-79	6,054	1,169	527	214	54	374	4,885	105,385	0.0574	2.57	0.7479	270,873	605,839	9.82
80-84	6,031	1,128	362	287	66	413	4,903	62,541	0.0964	2.50	0.6115	185,988	334,966	7.26
85-89	4,171	740	152	270	32	286	3,431	26,909	0.1550	2.43	0.4458	100,913	148,978	5.28
90+	2,612	492	55	244	20	173	2,120	9,976	0.2618	0.0000	0.0000	48,065	48,065	3.82

b) Ontario: Median Multiple Decrement Life Table for Males (1985-1987)

x	nD_x	$nD_x(\text{all_res})$	$nD_x(\text{neo})$	$nD_x(\text{pneu})$	$nD_x(\text{hea})$	$nD_x(\text{oth_res})$	$nD_x(\text{residual})$	$nPx(96)$	nm_x	na_x	np_x	nL_x	T_x	ex
00-01	543	10	0	5	0	5	533	68,699	0.0079	0.07	0.9922	99,267	7,371,300	73.71
01-04	109	6	0	3	0	3	103	262,335	0.0004	1.63	0.9983	396,471	7,272,032	73.30
05-09	77	3	0	1	1	1	74	320,381	0.0002	2.45	0.9988	494,950	6,875,561	69.41
10-14	90	3	0	0	1	2	87	328,604	0.0003	2.93	0.9986	494,378	6,380,612	64.50
15-19	298	5	1	1	1	2	293	370,864	0.0008	2.68	0.9960	493,063	5,886,234	59.58
20-24	452	7	1	2	2	2	445	459,749	0.0010	2.53	0.9951	490,810	5,393,171	54.81
25-29	428	9	2	2	3	2	419	440,998	0.0010	2.53	0.9952	488,415	4,902,360	50.07
30-34	440	10	2	3	4	1	430	394,968	0.0011	2.58	0.9944	485,907	4,413,945	45.30
35-39	526	31	18	4	2	7	495	374,356	0.0014	2.66	0.9930	482,920	3,928,038	40.54
40-44	668	47	34	5	2	6	621	305,016	0.0022	2.69	0.9891	478,701	3,445,118	35.80
45-49	880	101	80	10	3	8	779	251,214	0.0035	2.75	0.9826	472,153	2,966,417	31.17
50-54	1,546	230	186	16	10	18	1,316	235,683	0.0066	2.71	0.9677	460,681	2,494,264	26.67
55-59	2,451	438	357	26	22	33	2,013	231,769	0.0106	2.68	0.9484	441,684	2,033,583	22.47
60-64	3,559	681	511	38	32	100	2,878	204,730	0.0174	2.66	0.9165	412,400	1,591,899	18.55
65-69	4,326	848	561	64	58	165	3,478	154,380	0.0280	2.63	0.8686	368,803	1,179,499	15.00
70-74	5,272	988	542	120	73	253	4,284	119,620	0.0441	2.59	0.8008	308,787	810,696	11.87
75-79	5,241	976	424	175	83	294	4,265	76,579	0.0684	2.53	0.7072	234,076	501,910	9.17
80-84	4,470	786	269	202	73	242	3,684	41,921	0.1066	2.46	0.5805	152,234	267,834	6.92
85-89	2,890	491	101	186	37	167	2,399	17,739	0.1629	2.39	0.4283	78,831	115,599	5.15
90+	1,848	365	41	204	19	101	1,483	7,063	0.2616	0.0000	0.0000	36,769	36,769	3.82

c) Ontario: Median Multiple Decrement Life Table for Males (1975-1977)

x	nD_x	$nD_x(\text{all_res})$	$nD_x(\text{neo})$	$nD_x(\text{pneu})$	$nD_x(\text{hea})$	$nD_x(\text{oth_res})$	$nD_x(\text{residual})$	$nPx(96)$	nm_x	na_x	np_x	nL_x	T_x	ex
00-01	858	41	0	33	0	8	817	62,615	0.0137	0.08	0.9865	98,757	7,078,909	70.79
01-04	155	12	0	6	1	5	143	252,747	0.0006	1.61	0.9976	394,010	6,980,151	70.76
05-09	140	8	0	5	1	2	132	345,310	0.0004	2.43	0.9980	491,513	6,586,141	66.93
10-14	143	5	0	2	2	1	138	411,347	0.0003	2.95	0.9983	490,679	6,094,629	62.06
15-19	487	9	1	4	2	2	478	421,284	0.0012	2.69	0.9942	488,870	5,603,950	57.16
20-24	551	11	1	4	1	5	540	391,308	0.0014	2.50	0.9930	485,644	5,115,079	52.48
25-29	443	9	1	6	1	1	434	370,454	0.0012	2.47	0.9940	482,471	4,629,436	47.83
30-34	383	13	5	5	2	1	370	307,033	0.0012	2.62	0.9938	479,620	4,146,964	43.10
35-39	483	22	7	6	2	7	461	253,230	0.0019	2.69	0.9905	475,956	3,667,344	38.36
40-44	736	52	33	13	5	1	684	244,907	0.0030	2.72	0.9851	470,301	3,191,389	33.70
45-49	1,277	134	92	21	9	12	1,143	241,923	0.0053	2.72	0.9739	460,900	2,721,088	29.17
50-54	2,041	245	172	28	21	24	1,796	228,895	0.0089	2.68	0.9563	445,070	2,260,189	24.88
55-59	2,510	367	256	34	45	32	2,143	181,399	0.0138	2.66	0.9330	420,811	1,815,119	20.89
60-64	3,467	581	371	47	65	98	2,886	158,855	0.0218	2.64	0.8962	385,472	1,394,308	17.20
65-69	4,166	726	438	89	104	95	3,440	122,015	0.0341	2.61	0.8422	335,832	1,008,836	13.89
70-74	4,617	749	391	126	132	100	3,868	87,242	0.0529	2.56	0.7657	270,906	673,003	11.00
75-79	4,320	719	282	199	121	117	3,601	54,990	0.0786	2.50	0.6716	195,827	402,097	8.58
80-84	3,630	536	150	206	79	101	3,094	29,977	0.1211	2.43	0.5384	119,940	206,270	6.56
85-89	2,424	319	50	163	44	62	2,105	13,648	0.1776	2.34	0.3968	57,535	86,331	5.10
90+	1,391	217	24	155	23	15	1,174	5,958	0.2335	0.0000	0.0000	28,796	28,796	4.28

Table 4.2 Females: Median Number of Deaths by Specified Cause i , Mid-Period Population & Single Decrement Life Table Functions by Period**a) Ontario: Median Multiple Decrement Life Table for Females (1995-1997)**

x	nD_x	$nD_x(alt_res)$	$nD_x(neo)$	$nD_x(pneu)$	$nD_x(hea)$	$nD_x(oth_res)$	$nD_x(residual)$	$nPx(96)$	nm_x	na_x	np_x	nL_x	T_x	ex
00-01	341	4	0	1	0	3	337	68,251	0.0050	0.07	0.9950	99,536	8,132,843	81.33
01-04	64	5	0	4	0	1	59	300,172	0.0002	1.51	0.9991	397,800	8,033,307	80.73
05-09	46	3	0	0	0	3	43	370,243	0.0001	2.45	0.9994	496,932	7,635,507	76.80
10-14	50	2	0	0	1	1	48	360,157	0.0001	2.72	0.9993	496,624	7,138,576	71.85
15-19	96	1	0	1	0	0	95	350,240	0.0003	2.60	0.9986	496,109	6,641,952	66.90
20-24	99	5	1	2	2	0	94	368,944	0.0003	2.54	0.9987	495,429	6,145,842	61.98
25-29	134	6	2	1	2	1	128	414,384	0.0003	2.63	0.9984	494,713	5,650,414	57.06
30-34	236	10	3	2	0	5	226	494,189	0.0005	2.65	0.9976	493,737	5,155,701	52.15
35-39	323	17	10	3	2	2	306	488,432	0.0007	2.70	0.9967	492,365	4,661,964	47.27
40-44	496	51	36	6	1	8	445	439,668	0.0011	2.71	0.9944	490,220	4,169,600	42.42
45-49	731	93	72	7	8	6	638	398,600	0.0018	2.70	0.9909	486,669	3,679,380	37.64
50-54	906	139	107	12	5	15	767	306,701	0.0030	2.70	0.9853	480,987	3,192,711	32.97
55-59	1,210	212	151	16	9	36	998	254,078	0.0048	2.70	0.9764	471,983	2,711,724	28.42
60-64	1,833	350	249	27	19	55	1,483	234,284	0.0078	2.68	0.9616	457,608	2,239,741	24.04
65-69	2,772	519	325	49	25	120	2,253	226,109	0.0123	2.68	0.9404	435,607	1,782,133	19.89
70-74	4,234	714	387	85	42	200	3,520	209,905	0.0202	2.68	0.9037	402,461	1,346,526	15.98
75-79	5,245	786	314	158	48	266	4,459	150,369	0.0349	2.65	0.8388	351,916	944,065	12.40
80-84	6,478	856	206	304	48	298	5,622	104,954	0.0617	2.59	0.7313	278,015	592,149	9.27
85-89	6,244	720	93	358	36	233	5,524	58,676	0.1064	2.60	0.5761	186,073	314,134	6.73
90+	6,776	834	45	563	34	192	5,942	32,248	0.2101		0.0000	128,061	128,061	4.76

b) Ontario: Median Multiple Decrement Life Table for Females (1985-1987)

x	nD_x	$nD_x(alt_res)$	$nD_x(neo)$	$nD_x(pneu)$	$nD_x(hea)$	$nD_x(oth_res)$	$nD_x(residual)$	$nPx(96)$	nm_x	na_x	np_x	nL_x	T_x	ex
00-01	415	10	0	6	0	4	405	65,183	0.0064	0.07	0.9937	99,412	8,003,075	80.03
01-04	92	7	0	5	0	2	85	249,687	0.0004	1.51	0.9985	397,104	7,903,663	79.54
05-09	45	1	0	0	1	0	44	303,366	0.0001	2.29	0.9993	495,905	7,506,558	75.66
10-14	46	3	0	1	1	1	43	313,308	0.0001	2.77	0.9993	495,574	7,010,654	70.71
15-19	118	4	1	2	1	0	114	349,393	0.0003	2.62	0.9983	494,975	6,515,080	65.76
20-24	151	6	0	2	2	2	145	436,604	0.0003	2.52	0.9983	494,113	6,020,106	60.87
25-29	164	5	1	1	2	1	159	435,789	0.0004	2.59	0.9981	493,234	5,525,993	55.97
30-34	204	9	5	1	1	2	195	406,401	0.0005	2.65	0.9975	492,174	5,032,759	51.07
35-39	279	12	8	1	2	1	267	375,147	0.0007	2.72	0.9963	490,687	4,540,585	46.19
40-44	388	44	32	3	4	5	344	299,425	0.0013	2.74	0.9935	488,265	4,049,899	41.35
45-49	560	64	49	5	5	5	496	246,806	0.0023	2.72	0.9887	484,026	3,561,634	36.60
50-54	876	130	104	5	8	13	746	233,121	0.0038	2.68	0.9814	476,881	3,077,608	31.99
55-59	1,329	204	151	16	16	21	1,125	234,479	0.0057	2.68	0.9720	465,943	2,600,727	27.55
60-64	2,070	310	211	22	22	55	1,760	230,920	0.0090	2.68	0.9561	449,529	2,134,784	23.26
65-69	2,679	400	240	40	29	91	2,279	185,225	0.0145	2.67	0.9300	424,406	1,685,255	19.21
70-74	3,539	448	206	65	47	130	3,091	153,007	0.0231	2.66	0.8903	387,078	1,260,848	15.45
75-79	4,434	469	169	116	40	144	3,965	113,530	0.0391	2.63	0.8213	332,446	873,770	12.03
80-84	4,938	454	96	206	24	128	4,484	75,664	0.0653	2.57	0.7183	257,524	541,324	9.07
85-89	4,621	392	45	237	19	91	4,229	41,807	0.1105	2.58	0.5639	169,118	283,800	6.62
90+	4,701	579	19	432	14	114	4,122	22,305	0.2108		0.0000	114,683	114,683	4.74

c) Ontario: Median Multiple Decrement Life Table for Females (1975-1977)

x	nD_x	$nD_x(alt_res)$	$nD_x(neo)$	$nD_x(pneu)$	$nD_x(hea)$	$nD_x(oth_res)$	$nD_x(residual)$	$nPx(96)$	nm_x	na_x	np_x	nL_x	T_x	ex
00-01	657	23	0	18	0	5	634	60,085	0.0109	0.08	0.9892	99,008	7,797,132	77.97
01-04	118	9	0	4	0	5	109	239,053	0.0005	1.51	0.9980	395,183	7,698,124	77.82
05-09	84	5	0	2	0	3	79	328,596	0.0003	2.38	0.9987	493,281	7,302,941	73.97
10-14	98	7	0	4	2	1	91	391,589	0.0003	2.63	0.9987	492,689	6,809,660	69.07
15-19	168	5	0	2	2	1	163	403,264	0.0004	2.59	0.9979	491,870	6,316,970	64.15
20-24	166	5	0	2	2	1	161	393,397	0.0004	2.55	0.9979	490,832	5,825,101	59.28
25-29	189	6	2	3	1	0	183	367,752	0.0005	2.59	0.9974	489,699	5,334,269	54.40
30-34	196	10	2	3	2	3	186	298,048	0.0007	2.68	0.9967	488,301	4,844,569	49.53
35-39	266	16	5	6	2	3	250	245,329	0.0011	2.72	0.9946	486,238	4,356,269	44.69
40-44	426	33	20	8	4	1	393	235,472	0.0018	2.71	0.9910	482,804	3,870,031	39.91
45-49	690	58	34	10	6	8	632	234,215	0.0029	2.68	0.9854	477,172	3,387,227	35.25
50-54	1,055	96	62	14	10	10	959	238,902	0.0044	2.67	0.9781	468,580	2,910,055	30.74
55-59	1,289	132	71	22	19	20	1,157	192,132	0.0067	2.67	0.9670	455,932	2,441,475	26.36
60-64	1,765	167	90	34	24	19	1,598	169,589	0.0104	2.67	0.9492	437,179	1,985,543	22.17
65-69	2,360	197	83	39	25	50	2,163	141,292	0.0167	2.66	0.9196	409,044	1,548,364	18.22
70-74	2,992	213	59	84	34	36	2,779	111,534	0.0268	2.64	0.8738	367,618	1,139,320	14.57
75-79	3,661	244	49	129	28	38	3,417	83,074	0.0441	2.62	0.8006	309,129	771,702	11.30
80-84	4,131	289	35	209	23	22	3,842	53,605	0.0771	2.55	0.6759	229,987	462,573	8.46
85-89	3,561	239	16	187	18	18	3,322	28,203	0.1263	2.52	0.5194	140,706	232,586	6.29
90+	2,829	301	7	253	10	31	2,528	13,540	0.2089		0.0000	91,880	91,880	4.79

Table 4.3 Probabilities of Death for All Causes and Specified Cause *i* by Gender and Period

a) Males 1995-1997

<i>x</i>	<i>nq_x</i>	<i>nq_x(all_res)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(residual)</i>
00-01	0.0064	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0063
01-04	0.0011	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0011
05-09	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0006
10-14	0.0009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009
15-19	0.0029	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0028
20-24	0.0038	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0037
25-29	0.0041	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0041
30-34	0.0053	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0052
35-39	0.0074	0.0003	0.0002	0.0001	0.0000	0.0000	0.0000	0.0071
40-44	0.0101	0.0005	0.0004	0.0001	0.0000	0.0000	0.0000	0.0096
45-49	0.0140	0.0012	0.0009	0.0002	0.0001	0.0001	0.0001	0.0127
50-54	0.0242	0.0031	0.0024	0.0003	0.0001	0.0003	0.0003	0.0210
55-59	0.0391	0.0064	0.0051	0.0005	0.0002	0.0007	0.0007	0.0327
60-64	0.0642	0.0120	0.0091	0.0008	0.0004	0.0017	0.0017	0.0522
65-69	0.1064	0.0214	0.0147	0.0017	0.0009	0.0041	0.0041	0.0850
70-74	0.1669	0.0346	0.0203	0.0037	0.0015	0.0092	0.0092	0.1322
75-79	0.2521	0.0487	0.0219	0.0089	0.0022	0.0156	0.0156	0.2034
80-84	0.3885	0.0727	0.0233	0.0185	0.0043	0.0266	0.0266	0.3159
85-89	0.5542	0.0983	0.0202	0.0359	0.0043	0.0380	0.0380	0.4558
90+	1.0000	0.1884	0.0211	0.0934	0.0077	0.0662	0.0662	0.8116

b) Females 1995-1997

<i>x</i>	<i>nq_x</i>	<i>nq_x(all_res)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(residual)</i>
00-01	0.0050	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0049
01-04	0.0009	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0008
05-09	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0006
10-14	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007
15-19	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0014
20-24	0.0013	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0013
25-29	0.0016	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0015
30-34	0.0024	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001	0.0023
35-39	0.0033	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	0.0031
40-44	0.0056	0.0006	0.0004	0.0001	0.0000	0.0000	0.0001	0.0050
45-49	0.0091	0.0012	0.0009	0.0001	0.0001	0.0001	0.0001	0.0080
50-54	0.0147	0.0023	0.0017	0.0002	0.0001	0.0002	0.0002	0.0124
55-59	0.0236	0.0041	0.0029	0.0003	0.0002	0.0007	0.0007	0.0194
60-64	0.0384	0.0073	0.0052	0.0006	0.0004	0.0012	0.0012	0.0311
65-69	0.0596	0.0112	0.0070	0.0011	0.0005	0.0026	0.0026	0.0484
70-74	0.0963	0.0162	0.0088	0.0019	0.0010	0.0046	0.0046	0.0801
75-79	0.1612	0.0242	0.0097	0.0049	0.0015	0.0082	0.0082	0.1371
80-84	0.2687	0.0355	0.0085	0.0126	0.0020	0.0124	0.0124	0.2332
85-89	0.4239	0.0489	0.0063	0.0243	0.0024	0.0158	0.0158	0.3750
90+	1.0000	0.1231	0.0066	0.0831	0.0050	0.0283	0.0283	0.8769

c) Males 1985-1987

<i>x</i>	<i>nq_x</i>	<i>nq_x(all_res)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(residual)</i>
00-01	0.0078	0.0001	0.0000	0.0001	0.0000	0.0001	0.0001	0.0077
01-04	0.0017	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0016
05-09	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0012
10-14	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0013
15-19	0.0040	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0039
20-24	0.0049	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0048
25-29	0.0048	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0047
30-34	0.0056	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	0.0054
35-39	0.0070	0.0004	0.0002	0.0001	0.0000	0.0001	0.0001	0.0066
40-44	0.0109	0.0008	0.0006	0.0001	0.0000	0.0001	0.0001	0.0101
45-49	0.0174	0.0020	0.0016	0.0002	0.0001	0.0002	0.0002	0.0154
50-54	0.0323	0.0048	0.0039	0.0003	0.0002	0.0004	0.0004	0.0275
55-59	0.0516	0.0092	0.0075	0.0005	0.0005	0.0007	0.0007	0.0424
60-64	0.0835	0.0160	0.0120	0.0009	0.0008	0.0023	0.0023	0.0675
65-69	0.1314	0.0258	0.0170	0.0019	0.0018	0.0050	0.0050	0.1056
70-74	0.1992	0.0373	0.0205	0.0045	0.0028	0.0096	0.0096	0.1619
75-79	0.2928	0.0545	0.0237	0.0098	0.0046	0.0164	0.0164	0.2383
80-84	0.4195	0.0738	0.0252	0.0190	0.0069	0.0227	0.0227	0.3457
85-89	0.5717	0.0971	0.0200	0.0368	0.0073	0.0330	0.0330	0.4746
90+	1.0000	0.1975	0.0222	0.1104	0.0103	0.0547	0.0547	0.8025

d) Females 1985-1987

<i>x</i>	<i>nq_x</i>	<i>nq_x(all_res)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(residual)</i>
00-01	0.0063	0.0002	0.0000	0.0001	0.0000	0.0001	0.0001	0.0062
01-04	0.0015	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0014
05-09	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007
10-14	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007
15-19	0.0017	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0016
20-24	0.0017	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0017
25-29	0.0019	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0018
30-34	0.0025	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0024
35-39	0.0037	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	0.0036
40-44	0.0065	0.0007	0.0005	0.0000	0.0001	0.0001	0.0001	0.0057
45-49	0.0113	0.0013	0.0010	0.0001	0.0001	0.0001	0.0001	0.0100
50-54	0.0186	0.0028	0.0022	0.0001	0.0002	0.0003	0.0003	0.0159
55-59	0.0280	0.0043	0.0032	0.0003	0.0003	0.0004	0.0004	0.0237
60-64	0.0439	0.0066	0.0045	0.0005	0.0005	0.0012	0.0012	0.0373
65-69	0.0700	0.0104	0.0063	0.0010	0.0008	0.0024	0.0024	0.0595
70-74	0.1097	0.0139	0.0064	0.0020	0.0015	0.0040	0.0040	0.0958
75-79	0.1787	0.0189	0.0068	0.0047	0.0016	0.0058	0.0058	0.1598
80-84	0.2817	0.0259	0.0055	0.0118	0.0014	0.0073	0.0073	0.2558
85-89	0.4361	0.0370	0.0042	0.0224	0.0018	0.0086	0.0086	0.3991
90+	1.0000	0.1232	0.0040	0.0919	0.0030	0.0243	0.0243	0.8768

e) Males 1975-1977

<i>x</i>	<i>nq_x</i>	<i>nq_x(all_res)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(residual)</i>
00-01	0.0135	0.0006	0.0000	0.0005	0.0000	0.0001	0.0019	0.0129
01-04	0.0024	0.0002	0.0000	0.0001	0.0000	0.0001	0.0023	0.0023
05-09	0.0020	0.0001	0.0000	0.0001	0.0000	0.0000	0.0019	0.0019
10-14	0.0017	0.0001	0.0000	0.0000	0.0000	0.0000	0.0017	0.0017
15-19	0.0058	0.0001	0.0000	0.0000	0.0000	0.0000	0.0057	0.0057
20-24	0.0070	0.0001	0.0000	0.0001	0.0000	0.0001	0.0069	0.0069
25-29	0.0060	0.0001	0.0000	0.0001	0.0000	0.0000	0.0058	0.0058
30-34	0.0062	0.0002	0.0001	0.0001	0.0000	0.0000	0.0060	0.0060
35-39	0.0095	0.0004	0.0001	0.0001	0.0000	0.0001	0.0091	0.0091
40-44	0.0149	0.0011	0.0007	0.0003	0.0001	0.0000	0.0139	0.0139
45-49	0.0261	0.0027	0.0019	0.0004	0.0002	0.0002	0.0233	0.0233
50-54	0.0437	0.0052	0.0037	0.0006	0.0004	0.0005	0.0384	0.0384
55-59	0.0670	0.0098	0.0068	0.0009	0.0012	0.0009	0.0572	0.0572
60-64	0.1038	0.0174	0.0111	0.0014	0.0019	0.0029	0.0864	0.0864
65-69	0.1578	0.0275	0.0166	0.0034	0.0039	0.0036	0.1303	0.1303
70-74	0.2343	0.0380	0.0198	0.0064	0.0067	0.0051	0.1963	0.1963
75-79	0.3284	0.0547	0.0214	0.0151	0.0092	0.0089	0.2737	0.2737
80-84	0.4616	0.0682	0.0191	0.0262	0.0100	0.0128	0.3934	0.3934
85-89	0.6032	0.0794	0.0124	0.0406	0.0109	0.0154	0.5238	0.5238
90+	1.0000	0.1560	0.0173	0.1114	0.0165	0.0108	0.8440	0.8440

f) Females 1975-1977

<i>x</i>	<i>nq_x</i>	<i>nq_x(all_res)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(neo)</i>	<i>nq_x(residual)</i>
00-01	0.0108	0.0004	0.0000	0.0003	0.0000	0.0001	0.0104	0.0104
01-04	0.0020	0.0002	0.0000	0.0001	0.0000	0.0001	0.0018	0.0018
05-09	0.0013	0.0001	0.0000	0.0000	0.0000	0.0000	0.0012	0.0012
10-14	0.0013	0.0001	0.0000	0.0001	0.0000	0.0000	0.0012	0.0012
15-19	0.0021	0.0001	0.0000	0.0000	0.0000	0.0000	0.0020	0.0020
20-24	0.0021	0.0001	0.0000	0.0000	0.0000	0.0000	0.0020	0.

Table 4.4 Life Table Deaths for All Causes and Specified Cause *i* by Gender and Period

a) Males 1995-1997

<i>x</i>	<i>nd x</i>	<i>nd x(all_res)</i>	<i>nd x(nco)</i>	<i>nd x(pneo)</i>	<i>nd x(bco)</i>	<i>nd x(oth_res)</i>	<i>nd x(residu)</i>
00-01	639	6	0	1	0	4	633
01-04	112	6	0	3	0	4	106
05-09	58	3	0	1	0	1	56
10-14	89	1	0	0	0	1	87
15-19	283	8	0	4	3	1	275
20-24	372	7	0	3	4	0	365
25-29	405	4	1	1	1	0	402
30-34	523	11	5	5	1	0	512
35-39	720	26	16	5	2	3	694
40-44	981	48	36	7	1	3	934
45-49	1,337	118	90	15	5	9	1,219
50-54	2,284	297	231	32	6	28	1,987
55-59	3,603	590	469	42	15	64	3,013
60-64	5,689	1,062	810	69	32	151	4,627
65-69	8,820	1,776	1,216	144	75	342	7,044
70-74	12,364	2,566	1,502	276	110	678	9,798
75-79	15,561	3,005	1,355	550	139	961	12,556
80-84	17,935	3,355	1,077	853	196	1,228	14,581
85-89	15,642	2,775	570	1,013	120	1,073	12,867
90+	12,585	2,370	265	1,176	96	834	10,214

c) Males 1985-1987

<i>x</i>	<i>nd x</i>	<i>nd x(all_res)</i>	<i>nd x(nco)</i>	<i>nd x(pneo)</i>	<i>nd x(bco)</i>	<i>nd x(oth_res)</i>	<i>nd x(residu)</i>
00-01	785	14	0	7	0	7	770
01-04	165	9	0	5	0	5	156
05-09	119	5	0	2	2	2	114
10-14	135	5	0	0	2	3	131
15-19	396	7	1	1	1	3	390
20-24	483	7	1	2	2	2	475
25-29	474	10	2	2	3	2	464
30-34	541	12	2	4	5	1	529
35-39	679	40	23	5	3	9	639
40-44	1,048	74	53	8	3	9	975
45-49	1,654	190	150	19	6	15	1,464
50-54	3,022	450	364	31	20	35	2,572
55-59	4,671	835	680	50	42	63	3,836
60-64	7,169	1,372	1,029	77	64	201	5,797
65-69	10,335	2,026	1,340	153	139	394	8,309
70-74	13,609	2,550	1,399	310	188	653	11,059
75-79	16,020	2,983	1,296	535	254	899	13,037
80-84	16,233	2,854	977	734	265	879	13,378
85-89	12,843	2,182	449	827	164	742	10,661
90+	9,620	1,900	213	1,062	99	526	7,720

e) Males 1975-1977

<i>x</i>	<i>nd x</i>	<i>nd x(all_res)</i>	<i>nd x(nco)</i>	<i>nd x(pneo)</i>	<i>nd x(bco)</i>	<i>nd x(oth_res)</i>	<i>nd x(residu)</i>
00-01	1,353	65	0	52	0	13	1,289
01-04	242	19	0	9	2	8	223
05-09	199	11	0	7	1	3	188
10-14	171	6	0	2	2	1	165
15-19	565	10	1	5	2	2	555
20-24	684	14	1	5	1	6	670
25-29	577	12	1	8	1	1	565
30-34	598	20	8	8	3	2	578
35-39	908	41	13	11	4	13	866
40-44	1,413	100	63	25	10	2	1,314
45-49	2,433	255	175	40	17	23	2,178
50-54	3,969	476	334	54	41	47	3,492
55-59	5,823	851	594	79	104	74	4,971
60-64	8,413	1,410	900	114	158	238	7,003
65-69	11,466	1,998	1,206	245	286	261	9,468
70-74	14,337	2,326	1,214	391	410	311	12,011
75-79	15,384	2,560	1,004	709	431	417	12,824
80-84	14,524	2,145	600	824	316	404	12,379
85-89	10,219	1,345	211	687	185	261	8,874
90+	6,723	1,049	116	749	111	72	5,674

Notes:

The sum of each cause *i* equals the total life table number of deaths for all causes. The numbers are rounded, so it may seem that some age groups do not have equivalent sums.

b) Females 1995-1997

<i>x</i>	<i>nd x</i>	<i>nd x(all_res)</i>	<i>nd x(nco)</i>	<i>nd x(pneo)</i>	<i>nd x(bco)</i>	<i>nd x(oth_res)</i>	<i>nd x(residu)</i>
00-01	497	6	0	1	0	4	491
01-04	85	7	0	5	0	1	78
05-09	62	4	0	0	0	4	58
10-14	69	3	0	0	1	1	66
15-19	136	1	0	1	0	0	135
20-24	133	7	1	3	3	0	126
25-29	160	7	2	1	2	1	153
30-34	236	10	3	2	0	5	226
35-39	326	17	10	3	2	2	308
40-44	553	57	40	7	1	9	496
45-49	893	114	88	9	10	7	779
50-54	1,421	218	168	19	8	24	1,203
55-59	2,248	394	281	30	17	67	1,854
60-64	3,580	684	486	53	37	107	2,897
65-69	5,340	1,000	626	94	48	231	4,340
70-74	8,118	1,369	742	163	81	383	6,749
75-79	12,275	1,840	735	370	112	623	10,436
80-84	17,160	2,267	546	805	127	789	14,892
85-89	19,801	2,283	295	1,135	114	739	17,518
90+	26,908	3,312	179	2,236	135	762	23,596

d) Females 1985-1987

<i>x</i>	<i>nd x</i>	<i>nd x(all_res)</i>	<i>nd x(nco)</i>	<i>nd x(pneo)</i>	<i>nd x(bco)</i>	<i>nd x(oth_res)</i>	<i>nd x(residu)</i>
00-01	633	15	0	9	0	6	618
01-04	146	11	0	8	0	3	135
05-09	74	2	0	0	2	0	72
10-14	73	5	0	2	2	2	68
15-19	167	6	1	3	1	0	162
20-24	171	7	0	2	2	2	164
25-29	186	6	1	1	2	1	180
30-34	247	11	6	1	1	2	236
35-39	365	16	10	1	3	1	349
40-44	633	72	52	5	7	8	561
45-49	1,098	126	96	10	10	10	973
50-54	1,792	266	213	10	16	27	1,526
55-59	2,641	405	300	32	32	42	2,236
60-64	4,030	603	411	43	43	107	3,426
65-69	6,138	917	550	92	66	209	5,222
70-74	8,953	1,133	521	164	119	329	7,820
75-79	12,984	1,373	495	340	117	422	11,611
80-84	16,807	1,545	327	701	82	436	15,261
85-89	18,693	1,586	182	959	77	368	17,107
90+	24,171	2,977	98	2,221	72	586	21,194

f) Females 1975-1977

<i>x</i>	<i>nd x</i>	<i>nd x(all_res)</i>	<i>nd x(nco)</i>	<i>nd x(pneo)</i>	<i>nd x(bco)</i>	<i>nd x(oth_res)</i>	<i>nd x(residu)</i>
00-01	1,083	38	0	30	0	8	1,045
01-04	195	15	0	7	0	8	180
05-09	126	8	0	3	0	5	119
10-14	123	9	0	5	3	1	114
15-19	205	6	0	2	2	1	199
20-24	207	6	0	2	2	1	201
25-29	252	8	3	4	1	0	244
30-34	321	16	3	5	3	5	305
35-39	527	32	10	12	4	6	495
40-44	873	68	41	16	8	2	806
45-49	1,406	118	69	20	12	16	1,288
50-54	2,069	188	122	27	20	20	1,881
55-59	3,059	313	168	52	45	47	2,746
60-64	4,550	431	232	88	62	49	4,119
65-69	6,832	570	240	113	72	145	6,262
70-74	9,862	702	194	277	112	119	9,160
75-79	13,623	908	182	480	104	141	12,715
80-84	17,724	1,240	150	897	99	94	16,484
85-89	17,766	1,192	80	933	90	90	16,574
90+	19,197	2,043	48	1,717	68	210	17,154

Table 4.5 Expected Number of Individuals at Age x that will Eventually Die from Cause i by Gender and Period

a) Males 1995-1997

x	l_x	$l_x(\text{all_res})$	$l_x(\text{neo})$	$l_x(\text{pneu})$	$l_x(\text{hea})$	$l_x(\text{oth_res})$	$l_x(\text{residual})$
00-01	100,000	18,032	7,641	4,199	806	5,385	81,968
01-04	99,361	18,026	7,641	4,198	806	5,381	81,335
05-09	99,250	18,020	7,641	4,195	806	5,377	81,229
10-14	99,191	18,018	7,641	4,194	806	5,376	81,173
15-19	99,102	18,016	7,641	4,194	806	5,375	81,086
20-24	98,820	18,008	7,641	4,190	804	5,373	80,811
25-29	98,448	18,002	7,641	4,187	800	5,373	80,446
30-34	98,043	17,998	7,640	4,186	799	5,373	80,044
35-39	97,520	17,987	7,635	4,181	798	5,373	79,533
40-44	96,801	17,961	7,619	4,176	796	5,370	78,839
45-49	95,819	17,914	7,583	4,170	794	5,367	77,906
50-54	94,482	17,796	7,493	4,155	790	5,359	76,687
55-59	92,199	17,499	7,262	4,123	783	5,331	74,700
60-64	88,596	16,909	6,793	4,080	769	5,267	71,687
65-69	82,907	15,847	5,984	4,012	736	5,116	67,059
70-74	74,087	14,071	4,768	3,868	661	4,774	60,016
75-79	61,723	11,505	3,266	3,592	551	4,096	50,218
80-84	46,162	8,500	1,912	3,042	413	3,134	37,662
85-89	28,227	5,146	835	2,188	216	1,906	23,081
90+	12,585	2,370	265	1,176	96	834	10,214

b) Females 1995-1997

x	l_x	$l_x(\text{all_res})$	$l_x(\text{neo})$	$l_x(\text{pneu})$	$l_x(\text{hea})$	$l_x(\text{oth_res})$	$l_x(\text{residual})$
00-01	100,000	13,599	4,202	4,937	698	3,761	86,401
01-04	99,503	13,593	4,202	4,936	698	3,757	85,910
05-09	99,418	13,586	4,202	4,930	698	3,756	85,832
10-14	99,356	13,582	4,202	4,930	698	3,752	85,774
15-19	99,287	13,579	4,202	4,930	697	3,750	85,708
20-24	99,151	13,578	4,202	4,929	697	3,750	85,573
25-29	99,018	13,571	4,200	4,926	694	3,750	85,447
30-34	98,858	13,564	4,198	4,925	692	3,749	85,294
35-39	98,623	13,554	4,195	4,923	692	3,744	85,068
40-44	98,297	13,537	4,185	4,920	690	3,742	84,760
45-49	97,744	13,480	4,145	4,913	689	3,733	84,264
50-54	96,851	13,366	4,057	4,905	679	3,726	83,485
55-59	95,431	13,148	3,889	4,886	671	3,702	82,282
60-64	93,183	12,755	3,609	4,856	654	3,635	80,428
65-69	89,603	12,071	3,122	4,803	617	3,528	77,532
70-74	84,262	11,071	2,496	4,709	569	3,297	73,191
75-79	76,144	9,702	1,754	4,546	489	2,913	66,442
80-84	63,869	7,863	1,019	4,176	376	2,291	56,006
85-89	46,709	5,595	474	3,371	249	1,501	41,114
90+	26,908	3,312	179	2,236	135	762	23,596

c) Males 1985-1987

x	l_x	$l_x(\text{all_res})$	$l_x(\text{neo})$	$l_x(\text{pneu})$	$l_x(\text{hea})$	$l_x(\text{oth_res})$	$l_x(\text{residual})$
00-01	100,000	17,525	7,982	3,832	1,261	4,450	82,475
01-04	99,215	17,510	7,982	3,824	1,261	4,443	81,705
05-09	99,051	17,501	7,982	3,820	1,261	4,438	81,550
10-14	98,932	17,496	7,982	3,818	1,260	4,437	81,435
15-19	98,796	17,492	7,982	3,818	1,258	4,434	81,304
20-24	98,400	17,485	7,980	3,817	1,257	4,431	80,915
25-29	97,918	17,478	7,979	3,815	1,255	4,429	80,440
30-34	97,444	17,468	7,977	3,813	1,251	4,427	79,976
35-39	96,902	17,456	7,975	3,809	1,246	4,426	79,447
40-44	96,224	17,416	7,951	3,804	1,244	4,417	78,808
45-49	95,175	17,342	7,898	3,796	1,241	4,407	77,833
50-54	93,521	17,152	7,748	3,777	1,235	4,392	76,369
55-59	90,499	16,702	7,384	3,746	1,216	4,357	73,797
60-64	85,829	15,868	6,704	3,696	1,174	4,294	69,961
65-69	78,659	14,496	5,674	3,620	1,109	4,093	64,164
70-74	68,325	12,470	4,334	3,467	971	3,698	55,855
75-79	54,716	9,920	2,935	3,157	782	3,045	44,796
80-84	38,696	6,936	1,639	2,622	528	2,147	31,759
85-89	22,463	4,082	662	1,889	263	1,268	18,381
90+	9,620	1,900	213	1,062	99	526	7,720

d) Females 1985-1987

x	l_x	$l_x(\text{all_res})$	$l_x(\text{neo})$	$l_x(\text{pneu})$	$l_x(\text{hea})$	$l_x(\text{oth_res})$	$l_x(\text{residual})$
00-01	100,000	11,081	3,263	4,604	653	2,560	88,919
01-04	99,367	11,065	3,263	4,595	653	2,554	88,302
05-09	99,221	11,054	3,263	4,587	653	2,551	88,167
10-14	99,147	11,053	3,263	4,587	652	2,551	88,095
15-19	99,074	11,048	3,263	4,585	650	2,549	88,027
20-24	98,907	11,042	3,262	4,582	649	2,549	87,865
25-29	98,736	11,035	3,262	4,580	646	2,547	87,701
30-34	98,551	11,030	3,261	4,579	644	2,546	87,521
35-39	98,304	11,019	3,255	4,578	643	2,544	87,285
40-44	97,939	11,003	3,244	4,576	640	2,542	86,936
45-49	97,306	10,931	3,192	4,571	634	2,534	86,375
50-54	96,208	10,806	3,096	4,562	624	2,524	85,402
55-59	94,416	10,540	2,883	4,551	608	2,498	83,876
60-64	91,775	10,135	2,583	4,520	576	2,456	81,640
65-69	87,745	9,531	2,172	4,477	533	2,349	78,214
70-74	81,607	8,615	1,622	4,385	467	2,140	72,992
75-79	72,654	7,481	1,101	4,221	348	1,812	65,173
80-84	59,670	6,108	606	3,881	231	1,390	53,562
85-89	42,863	4,563	280	3,180	149	954	38,301
90+	24,171	2,977	98	2,221	72	586	21,194

e) Males 1975-1977

x	l_x	$l_x(\text{all_res})$	$l_x(\text{neo})$	$l_x(\text{pneu})$	$l_x(\text{hea})$	$l_x(\text{oth_res})$	$l_x(\text{residual})$
00-01	100,000	14,714	6,443	4,025	2,087	2,159	85,286
01-04	98,647	14,649	6,443	3,973	2,087	2,146	83,998
05-09	98,405	14,630	6,443	3,964	2,085	2,139	83,775
10-14	98,206	14,619	6,443	3,957	2,084	2,136	83,587
15-19	98,035	14,613	6,443	3,954	2,081	2,135	83,422
20-24	97,470	14,602	6,442	3,950	2,079	2,132	82,868
25-29	96,786	14,589	6,440	3,945	2,078	2,126	82,198
30-34	96,209	14,577	6,439	3,937	2,076	2,125	81,632
35-39	95,611	14,557	6,431	3,929	2,073	2,123	81,054
40-44	94,703	14,515	6,418	3,918	2,069	2,110	80,188
45-49	93,290	14,416	6,355	3,893	2,060	2,108	78,874
50-54	90,857	14,160	6,179	3,853	2,043	2,085	76,697
55-59	86,888	13,684	5,845	3,798	2,002	2,039	73,205
60-64	81,066	12,832	5,251	3,719	1,897	1,964	68,233
65-69	72,653	11,423	4,351	3,605	1,740	1,727	61,230
70-74	61,186	9,424	3,145	3,360	1,454	1,465	51,762
75-79	46,850	7,099	1,931	2,969	1,044	1,155	39,751
80-84	31,465	4,538	927	2,261	613	738	26,927
85-89	16,942	2,394	327	1,436	297	334	14,548
90+	6,723	1,049	116	749	111	72	5,674

f) Females 1975-1977

x	l_x	$l_x(\text{all_res})$	$l_x(\text{neo})$	$l_x(\text{pneu})$	$l_x(\text{hea})$	$l_x(\text{oth_res})$	$l_x(\text{residual})$
00-01	100,000	7,911	1,543	4,690	708	969	92,089
01-04	98,917	7,873	1,543	4,661	708	961	91,045
05-09	98,722	7,858	1,543	4,654	708	953	90,865
10-14	98,596	7,850	1,543	4,651	708	948	90,746
15-19	98,473	7,841	1,543	4,646	705	947	90,631
20-24	98,268	7,835	1,543	4,644	703	946	90,433
25-29	98,061	7,829	1,543	4,641	701	945	90,232
30-34	97,809	7,821	1,540	4,637	699	945	89,988
35-39	97,488	7,805	1,537	4,632	696	940	89,683
40-44	96,961	7,773	1,527	4,620	692	934	89,188
45-49	96,087	7,705	1,486	4,604	684	932	88,382
50-54	94,682	7,587	1,417	4,584	672	915	87,095
55-59	92,612	7,399	1,295	4,556	652	896	85,214
60-64	89,554	7,086	1,127	4,504	607	848	82,468
65-69	85,004	6,655	895	4,416	545	799	78,349
70-74	78,171	6,085	654	4,303	473	655	72,087
75-79	68,310	5,383	460	4,026	361	536	62,927
80-84	54,687	4,475	277	3,546	256	395	50,212
85-89	36,963	3,235	127	2,650	158	300	33,728
90+	19,197	2,043	48	1,717	68	210	17,154

Table 4.6 Probability Density Functions of All Causes and Specified Cause *i* by Gender and Period

a) Males 1995-1997

<i>x</i>	<i>nf_x</i>	<i>nf_x(all_res)</i>	<i>nf_x(neo)</i>	<i>nf_x(pneu)</i>	<i>nf_x(hep)</i>	<i>nf_x(oth_res)</i>	<i>nf_x(residual)</i>
00-01	0.0064	0.0003	0.0000	0.0003	0.0000	0.0008	0.0077
01-04	0.0003	0.0001	0.0000	0.0001	0.0000	0.0002	0.0003
05-09	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	0.0001
10-14	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002
15-19	0.0006	0.0001	0.0000	0.0002	0.0007	0.0000	0.0007
20-24	0.0007	0.0001	0.0000	0.0001	0.0010	0.0000	0.0009
25-29	0.0008	0.0000	0.0000	0.0001	0.0003	0.0000	0.0010
30-34	0.0010	0.0001	0.0001	0.0002	0.0002	0.0000	0.0012
35-39	0.0014	0.0003	0.0004	0.0002	0.0005	0.0001	0.0017
40-44	0.0020	0.0005	0.0009	0.0003	0.0003	0.0001	0.0023
45-49	0.0027	0.0013	0.0024	0.0007	0.0012	0.0003	0.0030
50-54	0.0046	0.0033	0.0060	0.0015	0.0015	0.0010	0.0048
55-59	0.0072	0.0065	0.0123	0.0020	0.0036	0.0024	0.0074
60-64	0.0114	0.0118	0.0212	0.0033	0.0081	0.0056	0.0113
65-69	0.0176	0.0197	0.0318	0.0069	0.0186	0.0127	0.0172
70-74	0.0247	0.0285	0.0393	0.0131	0.0273	0.0252	0.0239
75-79	0.0311	0.0333	0.0355	0.0262	0.0344	0.0357	0.0306
80-84	0.0359	0.0372	0.0282	0.0407	0.0487	0.0456	0.0356
85-89	0.0313	0.0308	0.0149	0.0482	0.0298	0.0398	0.0314
90+	0.0063	0.0066	0.0017	0.0140	0.0060	0.0077	0.0062

c) Males 1985-1987

<i>x</i>	<i>nf_x</i>	<i>nf_x(all_res)</i>	<i>nf_x(neo)</i>	<i>nf_x(pneu)</i>	<i>nf_x(hep)</i>	<i>nf_x(oth_res)</i>	<i>nf_x(residual)</i>
00-01	0.0078	0.0008	0.0000	0.0019	0.0000	0.0016	0.0093
01-04	0.0004	0.0001	0.0000	0.0003	0.0000	0.0003	0.0005
05-09	0.0002	0.0001	0.0000	0.0001	0.0002	0.0001	0.0003
10-14	0.0003	0.0001	0.0000	0.0000	0.0002	0.0001	0.0003
15-19	0.0008	0.0001	0.0000	0.0001	0.0002	0.0001	0.0009
20-24	0.0010	0.0001	0.0000	0.0001	0.0003	0.0001	0.0012
25-29	0.0009	0.0001	0.0001	0.0001	0.0005	0.0001	0.0011
30-34	0.0011	0.0001	0.0001	0.0002	0.0008	0.0001	0.0013
35-39	0.0014	0.0005	0.0006	0.0003	0.0004	0.0004	0.0015
40-44	0.0021	0.0008	0.0013	0.0004	0.0005	0.0004	0.0024
45-49	0.0033	0.0022	0.0038	0.0010	0.0009	0.0007	0.0036
50-54	0.0060	0.0051	0.0091	0.0016	0.0031	0.0016	0.0062
55-59	0.0093	0.0095	0.0170	0.0026	0.0066	0.0028	0.0093
60-64	0.0143	0.0157	0.0258	0.0040	0.0102	0.0091	0.0141
65-69	0.0207	0.0231	0.0336	0.0080	0.0220	0.0177	0.0201
70-74	0.0272	0.0291	0.0351	0.0162	0.0299	0.0294	0.0268
75-79	0.0320	0.0340	0.0325	0.0279	0.0402	0.0404	0.0316
80-84	0.0325	0.0326	0.0245	0.0383	0.0420	0.0395	0.0324
85-89	0.0257	0.0249	0.0112	0.0431	0.0261	0.0334	0.0259
90+	0.0048	0.0054	0.0013	0.0139	0.0039	0.0059	0.0047

e) Males 1975-1977

<i>x</i>	<i>nf_x</i>	<i>nf_x(all_res)</i>	<i>nf_x(neo)</i>	<i>nf_x(pneu)</i>	<i>nf_x(hep)</i>	<i>nf_x(oth_res)</i>	<i>nf_x(residual)</i>
00-01	0.0135	0.0044	0.0000	0.0129	0.0000	0.0058	0.0151
01-04	0.0006	0.0003	0.0000	0.0006	0.0002	0.0009	0.0007
05-09	0.0004	0.0002	0.0000	0.0004	0.0001	0.0003	0.0004
10-14	0.0003	0.0001	0.0000	0.0001	0.0002	0.0001	0.0004
15-19	0.0011	0.0001	0.0000	0.0002	0.0002	0.0002	0.0013
20-24	0.0014	0.0002	0.0000	0.0002	0.0001	0.0006	0.0016
25-29	0.0012	0.0002	0.0000	0.0004	0.0001	0.0001	0.0013
30-34	0.0012	0.0003	0.0002	0.0004	0.0003	0.0001	0.0014
35-39	0.0018	0.0006	0.0004	0.0006	0.0004	0.0012	0.0020
40-44	0.0028	0.0014	0.0020	0.0012	0.0009	0.0002	0.0031
45-49	0.0049	0.0035	0.0054	0.0020	0.0016	0.0021	0.0051
50-54	0.0079	0.0065	0.0104	0.0027	0.0039	0.0043	0.0082
55-59	0.0116	0.0116	0.0184	0.0039	0.0100	0.0069	0.0117
60-64	0.0168	0.0192	0.0279	0.0057	0.0151	0.0220	0.0164
65-69	0.0229	0.0272	0.0374	0.0122	0.0274	0.0242	0.0222
70-74	0.0287	0.0316	0.0377	0.0194	0.0393	0.0288	0.0282
75-79	0.0308	0.0348	0.0312	0.0352	0.0413	0.0386	0.0301
80-84	0.0290	0.0292	0.0186	0.0410	0.0303	0.0374	0.0290
85-89	0.0204	0.0183	0.0065	0.0341	0.0178	0.0242	0.0208
90+	0.0034	0.0036	0.0009	0.0093	0.0027	0.0017	0.0033

b) Females 1995-1997

<i>x</i>	<i>nf_x</i>	<i>nf_x(all_res)</i>	<i>nf_x(neo)</i>	<i>nf_x(pneu)</i>	<i>nf_x(hep)</i>	<i>nf_x(oth_res)</i>	<i>nf_x(residual)</i>
00-01	0.0050	0.0004	0.0000	0.0003	0.0000	0.0012	0.0057
01-04	0.0002	0.0001	0.0000	0.0003	0.0000	0.0001	0.0002
05-09	0.0001	0.0001	0.0000	0.0000	0.0000	0.0002	0.0001
10-14	0.0001	0.0000	0.0000	0.0000	0.0004	0.0001	0.0002
15-19	0.0003	0.0000	0.0000	0.0001	0.0000	0.0000	0.0003
20-24	0.0003	0.0001	0.0001	0.0001	0.0008	0.0000	0.0003
25-29	0.0003	0.0001	0.0001	0.0000	0.0007	0.0001	0.0004
30-34	0.0005	0.0001	0.0001	0.0001	0.0000	0.0003	0.0005
35-39	0.0007	0.0003	0.0005	0.0001	0.0006	0.0001	0.0007
40-44	0.0011	0.0008	0.0019	0.0003	0.0003	0.0005	0.0011
45-49	0.0018	0.0017	0.0042	0.0003	0.0028	0.0004	0.0018
50-54	0.0028	0.0032	0.0080	0.0008	0.0022	0.0013	0.0028
55-59	0.0045	0.0058	0.0134	0.0012	0.0048	0.0036	0.0043
60-64	0.0072	0.0101	0.0231	0.0021	0.0106	0.0057	0.0067
65-69	0.0107	0.0147	0.0298	0.0038	0.0138	0.0123	0.0100
70-74	0.0162	0.0201	0.0353	0.0066	0.0231	0.0204	0.0156
75-79	0.0246	0.0271	0.0350	0.0150	0.0322	0.0331	0.0242
80-84	0.0343	0.0333	0.0260	0.0326	0.0364	0.0420	0.0345
85-89	0.0396	0.0336	0.0140	0.0460	0.0327	0.0393	0.0405
90+	0.0135	0.0122	0.0021	0.0226	0.0097	0.0101	0.0137

d) Females 1985-1987

<i>x</i>	<i>nf_x</i>	<i>nf_x(all_res)</i>	<i>nf_x(neo)</i>	<i>nf_x(pneu)</i>	<i>nf_x(hep)</i>	<i>nf_x(oth_res)</i>	<i>nf_x(residual)</i>
00-01	0.0063	0.0014	0.0000	0.0020	0.0000	0.0024	0.0069
01-04	0.0004	0.0003	0.0000	0.0004	0.0000	0.0003	0.0004
05-09	0.0001	0.0000	0.0000	0.0000	0.0005	0.0000	0.0002
10-14	0.0001	0.0001	0.0000	0.0001	0.0005	0.0001	0.0002
15-19	0.0003	0.0001	0.0001	0.0001	0.0004	0.0000	0.0004
20-24	0.0003	0.0001	0.0000	0.0001	0.0007	0.0002	0.0004
25-29	0.0004	0.0001	0.0001	0.0000	0.0007	0.0001	0.0004
30-34	0.0005	0.0002	0.0004	0.0001	0.0004	0.0002	0.0005
35-39	0.0008	0.0003	0.0006	0.0001	0.0008	0.0001	0.0008
40-44	0.0013	0.0013	0.0032	0.0002	0.0020	0.0006	0.0013
45-49	0.0022	0.0023	0.0059	0.0004	0.0030	0.0008	0.0022
50-54	0.0036	0.0048	0.0130	0.0004	0.0050	0.0021	0.0034
55-59	0.0053	0.0073	0.0184	0.0014	0.0097	0.0033	0.0050
60-64	0.0081	0.0109	0.0252	0.0019	0.0131	0.0084	0.0077
65-69	0.0123	0.0165	0.0337	0.0040	0.0203	0.0163	0.0117
70-74	0.0179	0.0205	0.0319	0.0071	0.0364	0.0257	0.0176
75-79	0.0260	0.0248	0.0303	0.0148	0.0359	0.0329	0.0261
80-84	0.0336	0.0279	0.0200	0.0305	0.0250	0.0340	0.0343
85-89	0.0374	0.0286	0.0112	0.0416	0.0235	0.0288	0.0385
90+	0.0121	0.0134	0.0015	0.0241	0.0055	0.0114	0.0119

f) Females 1975-1977

<i>x</i>	<i>nf_x</i>	<i>nf_x(all_res)</i>	<i>nf_x(neo)</i>	<i>nf_x(pneu)</i>	<i>nf_x(hep)</i>	<i>nf_x(oth_res)</i>	<i>nf_x(residual)</i>
00-01	0.0108	0.0048	0.0000	0.0063	0.0000	0.0085	0.0113
01-04	0.0005	0.0005	0.0000	0.0004	0.0000	0.0021	0.0005
05-09	0.0003	0.0002	0.0000	0.0001	0.0000	0.0009	0.0003
10-14	0.0002	0.0002	0.0000	0.0002	0.0007	0.0003	0.0002
15-19	0.0004	0.0002	0.0000	0.0001	0.0007	0.0003	0.0004
20-24	0.0004	0.0002	0.0000	0.0001	0.0007	0.0003	0.0004
25-29	0.0005	0.0002	0.0003	0.0002	0.0004	0.0000	0.0005
30-34	0.0006	0.0004	0.0004	0.0002	0.0009	0.0010	0.0007
35-39	0.0011	0.0008	0.0013	0.0005	0.0011	0.0012	0.0011
40-44	0.0017	0.0017	0.0053	0.0007	0.0023	0.0004	0.0018
45-49	0.0028	0.0030	0.0090	0.0009	0.0035	0.0034	0.0028
50-54	0.0041	0.0048	0.0158	0.0012	0.0055	0.0040	0.0041
55-59	0.0061	0.0079	0.0218	0.0022	0.0127	0.0098	0.0060
60-64	0.0091	0.0109	0.0301	0.0037	0.0175	0.0101	0.0089
65-69	0.0137	0.0144	0.0311	0.0048	0.0204	0.0299	0.0136
70-74	0.0197	0.0177	0.0252	0.0118	0.0317	0.0245	0.0199
75-79	0.0272	0.0230	0.0236	0.0205	0.0294	0.0292	0.0276
80-84	0.0354	0.0313	0.0195	0.0382	0.0279	0.0195	0.0358
85-89	0.0355	0.0301	0.0103	0.0398	0.0254	0.0185	0.0360
90+	0.0096	0.0129	0.0015	0.0183	0.0048	0.0109	0.0093

Table 4.7 Cumulative Hazard Functions of All Causes and Specified Cause i by Gender and Period

a) Males 1995-1997

x	$H x$	$H x(\text{all}_\text{res})$	$H x(\text{neo})$	$H x(\text{gnew})$	$H x(\text{ben})$	$H x(\text{oth}_\text{res})$	$H x(\text{residual})$
00-01	0.0064	0.0001	0.0000	0.0000	0.0000	0.0000	0.0064
01-04	0.0011	0.0001	0.0000	0.0000	0.0000	0.0000	0.0011
05-09	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0006
10-14	0.0009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0009
15-19	0.0029	0.0001	0.0000	0.0000	0.0000	0.0000	0.0028
20-24	0.0038	0.0001	0.0000	0.0000	0.0000	0.0000	0.0037
25-29	0.0041	0.0000	0.0000	0.0000	0.0000	0.0000	0.0041
30-34	0.0053	0.0001	0.0000	0.0000	0.0000	0.0000	0.0052
35-39	0.0074	0.0003	0.0002	0.0001	0.0000	0.0000	0.0071
40-44	0.0102	0.0005	0.0004	0.0001	0.0000	0.0000	0.0097
45-49	0.0141	0.0012	0.0009	0.0002	0.0001	0.0001	0.0128
50-54	0.0245	0.0032	0.0025	0.0003	0.0001	0.0003	0.0213
55-59	0.0399	0.0065	0.0052	0.0005	0.0002	0.0007	0.0333
60-64	0.0664	0.0124	0.0094	0.0008	0.0004	0.0018	0.0540
65-69	0.1125	0.0227	0.0155	0.0018	0.0010	0.0044	0.0898
70-74	0.1826	0.0379	0.0222	0.0041	0.0016	0.0100	0.1447
75-79	0.2905	0.0561	0.0253	0.0103	0.0026	0.0179	0.2344
80-84	0.4919	0.0920	0.0295	0.0234	0.0054	0.0337	0.3999
85-89	0.8078	0.1433	0.0294	0.0523	0.0062	0.0554	0.6645
90+	-	-	-	-	-	-	-

b) Females 1995-1997

x	$H x$	$H x(\text{all}_\text{res})$	$H x(\text{neo})$	$H x(\text{gnew})$	$H x(\text{ben})$	$H x(\text{oth}_\text{res})$	$H x(\text{residual})$
00-01	0.0050	0.0001	0.0000	0.0000	0.0000	0.0000	0.0049
01-04	0.0009	0.0001	0.0000	0.0001	0.0000	0.0000	0.0008
05-09	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0006
10-14	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007
15-19	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0014
20-24	0.0013	0.0001	0.0000	0.0000	0.0000	0.0000	0.0013
25-29	0.0016	0.0001	0.0000	0.0000	0.0000	0.0000	0.0015
30-34	0.0024	0.0001	0.0000	0.0000	0.0000	0.0001	0.0023
35-39	0.0033	0.0002	0.0001	0.0000	0.0000	0.0000	0.0031
40-44	0.0056	0.0006	0.0004	0.0001	0.0000	0.0001	0.0051
45-49	0.0092	0.0012	0.0009	0.0001	0.0001	0.0001	0.0080
50-54	0.0148	0.0023	0.0017	0.0002	0.0001	0.0002	0.0125
55-59	0.0238	0.0042	0.0030	0.0003	0.0002	0.0007	0.0197
60-64	0.0392	0.0075	0.0053	0.0006	0.0004	0.0012	0.0317
65-69	0.0615	0.0115	0.0072	0.0011	0.0006	0.0027	0.0499
70-74	0.1013	0.0171	0.0093	0.0020	0.0010	0.0048	0.0842
75-79	0.1758	0.0263	0.0105	0.0053	0.0016	0.0089	0.1495
80-84	0.3129	0.0413	0.0099	0.0147	0.0023	0.0144	0.2715
85-89	0.5515	0.0636	0.0082	0.0316	0.0032	0.0206	0.4879
90+	-	-	-	-	-	-	-

c) Males 1985-1987

x	$H x$	$H x(\text{all}_\text{res})$	$H x(\text{neo})$	$H x(\text{gnew})$	$H x(\text{ben})$	$H x(\text{oth}_\text{res})$	$H x(\text{residual})$
00-01	0.0079	0.0001	0.0000	0.0001	0.0000	0.0001	0.0077
01-04	0.0017	0.0001	0.0000	0.0000	0.0000	0.0000	0.0016
05-09	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0012
10-14	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0013
15-19	0.0040	0.0001	0.0000	0.0000	0.0000	0.0000	0.0040
20-24	0.0049	0.0001	0.0000	0.0000	0.0000	0.0000	0.0048
25-29	0.0049	0.0001	0.0000	0.0000	0.0000	0.0000	0.0048
30-34	0.0056	0.0001	0.0000	0.0000	0.0001	0.0000	0.0054
35-39	0.0070	0.0004	0.0002	0.0001	0.0000	0.0001	0.0066
40-44	0.0110	0.0008	0.0006	0.0001	0.0000	0.0001	0.0102
45-49	0.0175	0.0020	0.0016	0.0002	0.0001	0.0002	0.0155
50-54	0.0328	0.0049	0.0040	0.0003	0.0002	0.0004	0.0280
55-59	0.0530	0.0095	0.0077	0.0006	0.0005	0.0007	0.0435
60-64	0.0872	0.0167	0.0125	0.0009	0.0008	0.0025	0.0705
65-69	0.1409	0.0276	0.0183	0.0021	0.0019	0.0054	0.1132
70-74	0.2221	0.0416	0.0228	0.0051	0.0031	0.0107	0.1805
75-79	0.3464	0.0645	0.0280	0.0116	0.0055	0.0194	0.2819
80-84	0.5439	0.0956	0.0327	0.0246	0.0089	0.0294	0.4482
85-89	0.8480	0.1441	0.0296	0.0546	0.0109	0.0490	0.7039
90+	-	-	-	-	-	-	-

d) Females 1985-1987

x	$H x$	$H x(\text{all}_\text{res})$	$H x(\text{neo})$	$H x(\text{gnew})$	$H x(\text{ben})$	$H x(\text{oth}_\text{res})$	$H x(\text{residual})$
00-01	0.0063	0.0002	0.0000	0.0001	0.0000	0.0001	0.0062
01-04	0.0015	0.0001	0.0000	0.0001	0.0000	0.0000	0.0014
05-09	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007
10-14	0.0007	0.0000	0.0000	0.0000	0.0000	0.0000	0.0007
15-19	0.0017	0.0001	0.0000	0.0000	0.0000	0.0000	0.0016
20-24	0.0017	0.0001	0.0000	0.0000	0.0000	0.0000	0.0017
25-29	0.0019	0.0001	0.0000	0.0000	0.0000	0.0000	0.0018
30-34	0.0025	0.0001	0.0001	0.0000	0.0000	0.0000	0.0024
35-39	0.0037	0.0002	0.0001	0.0000	0.0000	0.0000	0.0036
40-44	0.0065	0.0007	0.0005	0.0001	0.0001	0.0001	0.0057
45-49	0.0114	0.0013	0.0010	0.0001	0.0001	0.0001	0.0101
50-54	0.0188	0.0028	0.0022	0.0001	0.0002	0.0003	0.0160
55-59	0.0284	0.0044	0.0032	0.0003	0.0003	0.0004	0.0240
60-64	0.0449	0.0067	0.0046	0.0005	0.0005	0.0012	0.0382
65-69	0.0725	0.0108	0.0065	0.0011	0.0008	0.0025	0.0617
70-74	0.1162	0.0147	0.0068	0.0021	0.0015	0.0043	0.1015
75-79	0.1969	0.0208	0.0075	0.0052	0.0018	0.0064	0.1761
80-84	0.3308	0.0304	0.0064	0.0138	0.0016	0.0086	0.3004
85-89	0.5729	0.0486	0.0056	0.0294	0.0024	0.0113	0.5243
90+	-	-	-	-	-	-	-

e) Males 1975-1977

x	$H x$	$H x(\text{all}_\text{res})$	$H x(\text{neo})$	$H x(\text{gnew})$	$H x(\text{ben})$	$H x(\text{oth}_\text{res})$	$H x(\text{residual})$
00-01	0.0136	0.0007	0.0000	0.0005	0.0000	0.0001	0.0130
01-04	0.0025	0.0002	0.0000	0.0001	0.0000	0.0001	0.0023
05-09	0.0020	0.0001	0.0000	0.0001	0.0000	0.0000	0.0019
10-14	0.0017	0.0001	0.0000	0.0000	0.0000	0.0000	0.0017
15-19	0.0058	0.0001	0.0000	0.0000	0.0000	0.0000	0.0057
20-24	0.0070	0.0001	0.0000	0.0001	0.0000	0.0001	0.0069
25-29	0.0060	0.0001	0.0000	0.0001	0.0000	0.0000	0.0059
30-34	0.0062	0.0002	0.0001	0.0001	0.0000	0.0000	0.0060
35-39	0.0095	0.0004	0.0001	0.0001	0.0000	0.0001	0.0091
40-44	0.0150	0.0011	0.0007	0.0003	0.0001	0.0000	0.0140
45-49	0.0264	0.0028	0.0019	0.0004	0.0002	0.0002	0.0237
50-54	0.0447	0.0054	0.0038	0.0006	0.0005	0.0005	0.0393
55-59	0.0694	0.0101	0.0071	0.0009	0.0012	0.0009	0.0592
60-64	0.1096	0.0184	0.0117	0.0015	0.0021	0.0031	0.0912
65-69	0.1718	0.0299	0.0181	0.0037	0.0043	0.0039	0.1418
70-74	0.2670	0.0433	0.0226	0.0073	0.0076	0.0058	0.2237
75-79	0.3981	0.0662	0.0260	0.0183	0.0111	0.0108	0.3318
80-84	0.6191	0.0914	0.0256	0.0351	0.0135	0.0172	0.5277
85-89	0.9243	0.1216	0.0191	0.0622	0.0168	0.0236	0.8026
90+	-	-	-	-	-	-	-

f) Females 1975-1977

x	$H x$	$H x(\text{all}_\text{res})$	$H x(\text{neo})$	$H x(\text{gnew})$	$H x(\text{ben})$	$H x(\text{oth}_\text{res})$	$H x(\text{residual})$
00-01	0.0109	0.0004	0.0000	0.0003	0.0000	0.0001	0.0105
01-04	0.0020	0.0002	0.0000	0.0001	0.0000	0.0001	0.0018
05-09	0.0013	0.0001	0.0000	0.0000	0.0000	0.0000	0.0012
10-14	0.0013	0.0001	0.0000	0.0001	0.0000	0.0000	0.0012
15-19	0.0021	0.0001	0.0000	0.0000	0.0000	0.0000	0.0020
20-24	0.0021	0.0001	0.0000	0.0000	0.0000	0.0000	0.0020
25-29	0.0026	0.0001	0.0000	0.0000	0.0000	0.0000	0.0025
30-34	0.0033	0.0002	0.0000	0.0001	0.0000	0.0001	0.0031
35-39	0.0054	0.0003	0.0001	0.0001	0.0000	0.0001	0.0051
40-44	0.0090	0.0007	0.0004	0.0002	0.0001	0.0000	0.0083
45-49	0.0147	0.0012	0.0007	0.0002	0.0001	0.0002	0.0135
50-54	0.0221	0.0020	0.0013	0.0003	0.0002	0.0002	0.0201
55-59	0.0336	0.0034	0.0018	0.0006	0.0005	0.0005	0.0301
60-64	0.0521	0.0049	0.0027	0.0010	0.0007	0.0006	0.0472
65-69	0.0838	0.0070	0.0029	0.0014	0.0009	0.0018	0.0768
70-74	0.1349	0.0096	0.0027	0.0038	0.0015	0.0016	0.1253
75-79	0.2224	0.0148	0.0030	0.0078	0.0017	0.0023	0.2076
80-84	0.3917	0.0274	0.0033	0.0198	0.0022	0.0021	0.3643
85-89	0.6552	0.0440	0.0029	0.0344	0.0033	0.0033	0.6112
90+	-	-	-	-	-	-	-

Table 4.8 Conditional Probabilities of Eventually Dying from Specified Cause i for those Alive at Age x by Gender and Period

a) Males 1995-1997

x	$c x(\text{all_res})$	$c x(\text{neo})$	$c x(\text{pneu})$	$c x(\text{bea})$	$c x(\text{oth_res})$	$c x(\text{residual})$
00-01	0.1803	0.0764	0.0420	0.0081	0.0539	0.8197
01-04	0.1814	0.0769	0.0422	0.0081	0.0542	0.8186
05-09	0.1816	0.0770	0.0423	0.0081	0.0542	0.8184
10-14	0.1816	0.0770	0.0423	0.0081	0.0542	0.8184
15-19	0.1818	0.0771	0.0423	0.0081	0.0542	0.8182
20-24	0.1822	0.0773	0.0424	0.0081	0.0544	0.8178
25-29	0.1829	0.0776	0.0425	0.0081	0.0546	0.8171
30-34	0.1836	0.0779	0.0427	0.0081	0.0548	0.8164
35-39	0.1844	0.0783	0.0429	0.0082	0.0551	0.8156
40-44	0.1856	0.0787	0.0431	0.0082	0.0555	0.8144
45-49	0.1870	0.0791	0.0435	0.0083	0.0560	0.8130
50-54	0.1884	0.0793	0.0440	0.0084	0.0567	0.8116
55-59	0.1898	0.0788	0.0447	0.0085	0.0578	0.8102
60-64	0.1909	0.0767	0.0461	0.0087	0.0594	0.8091
65-69	0.1911	0.0722	0.0484	0.0089	0.0617	0.8089
70-74	0.1899	0.0644	0.0522	0.0089	0.0644	0.8101
75-79	0.1864	0.0529	0.0582	0.0089	0.0664	0.8136
80-84	0.1841	0.0414	0.0659	0.0089	0.0679	0.8159
85-89	0.1823	0.0296	0.0775	0.0077	0.0675	0.8177
90+	0.1884	0.0211	0.0934	0.0077	0.0662	0.8116

b) Females 1995-1997

x	$c x(\text{all_res})$	$c x(\text{neo})$	$c x(\text{pneu})$	$c x(\text{bea})$	$c x(\text{oth_res})$	$c x(\text{residual})$
00-01	0.1360	0.0420	0.0494	0.0070	0.0376	0.8640
01-04	0.1366	0.0422	0.0496	0.0070	0.0378	0.8634
05-09	0.1367	0.0423	0.0496	0.0070	0.0378	0.8633
10-14	0.1367	0.0423	0.0496	0.0070	0.0378	0.8633
15-19	0.1368	0.0423	0.0497	0.0070	0.0378	0.8632
20-24	0.1369	0.0424	0.0497	0.0070	0.0378	0.8631
25-29	0.1371	0.0424	0.0498	0.0070	0.0379	0.8629
30-34	0.1372	0.0425	0.0498	0.0070	0.0379	0.8628
35-39	0.1374	0.0425	0.0499	0.0070	0.0380	0.8626
40-44	0.1377	0.0426	0.0501	0.0070	0.0381	0.8623
45-49	0.1379	0.0424	0.0503	0.0070	0.0382	0.8621
50-54	0.1380	0.0419	0.0506	0.0070	0.0385	0.8620
55-59	0.1378	0.0408	0.0512	0.0070	0.0388	0.8622
60-64	0.1369	0.0387	0.0521	0.0070	0.0390	0.8631
65-69	0.1347	0.0348	0.0536	0.0069	0.0394	0.8653
70-74	0.1314	0.0296	0.0559	0.0068	0.0391	0.8686
75-79	0.1274	0.0230	0.0597	0.0064	0.0383	0.8726
80-84	0.1231	0.0160	0.0654	0.0059	0.0359	0.8769
85-89	0.1198	0.0101	0.0722	0.0053	0.0321	0.8802
90+	0.1231	0.0066	0.0831	0.0050	0.0283	0.8769

c) Males 1985-1987

x	$c x(\text{all_res})$	$c x(\text{neo})$	$c x(\text{pneu})$	$c x(\text{bea})$	$c x(\text{oth_res})$	$c x(\text{residual})$
00-01	0.1752	0.0798	0.0383	0.0126	0.0445	0.8248
01-04	0.1765	0.0804	0.0385	0.0127	0.0448	0.8235
05-09	0.1767	0.0806	0.0386	0.0127	0.0448	0.8233
10-14	0.1769	0.0807	0.0386	0.0127	0.0448	0.8231
15-19	0.1771	0.0808	0.0386	0.0127	0.0449	0.8229
20-24	0.1777	0.0811	0.0388	0.0128	0.0450	0.8223
25-29	0.1785	0.0815	0.0390	0.0128	0.0452	0.8215
30-34	0.1793	0.0819	0.0391	0.0128	0.0454	0.8207
35-39	0.1801	0.0823	0.0393	0.0129	0.0457	0.8199
40-44	0.1810	0.0826	0.0395	0.0129	0.0459	0.8190
45-49	0.1822	0.0830	0.0399	0.0130	0.0463	0.8178
50-54	0.1834	0.0828	0.0404	0.0132	0.0470	0.8166
55-59	0.1846	0.0816	0.0414	0.0134	0.0481	0.8154
60-64	0.1849	0.0781	0.0431	0.0137	0.0500	0.8151
65-69	0.1843	0.0721	0.0460	0.0141	0.0520	0.8157
70-74	0.1825	0.0634	0.0507	0.0142	0.0541	0.8175
75-79	0.1813	0.0536	0.0577	0.0143	0.0557	0.8187
80-84	0.1793	0.0424	0.0678	0.0137	0.0555	0.8207
85-89	0.1817	0.0295	0.0841	0.0117	0.0564	0.8183
90+	0.1975	0.0222	0.1104	0.0103	0.0547	0.8025

d) Females 1985-1987

x	$c x(\text{all_res})$	$c x(\text{neo})$	$c x(\text{pneu})$	$c x(\text{bea})$	$c x(\text{oth_res})$	$c x(\text{residual})$
00-01	0.1108	0.0326	0.0460	0.0065	0.0256	0.8892
01-04	0.1114	0.0328	0.0462	0.0066	0.0257	0.8886
05-09	0.1114	0.0329	0.0462	0.0066	0.0257	0.8886
10-14	0.1115	0.0329	0.0463	0.0066	0.0257	0.8885
15-19	0.1115	0.0329	0.0463	0.0066	0.0257	0.8885
20-24	0.1116	0.0330	0.0463	0.0066	0.0258	0.8884
25-29	0.1118	0.0330	0.0464	0.0065	0.0258	0.8882
30-34	0.1119	0.0331	0.0465	0.0065	0.0258	0.8881
35-39	0.1121	0.0331	0.0466	0.0065	0.0259	0.8879
40-44	0.1123	0.0331	0.0467	0.0065	0.0260	0.8877
45-49	0.1123	0.0328	0.0470	0.0065	0.0260	0.8877
50-54	0.1123	0.0322	0.0474	0.0065	0.0262	0.8877
55-59	0.1116	0.0305	0.0482	0.0064	0.0265	0.8884
60-64	0.1104	0.0281	0.0492	0.0063	0.0268	0.8896
65-69	0.1086	0.0248	0.0510	0.0061	0.0268	0.8914
70-74	0.1056	0.0199	0.0537	0.0057	0.0262	0.8944
75-79	0.1030	0.0152	0.0581	0.0048	0.0249	0.8970
80-84	0.1024	0.0102	0.0650	0.0039	0.0233	0.8976
85-89	0.1064	0.0065	0.0742	0.0035	0.0223	0.8936
90+	0.1232	0.0040	0.0919	0.0030	0.0243	0.8768

e) Males 1975-1977

x	$c x(\text{all_res})$	$c x(\text{neo})$	$c x(\text{pneu})$	$c x(\text{bea})$	$c x(\text{oth_res})$	$c x(\text{residual})$
00-01	0.1471	0.0644	0.0403	0.0209	0.0216	0.8529
01-04	0.1485	0.0653	0.0403	0.0212	0.0218	0.8515
05-09	0.1487	0.0655	0.0403	0.0212	0.0217	0.8513
10-14	0.1489	0.0656	0.0403	0.0212	0.0217	0.8511
15-19	0.1491	0.0657	0.0403	0.0212	0.0218	0.8509
20-24	0.1498	0.0661	0.0405	0.0213	0.0219	0.8502
25-29	0.1507	0.0665	0.0408	0.0215	0.0220	0.8493
30-34	0.1515	0.0669	0.0409	0.0216	0.0221	0.8485
35-39	0.1522	0.0673	0.0411	0.0217	0.0222	0.8478
40-44	0.1533	0.0678	0.0414	0.0219	0.0223	0.8467
45-49	0.1545	0.0681	0.0417	0.0221	0.0226	0.8455
50-54	0.1559	0.0680	0.0424	0.0225	0.0230	0.8441
55-59	0.1575	0.0673	0.0437	0.0230	0.0235	0.8425
60-64	0.1583	0.0648	0.0459	0.0234	0.0242	0.8417
65-69	0.1572	0.0599	0.0496	0.0239	0.0238	0.8428
70-74	0.1540	0.0514	0.0549	0.0238	0.0239	0.8460
75-79	0.1515	0.0412	0.0634	0.0223	0.0246	0.8485
80-84	0.1442	0.0295	0.0718	0.0195	0.0235	0.8558
85-89	0.1413	0.0193	0.0848	0.0175	0.0197	0.8587
90+	0.1560	0.0173	0.1114	0.0165	0.0108	0.8440

f) Females 1975-1977

x	$c x(\text{all_res})$	$c x(\text{neo})$	$c x(\text{pneu})$	$c x(\text{bea})$	$c x(\text{oth_res})$	$c x(\text{residual})$
00-01	0.0791	0.0154	0.0469	0.0071	0.0097	0.9209
01-04	0.0796	0.0156	0.0471	0.0072	0.0097	0.9204
05-09	0.0796	0.0156	0.0471	0.0072	0.0097	0.9204
10-14	0.0796	0.0156	0.0472	0.0072	0.0096	0.9204
15-19	0.0796	0.0157	0.0472	0.0072	0.0096	0.9204
20-24	0.0797	0.0157	0.0473	0.0072	0.0096	0.9203
25-29	0.0798	0.0157	0.0473	0.0071	0.0096	0.9202
30-34	0.0800	0.0157	0.0474	0.0071	0.0097	0.9200
35-39	0.0801	0.0158	0.0475	0.0071	0.0096	0.9199
40-44	0.0802	0.0157	0.0477	0.0071	0.0096	0.9198
45-49	0.0802	0.0155	0.0479	0.0071	0.0097	0.9198
50-54	0.0801	0.0150	0.0484	0.0071	0.0097	0.9199
55-59	0.0799	0.0140	0.0492	0.0070	0.0097	0.9201
60-64	0.0791	0.0126	0.0503	0.0068	0.0095	0.9209
65-69	0.0783	0.0105	0.0520	0.0064	0.0094	0.9217
70-74	0.0778	0.0084	0.0551	0.0060	0.0084	0.9222
75-79	0.0788	0.0067	0.0589	0.0053	0.0078	0.9212
80-84	0.0818	0.0051	0.0649	0.0047	0.0072	0.9182
85-89	0.0875	0.0034	0.0717	0.0043	0.0081	0.9125
90+	0.1064	0.0025	0.0894	0.0035	0.0110	0.8936

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