Master Thesis

Disability Free Lifetime Expectancy

for men and women in Skåne
using Sullivan's Method

Supervisor:
Jan Lanke

Daniel Åström

Abstract

Title: Disability Free Lifetime Expectancy for men and women in Skåne using Sullivan's Method.

Author: Daniel Åström

Supervisor: Jan Lanke

Aim: The aim of the thesis is to investigate if differences in DFLE between genders and between 2000 and 2004 can be detected in Region Skåne

Method: Using data from Region Skåne's Folkhälsoenkät new weights for the data set have been computed and the proportion of disabled calculated. Life tables specific to Skåne were created and from those DFLE in Skåne were calculated. To see if the results are statistically significant Wilcoxon signed rank test is used.

Results: The study indicates that differences in DFLE between the genders could not be detected in 2000 but in 2004 the men were living a life free of disability to a higher extent than women. No statistical significant differences in DFLE for women between 2000 and 2004 were noted. For men the increase in DFLE between 2000 and 2004 was significant.

Key words: Life expectancy, Disability Free Lifetime Expectancy, disabled, Wilcoxon

1 Introduction

1.1 Background

The changes in society together with advancements made in both the technological field as well as in the field of medicine that have taken place over the last 200 years have meant that today's society is facing an entirely new demography. Life expectancy at birth has, in some countries, increased by almost 40 years, thus changing the population structure entirely. Demographers have for quite some time now been studying the increased longevity of populations around the world. Since the 1960s this field of research has been expanded to take into account also how these years gained by increasing life expectancies are being spent, in a state free of disability or disabled. Having a thorough knowledge about the development of Disability-Free Life Expectancy (DFLE) over time and between gender as well as knowing the direction DFLE is taking, i.e. if the years of life added to the life expectancy are increasing more rapidly than a decline in disability rates (Imai & Soneji 2007). This new population structure, where a larger share of the population can be considered to be elderly, means that the societies of today, and for that matter, in the future will be facing very different issues than previously in history. The advantages and disadvantages with an increasingly ageing population is a complex issue that needs to be investigated further. This paper will discuss some of the reasons why this development has taken place, some of the consequences of an ageing population in a society and try to investigate in what state of health these extra years of life gained are being spent. The state of health in which the years gained are being spent will be investigated by using Sullivan's Method and hopefully I will be able to present some region specific and for the future interesting results.

1.2 Aim of the paper

The aim of the paper is to use Sullivan's Method to calculate Disability Free Lifetime Expectancy (DFLE) in Region Skåne. Disability-Free Lifetime Expectancy can according to the OECD Glossary of Statistical Terms be defined as: "Disability-Free Lifetime Expectancy is the average number of years an individual is expected to live free of disability if current patterns of mortality and disability continue to apply."[1] According to Crimmins et al (1989) a person is considered disabled if he/she cannot perform his/her usual activities (or activities normal to the age-group he/she belongs to) due to ill health. A person must also not have been able to perform these usual activities for at least three months or because of a longstanding specified chronic disease. Sullivan's method is often used as an attempt to estimate the DFLE in a population. This is done by estimating the proportion of the population that live their lives in a disabled state, then calculating the person years lived by a cohort free of disability or in a disabled state. The normal life expectancy for an age-group just takes the person years lived by the cohort into consideration.

DFLE can be used in order to compare the health states of an entire population at two time points or of two different populations at the same time point. Here it will be used to investigate if any differences in DFLE between men and women can be detected. Differences between two points in time will also be made. DFLE of the population in Region Skåne 2000 will be compared with DFLE in 2004, thus giving some sort of indicator as to the development of DFLE in Region Skåne over time. DFLE is often calculated in the form of a life table by estimating the proportion of disabled in a population. To calculate DFLE using Sullivan's Method two different datasets are needed. The first part is made up using an abridged life table that can be constructed after obtaining data from Statistics Sweden. The second part of Sullivan's Method will have to be constructed after that the proportion of disabled people in each age group is found. In my paper I will use Region Skåne's Folkhälsoenkät (a survey of the state of health of the respondents) from the years 2000 and 2004 to estimate the proportion disabled.

[1] http://stats.oecd.org/glossary/detail.asp?ID=632

The reasoning above yields the following research questions, which I will try to answer in this thesis:

Is there a difference between genders when it comes to Disability Free Lifetime Expectancy?

Is there a difference in mortality patterns such that the cohort of 2004 will, to a larger extent, live a life free of disability compared with the cohort born in 2000?

1.3 Target group

The target group for this thesis is most likely to be other students at a Master level in Economic Demography. Other readers of this thesis are probably interested in the fields of economic demography, social sciences, demography and statistics. The reader will also be assumed to have a general knowledge of the most common economic and demographic theories as well as some of the terminology used in the field.

1.4 Synopsis

Method

In the part concerning methodology the way this study has been conducted will be thoroughly discussed, including a illustration of the general way of procedure and an explanation of the variables included in the study.
Furthermore the underlying assumptions made by me will be explained (for instance when and why a person is considered disabled) and the implications this will have to the study and the validity of the study.

Theory

The part dealing with the theory of the field aims to give the reader a short introductory description of the theoretical foundation on which the thesis is being built. Areas that will be discussed: the reasons behind the demographic change, some consequences of demographic change, Disability Free Lifetime Expectancy and Sullivan's Method.

Results of the study

The data material will be presented using cross tables and life tables. The results of the study will also be presented and explained more thoroughly in this part of the thesis. Areas that will be discussed are: Differences between gender when it comes to DFLE and if a change in DFLE between the two cohorts of 2000 and 2004 can be detected.

Analysis

The analysis of the data and the results are in focus in this final part of the thesis. Now it is time to draw some conclusions about the result of the study.

Conclusions

Given the research questions asked this part of the thesis is discussing what conclusions can be drawn form the material and the study. Also some problems that are arising with the conclusions drawn from the study will be discussed.

2 Method

This method section of the thesis consists of three parts. The first part consists of a theoretical discussion as to what kind of method of investigation is the best to choose when working with data like the ones I have got at hand. Also in the first part the validity of the study will be discussed. In the second part a short description of the way this study is carried out will be presented. This is done in order to give the reader a more overall picture about the study and to present the aim, methods and data sources. The third part provides a more detailed presentation of the data. Also differences between Administrative data and Sample Survey data and its applications will be discussed. Region Skåne's Folkhälsoenkät and the use of weights in the data set will be further explained. This part also contains a definition of when one can be considered to be disabled using the questions in the survey. Advantages and disadvantages of using the two different data sets will be discussed and also some concerns one might have when using the data provided.

2.1 A brief discussion about the method used

When choosing a method of investigation it is important to ask oneself: what do I want to achieve and what is the aim with this study. The answer to this question will reflect what kind of method that fits the study the best and thus the increasing the validity of the study.

I chose to take a hypothetic-deductive approach. This means that using existing theories within the field I will create some hypotheses about differences in socio-economic belonging, gender and regions within Region Skåne to see if these can be rejected or not (Patel & Tebelius 1987). The approach I see most fit to tackle these problems in a quantitative approach. This approach is preferred when the aim of the study is to show the strength of a relationship or from a sample draw some conclusions about a population. The advantages with this approach is that the information gathered can be generalized, however one must be very careful since there is no guarantee that the information gathered is relevant to the research question asked. (Holme & Solvang 1997)

When using a quantitative approach, the collection of data can cause some problems. Usually one is concerned with the reliability and the validity of the study. Validity in a study means that one really is studying what one set out to study. Reliability is the absence of randomly generated errors in the sample. If high reliability is achieved there is a minimum of random errors in the data set, this means that the study will generate the same outcome no matter who is performing the study. Having high reliability is thus a prerequisite if one wants to achieve high validity in a study (Lundahl & Skärvad 1992**)**. When discussing the reliability of my data, the part of the data received from Statistics Sweden can be considered to have high reliability. The second part of the data, Region Skånes Folkhälsoenkät, might however be less reliable.

2.1.1 About validity

Having high validity in an investigation means that one truly measures what one set out to measure. The aim of this paper has already been explained, but repeating it will help to bring clarity on the problems this study is having with validity. Since I will investigate Region Skånes Folkhälsoenkät from the years 2000 and 2004, this means that I am dealing with self reported health. The questions asked, and thus the answers, might not be following the theoretical praxis. Also concerning is the fact that the questions asked in 2000 and in 2004 are not exactly the same, except for one crucial question, meaning that the questions asked to gather information about self reported health might, and do, differ. This means that I will be the one to interpret the answers and give them appropriate weight when it comes to the degree of disability. All of this is leading up to the fact that other researchers using the same material might end up with different conclusions about DFLE in Region Skåne. This is very concerning when discussing the validity of the study. Another problem is the fact that the answers in Region Skånes Folkhälsoenkät might be biased due to a number of reasons; this will be discussed more thoroughly when the data is presented.

2.2 General way of procedure

The investigation of DFLE in Region Skåne will be carried out in three separate parts. The first part will focus on constructing a life table for Region Skåne presenting information about life expectancy at birth for different age groups in Region Skåne. The reason for constructing my own life tables is that I am only investigating Skåne and the mortality patterns of Skåne are somewhat different from other regions in Sweden. Had the study been about Sweden I could have used a life table constructed by Statistics Sweden. The second part will be to analyse Region Skåne's Folkhälsoenkät. This will be done in order to find the proportion of the population that is living in a state of disability. This part of the study will try to find answers about how the respondents report their own health. After this is done the sample answers can be used to make a generalized assumption about the proportion of the population that is spending their life in a state of disability. When all of this is done the focus will shift to combine the information gathered into the third part of the paper, calculations of DFLE using Sullivan's Method. The results from these calculations will be presented in the form of tables and analyzed. As mentioned before, I will analyze if there exists differences between genders when it comes to DFLE and if differences can be detected over time within Region Skåne.

Table 1 below presents the general outline of how I will conduct the investigation.

	Part 1	Part 2	Part 3
Aim	Find cohort specific mortality data	Find the proportion of disabled in the population	Combine both to calculate DFLE
Method	Life table Mortality data	Analyze survey answers	Sullivan's Method
Data	Statistics Sweden	Region Skåne Folkhälsoenkät	

2.3 The data

It is time for the different data sets to be analysed more in detail. The data required are the age-specific proportions of the population in healthy and unhealthy states (cross-sectional surveys), and age-specific mortality information taken from a period life table using five-year intervals. The data for my study come from two different sources and will be used together to create an extended abridged life table needed to calculate DFLE.

2.2.1 Administrative data from Statistics Sweden

The data for the first part of the thesis, as mentioned before, were received from Statistics Sweden. This data set is covering all of the 33 municipalities in Skåne. Statistics Sweden provides the number of inhabitants in Region Skåne in five-year intervals, thus the number of people living in Region Skåne aged between 20-24, 25-29 (these intervals will be presented because the Folkhälsoenkät only ranges between ages 18-80, of course a more detailed and complete data set is available at Statistics Sweden) and so on will be known. Statistics Sweden also provides the number of deaths in Region Skåne in the same five-year intervals as presented above. Given these two numbers (inhabitants and deaths) the life expectancy can be calculated for each age-group. Knowing the number of inhabitants in Region Skåne and the number of disabled individuals means that the proportion of disabled individuals in the region can easily be calculated. See the Theory part for more details.

When considering the reliability of the data, Statistics Sweden should guarantee that the information gathered and presented by them is highly accurate and the presence of randomly generated errors should be minimized. This source of data is according to Hakim (2000) called administrative records; these records are nowadays becoming more and more available and less costly because of the computerization of older records created and kept by different kinds of governmental institutions and other organizations. Since the records easily can be anonymised, confidentiality problems can be kept as low as possible. One of the advantages with these administrative records is that they are usually available for a long period of time and another advantage being the extent of the information gathered, as is the case with the life tables constructed by Statistics Sweden. Due to the fact that there are so many institutions and organizations and their reasons to collect data may differ significantly it is more difficult to generalize about the characteristics, strength and limitations of administrative data than other types of studies. A record based study needs to be designed so that is carried out back to front, so rather than designing the study and then collecting the data one starts out with an existing data set of which the characteristics are known and first then creates the research model.

2.2.2 Sample survey data

The data needed to estimate the proportion of disabled in the population come from Region Skåne’s Folkhälsoenkät. According to Hakim (2000) the use of this kind of sample surveys is now one of the most used techniques to gather information. The idea is that a sample of a population takes part in a survey and the answers to the survey questions could then be thought to be valid estimate for how the entire population is behaving. This approach of gathering data can generally be considered to be advantageous in a number of studies. This because they can be cheaply administered and conducted, designed in away that make it easy to extract data and analyze it and the individuals in the sample may turn out to be a good proxy of the entire population. For example election exit polls have in the past turned out to be quite accurate in a lot of different cases.

It is of importance, both for me and for the reader, to know that every person in the data set is completely anonymous and there is no way for me to identify any of the participants. This is standard procedure and a very important measure taken to ensure personal integrity. If personal integrity can not be upheld and assured a significant amount of information would inevitably be lost due to people not wanting to partake in surveys which are intended to report their current and previous states of health.

2.2.3 Region Skånes Folkhälsoenkät.

It is important to further explain the design of Region Skånes Folkhälsoenkät[2] and how the information was gathered in 2000 and 2004.

To perform the study of 2000 a selection of the population was randomly drawn from people born between 1919 and 1981 and living in Skåne on the 4th of November 1999. The selection was stratified after 60 different geographical regions with each municipality represented. The four large municipalities where further divided into different city areas (Lund ten areas, Helsingborg six areas, Kristianstad five areas and Malmö ten areas). The size of the selection for each area was approximately the same. The gross selection resulted in that 24 922 people were sent questionnaires by mail and asked to participate. Together with the questionnaire a letter was sent containing information about the background and aim of the study and the way the study was to be conducted. The participants were also informed about the rules and permissions concerning the data material according to **sekretesslagen** and **personuppgiftslagen** and that information gained from the questionnaires might be cross-referenced with official records. Some of the questionnaires were returned as undelivered due to the fact that the person in question was deceased, severely ill, hade moved outside of Skåne or was away for a longer period of time. This yielded a net selection of 23 437 persons when the returned number of questionnaires had been subtracted from the number of questionnaires sent to the participants. Out of the 23 437 individuals contacted, 13 715 people did answer the questionnaire, which is a response rate of 58.5 percent of the net selection. Some common reasons for not wanting to participate are that the respondents find the questionnaire too long and time consuming to answer, too personal and also worries about the secrecy of the answers.

In the 2004 study the entire population living in Skåne between the ages of 18 and 80 (n = 855 599) were potential interviewees. The selection of participants was performed using the same procedure and the same 60 geographical regions as in 2000 but this time a larger selection was used (49 000 individuals). The selection was made using stratified random sampling, which means that each individual in each stratum had the same possibility of being

2 http://www.skane.se/upload/Webbplatser/UMAS/VERKSAMHETER%20UMAS/Socialmedicin/distrikt/49107mellersta1.pdf

chosen. The men and women of each municipality/city area constituted a stratum and in each stratum 400 individuals were contacted. Out of the original 49 000 questionnaires sent to potential interviewees, 1379 were returned as undeliverable due to the fact that the person in question was deceased, severely ill, hade moved outside of Skåne or was away for a longer period of time. This resulted in a net selection of 47 671 individuals. Out of the net selection 27 963 people did answer the questionnaire which is a response rate of 58.7 percent of the net selection.

2.2.4 The use of weights in the data sets

In order to get reliable statistical results when investigating Region Skåne one has to use weights. To get enough answers from each of the 60 different regions, 400 persons were contacted in each, which means that the all the different geographical regions contributed with approximately the same number of people. This in turn means that the results gained in a small municipality will have the same weight as a much larger municipality. When presenting the results from the entire Region the larger municipality should have a larger influence on the outcome than a smaller one. This is the reason for using weights on the data set; each different group in the selection will then be assigned a weight that is equal to the group's share of the total population. It is unfortunately also the case that some groups in society have a tendency to respond to surveys to a larger extent than other groups, for instance are elderly and women more likely to respond to a survey than younger people and men. To get a more reliable study it is important that not only the regions are weighted but also age and gender. Again it is important that each age-group is assigned a weight that is equal to the age-group's share of the total population.

When calculating the weights in the original data set from 2000 Region Skåne was using different age groups (18-40, 41-60 and 61-80) to weight the material than those of interest to this investigation. In 2004 the weight were calculated using the same age groups but were also taking into account how the individuals had responded to the eight most important questions of the survey. This yielded weights that meant two people of the same sex, age group and living in the same municipality could be given a different weight in the data set according to how they did answer the survey questions. This investigation is only interested in the answers to one particular question and does not need to be concerned with how the respondents answered the other questions in the survey.

The weights in this thesis was constructed in order to get an equal weight for two, or more, individuals of the same sex, belonging to the same age group and living in the same municipality. The weights for men aged 20-24 in a certain municipality were constructed as:

$$\frac{\text{The total number of male inhabitants aged 20-24 in municipality X}}{\text{The total number of responses received from males aged 20-24 in municipality X.}}$$

The same procedure was followed when calculating the rest of the new weights used in the data set. All of this should allow a large municipality to have a larger influence on the outcome than a small one.

2.2.5 How to define Disabled

One of the most important definitions of the entire thesis is how to define when a person can be considered to be disabled. This definition will lay the foundation for further calculations done in the thesis and therefore needs to be explained in further detail. One thing one must have in mind when working with the definition of disabled is that it is not a permanent condition. It is a quite likely event that a person for a period of time can be considered disabled and then gets better and moves into a healthy state.

Region Skåne's Folkhälsoenkät (both 2000 and 2004) asks a number of questions about the health of the individual participating in the study. The choice of question, or rather combination of questions, which best fits the criteria if a respondent can be considered to be disabled through self reported health will now be presented. One big disadvantage is that the questions in the questionnaire differ between the years. Using different definitions of when a person is considered to be disabled means that valid conclusions can not be drawn from the investigations. However one question and its follow up is designed in the same way in both questionnaires and luckily for the study the answer to this question can indeed be used as a proxy for the proportion of disabled in Region Skåne.

The question, and its follow-up, asked both in 2000 and 2004 (Numbers 23 and 24 in 2000 and Numbers 6a and 6b in 2004) is presented below (the question of 2004 that is):

Q 6a) Have you any time during the last 14 days due to some kind of illness, injury or other health problems been prevented to perform your usual activities (for instance work inside or outside the home, leisure activities or similar)?

1) Yes

2) No → Go to Q 7!

Q6b) If Yes: Are these health problems of a more permanent nature? Permanent health problems meaning that they have or are expected to last for 6 months or more.

1) Yes

2) No

Is the answer to the first question is No then the individual is clearly not disabled. If a person answers Yes on these two questions he or she can, very likely, be considered disabled. A problem as to where to draw the line when considering a person disabled arises in the case of a person having been prevented to perform usual activities for a period of 14 days but not as long a time as six months. That is answering Yes on Q 6a) and No on Q 6b). As previously mentioned Crimmins et al (1989) considers a person disabled if the health problems lasts for three months or more. Region Skåne's Folkhälsoenkät extends this period to be at least six months. The advantage of extending the period of time that the health problems need to last before one can be considered disabled is that it is unfortunately less likely to move back into a healthy state of life after being disabled for a longer period of time.

2.3 Limitations

2.3.1 Choice of Region

The choice of Region Skåne as the population investigated will certainly limit the study. Having access to self reported health for the entire country of Sweden a more general study of DFLE could be made. However due to limitations, both when it comes to the time available for this study and the very real limitation of gathering sufficient material, a study on the population of Region Skåne will be of a sufficient size to, hopefully, permit drawing some conclusions.

2.3.2 Choice of time period

Region Skåne's task of gathering the all the information in Folkhälsoenkäten is extensive and can not be undertaken every year. The data I have access to are from two years, 2000 and 2004, thus setting the framework for the choice of time period. Some conclusions about which direction the disability patterns are taking can be made but having access to more than two Folkhälsoenkäter would have meant that further, and more precise, conclusions about the development of DFLE could have been made.

2.3.3 Disadvantages with the data

The advantages of using this kind of data was discussed when presenting the two different data sets and it is now time to turn the attention to the possible disadvantages of using the data available to me. One thing one must have in mind though when working with survey questions is the possibility of biased answers.

First of all one can discuss if the people responding to a voluntary survey can be thought to be representative of the population. The mere fact that they are responding should mean that the answers could be considered to be biased away from the true situation in the society one sets out to investigate. To control for bias in this kind of study is a hard task. The alternative however is not appealing since it would mean that no information could be gathered due to the possibilities of biased answers.

An answer might be biased due to a number of reasons and thus not show the reality; however since the information needed to perform this study is only available this way it has to be used. An increase in disability rates can simply be because of an increasing proportion of people who answer affirmatively on sample questions. This means that reported disability might increase/decrease when there might not be a change in actual disability in society. Therefore a number of scholars have questioned, and rightfully so, the validity of results gained through self-reported disability.

The data are not longitudinal, which means that it is not the same persons answering to the questions about their health in 2000 and in 2004. One loses information about the development over time for the people participating in the survey. Had the data been longitudinal a number of interesting extensions to the study could have been performed. For instance would it be interesting to see if there exists a difference over time in self reported health for respondents who participated in both surveys and if there are individuals moving from a disabled state into a healthy state. It would be interesting to see if the self-reported health is deteriorating between 2000 and 2004 for persons belonging to the youngest old (65-74 years of age) and to the oldest old (75+) in both surveys. Having access to longitudinal data would also mean that a comparison of the transition from youngest old to oldest old could have been made. This transition between different age groups, not only for the elderly, is of great interest when studying DFLE. The data available, even though not longitudinal, will hopefully give some insight as to whether the self reported health has improved or not and also how the measure of DFLE is developing over a four-year period.

3 Theory

This part of the thesis will discuss some of the theories within the field of Economic Demography. The first part, the development of the human life expectancy at birth, will shortly discuss the reasons behind the dramatic increase in life expectancy at birth that has occurred over the last two centuries. The consequences of population ageing, such as the need to reform pension systems, changes in the median age of the voters and increased costs of medical schemes, will be discussed in the second part. All of this is leading up to the third, and perhaps most exciting part, where the topic of Disability-Free Lifetime Expectancy (DFLE) will be discussed. The discussion will start with defining Disability-Free Lifetime Expectancy and how this measure is used. Sullivan’s method of calculating DFLE will be presented and the formula explained. This is followed by an overview of different scientific papers written previously discussing DFLE and some papers using Sullivan’s method. The results of these papers will also be discussed.

3.1 The development of the human life expectancy at birth

The human life expectancy at birth has increased dramatically from about 45 years for women in Sweden 1840 to close to 82.4 years today. There are a lot of reasons why this dramatic change in life expectancy at birth has occurred and since the time period covers almost two centuries it makes sense to first take a look at what happened in the 19th century.

An important factor when it comes to the decline in mortality during the 19th century in the western world is the improvement of living standards. In the 19th century the development of better techniques to raise productivity in the agricultural area meant that fewer people died of starvation. More food also had the positive effect that infants were healthier and therefore could resist diseases better. Since sanitary conditions were not the best, the environment for spread of infectious diseases was ideal. With the implementation of usage of sewers and other sanitary measures the reduction of the spread of infectious diseases was rapid. Also changes in the behaviour among people led to the spread of fewer diseases. (McKeown 1972, Easterlin 1999). At the end of the 19th century the knowledge of diseases increased as the standard of medical sciences improved. This in turn led to more efficient treatments of diseases and methods to prevent the outbreak of infectious diseases.

In the beginning of the 20th century the decline in mortality due to infectious diseases continued at a rapid pace. The emergence of a public health system in the Western World made the ability to control, vaccinate and inform the public easier and much more efficient. Not only did the medical sciences continue to improve and the knowledge of infectious diseases increase, the increasing availability of hospitals and medical treatment had a positive effect on bringing mortality rates down. The eradication of smallpox in 1977 (according to the World Health Organization) can be said to be one of mankind's great achievements since some experts calculate that smallpox have killed more people than all other infectious diseases combined.

Without doubt the almost eradication of infectious diseases can be said to be the largest single factor behind the decline in mortality in the world during the last two centuries. The number of deaths due to non-infectious diseases is almost constant throughout the centuries whereas the number of deaths of infectious diseases decreased to a very low level. Easterlin argues that this could not have been done by a free market alone, this because of problems that exist on such a market, the classic free-rider problem being one of them. Although a great deal can be done by the individual the effect of governmental distribution of knowledge and the means, vaccinations etc, how to keep infectious diseases under control is significant.

The large increase in human life expectancy at birth was until the middle of the 20th century largely due to the reduction of infant mortality. Later in the 20th century, around 1970, life expectancy increased even more as medical science broke new grounds and found ways to cure degenerative diseases among the elderly. The main reason behind the mortality decline among elderly is that new and better ways to treat cardiovascular diseases such as stroke have been developed. Also the advances of the medical sciences have clearly reduced the number of deaths due to cancer. (Wilmoth 2000)

3.2 Consequences of Population Ageing

Having discussed shortly the reasons behind the dramatic increase in life expectancy at birth the focus now changes to what happens in society when the elderly increase their share of the population. When a society is facing an increasingly ageing population a number of issues might arise. One direct consequence of population ageing is an increased fiscal pressure on the social security systems. This pressure is due to the increasingly expensive pension systems, increased costs of medical care for the elderly and disability benefits. Another consequence of this changing demography is that the age of the median voter increases thus yielding changes in the political environment. Also increased longevity leads to changing consumer behaviours among the population.

Increased longevity has an important impact on a society's spending on health care; however the costs of medical treatments and disability benefits are closely linked to the health of the elderly. As can be expected, the more elderly in a society will increase the per capita spending on medical care. Depending on the health of the elderly this spending will probably change over time and between different societies. It is therefore very important to investigate to what extent the elderly are continuing to lead their lives in a healthy state (Wilmoth 2000). A measure of doing so is to compute DFLE, which will be more closely examined later on in this thesis. Another thing that might have an influence on medical spending in an ageing society is the fact that as a larger share of the population is facing health issues due to old age, resources and scientific focus might shift to this area. When doing so the medical sciences might come up with new, more efficient and improved ways of treating "old-age" diseases and thus lowering the cost of per capita spending. Thus the magnitude of the spending on health benefits is not easy to foresee.

As the population of elderly grows at the same time as fertility declines, this demographic change can result in a shift in the allocation of public means. This can be the result of the increased political influence gained when a larger share of the population is elderly. The increased political power of the elderly may be referred to as "Grey Power". Preston (1984) argues that, in the case of USA with an increased scarcity of the public sectors social budgets, this shift would mean that a larger share of the public means was allocated to the elderly and the young would stand to lose accordingly. Gornick (2006) finds some evidence, in the case of 15 OECD countries, that even though the increased political power of the elderly, reforms that would mean a reduction of the social spending on the youngsters were not taken. Gornick also finds some evidence that, in countries facing a more rapid ageing of the population, the social spending per elderly did in fact increase more that did spending per young.

One of the biggest fiscal issues in the western world when it comes to dealing with an increasingly ageing population is how the pension systems are constructed and how they can be redesigned to better fit in a not so distant future. The pay-as-you-go system means that the population in working ages pays through taxes into the social security system and the retirees receive a pension after having contributed in their working ages. When a society is facing an increasingly elderly population there will inevitably be an increase in the proportion of retirees, who receive benefits from the pay-as-you-go system, and the proportion of people in working ages, who contribute, will be reduced. If this is a continuing trend, which it most likely is due to increased longevity and falling fertility rates, it takes either an increase in productivity among the working population or an increased financial burden on the population in working ages to finance these future commitments. The changes mentioned above needs to take place otherwise the pension benefits granted will not be covered by the contributions of people in working ages and the current pay-as-you-go system will be financially unsustainable. Galasso & Profeta (2004) argues that fact the problems with the financing of the current pay-as-you-go systems will become a political issue to a larger extent in the future. Since either higher contribution from the workers or lower pension benefits for the retired is needed to solve the financing of the pensions a divergence in opinions how to best solve the problems between generations might occur. They also argue that the rate of return of a pay-as-you-go system is lowered if a society is facing an increasing ratio of retirees to workers. This in turn makes the people prefer a system that increases the importance of private savings for the pension and thus lowering the contribution rate to a pay-as-you-go system. On the other hand the median age of the voter will increase, this in turn meaning that politicians wanting to get elected increase the focus on such issues and thus increase the size of the pay-as-you-go system.

3.3 Disability-Free Lifetime Expectancy

Disability-Free Lifetime Expectancy can, as previously mentioned, be defined according to the OECD Glossary of Statistical Terms. "Disability-Free Lifetime Expectancy is the average number of years an individual is expected to live free of disability if current patterns of mortality and disability continue to apply."[3]

DFLE thus expands the regular measure of Life expectancy and to this adds relative well-being of the population. Life expectancy can thus be thought of as being the sum of lengths of time spent in different states of health until death. According to Crimmins et al (1989) a person is considered disabled if he/she cannot perform his/her usual activities (or activities normal to the age-group he/she belongs to) due to ill health. A person must also not have been able to perform these usual activities for at least three months or more because of a longstanding specified chronic disease.

Having a thorough knowledge about the development of DFLE over time, between different socio-economic groups and between different regions, is truly important when it comes to evaluating in what state of health the extra years of life gained through the improvements discussed in the first part are being spent. Another important area of research is to examine if years of life added to the life expectancy of the populations are increasing more rapidly than a decline in disability rates (Imai & Soneji 2007).

The importance, both for the individual and a country's social spending, of the measure can easily be understood when remembering the second part of this paper. For the individual, of course, a life in health is preferred over a life spent in a disabled state. If the disability rates are going down at the same time as life expectancy is only increasing slightly or levelling out this would mean a healthier population and thus if the remaining years of life are spent in good health then the society's costs for health care are likely to be reduced. The pension system will however not be affected if life expectancy stays the same.

[3] http://stats.oecd.org/glossary/detail.asp?ID=632

Sullivan's method is used as an attempt to estimate the DFLE in a population. This is done by dividing the population into disabled and not disabled. The normal life expectancy for an age-group just takes the person years lived by the cohort into consideration whereas Sullivan distinguishes between the part of the population who are disabled and those who are not and calculates the person years lived by the cohort in different states of health. The calculation of DFLE is often done using a life table approach. In order to calculate DFLE with Sullivan's Method two different sets of information are needed. The data required are the age-specific proportions of the population in healthy and unhealthy states and age-specific mortality information taken from a period life table. The period life table is used to calculate the life expectancy of the population. Information about the age-specific disability prevalence is a harder task to come by. This information is usually gathered through a cross-sectional survey, in this case Region Skåne's Folkhälsoenkät presented earlier.

Crimmins et al (1989) used in their study of the population in the United States of America two different surveys, National Health Interview Survey (NHIS) and National Nursing Home Survey (NNHS), in order to give a more complete account of the disability rate among both institutionalized and non-institutionalized populations. In these surveys "a respondent was considered disabled if he/she responded affirmatively to the following question: "Because of a physical, mental or emotional problem, do you need the help of other persons with personal care needs, such as …?" where "…" represents various activities of daily living (ADL). ADL includes bathing and showering, dressing, eating, getting in/out of bed or chair, using the toilet, and getting around in home." (Imai & Soneji, 2007 p.1202)

3.3.1 Life tables

The following pages will describe the procedures conducted when constructing a regular life table and a life table using Sullivan's Method. The components of the life tables will be presented and explained. When this is done an extension to the life table using Sullivan's Method will be presented in the form of a second life table. Again the components of this second table will be defined and explained.

The table beneath presents the different components needed when constructing a life table.

Age group	Midyear population in interval (x,x+4)	Number of deaths	Death rate in interval (x,x+4)	Probability of dying in interval (x,x+4)	Number of people surviving to age x+5	Number of years lived by the cohort in interval (x,x+4)	Number of years lived beyond x but before 80.	Expectation of further life between ages x and 80.
(x,x+4)	P_x	D_x	M_x	${}_5q_x$	l_x	${}_5L_x$	${}_{80-x}L_x$	${}_{80-x}e_x$

In the first column the age group, x, is presented. Given the data available it makes sense to use an abridged life table resulting in five-year intervals of the population. Region Skåne's Folkhälsoenkät was only sent to people between 18 and 80 years of age. This is why my life table will take the form of a truncated abridged life table, i.e. the age-groups will be 20-24, 25-29 … 75-79. The reason for leaving out the individuals aged 18 and 19 is simply that it is not of much interest to study the disability rate at such young ages. The reason for not including the people aged 80 at the time of the survey is that the number of respondents was low and a valid conclusion for the age group might be hard to draw.

The second column presents the mid-year population, P_x, that is the population in interval (x,x+4). For instance the mid-year population in the age-group 20-24 in 2000 was calculated as:

$$\frac{\frac{4}{5}Pop1999.(20-24)+\frac{1}{5}Pop1999.(15-19)+Pop2000.(20-24)}{2}$$

*Pop*2000(20-24) is the population in Skåne 31 of December 2000.

In the third column the number of deaths, D_x, in each age-group in interval (x,x+4) is presented. This is easily found in the public records.

The fourth column is the death rate in interval (x, x+4), M_x. This is calculated by dividing D_x with P_x.

The columns described so far relate to the actual population, in our case the people in Skåne. The remaining columns concern a hypothetical population, assumed to experience during their entire lives the death rates in Skåne 2000.

The fifth column presents the probability of dying in the interval. This is calculated using the formula: ${}_5\hat{q}_x = \dfrac{5M_x}{1+\frac{1}{2}*5M_x}$

Presented in column six are the numbers surviving until reaching the next age group. The starting number of this is usually, somewhat arbitrarily, set to be l_0=100000. Then l_{x+5} is calculated as $l_x(1-{}_5q_x)$.

In the seventh column, ${}_5L_x$, is the number of years lived by the total age group in the interval (x,x+4). ${}_5L_x = 5l_x(1-\frac{1}{2}{}_5q_x)$.

The eight column presents the total number of years lived by the age group up until they reach the age of 80, ${}_{80-x}L_x$. ${}_{80-x}L_x = \sum_x^n {}_5L_x$.

The last column the presents the expectation of further life for the age group until they reach the age of 80, ${}_{80-x}e_x$, which is calculated by dividing ${}_{80-x}L_x$ with l_x.

The only result in the life table that is needed when calculating DFLE is ${}_5L_x$, which was calculated above. The answers from the survey reveal the proportion of the population with a disability and using these measures DFLE can be calculated.

The table below presents an extended Life table using Sullivan's Method to calculate DFLE.

Age group	Number of years lived by the cohort in interval (x,x+4)	Proportion with disability	Number of years lived without disability in interval (x,x+4)	Number of years lived free of disability beyond x but before 80	Expectation of further life between ages x and 80.	Disability Free Lifetime Expectancy between ages x and 80.	Difference between ${}_{80-x}e_x$ and eDF_x
(x,x+4)	${}_5L_x$	π_x	${}_5DFL_x$	${}_{80-x}DFL_x$	${}_{80-x}e_x$	${}_{80-x}eDF_x$	${}_{80-x}eD_x$

The first, second and the sixth columns represent the same information as in the previous life table.

In the third column is presented the proportion of the population with a disability that was gathered from the cross-sectional survey. This is the number of disabled people divided by the entire population.

The fourth column is person years lived without disability in interval (x,x+4). This is calculated as : $(1-\pi_{x)}*_5L_x$.

The fifth column shows the number of years lived without disability beyond age x but before 80 and is calculated as: ${}_{80\text{-x}}\text{eDFL}_{\text{x}} = \sum_{x}^{n} (1-\pi_x)_5 L_x$.

In the seventh column DFLE is finally presented. DFLE is calculated the same way as e_x, but this time by dividing ${}_5L_x$ with l_x.

The last column presents the difference between ${}_{80\text{-x}}e_x$ and $eDF_{x.}$

The information needed to construct these two tables is taken from Hinde (1998), Jagger et al (2007) and Quensel (1966).

3.4 Empirical studies of Disability-Free Lifetime Expectancy

There have been a number of previous studies on DFLE, for instance discussing the importance of socio-economic status, gender and the statistical properties of the Sullivan estimator. A number of articles and their findings will be presented in this part of the thesis.

Crimmins et al (1989) are comparing changes is total life expectancy and DFLE over time in the United States of America. During the period investigated, 1970-1980, they find that mortality rates have gone down significantly and that this yields an increase in life expectancy at birth; this increase was larger for the black population in USA than for the white. However in 1980 the life expectancy at birth for black males was 6,7 years lower than for white males. Black women could expect to live 5,3 years less than white women in general. The direction of the disability rates is less clear, meaning that DFLE will be less accurate. The difference between men's and women's life expectancy at birth and at age 65 detected in the study is largely due to differences in DFLE. A girl born in 1980 is expected to live approximately 7,5 years longer than a boy born in the same year and out of these extra years almost five are spent free of disability. At 65, women are likely to live an extra four years compared to the men. Two of these can be assumed to be spent free of disability. They also find that at age 85 females live about a year longer than males but this year is mostly spent institutionalized.

Another study on the population in United States was performed by Itai & Someji (2007). They discuss the statistical properties of the Sullivan Method and apply an extension to the model developed by them. The cohorts investigated in the study are people born 1907 and 1912 and their approach in estimating the disability rate differs from that of Crimmins et al (1989). They use a continuous, multipurpose survey of a representative national sample of the Medicare population in the United States, Medicare Current Beneficiary Survey (MCBS). They argue that since 95% of the population over 65 is covered by Medicare this survey should give a representative picture of the disability status among the chosen cohorts. They find evidence that even though the life expectancy increased slightly when comparing the two cohorts they are lacking statistical significance about the remaining life spent disability free due to wide confidence intervals. Additional data available in the future should however narrow these confidence intervals and quite possibly show that there exists a statistical significant difference between the two cohorts.

Crimmins et al (1997) continue their research a decade later and again investigates the trend of the DFLE in the United States, this time investigating the time period 1970-1990 using the same data sets as discussed previously. Their reason for doing so is that they observed changing trends in mortality (the decline observed in the 1980s is less than in previous decades) and disability (decline in the prevalence of disability). Also international trends indicating an increase in DFLE in a number of countries is an important reason for reinvestigation. They find that DFLE at birth increased over the entire period investigated; for men and for women an increase was noted 1980-1990. Of the increase in life expectancy at birth during this decade, for both men and women, over 90% was in disability-free years. Women at age 65 find most of their increase in life expectancy to be spent free of disability whereas for men at age 65 a small increase in the expected years disabled is detected. As a number of scholars have shown in other articles, Crimmins et al (1997) find that the total life expectancy and DFLE for women are higher at all ages than for men. The only exception is that at age 85 expected years free of disability is the same for men and women. Thus the only difference between the genders at old age is the length of disabled life, not disability-free life.

Mathews et al (2006) are studying the elderly population in 12 geographic areas in England to see the effects on life expectancy and DFLE of belonging to certain a socio-economic group since evidence exists that being in a socio-economic disadvantage increases mortality. They want to know if this translates into differences in DFLE at old age. To answer this question they perform a longitudinal study (at least seven measure points between 1988 and 2003) of 1480 persons aged 76 or over in 1988.

They find, as almost could be expected having previous research in mind, that the women have a lower mortality rate than the men in the sample. Among their other findings are that mortality rates, the prevalence and incidence of disability were generally higher for the socio-economic disadvantaged. A woman owning a house (or mortgaged) could at age 75 look forward to a full extra year of living without disability compared to a woman the same age but living in a rented home. For men this difference was a year and a half. They also find evidence that socio-economic disadvantage has a stronger effect on men than women, with men losing almost a year of DFLE if belonging to a manual social class compared to a non-manual whereas the same loss for women would only be half a year.

Jitapunkul et al (2003) are also studying DFLE in the elderly. They are doing so in Thailand, a country experiencing an ongoing demographic transition, with falling mortality rates as well as falling fertility rates. They ask the same question as in previous articles, are the years gained due to an increase in life expectancy spent in good health? Sullivan's method is used to calculate DFLE. As can be expected they find that disabilities increase with age and that women have a longer life expectancy than men. However they find, somewhat surprising, that women spend time in disabled states to a larger extent than men. A woman in the age-group 60-64 can expect to live another 23,9 years but of these, on average, 18,2 years are spent disability-free and 5,7 years are spent in a disabled state. For a man in the same age-group the life expectancy is 20,3 years of which 16,4 years are spent disability-free and 3,9 years are spent in a disabled state.

4. Descriptive statistics

This chapter will consist of two parts. The first one aims to give the reader a more thorough insight into the data material from Statistics Sweden and Region Skåne. This descriptive statistics will be presented using regular tables and cross tables of the data material. The second part of this chapter will present the results of the calculations done on the data. Here the calculated life expectancy for Region Skåne and the DFLE will be presented.

4.1 The data

It is the aim of this part to present the data more thoroughly and explain the variables and the results of the calculations done on the data material. Some comments on the data will also be made, this to point out some interesting observations, for instance the great drop in people reporting themselves as disabled when retiring.

4.1.1 Population size and number of deaths in Region Skåne 2000 and 2004

The population of Skåne and the number of deaths that occurred will be presented, as previously mentioned, in five-year intervals, 20-24, 25-29 etc for 2000 and 2004. The reason for doing so is that Statistics Sweden presents the number of people currently residing in Skåne in those intervals. Since it is of interest to find the midyear population for 2000 and 2004 one must remember to take a few things into consideration. If one can assume that each of the five years in the cohort is of equal size, which one must do when calculating the midyear population since no other figures are presented, one fifth of an age-specific cohort population year X will in the year X+1 be accounted for in the next, older age-specific cohort. This means that one must also take into the calculations one fifth of the previous, one cohort younger age-group in the year X. The number of deaths throughout the year will however not be affected.

Table 1 in the appendix presents the number of inhabitants and the number of deaths in each age-group for men and women in Region Skåne in 2000 and 2004. One of reasons for presenting the genders separately is that I later on want to test, as mentioned in the research question, if differences between genders can be detected. Another important reason is the fact that this is praxis to differentiate between the genders when it comes to medical investigations.

The midyear population is increasing somewhat between 2000 and 2004 and the number of deaths seems to be approximately the same between the years, given changes in the population size. This is interesting since it will have an impact on DFLE later on through the mortality patterns for each year.

4.1.2 Selection based on Region Skåne's Folkhälsoenkät

How the selection of participants was made was discussed in the methods part. The tables and charts referred to in the appendix therefore have the sole purpose of providing some more detailed information about the selection made.

Table 2 and 3 in the appendix will present how many participants there are in each age-group and also how many women, as well as men, that did answer the questionnaire in 2000 and 2004 respectively. As can be seen in table 2, the number of women answering the questionnaire was slightly larger than the number of men. The number of respondents in this truncated table was 13134, which should be a large enough number in order for the survey to serve as a proxy for the population of Skåne 2000. From the total number of respondents the 18 and19 year olds and the people age 80+ were deducted to construct the truncated table.

The total number of respondents 2004 was 27963, which guarantees that the number of participants is large enough in order for the survey to serve as a proxy for the population of Skåne 2004. The truncated table will consist of 26719 individuals after the 18 and19 year olds and the people age 80+ has been deducted. Again women answered the questionnaire to a slightly larger extent than did men. Both surveys have a similar, quite evenly distributed age structure which ensures that the respondents in different age-groups are mimicking the real population.

4.1.3 Proportion of disabled

The proportion of disabled in the population is one of the key measures needed to calculate DFLE in Region Skåne. How I chose to define disabled was previously discussed in the method part. Having access to the answers to Q 6a) and Q 6b) a new variable can easily be generated that shows the proportion of the population that can be considered to be disabled. Tables 4–7 are cross tables presenting the number and percentage of the female and male population in each age group 2000 and 2004 that can be considered to be either disabled, having short term health problem or are healthy. In order to calculate DFLE only the proportion disabled are needed but it is interesting to have a grasp of the proportion of the population in each age group that are having short term health problems or are healthy. As can be seen from these tables women are disabled to a larger extent than men. The differences over time are quite small as well, thus not giving any conclusive answers as to if the self reported health of the region has improved from 2000 to 2004.

One thing that is very interesting indeed is the drop in the proportion of the population that is disabled between the age-groups 60-64 and 65-69. This is a significant drop and it can be observed for both genders and the two different time periods. In 2000 the proportion of women that can be considered to be disabled drops from 18.5 % for the age-group 60-64 to just 8.1 % for the age-group 65-69. For men the same year a drop in the proportion of disabled is observed, from 11.4 % in the age-group 60-64 to 7.1 % in the age-group 65-69. The 2004 survey reveals the same pattern, with a drop from 16.2 % to 9.9 % for women and from 11.8 % to 7.1 % for men when comparing the age-groups 60-64 with 65-69.

These are quite remarkable results, indicating some kind of retiring effect. It might be, and in many cases quite possibly is, the case that the activities of daily life changes when a person retires. For instance if a person was prevented to go to work due to some work-related affliction when retiring this is all of a sudden no longer part of the activities of daily life and thus the way the person reports his/her health changes. This dramatic drop that is observed is also interesting when it comes to fiscal issues. If this is a permanent drop it is likely to be able to more accurately predict the number of people in a disabled state and thus the fiscal implications will be known and appropriate actions can be taken.

4.2 Life tables and DFLE

This second part will present the results of the life tables over life expectancy that I constructed for Region Skåne and the results on DFLE calculated using Sullivan's Method. These two measurements will also be extended with another measure, which is the difference between life expectancy at a certain age-group and DFLE at the same age-group. This shows us the number of years a person can expect to live in a disabled state. This is a very interesting measure and will be analysed more in a later part of the thesis.

4.2.1 Life expectancy using life tables

Life expectancy for the men and women in Region Skåne has been calculated separately for 2000 and 2004. This is done using the midyear population and the number of deaths in Region Skåne in both years. How a life table is constructed was explained in the theory part and thus only the results will be presented. As previously mentioned I am working with a truncated life table resulting in that the first age group to be presented is men and women aged 20-24.

Tables 8-11 present the life expectancy at a certain age-group for men and women in 2000 and 2004.

The tables clearly show that women are expected to live longer than men at all ages. This is the case both in 2000 and 2004. To get results indicating that women live longer than men was quite expected. It can also be noted that over the four-year period between 2000 and 2004 life expectancy has increased both for men and women. The increase takes place in all age groups. Even though it is quite a small increase it is of interest.

4.2.2 Disability-Free Life Expectancy

It is time to present the calculations made using Sullivan's method in order to find some estimates of disability-free life expectancy in region Skåne. DFLE for the men and women in region Skåne has again been calculated separately for 2000 and 2004.

Tables 12-15 present the disability-free life expectancy at a certain age-group for men and women in 2000 and 2004. Women seem to spend a longer time in a state of disability than do men according to these constructed tables. The facts that women live longer than men and that the proportion of disabled are higher among women than men are likely to be two reasons as to why this is noticed. Also the difference between life expectancy and DFLE is computed. This difference is interesting to know and compare between genders and over time. A large difference between life expectancy and DFLE means that the individual will live a longer time in a disabled state of health. If this difference could be minimized or at least show a diminishing trend a lot would be gained, both fiscally and for the individuals concerned.

To be able to compare these numbers using Wilcoxon signed rank test the different five-year periods must be taken into account. This because the numbers calculated for life expectancy and DFLE will have a carry over effect from the previous period. Life expectancy and DFLE (and of course the difference) will be dependent on events taken place in previous age groups and this will make the comparison biased. To deal with this problem a new set of variables are constructed. The first new variable is the expectation of further life for an individual at, for instance, age 20 and the next five years, ${}_5e_x$. This new variable represents how many of the next following five years the individual might be expected to live if the mortality patterns stay the same in the region. The expectation of further life free of disability at age 20 and the next five years, ${}_5eDF_{x,}$ is also calculated. ${}_5eDF_x$ is how many of the next following five years the individual might be expected to live free of disability if disability and mortality patterns remains the same. The difference, ${}_5eD_x$, can then be calculated for the same reasons as above. The number for each age group will then be calculated independently of the previous age group using the specific mortality patterns for that specific age group. This will be presented in tables 16-19.

5. Analysis

This chapter will focus on the analysis of the calculations carried out in order to get region specific life expectancies and DFLE:s. The differences in life expectancy and disability free life expectancy between men and women will be analysed. This will be done for the years 2000 and 2004 separately. I will also analyse if any differences in life expectancy for men and women between 2000 and 2004 can be detected. To see if it is possible to detect statistically significant results between the genders and the different periods of investigation the Wilcoxon signed rank test will be used. Also an analysis of the data material concerning the differences between life expectancy and DFLE will be conducted. This will be analysed for men and women in 2000 and 2004. Again Wilcoxon signed rank test will be used to investigate if there are statistically significant differences between the genders and over time. The null hypothesis is that no differences between men and women and over time can be detected. The critical level for rejecting the null hypothesis will throughout the thesis be 5 %.

5.1 In depth analysis of age group 20-24

The table below is presenting all the different numbers for the age group 20-24 used in the analysis. The numbers are taken from tables 8-19 in the appendix.

Age group 20-24	**2000**		**2004**	
	Female	*Male*	*Female*	*Male*
$_{60}e_{20}$	55.70	53.07	56.49	54,71
$_{60}eDF_{20}$	49.53	48.50	49.77	50.59
$_{60}eD_{20}$	6.17	4.01	6.72	4.11
$_{5}e_{20}$	4.998	4.988	4.998	4.992
$_{5}eDF_{20}$	4.598	4.819	4.653	4.792
$_{5}eD_{20}$	0.400	0.169	0.345	0.200

Having the table in first part of the chapter will hopefully allow the reader to get more acquainted with the numbers and the different denotations used.

The third row is presenting the male and female expectation of further life at 20 years of age until 80 years of age. The fourth row is presenting how many years men and women are expected to live a life free of disability from the tender age of 20 until the age of 80. The fifth row represents the difference between life expectancy and DFLE. Rows six to eight are presenting the expectation of further life for an individual at age 20 and the next five years, the expectation of further life free of disability at age 20 and the next five years and the difference between these two measures.

Comparing the male and females in the age group 2000 yields some interesting results. Women are expected to live an extra 2.63 years compared to men between ages 20 and 80. This is 4.96% longer than men in Region Skåne if the mortality patterns stay the same. Women are also expected to live 1.03 years longer free of disability than the men (49.53 vs. 48.50 years). When comparing the difference between life expectancy and DFLE it becomes clear that women will end up spending a longer time in a disabled state than men (6.17 vs. 4.01 years).

In 2004 the life expectancy and DFLE has increased for both men (with 1.64 and 2.09 years) women (with 0.79 and 0.24 years). The increase is thus higher for men than for women. Also the differences for women and men increased (6.72 and 4.11 years).

5.2 Differences in life expectancy

The analysis of the differences in life expectancy will be conducted even though it is well known that women generally live longer than men do. A test will be also made see if the differences in life expectancy between the genders in region Skåne are statistically significant. From tables 8-11 presented in the last chapter it can be concluded that women in Skåne tend to live longer than men do at all age groups between 20 and 80. A Wilcoxon signed rank test can however not be performed on the number presented in these tables due to the reasons explained in the previous chapter. Tables 16-19 presents, for men and women in 2000 and 2004, the expectation of further life at age x and the next five years, the expectation of further life free of disability at age x and the next five years and the difference between the two measures. Performing a Wilcoxon signed rank test on these numbers allows for some conclusions to be drawn. P-values presented are calculated using these last variables.

The differences in life expectancy between men and women in 2000 is first to be analysed. As can be seen in table 20 the differences between men and women are statistically significant, p=0.002. In 2004 the results are the same with a p-value of 0.002 (table 21). Since this was known and expected I will not investigate it further.

Another area of interest is to evaluate how these measures change over time. Life expectancy between 20 and 80 calculated for the men and women in 2004 will be compared with those calculated for 2000. Just by comparing the numbers in table 8-11 an increase at all ages can be detected for both genders. The outcome of the test can be seen in tables 22 and 23, again a statistically significant difference can be detected. The p-value for women is 0.003 and that of men is 0.002. There are twelve negative ranks for men and eleven for women meaning that the numbers for 2004 were in all cases but one (and that was a tie) higher than in 2000. This result indicates an increase in the number of years the male and female population are expected to live between the ages 20 to 80 for Region Skåne.

5.3 Differences in DFLE

Now it is of interest to see in what state of health these years are being spent. For 2000 we find that DFLE for women is higher than DFLE for men at all ages (tables 12 and 13). Even though disability rates are generally higher for women the fact that they are expected to live longer seem to offset this effect. The test to see if the differences between genders when it comes to the expectation of further life free of disability at age x and the next five years are statistically significant results in a p-value of 0.308 (table 20). The differences observed in DFLE between the genders cannot be considered large enough to be statistically significant.

When it comes to 2004 is the difference however significant with a p-value of 0.003 (table 21). It is the men who in eleven cases out of twelve are living a life free of disability at age x and the next five years to a higher extent than women. It is likely that the much higher disability rates among women is the cause of this. For instance in the age group 40-44 in 2004 the disability rate among women is more than twice as high as that of men.

Now to one of the more interesting questions; can differences between 2000 and 2004 be detected for DFLE as it was for life expectancy? The calculated DFLE:s in tables 13-16 seems to imply that for both men and women this measure is increasing between 2000 and 2004 which undoubtedly is a good thing. The disability rates are increasing for some age groups whereas they are decreasing for other age groups. A pattern of which direction the disability rates are developing can not be detected. Even if disability rates were going up or down, measuring differences between just two different time periods makes it hard to draw any valid conclusions about the development. The only thing that can be measured is if the numbers from 2000 are statistically significant different from those of 2004. The p-value (table 22 and 23) for the women is 0.610 and for the men 0.008. Table 22 presents the fact that six ranks were positive and six negative for the women. The change is thus not of such magnitude as to allow us to say that there exists a difference in DFLE between 2000 and 2004. For the men on the other hand such a difference seems to exist. From looking at the ranks in table 23 becomes clear that ten out of twelve age groups actually are experiencing a higher calculated DFLE in 2004 than in 2000. It seems to be the case that men are extending their life free of disability where it is hard to draw any conclusions as to the direction of DFLE among women.

5.4 Differences between the measures

It is also interesting to investigate if any changes in the difference between life expectancy and DFLE can be detected. As previously mentioned this figure is showing the number of years a person can expect to live in a state of disability. Having a grasp of this number and the direction it is taking will quite possibly become more and more interesting as disability rates and life expectancy change over time. Certainly this is the case for the individual as well as policy makers. Naturally the difference will be larger in the younger age groups but this will not be commented on further. Again men and women will be compared using the same procedure as above.

When first comparing this difference between men and women it appears that women tend to have a higher expected period of time to spend in a disabled state. This is the case in 2000 as well as in 2004. These results were expected since women are expected to live longer than men and also have higher disability rates in a lot of the age groups. The p-values for the difference between the measures for 2000 and 2004 (tables 20 and 21) are 0.038 and 0.002. Both are, as could be expected, significant.

The final thing to test is if the difference between life expectancy and DFLE for men and women have increased or decreased over the four-year period between the two surveys. The results of the tests can be found in tables 22 and 23. For women, with a p-value of 0.06, it is not possible to detect any significant differences between 2000 and 2004. For men the result is the same. With a p-value of 0.126 not enough evidence exists to say that there has been a change in this measure over time.

6. Conclusions and comments

6.1 Conclusions

The aim of this thesis was to evaluate the disability free lifetime expectancy of men and women in Region Skåne in 2000 and 2004. After calculating all new weights to use in the analysis of the data at hand I found some evidence that women are, both in 2000 and 2004, generally experiencing higher disability rates than men. Differences in DFLE between the genders could not be detected in 2000 but in 2004 the men were living a life free of disability to a higher extent than women. No statistical significant differences in DFLE for women between 2000 and 2004 could be detected whereas this was the case for men.

6.2 Suggestions for further research

Since the last survey was conducted in 2004 it would be interesting to expand this study with the result of Folkhälsoenkäten 2008, and of course continuously after that. This would certainly make it easier to detect trends in DFLE and the disability rates, if such trends exist. It would also be interesting to expand the study to be not only about differences between genders and over time. It would be very exiting to investigate differences between different municipalities within Skåne, socio-economic belonging and educational background. It may be very hard to find the mortality data needed to perform such a study but it would certainly be of interest.

Acknowledgements

First of all I want to thank my fiancée Anna Oudin for her all her support, patience and constructive suggestions. Without her this thesis would not have been written.

I would like to thank Juan Merlo, Professor Social Epidemiology and Health Economics, Medical Faculty, Lund University for providing the data needed in order to write this thesis.

I would like to thank Martin Lindström, Associate Professor and Senior Lecturer, Department of Clinical Sciences, Medical Faculty, Lund University, for providing an answer to the very crucial question when a person can be considered to be disabled.

I would also like to thank Mathias Grahn, statistician at MAS, for all his help with the data from Folkhälsenkäten used in this thesis and his rapid responses to my numerous questions.

References

References on the World Wide Web

OECD Glossary of Statistical Terms

http://stats.oecd.org/glossary/detail.asp?ID=632

Khan, F; Rosvall, M; Grahn, M; Östergren P-O, *Hälsa, hälsorisker och levnadsförhållanden i Mellersta Skånes sjukvårdsdistriktet,* Socialmedicinska enheten Universitetssjukhuset MAS Region Skåne, 2006 http://www.skane.se/upload/Webbplatser/UMAS/VERKSAMHETER%20UMAS/Socialmedicin/distrikt/49107mellersta1.pdf

References

Crimmins, E; Saito, Y; Ingegneri, D, *Changes in Life Expectancy and Disability-Free Life Expectancy in the United States,* Population and Development Review, Vol. 15, No. 2. (1989), pp. 235-267

Crimmins, E; Saito, Y; Ingegneri, D, *Trends in Disability-Free Life Expectancy in the United States, 1970-90,* Population and Development Review, Vol. 23, No. 3. 1997, pp. 555-572

Easterlin, R, *How beneficent is the market? A look at the modern history of mortality,* European Review of Economic History, 3, 1999, pp. 257-294

Galasso, V; Profeta, P, *Politics, ageing and pensions,* Economic Policy, 2004, pp. 63-115

Gornick, J, *Social expenditures on children and the elderly in OECD countries, 1980-1995: Shifting allocation, changing needs,* Chapter 8 in Gauthier, A; Chu, CYC; Tulaparkar S, *Allocating Public and Private Resources across Generations,* 2006, Springer: Dordrecht

Hakim, C, *Research Design – successful designs for social and economic research,* Routledge, 2000

Hinde, A, *Demographic Methods,* Arnold 1998

Imai, K; Soneji, S, On the Estimation of Disability-Free Lifetime Expectancy: Sullivan's Method and Its Extensions, Journal of the American Statistical Association, 2007

Jagger, C; Cox, B; Le Roy, S and the EHEMU team, *Health Expectancy Calculations by the Sullivan Method: A Practical Guide,* EHEMU Technical report 2006_3

Jitapunkul, S; Kunanusont, C; Phoolcharoen, W; Suriyawongpaisal, P; Ebrahim, S, *Disability-Free life expectancy of elderly people in a population undergoing demographic and epidemiologic transition,* Age and Ageing, 2003; 32 pp. 401-405

Lundahl, U; Skärvad, P-H, *Utredningsmetodik för samhällsvetare och ekonomer*, Studentlitteratur, 1992

Holme, I; Solvang, B, *Forskningsmetodik*, Studentlitteratur, 1997

Matthews, R; Jagger, C; Hancock, R, *Does socio-economic advantage lead to a longer, healthier old age?,* Social Science & Medicine 62, 2006, pp.2489-2499

McKeown, T; Brown R.G; Record R.G, *An Interpretation of the Modern Rise of Population in Europe,* Population Studies, Vol. 26, No. 3. 1972, pp. 345-382.

Oeppen, J; Vaupel J.W, *Broken Limits to Life Expectancy,* SCIENCE VOL. 296 10, 2002, (www.sciencemag.org)

Patel, R; Tebelius, U (red), *Grundbok i forskningsmetodik,* Studentlitteratur, 1987

Quensel, C-E, *Kompendium i formell befolkningsteori, 2:nd ed,* Department of Statistics, Lund University, 1966

Preston, **S,** *Children and the elderly: Divergent paths for America's dependents,* Demography 21(4), 1984, pp.435-457

Region Skånes Folkhälsoenkät, 2000 and 2004

Statistics Sweden, *Befolkningsstatistik del 3,* 1999, 2000, 2003, 2004

Wilmoth, J.R, *Demography of longevity: past, present and future trends,* Experimental Gerontology 35, 2000, pp. 1111-1129.

Appendix

Table 1. The Male and Female population of Skåne 2000 and 2004

Table 1.

	Skåne Males 2000		Skåne Females 2000		Skåne Males 2004		Skåne Females 2004	
Age	Midyear population in interval (x,x+4)	Deaths	Midyear population in interval (x,x+4)	Deaths	Midyear population in interval (x,x+4)	Deaths	Midyear population in interval (x,x+4)	Deaths
(x to x+4)	Px	Dx	Px	Dx	Px	Dx	Px	Dx
20-24	34050	33	33654	6	34982	22	35065	5
25-29	37469	39	36642	16	40923	35	36579	9
30-34	39919	42	38991	12	39413	39	38177	12
35-39	39942	44	38625	25	42043	38	40963	22
40-44	37014	55	36053	38	39544	62	38520	34
45-49	37070	106	36707	55	37202	72	36354	67
50-54	40193	149	39885	113	37470	143	37462	118
55-59	37418	247	36760	162	40283	262	40144	148
60-64	28636	293	29373	212	34632	310	34667	241
65-69	23822	438	26233	282	26232	421	27746	271
70-74	21582	708	26254	468	21379	592	24881	444
75-79	18963	1023	25426	746	18099	806	23841	682

Table 2. The number of responses divided into gender and age group 2000.

Table 2. 2000		Gender		
		Female	Male	Total
Age group	20-24	547	529	1076
	25-29	583	594	1177
	30-34	651	704	1355
	35-39	637	682	1319
	40-44	564	524	1088
	45-49	617	587	1204
	50-54	700	674	1374
	55-59	572	657	1229
	60-64	477	453	930
	65-69	487	414	901
	70-74	428	366	794
	75-79	385	302	687
	Total	6648	6486	13134

Table 3. The number of responses divided into gender and age group 2004.

Table 3. 2004		Gender		
		Female	Male	Total
Age group	20-24	1190	1128	2318
	25-29	1254	1134	2388
	30-34	1248	1108	2356
	35-39	1366	1317	2683
	40-44	1284	1298	2582
	45-49	1150	1225	2375
	50-54	1209	1252	2461
	55-59	1249	1260	2509
	60-64	1134	1283	2417
	65-69	840	845	1685
	70-74	791	782	1573
	75-79	729	643	1372
	Total	13444	13275	26917

Table 4. The percentage of disabled females divided into age group 2000

Gender				Disabled			
				Disabled	Short term health problems	Healthy	Total
Female	5-year age group	20-24	Count	2526	4135	24812	31473
			% within 5-year age group	8.0%	13.1%	78.8%	100.0%
		25-29	Count	2180	3505	29673	35358
			% within 5-year age group	6.2%	9.9%	83.9%	100.0%
		30-34	Count	2866	4219	30557	37642
			% within 5-year age group	7.6%	11.2%	81.2%	100.0%
		35-39	Count	3331	2699	29247	35277
			% within 5-year age group	9.4%	7.7%	82.9%	100.0%
		40-44	Count	3741	2319	27398	33458
			% within 5-year age group	11.2%	6.9%	81.9%	100.0%
		45-49	Count	4268	2823	27634	34725
			% within 5-year age group	12.3%	8.1%	79.6%	100.0%
		50-54	Count	5378	2616	29554	37548
			% within 5-year age group	14.3%	7.0%	78.7%	100.0%
		55-59	Count	5646	1814	24986	32446
			% within 5-year age group	17.4%	5.6%	77.0%	100.0%
		60-64	Count	4669	1567	19056	25292
			% within 5-year age group	18.5%	6.2%	75.3%	100.0%
		65-69	Count	1813	532	20060	22405
			% within 5-year age group	8.1%	2.4%	89.5%	100.0%
		70-74	Count	2118	461	18071	20650
			% within 5-year age group	10.3%	2.2%	87.5%	100.0%
		75-79	Count	1875	673	16567	19115
			% within 5-year age group	9.8%	3.5%	86.7%	100.0%
		Total	Count	40411	27363	297615	365389
			% within 5-year age group	11.1%	7.5%	81.5%	100.0%

Table 5. The percentage of disabled males divided into age group 2000

Gender				Disabled			
				Disabled	Short term health problems	Healthy	Total
Male	5-year age group	20-24	Count	1024	3094	28279	32397
			% within 5-year age group	3.2%	9.6%	87.3%	100.0%
		25-29	Count	1995	2265	31990	36250
			% within 5-year age group	5.5%	6.2%	88.2%	100.0%
		30-34	Count	2814	2432	34055	39301
			% within 5-year age group	7.2%	6.2%	86.7%	100.0%
		35-39	Count	2501	2110	33300	37911
			% within 5-year age group	6.6%	5.6%	87.8%	100.0%
		40-44	Count	2503	2521	30324	35348
			% within 5-year age group	7.1%	7.1%	85.8%	100.0%
		45-49	Count	2951	2010	30519	35480
			% within 5-year age group	8.3%	5.7%	86.0%	100.0%
		50-54	Count	3756	1957	32489	38202
			% within 5-year age group	9.8%	5.1%	85.0%	100.0%
		55-59	Count	3141	2195	27288	32624
			% within 5-year age group	9.6%	6.7%	83.6%	100.0%
		60-64	Count	2780	512	21000	24292
			% within 5-year age group	11.4%	2.1%	86.4%	100.0%
		65-69	Count	1517	742	19024	21283
			% within 5-year age group	7.1%	3.5%	89.4%	100.0%
		70-74	Count	1218	256	16880	18354
			% within 5-year age group	6.6%	1.4%	92.0%	100.0%
		75-79	Count	1756	390	13020	15166
			% within 5-year age group	11.6%	2.6%	85.8%	100.0%
		Total	Count	27956	20484	318168	366608
			% within 5-year age group	7.6%	5.6%	86.8%	100.0%

Table 6. The percentage of disabled females divided into age group 2004

Gender				Disabled			
				Disabled	Short term health problems	Healthy	Total
Female	5-year age group	20-24	Count	2308	4213	26788	33309
			% within 5-year age group	6.9%	12.6%	80.4%	100.0%
		25-29	Count	2472	4261	28575	35308
			% within 5-year age group	7.0%	12.1%	80.9%	100.0%
		30-34	Count	2984	3369	29992	36345
			% within 5-year age group	8.2%	9.3%	82.5%	100.0%
		35-39	Count	4717	3754	31606	40077
			% within 5-year age group	11.8%	9.4%	78.9%	100.0%
		40-44	Count	4383	3514	27555	35452
			% within 5-year age group	12.4%	9.9%	77.7%	100.0%
		45-49	Count	4868	2689	26775	34332
			% within 5-year age group	14.2%	7.8%	78.0%	100.0%
		50-54	Count	5328	2062	28081	35471
			% within 5-year age group	15.0%	5.8%	79.2%	100.0%
		55-59	Count	6460	2636	28290	37386
			% within 5-year age group	17.3%	7.1%	75.7%	100.0%
		60-64	Count	4930	1417	24022	30369
			% within 5-year age group	16.2%	4.7%	79.1%	100.0%
		65-69	Count	2413	963	21114	24490
			% within 5-year age group	9.9%	3.9%	86.2%	100.0%
		70-74	Count	2466	742	18923	22131
			% within 5-year age group	11.1%	3.4%	85.5%	100.0%
		75-79	Count	2602	798	16085	19485
			% within 5-year age group	13.4%	4.1%	82.6%	100.0%
		Total	Count	45931	30418	307806	384155
			% within 5-year age group	12.0%	7.9%	80.1%	100.0%

Table 7. The percentage of disabled males divided into age group 2004

Gender				Disabled			
				Disabled	Short term health problems	Healthy	Total
Male	5-year age group	20-24	Count	1361	2796	29556	33713
			% within 5-year age group	4.0%	8.3%	87.7%	100.0%
		25-29	Count	1540	3202	31794	36536
			% within 5-year age group	4.2%	8.8%	87.0%	100.0%
		30-34	Count	1870	3337	32932	38139
			% within 5-year age group	4.9%	8.7%	86.3%	100.0%
		35-39	Count	3387	3495	34654	41536
			% within 5-year age group	8.2%	8.4%	83.4%	100.0%
		40-44	Count	2457	2475	32200	37132
			% within 5-year age group	6.6%	6.7%	86.7%	100.0%
		45-49	Count	2953	2528	29930	35411
			% within 5-year age group	8.3%	7.1%	84.5%	100.0%
		50-54	Count	3144	1576	31783	36503
			% within 5-year age group	8.6%	4.3%	87.1%	100.0%
		55-59	Count	3674	1768	32871	38313
			% within 5-year age group	9.6%	4.6%	85.8%	100.0%
		60-64	Count	3634	868	26253	30755
			% within 5-year age group	11.8%	2.8%	85.4%	100.0%
		65-69	Count	1640	922	20407	22969
			% within 5-year age group	7.1%	4.0%	88.8%	100.0%
		70-74	Count	1600	621	16796	19017
			% within 5-year age group	8.4%	3.3%	88.3%	100.0%
		75-79	Count	1630	286	13861	15777
			% within 5-year age group	10.3%	1.8%	87.9%	100.0%
		Total	Count	28890	23874	333037	385801
			% within 5-year age group	7.5%	6.2%	86.3%	100.0%

Table 8. Expectation of further life between ages x and 80 for females 2000

Table 8.

Age	Midyear population in interval (x,x+4)	Deaths	Death rate in interval (x,x+4)	Probability of dying in interval (x.x+4)	Number of people surviving to age x+5	Number of years lived by the cohort in interval (x,x+4)	Number of years lived beyond x but before 80.	Expectation of further life between ages x and 80
	Skåne Females 2000							
(x,x+4)	P_x	D_x	M_x	$_5q_x$	l_x	$_5L_x$	$_{80-x}L_x$	$_{80-x}e_x$
20-24	33654	6	0.000178	0.0008910	100000	499777	5569815	55.70
25-29	36642	16	0.000437	0.0021809	99911	498574	5070038	50.75
30-34	38991	12	0.000308	0.0015376	99693	497775	4571464	45.86
35-39	38625	25	0.000647	0.0032311	99540	496251	4073689	40.93
40-44	36053	38	0.001054	0.0052562	99218	493744	3577437	36.06
45-49	36707	55	0.001498	0.0074639	98697	490168	3083694	31.24
50-54	39885	113	0.002833	0.0140660	97960	483599	2593526	26.48
55-59	36760	162	0.004407	0.0217945	96582	473438	2109927	21.85
60-64	29373	212	0.007217	0.0354475	94477	457315	1636489	17.32
65-69	26233	282	0.010750	0.0523422	91128	434176	1179174	12.94
70-74	26254	468	0.017826	0.0853273	86358	398632	744998	8.63
75-79	25426	746	0.029340	0.1366751	78990	346366	346366	4.38

Table 9. Expectation of further life between ages x and 80 for males 2000

Table 9.

Age	Midyear population in interval (x,x+4)	Deaths	Death rate in interval (x,x+4)	Probability of dying in interval (x,x+4)	Number of people surviving to age x+5	Number of years lived by the cohort in interval (x,x+4)	Number of years lived beyond x but before 80.	Expectation of further life between ages x and 80
	Skåne Males 2000							
(x,x+4)	P_x	D_x	M_x	$_5q_x$	l_x	$_5L_x$	$_{80-x}L_x$	$_{80-x}e_x$
20-24	34050	33	0.000969	0.0048340	100000	498791	5307340	53.07
25-29	37469	39	0.001041	0.0051908	99517	495258	4808549	48.32
30-34	39919	42	0.001052	0.0052468	99000	492663	4313290	43.57
35-39	39942	44	0.001102	0.0054929	98481	489969	3820628	38.80
40-44	37014	55	0.001486	0.0074022	97940	486436	3330659	34.01
45-49	37070	106	0.002859	0.0141958	97215	479863	2844223	29.26
50-54	40193	149	0.003707	0.0183655	95835	471253	2364360	24.67
55-59	37418	247	0.006601	0.0324696	94075	456627	1893107	20.12
60-64	28636	293	0.010232	0.0498835	91020	434668	1436479	15.78
65-69	23822	438	0.018386	0.0878907	86480	398195	1001811	11.58
70-74	21582	708	0.032805	0.1515904	78879	340587	603616	7.65
75-79	18963	1023	0.053948	0.2376848	66922	263030	263030	3.93

Table 10. Expectation of further life between ages x and 80 for females 2004

Table 10.

Skåne Females 2004

Age	Midyear population in interval (x,x+4)	Deaths	Death rate in interval (x,x+4)	Probability of dying in interval (x,x+4)	Number of people surviving to age x+5	Number of years lived by the cohort in interval (x,x+4)	Number of years lived beyond x but before 80.	Expectation of further life between ages x and 80
(x,x+4)	P_x	D_x	M_x	$_5q_x$	l_x	$_5L_x$	$_{80-x}L_x$	$_{80-x}e_x$
20-24	35065	5	0.000143	0.000713	100000	499822	5649359	56.49
25-29	36579	9	0.000246	0.001229	99929	499337	5149537	51.53
30-34	38177	12	0.000314	0.001570	99806	498638	4650201	46.59
35-39	40963	22	0.000537	0.002682	99649	497578	4151563	41.66
40-44	38520	34	0.000883	0.004404	99382	495815	3653986	36.77
45-49	36354	67	0.001843	0.009173	98944	492452	3158170	31.92
50-54	37462	118	0.003150	0.015626	98037	486354	2665718	27.19
55-59	40144	148	0.003687	0.018266	96505	478117	2179364	22.58
60-64	34667	241	0.006952	0.034166	94742	465618	1701247	17.96
65-69	27746	271	0.009767	0.047671	91505	446620	1235629	13.50
70-74	24881	444	0.017845	0.085413	87143	417107	789009	9.05
75-79	23841	682	0.028606	0.133483	79700	371903	371903	4.67

Table 11. Expectation of further life between ages x and 80 for males 2004

Table 11.

Skåne Males 2004

Age	Midyear population in interval (x,x+4)	Deaths	Death rate in interval (x,x+4)	Probability of dying in interval (x.x+4)	Number of people surviving to age x+5	Number of years lived by the cohort in interval (x,x+4)	Number of years lived beyond x but before 80.	Expectation of further life between ages x and 80
(x,x+4)	P_x	D_x	M_x	$_5q_x$	l_x	$_5L_x$	$_{80-x}L_x$	$_{80-x}e_x$
20-24	34982	22	0,000629	0,003140	100000	499215	5470764	54,71
25-29	40923	35	0,000855	0,004267	99686	497367	4971549	49,87
30-34	39413	39	0,000990	0,004935	99261	495079	4474182	45,08
35-39	42043	38	0,000904	0,004509	98771	492740	3979103	40,29
40-44	39544	62	0,001568	0,007809	98325	489708	3486363	35,46
45-49	37202	72	0,001935	0,009630	97558	485439	2996656	30,72
50-54	37470	143	0,003816	0,018901	96618	478525	2511216	25,99
55-59	40283	262	0,006504	0,032000	94792	466376	2032691	21,44
60-64	34632	310	0,008951	0,043776	91759	448751	1566315	17,07
65-69	26232	421	0,016049	0,077150	87742	421785	1117564	12,74
70-74	21379	592	0,027691	0,129491	80972	378649	695779	8,59
75-79	18099	806	0,044533	0,200357	70487	317130	317130	4,50

Table 12. Disability free life expectancy between ages x and 80 for females 2000

Table 12.

Age	Number of years lived by the cohort in interval (x,x+4)	Proportion with disability	Personyears lived without disability at age x	Total years lived without disability from age x	Disability Free Lifetime Expectancy	Expectation of further life between ages x and 80	Difference between $_{80-x}e_x$ and eDF_x
	Skåne Females 2000						
(x,x+4)	$_5L_x$	πx	$_5DFL_x$	$_{80-x}DFL_x$	$_{80-x}eDF_x$	$_{80-x}e_x$	$_{80-x}eD_x$
20-24	499777	0.080	459795	4952546	49.53	55.70	6.17
25-29	498574	0.062	467662	4492751	44.97	50.75	5.78
30-34	497775	0.076	459944	4025088	40.37	45.86	5.48
35-39	496251	0.094	449604	3565144	35.82	40.93	5.11
40-44	493744	0.112	438444	3115540	31.40	36.06	4.66
45-49	490168	0.123	429877	2677096	27.12	31.24	4.12
50-54	483599	0.143	414444	2247219	22.94	26.48	3.54
55-59	473438	0.174	391060	1832774	18.98	21.85	2.87
60-64	457315	0.185	372712	1441715	15.26	17.32	2.06
65-69	434176	0.081	399008	1069003	11.73	12.94	1.21
70-74	398632	0.103	357573	669995	7.76	8.63	0.87
75-79	346366	0.098	312422	312422	3.96	4.38	0.43

Table 13. Disability free life expectancy between ages x and 80 for males 2000

Table 13.

Age	Number of years lived by the cohort in interval (x,x+4)	Proportion with disability	Personyears lived without disability at age x	Total years lived without disability from age x	Disability Free Lifetime Expectancy	Expectation of further life between ages x and 80	Difference between $_{80-x}e_x$ and eDF_x
	Skåne Males 2000						
(x,x+4)	$_5L_x$	πx	$_5DFL_x$	$_{80-x}DFL_x$	$_{80-x}eDF_x$	$_{80-x}e_x$	$_{80-x}eD_x$
20-24	498791	0.032	481884	4849806	48.50	53.07	4.01
25-29	495258	0.055	467997	4367922	43.89	48.32	3.87
30-34	492663	0.072	457156	3899925	39.40	43.57	3.61
35-39	489969	0.066	457582	3442769	34.96	38.80	3.27
40-44	486436	0.071	451827	2985186	30.48	34.01	2.96
45-49	479863	0.083	439880	2533359	26.06	29.26	2.63
50-54	471253	0.098	424778	2093479	21.85	24.67	2.25
55-59	456627	0.096	412076	1668701	17.75	20.12	1.80
60-64	434668	0.114	383456	1256624	13.83	15.78	1.38
65-69	398195	0.071	365174	873168	10.14	11.58	0.88
70-74	340587	0.066	304849	507995	6.53	7.65	0.62
75-79	263030	0.116	203145	203145	3.18	3.93	0.42

Table 14. Disability free life expectancy between ages x and 80 for females 2004

Table 14

	Skåne Females 2004						
Age	Number of years lived by the cohort in interval (x,x+4)	Proportion with disability	Personyears lived without disability at age x	Total years lived without disability from age x	Disability Free Lifetime Expectancy	Expectation of further life between ages x and 80	Difference between $_{80-x}e_x$ and eDF_x
(x,x+4)	$_5L_x$	πx	$_5DFL_x$	$_{80-x}DFL_x$	$_{80-x}eDF_x$	$_{80-x}e_x$	$_{80-x}eD_x$
20-24	499822	0.069	465334	4977460	49.77	56.49	6.72
25-29	499337	0.070	464383	4512125	45.15	51.53	6.38
30-34	498638	0.082	457749	4047742	40.56	46.59	6.04
35-39	497578	0.118	438863	3589993	36.03	41.66	5.64
40-44	495815	0.124	434334	3151130	31.71	36.77	5.06
45-49	492452	0.142	422524	2716795	27.46	31.92	4.46
50-54	486354	0.150	413401	2294271	23.40	27.19	3.79
55-59	478117	0.173	395403	1880871	19.49	22.58	3.09
60-64	465618	0.162	390188	1485468	15.68	17.96	2.28
65-69	446620	0.099	402405	1095280	11.97	13.50	1.53
70-74	417107	0.111	370808	692876	7.95	9.05	1.10
75-79	371903	0.134	322068	322068	4.04	4.67	0.63

Table 15. Disability free life expectancy between ages x and 80 for males 2004

Table 15.

	Skåne Males 2004						
Age	Number of years lived by the cohort in interval (x,x+4)	Proportion with disability	Personyears lived without disability at age x	Total years lived without disability from age x	Disability Free Lifetime Expectancy	Expectation of further life between ages x and 80	Difference between $_{80-x}e_x$ and eDF_x
(x,x+4)	$_5L_x$	πx	$_5DFL_x$	$_{80-x}DFL_x$	$_{80-x}eDF_x$	$_{80-x}e_x$	$_{80-x}eD_x$
20-24	499215	0.040	479247	5059335	50.59	54.71	4.11
25-29	497367	0.042	476477	4580088	45.95	49.87	3.93
30-34	495079	0.049	470820	4103611	41.34	45.08	3.73
35-39	492740	0.082	452336	3632791	36.78	40.29	3.51
40-44	489708	0.066	457387	3180455	32.35	35.46	3.11
45-49	485439	0.083	445148	2723069	27.91	30.72	2.80
50-54	478525	0.086	437372	2277921	23.58	25.99	2.41
55-59	466376	0.096	421604	1840549	19.42	21.44	2.03
60-64	448751	0.118	395798	1418945	15.46	17.07	1.61
65-69	421785	0.071	391839	1023147	11.66	12.74	1.08
70-74	378649	0.084	346843	631308	7.80	8.59	0.80
75-79	317130	0.103	284465	284465	4.04	4.50	0.46

Table 16. $_5e_x$, $_5eDF_x$, $_5eD_x$ for females 2000

Table 16.

	Skåne Females 2000					
Age	Number of people surviving to age x+5	Number of years lived by the cohort in interval (x.x+4)	Personyears lived without disability at age x	Expectation of further life at x until x+4	Expectation of further life free of disability at x until x+4	Difference between $_5e_x$ and $_5eDF_x$
(x,x+4)	l_x	$_5L_x$	$_5DFL_x$	$_5e_x$	$_5eDF_x$	$_5eD_x$
20-24	100000	499777	459795	4.998	4.598	0.400
25-29	99911	498574	467662	4.990	4.681	0.309
30-34	99693	497775	459944	4.993	4.614	0.379
35-39	99540	496251	449604	4.985	4.517	0.469
40-44	99218	493744	438444	4.976	4.419	0.557
45-49	98697	490168	429877	4.966	4.356	0.611
50-54	97960	483599	414444	4.937	4.231	0.706
55-59	96582	473438	391060	4.902	4.049	0.853
60-64	94477	457315	372712	4.840	3.945	0.895
65-69	91128	434176	399008	4.764	4.379	0.386
70-74	86358	398632	357573	4.616	4.141	0.475
75-79	78990	346366	312422	4.385	3.955	0.430

Table 17. $_5e_x$, $_5eDF_x$, $_5eD_x$ for males 2000

Table 17.

	Skåne Males 2000					
Age	Number of people surviving to age x+5	Number of years lived by the cohort in interval (x.x+4)	Personyears lived without disability at age x	Expectation of further life at x until x+4	Expectation of further life free of disability at x until x+4	Difference between $_5e_x$ and $_5eDF_x$
(x,x+4)	l_x	$_5L_x$	$_5DFL_x$	$_5e_x$	$_5eDF_x$	$_5eD_x$
20-24	100000	498791	481884	4.988	4.819	0.169
25-29	99517	495258	467997	4.977	4.703	0.274
30-34	99000	492663	457156	4.976	4.618	0.359
35-39	98481	489969	457582	4.975	4.646	0.329
40-44	97940	486436	451827	4.967	4.613	0.353
45-49	97215	479863	439880	4.936	4.525	0.411
50-54	95835	471253	424778	4.917	4.432	0.485
55-59	94075	456627	412076	4.854	4.380	0.474
60-64	91020	434668	383456	4.776	4.213	0.563
65-69	86480	398195	365174	4.604	4.223	0.382
70-74	78879	340587	304849	4.318	3.865	0.453
75-79	66922	263030	203145	3.930	3.036	0.895

Table 18. $_5e_x$, $_5eDF_x$, $_5eD_x$ for females 2004

Table 18

Skåne Females 2004

Age	Number of people surviving to age x+5	Number of years lived by the cohort in interval (x.x+4)	Personyears lived without disability at age x	Expectation of further life at x until x+4	Expectation of further life free of disability at x until x+4	Difference between $_5e_x$ and $_5eDF_x$
(x,x+4)	l_x	$_5L_x$	$_5DFL_x$	$_5e_x$	$_5eDF_x$	$_5eD_x$
20-24	100000	499822	465334	4.998	4.653	0.345
25-29	99929	499337	464383	4.997	4.647	0.350
30-34	99806	498638	457749	4.996	4.586	0.410
35-39	99649	497578	438863	4.993	4.404	0.589
40-44	99382	495815	434334	4.989	4.370	0.619
45-49	98944	492452	422524	4.977	4.270	0.707
50-54	98037	486354	413401	4.961	4.217	0.744
55-59	96505	478117	395403	4.954	4.097	0.857
60-64	94742	465618	390188	4.915	4.118	0.796
65-69	91505	446620	402405	4.881	4.398	0.483
70-74	87143	417107	370808	4.786	4.255	0.531
75-79	79700	371903	322068	4.666	4.041	0.625

Table 19. $_5e_x$, $_5eDF_x$, $_5eD_x$ for males 2004

Table 19.

Skåne Males 2004

Age	Number of people surviving to age x+5	Number of years lived by the cohort in interval (x.x+4)	Personyears lived without disability at age x	Expectation of further life at x until x+4	Expectation of further life free of disability at x until x+4	Difference between $_5e_x$ and $_5eDF_x$
(x,x+4)	l_x	$_5L_x$	$_5DFL_x$	$_5e_x$	$_5eDF_x$	$_5eD_x$
20-24	100000	499215	479247	4.992	4.792	0.200
25-29	99686	497367	476477	4.989	4.780	0.210
30-34	99261	495079	470820	4.988	4.743	0.244
35-39	98771	492740	452336	4.989	4.580	0.409
40-44	98325	489708	457387	4.980	4.652	0.329
45-49	97558	485439	445148	4.976	4.563	0.413
50-54	96618	478525	437372	4.953	4.527	0.426
55-59	94792	466376	421604	4.920	4.448	0.472
60-64	91759	448751	395798	4.891	4.313	0.577
65-69	87742	421785	391839	4.807	4.466	0.341
70-74	80972	378649	346843	4.676	4.283	0.393
75-79	70487	317130	284465	4.499	4.036	0.463

Table 20. Wilcoxon signed rank test for male and female 2000

		N	Mean Rank	Sum of Ranks
M_5ex_00 - F_5ex_00	Negative Ranks	12[a]	6.50	78.00
	Positive Ranks	0[b]	.00	.00
	Ties	0[c]		
	Total	12		
M_5eDFx_00 - F_5eDFx_00	Negative Ranks	3[d]	8.67	26.00
	Positive Ranks	9[e]	5.78	52.00
	Ties	0[f]		
	Total	12		
M_5eDx_00 - F_5eDx_00	Negative Ranks	11[g]	6.00	66.00
	Positive Ranks	1[h]	12.00	12.00
	Ties	0[i]		
	Total	12		

a. M_5ex_00 < F_5ex_00

b. M_5ex_00 > F_5ex_00

c. M_5ex_00 = F_5ex_00

d. M_5eDFx_00 < F_5eDFx_00

e. M_5eDFx_00 > F_5eDFx_00

f. M_5eDFx_00 = F_5eDFx_00

g. M_5eDx_00 < F_5eDx_00

h. M_5eDx_00 > F_5eDx_00

i. M_5eDx_00 = F_5eDx_00

Test Statistics[c]

	M_5ex_00 - F_5ex_00	M_5eDFx_00 - F_5eDFx_00	M_5eDx_00 - F_5eDx_00
Z	-3.061[a]	-1.020[b]	-2.118[a]
Asymp. Sig. (2-tailed)	.002	.308	.034

a. Based on positive ranks.

b. Based on negative ranks.

c. Wilcoxon Signed Ranks Test

Table 21. Wilcoxon signed rank test for male and female 2004

		N	Mean Rank	Sum of Ranks
M_5ex_04 - F_5ex_04	Negative Ranks	12[a]	6.50	78.00
	Positive Ranks	0[b]	.00	.00
	Ties	0[c]		
	Total	12		
M_5eDFx_04 - F_5eDFx_04	Negative Ranks	1[d]	1.00	1.00
	Positive Ranks	11[e]	7.00	77.00
	Ties	0[f]		
	Total	12		
M_5eDx_04 - F_5eDx_04	Negative Ranks	12[g]	6.50	78.00
	Positive Ranks	0[h]	.00	.00
	Ties	0[i]		
	Total	12		

a. M_5ex_04 < F_5ex_04

b. M_5ex_04 > F_5ex_04

c. M_5ex_04 = F_5ex_04

d. M_5eDFx_04 < F_5eDFx_04

e. M_5eDFx_04 > F_5eDFx_04

f. M_5eDFx_04 = F_5eDFx_04

g. M_5eDx_04 < F_5eDx_04

h. M_5eDx_04 > F_5eDx_04

i. M_5eDx_04 = F_5eDx_04

Test Statistics[c]

	M_5ex_04 - F_5ex_04	M_5eDFx_04 - F_5eDFx_04	M_5eDx_04 - F_5eDx_04
Z	-3.064[a]	-2.981[b]	-3.059[a]
Asymp. Sig. (2-tailed)	.002	.003	.002

a. Based on positive ranks.

b. Based on negative ranks.

c. Wilcoxon Signed Ranks Test

Table 22. Wilcoxon signed rank test for female between 2000 and 2004

		N	Mean Rank	Sum of Ranks
F_5ex_00 - F_5ex_04	Negative Ranks	11[a]	6.00	66.00
	Positive Ranks	0[b]	.00	.00
	Ties	1[c]		
	Total	12		
F_5eDFx_00 - F_5eDFx_04	Negative Ranks	6[d]	7.58	45.50
	Positive Ranks	6[e]	5.42	32.50
	Ties	0[f]		
	Total	12		
F_5eDx_00 - F_5eDx_04	Negative Ranks	10[g]	6.30	63.00
	Positive Ranks	2[h]	7.50	15.00
	Ties	0[i]		
	Total	12		

a. F_5ex_00 < F_5ex_04

b. F_5ex_00 > F_5ex_04

c. F_5ex_00 = F_5ex_04

d. F_5eDFx_00 < F_5eDFx_04

e. F_5eDFx_00 > F_5eDFx_04

f. F_5eDFx_00 = F_5eDFx_04

g. F_5eDx_00 < F_5eDx_04

h. F_5eDx_00 > F_5eDx_04

i. F_5eDx_00 = F_5eDx_04

Test Statistics[b]

	F_5ex_00 - F_5ex_04	F_5eDFx_00 - F_5eDFx_04	F_5eDx_00 - F_5eDx_04
Z	-2.934[a]	-.510[a]	-1.883[a]
Asymp. Sig. (2-tailed)	.003	.610	.060

a. Based on positive ranks.

b. Wilcoxon Signed Ranks Test

Table 23. Wilcoxon signed rank test for male between 2000 and 2004

		N	Mean Rank	Sum of Ranks
M_5ex_00 - M_5ex_04	Negative Ranks	12[a]	6.50	78.00
	Positive Ranks	0[b]	.00	.00
	Ties	0[c]		
	Total	12		
M_5eDFx_00 - M_5eDFx_04	Negative Ranks	10[d]	7.30	73.00
	Positive Ranks	2[e]	2.50	5.00
	Ties	0[f]		
	Total	12		
M_5eDx_00 - M_5eDx_04	Negative Ranks	4[g]	4.88	19.50
	Positive Ranks	8[h]	7.31	58.50
	Ties	0[i]		
	Total	12		

a. M_5ex_00 < M_5ex_04

b. M_5ex_00 > M_5ex_04

c. M_5ex_00 = M_5ex_04

d. M_5eDFx_00 < M_5eDFx_04

e. M_5eDFx_00 > M_5eDFx_04

f. M_5eDFx_00 = M_5eDFx_04

g. M_5eDx_00 < M_5eDx_04

h. M_5eDx_00 > M_5eDx_04

i. M_5eDx_00 = M_5eDx_04

Test Statistics[c]

	M_5ex_00 - M_5ex_04	M_5eDFx_00 - M_5eDFx_04	M_5eDx_00 - M_5eDx_04
Z	-3.061[a]	-2.667[a]	-1.530[b]
Asymp. Sig. (2-tailed)	.002	.008	.126

a. Based on positive ranks.

b. Based on negative ranks.

c. Wilcoxon Signed Ranks Test