UNIVERSITY OF GHANA

A PROBABILITY PROJECTION OF MALE AND FEMALE LIFE EXPECTANCY OF INHABITANTS LIVING IN GHANA. A CASE STUDY OF PEOPLE LIVING IN THE ACCRA METROPOLITAN AREA

BY

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THIS THESIS IS SUBMITTED TO UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MPHIL STATISTICS DEGREE

JULY, 2019

Candidate's Declaration

I, Abigail Owusu Oduro hereby declare that apart from references to other people's publications, which have been duly acknowledged, this thesis is a result of my independent ideas, thoughts, deliberations and has not been submitted for the award of any degree at this institution and other universities elsewhere.

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Supervisors' Declaration

We hereby certify that this thesis was prepared from the candidate's own work and supervised in accordance with guidelines on supervision of thesis laid down by the University of Ghana.

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DEDICATION

This work is dedicated to my parents Mr and Mrs Oduro who offered their financial assistance during this Mphil programme and all the lecturers in Department of Statistics especially Prof. Doku -Amponsah my principal Supervisor, University of Ghana.

ABSTRACT

This thesis is an educational piece which deals with methods and decision-making ways of detecting for life expectancy in the sub-Saharan region of Ghana precisely the Accra Metropolitan area. The data was picked from the archives of the district health directorate of Accra Metropolitan area. A secondary data was used the variables of interest includes age, number of deaths and population and this was done by searching for the age data of the given period and matching it to the number of deaths. The researcher also simulated population data from the 2010 population census. The type of sampling done was the cluster sampling. The methodology employed consists of the abridged life table means in calculating life expectancy. The data was then forecasted using forecasting methods namely the Lee Carter, the Age Period Cohort model and the Card Blake and Dowd model. The Lee Carter model was seen to be the most efficient model in predicting the life expectancy of people in Accra Metro followed by the CBD model. With the findings one can notice that the neonatal deaths which summed up to 184 with a population of 22,355 had a life expectancy of 71. The middle age ranging from 30 to 54 recorded a life expectancy of 52.3 and 22.8. A diagrammatic view shows a slope from a life expectancy of 71 to 2.5.

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TABLE OF CONTENTS

Content **Page**

DECLARATION .... **Error! Bookmark not defined.**

DEDICATION iii

ABSTRACT iv

ACKNOWLEDGEMENT v

TABLE OF CONTENTS vi

LIST OF TABLES x

LIST OF FIGURES xi

CHAPTER ONE 1

INTRODUCTION 1

1.1 Background of the Study 1

1.2 Statement of the Problem 2

1.3 Research Questions 3

1.4 Objectives to Study 3

1.5 Hypothesis 4

1.7 Scope of The Study 4

1.8 Limitations of Research 5

TABLE OF CONTENT

1.6 Significance of The Study .... Error! Bookmark not defined.

1.9 Organization of the study 5

CHAPTER TWO 6

LITERATURE REVIEW 6

2.0 Introduction 6

2.1 The Definition and Overview of Male and Female Life Expectancy 6

2.2 Method for Calculating Life Expectancy 7

2.3 Other Related Studies 8

CHAPTER THREE 19

METHODOLOGY 19

3.0 Introduction 19

3.1 Setting 19

3.2 Population of Study 20

3.3 Data 20

3.4 Methods 20

3.5 Lee Carter 21

3.5.1 Assumptions of the Lee Carter Model 22

3.6 The Cairns, Blake and Dowd (CBD) Model 23

3.6.1 Assumptions Cairns, Blake and Dowd (CBD) Model 24

3.7 Age-Period-Cohort Model (APCM) 24

3.7.1 Assumptions of Age-Period-Cohort Model 26

3.8 Plat Model 26

3.9 Hotelling's T^2 Test 30

3.10 Log-Rank Test 31

DATA ANALYSIS AND DISCUSSION 32
4.0 Introduction **32**
4.1 A construction of life tables **32**
4.3 Abridge Life Table **32**
4.1.1: Abridge Life Table for Males in 2013 32
4.1.2 Abridge Life Table for Females in 2013 34
4.2.1 Abridge Life Table for Males in 2014 35
4.2.2 Abridge Life Table for Females in 2014 36
4.3.1 Abridge Life Table for Males in 2015 37
4.3.2 Abridge Life Table for Females in 2015 38
4.4.1 Abridge Life Table for Males in 2016 39
4.4.2 Abridge Life Table for Females in 2016 40
4.5.1 Abridge Life Table for Males in 2017 41
4.5.2 Abridge Life Table for Females in 2017 42
4.6.1 Life Expectancy for Males (2013 – 2017) **43**
4.6.2 Life Expectancy for Females (2013 – 2017) **45**
4.7 Projection Models **46**
4.7.1 APC Model **46**
Male Life expectancy Projection Using APC Model 46
Female Life expectancy Using APC Model 47
4.7.2 CBD Model 48
Male Life expectancy Using CBD Model 48
Female Life expectancy Using CBD Model 49
4.7.3 Lee Carter Model 50
Male Life expectancy Using Lee Carter Model 50
Female Life expectancy Using Lee Carter Model 51
4.7.4 Plat Model 52
Male Life expectancy Using Plat Model 52
Female Life expectancy Using Plat Model 53
4.9 Testing for the equality of survivor functions among Gender **54**

4.10 Testing for the difference between Actual Life Expectancy and Projection of Life Expectancy among Male and Female. **55**

SUMMARY. FINDINGS AND RECOMMENDATION

5.0 Introduction **58**

5.1 Summary **58**

5.2 Summary of Findings **58**

5.3 Conclusion **59**

5.4 Recommendation **60**

References 62

Appendix A 65

LIST OF TABLES

Table **Page**

Table 4.1A: Abridge Life Table for Males in 2013 33
Table 4.1B: Abridge Life Table for Females in 2013 34
Table 4.2A: Abridge Life Table for Males in 2014 35
Table 4.2B: Abridge Life Table for Females in 2014 36
Table 4.3A: Abridge Life Table for Males in 2015 37
Table 4.3B: Abridge Life Table for Females in 2015 38
Table 4.4A: Abridge Life Table for Males in 2016 39
Table 4.4B: Abridge Life Table for Females in 2016 40
Table 4.5A: Abridge Life Table for Males in 2017 41
Table 4.5B: Abridge Life Table for Females in 2017 43
Tables 4.6A: Life Expectancy for Males (2013 – 2017) 44
Table 4.6B : Life Expectancy for Females (2013 – 2017) 45
Table 4.7A: Male Life expectancy Projection Using APC Model 47
Table 4.7B: Female Life expectancy Projection Using APC Model 48
Table 4.8A: Male Life expectancy Projection Using CBD Model 49
Table 4.8B: Female Life expectancy Projection Using CBD Model 50
Table 4.9A: Male Life expectancy Projection Using Lee Carter Model 51
Table 4.9B: Female Life expectancy Projection Using Lee Carter Model 52
Table 4.10A: Male Life expectancy Projection Using PLAT Model 53
Table 4.10B: Female Life expectancy Projection Using PLAT Model 54
Table 4.11: Log-rank test 54
Table 12: Hotelling's T^2 Test 55
Table 13: Identifying Which Projection Models Significantly Differs from Zero 56

LIST OF FIGURES

Figure **Page**

Figure 4.1: Life Expectancy chart for males.. 44
Figure 4.2: Life Expectancy chart for females.. 46

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

From the international perspective, it is believed that mortality trends have improved converging to a single long-term rate as reported by CMI (Continuous Mortality Investigation) mortality projection model. It is however been reported that for some countries there have been records of very low levels of longevity due to various harsh economic conditions and health factors. Statistics, according to the world data show that there is a 3.6 greater percentage of life expectancy in females than in males. Mortality trends reduced from 2-3% from 2000 to 2010. There has consequently been a dramatic decline in mortality just as recorded globally by (WHO). Life expectancy has increased from 46.5 years in 1950-1955 to 66.0 years in 2000–2005, and is expected to rise to 76 years by the 2045–2050.

Whereas most countries progress through the stages of demographic transitioning, there are however changes in population structure, notably size and age composition, so that by the end of the demographic transition, there is a typical population which is both larger and older. In Ghana, mortality is still moderately high as life expectancy at birth is still below 60 years and fertility (measured by total fertility rate) has declined moderately from 6.4 in 1988 to 4.4 children per woman in 2003 and then to 4.0 in 2008.

In recent years, statisticians and actuaries armed with the above information about mortality have made efforts to project or for want of a better word forecasted the life expectancy of male and female both globally and internally. Mortality is preferably projected due to the unreliability of the deterministic methods and its inability to fully take into account the variability in demographic processes across countries or to indicate a range of future population outcomes. Alkema et al. (2011), came out with subsequent methods of probability projection of fertility in all countries and was implemented in the WPP 2010 (United Nations 2011). The simplest method of forecasting mortality is to project life expectancy and use either recent mortality patterns or model life tables to obtain the age pattern required for use in cohort-component methods (Booth, 2006). Given missing and frequently inaccurate data for many countries, this method is used by the UN for most countries.

A probabilistic approach to projecting life expectancy for males has been developed by Raftery et al (2013) and is an extension of the UN's current method. It models life expectancy in a country as a random walk with a non-constant drift, where the drift term is a nonlinear function of current life expectancy and reflects varying rates of improvement for countries at different levels of life expectancy.

1.2 Statement of the Problem

Life expectancy being a major indicator of health and economic growth has gained much recognition in the government sector. The pace of population ageing is progressing faster in developing countries. As a result, developing countries will have less time to prepare for, and adjust to the consequences of population ageing. There are several implications of aged population on the socio-economic development of the country. Hence projection of life expectancy is very significant for the development of every country. A population with a substantial proportion having a high life expectancy has implications for the size and composition of its labour force being high as well, their participation in economic activities being good and the economic growth of the country being fast growing is overwhelming. For instance, older people tend to work less, meaning that they offer less labour, productivity and capital to economies. Similarly, the capacity to save may diminish with age, which could impact on the generation of savings in the economy as a greater number of persons grow older. This may also have implications for the level of savings and availability of investment finance at both the national and individual levels.

Despise all these benefits in projection of life expectancy, Africa lacks the empirical demographic data, to project its life expectancy and thus has limited data to planned for the consequences of the dynamics (ageing and young) in population. It is in this light that, this research projected the life expectancy of people living in the Accra Metropolitan Area (AMA).

1.3 Research Questions

- What are the male and female life expectancy of people in the Accra Metropolitan area?
- What are the mortality rates by Gender?
- Has there been a significant rise or fall in the projection of life expectancy among males and females within the past decade?
- Which model fits better among selected stochastic models?

1.4 Objectives to Study

The main objective is to project the male and female life expectancy of people living in the Accra Metropolitan Area. The study seeks to find out the specific objectives to the study which are:

- To check for the life expectancy of men and women at birth.
- To examine the mortality rates by Gender.
- To identify whether there has been a significant rise or fall in the projection of life expectancy among males and females within the past decade.
- To identify the stochastic models that best fit Ghanaian mortality.

1.5 Hypothesis

The study tests two major hypothesis

H_0: There is no difference between male and female life expectancy.

H_1: There is a significant difference in male and female life expectancy.

H_0: There is no change in the projection of life expectancy among male and female.

H_1 : There is significant rise in the projection of life expectancy among male and female.

1.6 Significance of the Study

This research has many benefit for Ghana, they are as follows:

- ✓ In the health sector, it is a very important indicator for determining good or poor health of individuals.
- ✓ It also enables the government to do budgetary allocations of state funds.
- ✓ It provides the social security service to make good pension schemes for their clients.
- ✓ The insurance companies also find it very useful for planning and implementing social policies.
- ✓ To the statistician it helps in coming up with statistical models for socio-economic benefits.

1.7 Scope of The Study

The research is basically centred on indigenes living in the Accra Metropolitan Area. The study employs the use of the abridged life table which exhibit five-year interval ages of individuals starting from 0 year to infinity. This is done to enable the researcher to estimate certain parameters required for life expectancies and in this case providing means of forecasting results with the use of forecasting models.

1.8 Limitations of Research

Despite the efforts to minimise all limitations, there were certain constraints within which the research was done. The major limitations were the vast nature of the geographical area and the delay in attaining data from the district and regional offices of health agencies.

1.9 Organization of the study

The first chapter is the introduction of the study which focuses on the Background to the Study, Statement of the Problem, Research Questions, Objectives and Significance of the Study. The second chapter provides a review of relevant literature on life table and competing risk. Chapter three discusses the research methods which includes the research design, the setting, the target population, and data collections. Chapter four presents the results and chapter five presents the conclusion and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter seeks to provide both an emphatic and detailed information on other related literature of the study. This information will be based on how various studies of male and female life expectancies were jointly calculated and projected into the future.

This type of review is a systematic review which exposes the details of projections in life expectancies. A systematic review is a type of review focused on research question trying to identify, appraise, select and synthesize all high-quality research evidence and arguments relevant to that question. Projections or to further describe the prediction of male and female life expectancies has been studied by many given the fact that most deterministic approaches have in most times failed. Lee Carter, Namboodiri, & Suchindran, Esteban Ortiz-Ospina and many others just to mention but a few have talked extensively about life expectancy with regards to projections. Lee Carter et al realised an increase in life expectancy when they examined mortality data from US data. In relation to the said research we want to find out which of the researchers explored the best approaches as the study in question wants to examine.

2.1 The Definition and Overview of Male and Female Life Expectancy

Life Expectancy as the average number of years a person of a specific age is expected to live, assuming age-specific mortality rates remain constant. This is a definition coined out by demographers of Organisation for Economic Co-operation and Development (OECD) Health Data 2007. Life Expectancy is one of the major indicators of health and socio-economic development in the world. In our attempt to calculate life expectancy we use data on age-specific deaths within the specific catchment area. However, in practice, getting information on this data is quite difficult due to poor or insufficient record-keeping. There are two types of Life Expectancies which are named as follows; **Cohort Life Expectancy** and **Period Life Expectancy**. By definition, the *Cohort Life Expectancy* takes into account observed and projected improvements in mortality for the cohort throughout its lifetime (Esteban Ortiz-Ospina, August 2017). The *Period or otherwise known as Hypothetical Life Expectancy* on the other hand consists of estimating the length of life for a hypothetical cohort assumed to be exposed from birth to death to the mortality rates observed at a given year.

2.2 Method for Calculating Life Expectancy

A life table is a statistical table which shows at each age the probability a person will die before his or her next birthday (Namboodiri, & Suchindran, 2013). It is also used extensively in biology and epidemiology. The life table just like life expectancy has two major types, the cohort and full life table. The abridge life table basically comprises of five-year age group whereas the complete life table is made of single years from 0 to infinity. The life table consists of eleven main components and these are *x* the beginning years, *n* the difference in years, the age group, q_x the probability of dying, p_x the probability of surviving, d_x the number of deaths, l_0 the radix and l_x surviving at age x, L_x the number of person years between age x and $x + n$, T_x number people surviving after age x and e_x the life expectancy at age x. To calculate for life expectancy, you go through a systematic process of calculating for all the various variables. At the initial stage, one however is to calculate the probability of dying at a given age x. This is done by using the formula which goes by

$$q_x = \frac{nM_x}{1+n(1-na_x)M_x} .$$

The formula above shows the q_x which is the probability of dying at age x.

- nM_X = Age specific death rate ,
- na_x = the assumption that an individual will die within specific age range x
- n = the number of years within the interval x and x+1.

After going through the formula to arrive at q_x the probability of dying we then find the reverse that is the probability of surviving which simply is calculated as 1 less the probability of dying $(1 - q_x)$. We then define a given radix which is then multiplied to the px at age level 0 and below. We then make reference to the formulae in the other component to finally arrive at the last component which is e_x, the Life Expectancy. However, in the full Life table this can be calculated with a formula briefly. The formula in question is

$$e_x = \frac{\sum_{i=x}^{\infty} l_x}{l_x} + \frac{1}{2}$$

2.3 Other Related Studies

This section concerns itself more with the different models that have been used by other researchers and how well it worked and which gives the best results with errors. Some researchers such as Alho and Spencer (2005), Booth (2006), Keilman (2001) and Lee and Carter (1992), have made effort to research on some forecasting models for life expectancy. They took data from Italy and US Human Mortality Database and realised an increase in female life expectancy. They then extrapolated the stochastic process using the ARIMA model in time series analysis. By modelling stochasticity, the researchers allowed the gap to diverge from its median value. The corresponding values for male Italians was 0.2 whiles 0.25 was recorded for females, then 0.28 was recorded for US females and 0.17 for US males. It was realised that modelling a linear function mortality converges but never rises above the line of best practice. Due to the fact that the gap does not fall to zero means the record-holding country cannot be determined exactly. In conclusion the study combined separate forecasts on best practices and gap. The discrete geometric Brownian model sometimes produced erratic results.

In another approach other researchers such as Bongarts (2005), Markhem (1860) and Booth (2006) used two components and they are the youth-to-adulthood and the old-to-the-oldest-old. They also adopted the ARIMA model in forecasting the Life Expectancy. The above-mentioned researchers also made use of the following functions which include the CH function, Compertz-Makenham function and the Logistic function. The CH function was then used to estimate the life table parameters. The annual parameters were taken from the US Life Table. The observed standard deviation of the females was lower than that of the males. The sample kurtosis for both male and female was negative with moderate magnitudes of values -1.32 and 0.26. Two tests of stationarity were used and these include the Dicky Fuller and the Phillips Perron tests of stationarity. For forecast of Life Expectancy of 40 and 65 years the mean absolute error and mean absolute percentage error were both relatively small. Comparing the models which are the CH model, the Bongart and For the Lee Carter Model it was realised that the model provided a less satisfactory life expectancy forecast at age 50. In all the CH Model provides the best fitting model since it falls directly on the actual.

According to some renowned researchers there is difficulty in the measurement of a country's health status since it is normally determined by social, economic and environmental factors. The total Turkish health expenditure accounted for 7.7% of the Gross Domestic Product. However, life expectancy in Turkey increased by over 20 years between 1960 and 2004, which stood by 71.2 years which is still below the OECD average. Murthy and Okunade (2016), conducted a study on the elasticity of life expectancy using Auto Regressive Distributed Lag Approach. Secondly, they wished to implement parameter stability to ascertain stability or instability.

As Lee and Miller (2001), point out, without weighting, the longer-horizon forecasts would count for less than the shorter-horizon forecasts. On the one hand, long-term horizons are both harder to predict and more relevant to the debate over the Trustees' ultimate rates of mortality decline. On the other hand, it is difficult to know how to compare a forecast made in 1952 based on state-of-the-art knowledge at the time with a forecast made more than 40 years later. In addition, the Trustees 'forecasts of life expectancy at birth have tended to be farther from actual values than have their forecasts of life expectancy at age 65. Because the majority of deaths occur after age 65, the age-65 measure could be judged to be more relevant for the Social Security Trustees Report; however, the literature reviewed for this article more commonly describes mortality improvements in terms of life expectancy at birth.

The Government Actuary's Department of the United Kingdom recently conducted an extensive review of its mortality projection methodology. This review included testing its current method of historical extrapolation and targeting against various other methods of mortality projection, including a variant of the Lee–Carter method (the type of method used by the 1993 and 2003 Technical Panels). The Government Actuary's Department of the United Kingdom found that their current method outperformed the Lee Carter method; specifically, they were better able to incorporate cohort differences using their method. In the United Kingdom, historical data show that birth cohorts 1925 through 1945 have experienced greater levels of mortality decline than those born on either side of this period, but it is not known why these cohort effects have occurred (Gallop, Adrian & Thompson, 2003).

A review of mortality projections leads one to conclude that differences of opinion correspond to some extent to the area of professional training. For example, when the Society of Actuaries conducted a survey of 79 experts from Canada, Mexico, and the United States, actuaries and economists tended on average to project lower rates of mortality decline than did demographers, and demographers tended to have a greater spread (standard deviation) between their opinions.

Although the majority of official forecasters adjust their extrapolations by using expert judgment, this approach is not without its criticism. A common critique of official forecasts is that the historical time period chosen to inform the long-term forecasts is frequently too short. For example, Mathews, MacDorman and Thoma (2015), discussed the tendency for forecasters to react to short-term fluctuations in mortality rates. When the rate of mortality decline slowed in the 1950s and 1960s, many forecasters predicted that the rise in life expectancy was over (Mathews, MacDorman & Thoma, 2015).

Olshansky (1988), examined the accuracy of the Trustees' forecasts over time and came to a similar conclusion. He states that the Trustees underestimated the pace of mortality decline in the 1970s because they were extrapolating the slow pace of mortality decline of the 1950s and 1960s. He adds that in the first half of the 1980s, the Trustees overestimated the pace of mortality decline (particularly for females) because they were extrapolating the fast pace of mortality improvement of the 1970s. However, unlike Wilmoth, Olshansky concludes that this highlights a flaw in the use of extrapolation models rather than a flaw in the length of the time periods selected for extrapolation.

Lee and Miller (2001), compared the performance of the forecasts of the Lee–Carter age-extrapolation model with that of the Trustees' past forecasts. Beginning with 1945 as a jump-off year, they found that the Lee–Carter model tended to underpredict gains in life expectancy but always predicted a life-expectancy value for 1998 that was within 2 years of the actual life-expectancy value for 1998 (Lee & Miller, 2001).By comparing the divergence from actual values in their forecast starting in 1950 with the Trustees' forecasts starting in 1950, Lee and Miller (2001), conclude that Social Security projections also have systematically underpredicted future gains in life expectancy at birth since 1950 (p. 547) but that the Trustees' divergence from actual life expectancy was greater than that of the Lee–Carter model.

Lee and Miller (2001), find systematic underprediction of gains in life expectancy by the Trustees when they give each decade since 1950 an equal weight; however, since 1980, the Trustees forecasts have diverged much less from the actual value in 2000 than they did before 1980. They have also not been consistently below the actual value since 1980 and also recorded a significant difference between past Trustees forecasts of life expectancy and actual life expectancy in 2000.

Although the two technical panels used international mortality experience to guide their recommendations, some researchers have gone farther by incorporating international experience directly into their forecasts for the United States. In addition, in contrast to the two technical panels and the Trustees, these researchers extrapolate trends in life expectancy, rather than trends in age-specific death rates, into the future. Note, however, that the technique of extrapolating trends in life expectancy into the future does not by itself provide the details required to project the population, as is done in the Social Security Trustees Report, because population projections require death probabilities by age and sex. The life-expectancy projections reached by life-expectancy extrapolations could theoretically be achieved by numerous combinations of age and sex death probabilities, which in turn implies theoretically numerous population projections.

White (2002), compared the fit of linear changes in life expectancy at birth with age-specific (both logged and unlogged) linear changes in life expectancy and found that linear changes in life expectancy fit average changes in mortality over time better than age-specific death rates. He used mortality data from 1955 through 1991 for his research (because that was the time period available in his data set). He also found evidence for convergence to group-average life expectancy among a group of high-income countries over time. In general, the lower the starting level of life expectancy for an individual country, the faster the average change in life expectancy. A developed country's life expectancy relative to the group average at the time of prediction was an even more powerful statistical predictor.

Thus, White (2002), favours extrapolating an individual country's life expectancy in the context of a model that measures convergence to average life expectancy among the group of high-income developed countries. He suggests that evidence of convergence among developed nation’s means that it may be dangerous to predict future life-expectancy trends for a specific country by only extrapolating from that country's own mortality experience. For example, Tuljapurkar, Li and Boe's (2000), using individual countries' mortality rates project the life expectancy at birth between Japan and the United States widens to 8 years by 2050. White (2002), believes that such a gap would be surprising, because it has not been observed since the 1950s in the seven-leading industrial (G7) countries. The gap is also almost twice the size of the largest gap between G7 countries in the 1980s or 1990s. In contrast, White's model predicts that the United States' rate of increase in life expectancy will speed up a little and that Japan's rate of increase will slow down. In this way, White (2002), implicitly assumes that the United States' divergence from average life expectancy is a temporary stochastic fluctuation below the mean and that Japan's divergence is a temporary fluctuation above the mean.

The pattern of decline in the gap in life expectancy has been observed only for high-income countries, and for some emerging economies. The question then arises: should we project that other countries will also follow this pattern? Vallin (2005), argued that there is no reason why the experience of English-speaking countries and Scandinavian countries (now extended to most high-income countries) should not become generalized, enabling men in most places to eventually regain some of the ground they lost during the 20th century. Bongaart (2009), agreed that mortality patterns observed for high-income countries will most likely be followed by others: There is an expectation that, as developing countries evolve, they will also get rid of non-senescent mortality, since non-senescent deaths unrelated to aging (e.g., accidents, certain infections) can be avoided by effective public health and safety measures and through medical intervention.

We note also in that non-OECD countries have much lower female life expectancy than OECD countries, and it is only at high levels of female life expectancy that a narrowing in the sex gap has been observed. Thus, it is plausible that the reversal has not yet been seen in most non-OECD countries simply because they have not yet reached the female life expectancy level at which the gap begins to narrow.

Between 1950 and 2010, several countries experienced events that have had a significant impact on the gap between female and male life expectancy. The gap in Bosnia and Herzegovina increased gradually from 2.2 to 5.3 years between 1950–1955 and 1985–1990, then jumped to 17.3 years in 1990–1995 during a period of conflict before falling to 5.4 years in the next quinquennium. Similarly, the gap in Iraq increased from 6.3 years in 1980–1985 to 12.7 years in 1985–1990, and remained at approximately that level until the 1995–2000 quinquennium, when it dropped to 5.6 years. Because we can expect such shocks to continue to occur in the future, we must allow for outliers in our model.

Ours is not the first attempt to deal with outliers in mortality data. Hyndman, Shahid and Ullah (2007), used robust statistics in developing their method for forecasting age-specific mortality and fertility rates observed over time. Hyndman et al. (2007), identify and remove data associated with extreme events. In order to allow for outliers in projections Hyndman et al. (2007), use the t-distribution rather than the normal distribution to model random perturbations, and estimate the parameters of the t-distribution, including the number of degrees of freedom. Using the maximum likelihood method of Lange et al (1989) and Taylor and Verbyla (2004) Hyndman et al. (2007), found that the t-distribution tended to generate outliers similar qualitatively to those observed in the data, but also occasionally generated very large outliers of much greater magnitude than any observed in the data. As a result, Hyndman et al. (2007), truncated the predictive distribution, with the truncation points estimated from the data. This gave a model that yielded outlying values of the gap similar to those observed historically, but not very extreme outliers beyond the range of experience

The project the gap in life expectancy by simulating a large number of future trajectories from a linear regression model with BHM female life expectancy projections as a covariate. For each simulated value of the gap, Raftery, Lalic, and Gerland (2014), subtract it from a simulated value of female life expectancy projection to obtain the corresponding simulated male life expectancy projection. The result is a large number of (female e_o, male e_o) pairs, which form a sample from the joint predictive distribution sought. Raftery, Lalic, and Gerland (2014), in their research used female rather than male life expectancy as a basis for projecting the gap because female life expectancy tends to be more stable and more accurately measured. For comparison purposes, however, they also build a model for the gap using male life expectancy projections from the BHM for comparison. They proposed model for the gap in life expectancy at birth between females and males represents the gap, $G_{c,t}$ for country c in the current quinquennium, t, as a linear combination of four terms. These are: the gap in the previous quinquennium, $G_{c,t-1}$; female life expectancy at birth in the first quinquennium in their dataset (1950–

1955),$e_{f0,c,1953}$; female life expectancy at birth in the current quinquennium, $e_{f0,c,t}$; and the number of years by which $e_{f0,c,t}$ exceeds τ, namely $e_{f0,c,t-\tau}$,. The quantity τ is the level of female life expectancy at which the gap is expected to stop widening and to start narrowing. Finally, at the highest observed levels of female life expectancy and beyond, denoted by ages *A* and greater, the gap is modelled as a random walk with normally distributed changes and no drift.

Following the method first proposed by Carter & Lee (1992), the United Nations models female and male life expectancy independently, using a modification of the method to ensure that projections for the two sexes do not diverge (Li & Lee 2005). In fact, with the exception of the few studies designed specifically to forecast the gap in life expectancy between the sexes, all existing methods we reviewed project life expectancy for each sex independently (Soneji & King 2011, Shang et al. 2011, Cairns et al. 2011, Bongaarts 2009, Haberman & Renshaw 2008, Hyndman & Shahid Ullah 2007).

BHM is also designed as a one-sex model. To obtain joint probabilistic projections of female and male life expectancy, we need to model the relationship between the two. We opt to do this by projecting the gap in life expectancy by ordinary least squares regression using female life expectancy as a covariate. In this chapter, we provide a description of our model, as well as a justification for our choices.

The pattern of decline in the gap in life expectancy has only been observed for high-income countries, and for some emerging economies. The question then arises: should we project that other countries will also follow this pattern? Vallin (2005) observed that τ here is no reason why the experience of English-speaking countries and Scandinavian countries now extended to most high-income countries should not become generalized, enabling men in most places to eventually regain some of the ground they lost during the 20th century. Bongaarts (2009), agrees that mortality patterns observed for high-income countries will most likely be followed by others: there is an expectation that, as developing countries evolve, they will also get rid of nonsenescent mortality, since non-senescent deaths unrelated to ageing (e.g., accidents, certain infections) can be avoided by effective public health and safety measures and through medical intervention.

Bongaarts (2009), also draw distinguished feature between OECD and non-OECD countries and found out that non-OECD countries have much lower female life expectancy than OECD countries, and it is only at high levels of female life expectancy that a narrowing in the sex gap has been observed. Thus, it is plausible that the reversal has not yet been seen in most non-OECD countries simply because they have not yet reached the female life expectancy level at which the gap begins to narrow.

Over the period 1950-2010, several countries experienced events that have had a significant impact on the gap between female and male life expectancy. Indeed, the gap in Bosnia and Herzegovina increased from 2.2 years to 5.3 years between 1950-1955 and 1985-1990, then jumped to 17.34 in 1990-1995 during a period of conflict before falling to 5.4 years in the next quinquennium. Similarly, the gap in Iraq increased from 6.33 years in 1980-1985 to 12.68 years in 1985-1990, and remained at approximately that level until the 1995-2000 quinquennium, when it dropped to 5.6 years. Because it is possible short-term shocks such as wars and epidemics to occur in the future, Bongaarts (2009), allow for outliers in their model. Hyndman & Shahid Ullah (2007) used robust statistics in developing their method for forecasting age-specific mortality and fertility rates observed over time. Their focus was to identify and remove data associated with extreme events.

2.4 Overview of Previous Chapter

To start with, the work begun from the major preceding chapter which is the first chapter, Chapter one (1). At that stage, the study the main points under the various headings which are, background to study, significance of the study, specific objectives, statement of the problem, limitations of the study, delimitation and the scope of the study. The chapter talks of how the topic under study has gone through various tremendous relay of processes. At the first stage that is background to the study, the study spells out how mortality rate fell at a constant rate and how it managed to rise considerably due to high epidemic conditions and economic hardships in our part of the world. The background also relayed certain statistical figures to buttress what the study thought to bring about. The researcher also found it prudent to discuss the various hurdles or impediments which occurred as result of the study which was discussed under the statement of the problem. Under the specific objectives also, the researcher underlines the various objectives that the study would like to address. The other headings quickly spelt out the challenges that is under the limitations and setting at which the study would be taken.

At the subsequent chapter which is the literature review aspect the writer clearly spells out the research which has been carried out by other researchers. The researcher talks of the overview of the male and female life expectancy which also spelt out the true outline and divulges the two types of life expectancies.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter highlights on the methodology that was used to achieve the desired results of the study. In this section, the researcher focuses on the setting, population of the study, sample techniques and size, data collection instrument, as well as methods of data analysis.

3.1 Setting

The research took place in the central part of Greater Accra in a very busy merchandise district popularly known as Accra Metro. The data was taken from the District Health Service of the Accra Metropolitan Area. Accra Metro district is an urban metropolis with a total population of 1,658,937 from the 2000 census. It is the most densely populated part of the region. It was divided into 6 sub-metros namely Ablekuma, Ashiedu-Keteke, Ayawaso, Kpeshie, Okaikoi, and Osu-Clottey. Up to mid-2004 when the number of sub-metros was increased by legislative instrument to 13 by further sub-dividing the original 6. However, the health sector continues to work according to the old system of 6 sub-metros. It will take time to have adequate human resource and infrastructure to enable the administrative arrangements needed in the health sector to operate 13 sub-metro administrations. The health directorate under the Accra Metro District has a sum total of about 57 hospitals due to the vast nature of the Municipality.

3.2 Population of Study

Considering the population of a study there are two main types which every researcher makes use of. These two include the, General Population and the Target Population. We first and foremost describe the general population as the overall population from which the researcher is going to sample from to make use in the analysis. The target population is also defined as the population which the researcher samples out. For the purposes of this study we would like to use Greater Accra Region as the general population and Accra Metropolitan Municipality as the target population. The population figure as stated in the above section from the 2010 census is said to be 1,658,937 and the general population which is the population of Greater Accra is said to be 2,905,726 also from the 2010 population. The target population would be drafted to their corresponding cohort ages in order to facilitate proper and more accurate research analysis.

3.3 Data

A secondary data was used to conduct the research. This data was taken from the research unit of the Accra Metropolitan Health Service located at Adabraka adjacent to Accra Polyclinic. The data was structured to give the following details which include the five-year age range and the number of deaths per specific age range. The data however was gender specific since the researcher sought to compare the life expectancies between male and female inhabitants. The data was also given in a five-year trend that is from 2013 to 2017.

3.4 Methods

In this project we would employ the use of Life Tables for both gender and compute the life expectancies of the inhabitants living in the required area under study. Hence, the researcher goes through all the necessary calculations on the Life Table systematically.

Since the research has another aspect that focuses on making probability projections of life Expectancies which demands the use of projection models we are going to study a few of them. Normally projection models involve three basic approaches and these are the extrapolation approach, the explanation and the expectation approach. The extrapolative approach makes use of the regularity typically found in age patterns and trends in time. The explanation approach makes use of structural or epidemiological models of mortality from certain causes of death for which the key exogenous variables are known and can be measured. In the past, most methods were simple and were largely based on exogeneity. Below are the various models under discussion;

3.5 Lee Carter

Mortality trends as it stands at the moment has become increasingly important in national policies. The Lee Carter model is therefore described as a benchmark stochastic projection model used in forecasting life expectancy. The Lee Carter method has been extended to have a cohort dimension (Renshaw and Harberman). The Lee Carter model as implemented by the Brouhns et al (2002) assumes a Poisson distribution using a Log link function to target the force of mortality μ_x.. The predictor structure proposed by Lee Carter (1992) assumes that there is a static age function , a unique non-parametric age-period term $(N = 1)$ and no cohort effect is given.

Mortality trends are normally derived using time series projection of the estimated k_t and y_{t-x} generated using univariate ARIMA process under the assumption of independence between period and cohort effects. To estimate the model, Renshaw and Haberman (2006) assume a Poisson distribution of deaths (random components) and use of log function targeting the force of mortality μ_{tx}.

Identifiability of the model can be ensured using the following set of parameter constraints:

$\sum ß^{(1)} = 1,\ \sum k^{(1)} = 0 \quad \sum ß^{(0)} = 1,\ \sum y^{2} = 0$

The Lee Carter Model though simply known as the commonest projection model has other comparative models with more impressive and reliably functional models. In this research we will closely examine these other models for the benefit of reliability and accuracy.

A DIAGRAM OF THE LEE CARTER MODEL

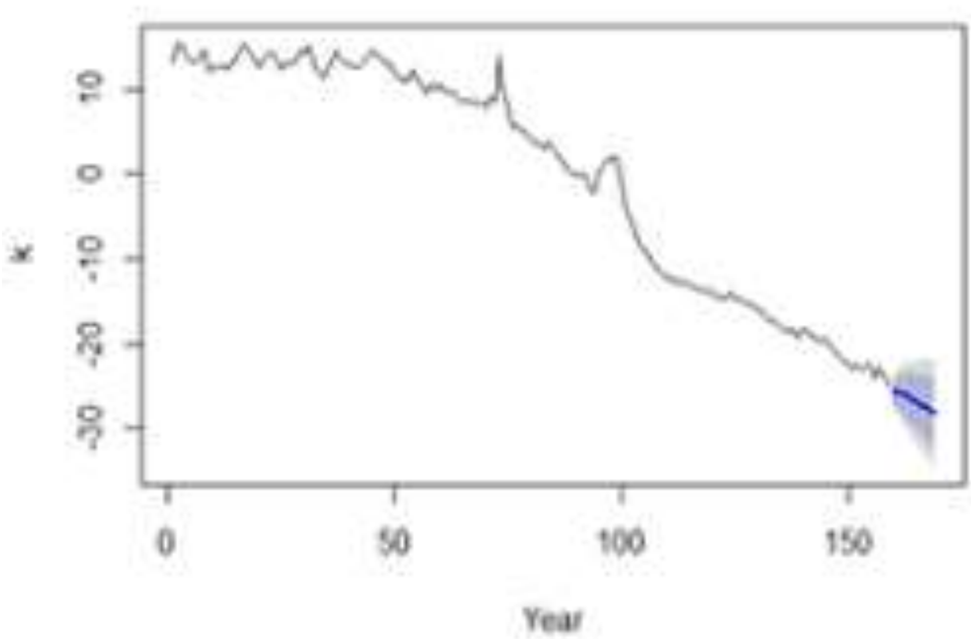

Figure 3.4: Diagrammatic view of the Lee Carter Model

3.5.1 Assumptions of the Lee Carter Model

The following are the assumptions of the Lee Carter Model;

- There is no variations in age-specific parameters: It assumes that combined effects of past processes will remain the same as the future (Lee 2000 : 85) and as such the age-specific mortality change remains constant.
- Relevant length of forecast: Wong- Fupuy and Haberman (2004: 85) and Alho and ‘Spencer (1985: 314) mentioned the issue of a reasonable length for a forecast and questioned the reliability of long-term forecast.

3.6 The Cairns, Blake and Dowd (CBD) Model

The CBD model describes the logit of the initial mortality rate with a slope term and an intercept term, allowing for the number of deaths to follow a Poisson distribution. Future stochastic simulations are then obtained by projecting these two terms as following correlated random walk.

$$log\left(\frac{q_{xy}}{1-q_{xy}}\right) = k_{1,y} + \left[\,(x-\bar{x}\,)\,\mathrm{k}_{2,y}\right] + e_{xy}$$

Where q_{xy} is the initial mortality rate for a life aged x in year ;

$\bar{x}$ is the average of the ages x used in the analysis;

$k_{1,y}$ is the intercept term in year y ;

$\mathrm{k}_{2,y}$ is the slope term in year y ; and

e_{xy} is an error term.

In order to construct the CBD model, it is required that the model on which the mortality indexes are based to be completely robust with respect to an extension of the sample period. That is, when an additional year of mortality data becomes available and the stochastic model is updated accordingly, indexes in previous years will not be affected. This property, which it called the new-data-invariant property, is crucially important, because it would be impossible to track an index if its historical values are revised from time to time.

3.6.1 Assumptions Cairns, Blake and Dowd (CBD) Model

The assumptions of CBD model are as follows;

- There is variability in the trends in mortality in a given population.
- The degree of longevity risk, that is, the risk associated with under- or over-estimating mortality improvements can be observed from the deviations between the expected and actual trajectories of a mortality index.

3.7 Age-Period-Cohort Model (APCM)

The APC model is that the force of mortality or hazard rate, λ_{ij}, at age i and in year j is given by:

$$Log\lambda_{ij} = \alpha_i + \kappa_j + \gamma_{j-1}, \qquad i = 1, \ldots, n, j = 1, \ldots, n$$

In the APCM model, the estimation method, whether frequentist (e.g. maximum likelihood) or Bayesian (e.g. MCMC), aims to minimise the amount of unexplained variation in the model (O'Brien, 2016). In the APCM model, the period and cohort random effects are considered, at least in part, unexplained, since they are in the random part of the model, whilst the age trend is considered explained since it is in the fixed part. The model will thus apportion variation to the trends in such a way that makes those unexplained components as small as possible, regardless of its effect on the explained part (the age parameter estimates).

Imagine, for example, the true APCM of a model consists only of a linear cohort trend with a slope of 1. In this case, the APCM model could assign the linear trend (correctly) to the cohort residuals, or it can apply it to the period trend, with an additional age trend in the opposite direction estimated in the fixed part of the model, cancelling it out. Adding a slope to the age trend does not in any way increase or decrease the unexplained variance, so the question is which of the periods or cohorts increases the unexplained variance the most. The answer is the cohorts, because it has a wider range. The random effects attached to the very new and very old cohorts will be much bigger than the equivalent random effects for periods, because a trend with a slope of 1 that spans 95 years (the range of cohorts) will reach much higher and lower values than a slope with the same gradient that spans 26 years (the range of periods), as shown clearly in Fig. 3.2, in Bayesian estimation, the larger variance of the cohorts would also make the effective number of parameters greater (a wider spread of cohorts results in those cohort residuals counting as more effective parameters (Spiegelhalter et al., 2002).

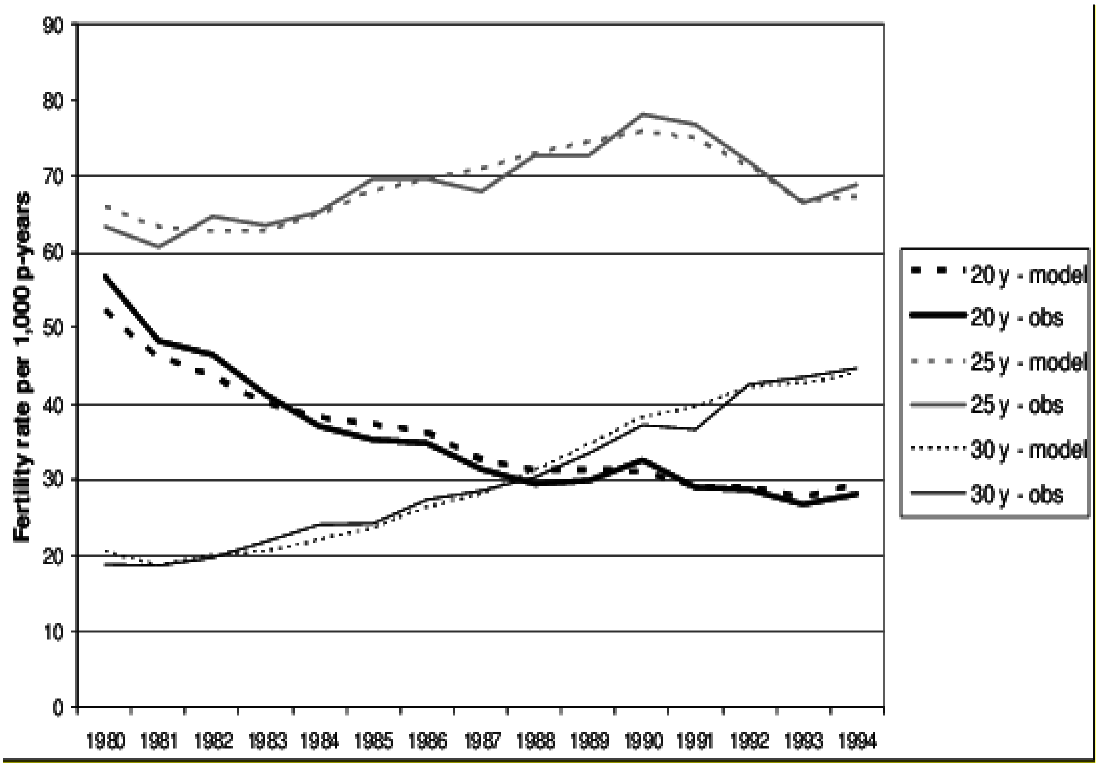

Figure 3.2: A Diagram on Age-Period-Cohort Model

3.7.1 Assumptions of Age-Period-Cohort Model

The Age-Period-Cohort Model comes with the following assumptions;

- There is no limit in systematic changes to simple linear trends.
- There is a degree of curvature for the factor at the right.

3.8 Plat Model

The Plat model combines the CBD model with some features of the Lee Carter to produce a model that is suitable. The proposed predictor structure assumes that there is a static age function, α_x three age-period terms $(N = 3)$ with pre-specified age-modulating parameters. $\beta^{(1)} = 1, \beta^{(2)} = \bar{x},, \beta^{(3)} = x - \bar{x} = \max(0, \bar{x} - x)$ and a cohort effect with pre-specified age-modulating parameters, $\beta^{(0)} = 1$.

Thus, the predictor is given by:

$$\eta_{xy} = \alpha_x + k_1^{(1)} + (\bar{x} - x)k_t^{(2)} + (\bar{x} - x) + k_t^{(3)} + \gamma_{t-x}$$

Plat (2009), targets the force of mortality μ_{xt} with the log link and estimates the parameters of the model by assuming a Poisson distribution of the deaths. The following parameter transformation leave in unchanged. $\left(\alpha_x + \Phi_1 - \Phi_2 x^2 k_1^{(1)} + \Phi_2 t + \Phi_2(t^2 - 2ft)\right)$

$$\left(\alpha_x, k_1^{(1)}, k_t^{(2)}, \gamma_{t-x}\right) \longrightarrow \left(\alpha_x + \Phi_1 - \Phi_2 x^2 k_1^{(1)} + \Phi_2 t + \Phi_2(t^2 - 2ft)\right)$$

$$\left(k_t^{(2)} + 2\Phi_3 t k_t^{(3)} + \gamma_{t-x} - \Phi_1 - \Phi_2(t-x) - \Phi_3(t-x)\right)$$

$$\left(\alpha_x, k_1^{(1)}, k_t^{(2)}, \gamma_{t-x}\right) \longrightarrow \alpha_x + c_1 - c_2(\bar{x} - x) + c_3(\bar{x} - x)k_1^{(1)} - c_2 k_t^{(3)} - c_3\gamma_{t-x}$$

where $c_1, c_2, c_3, \Phi_1, \Phi_2$ *and* Φ_3 are any real constants. The following set of parameter constraints can be imposed to ensure identifiability:

$$\sum k_t^{(1)} = 0, \sum k_t^{(2)} = 0, \sum k_t^{(3)} = 0, \qquad \sum_{c=t1-xt}^{tn-x1} \gamma c = 0 \quad \sum_{c=t1-xt}^{tn-x1} \gamma c = 0$$

The first three constraints ensure that the period indexes are centred around zero while the last three constraints ensure that the cohort effect fluctuates around zero and has no linear or quadratic trend. Following Haberman and Renshaw (2011, Appendix A), the constraints on the cohort effect can be imposed by applying transformation with constants $\sigma_1 - \sigma_2$ and σ_3 obtained by regressing γ_{t-x}, on $(t-x)^2$, so that

$$\gamma_{t-x} = \phi_1 - \phi_2(t-x) + \phi_3(t-x)^2 + \varepsilon_{t-x} \qquad \varepsilon_{t-x} \sim N(0, \sigma^2)$$

The constraints on the period indexes can be imposed by applying transformation with the omission of the transformation with:

$$C_t = \frac{1}{n}\sum_t k\,(i) \qquad i = 1,2,$$

In the cases where only older ages are of interest, Plat (2009) suggests to drop the third period from predictor.

$$\eta_{xy} = \alpha_x + k_1^{(1)} + (\bar{x} - x)k_t^{(2)} + (\bar{x} - x) + k_t^{(3)} + \gamma_{t-x}$$

we note that this reduced Plat model has the same identify ability issues as the complete model with the omission of the transformations and constraints involving $k_t^{(3)}$ and c_3.

Table 3.1: A Table Showing The Various Models And Their Predictors

Model	Predictor
LC	$\eta_{xt} = \alpha_x + \beta_x^{(1)}\kappa_t^{(1)}$
CBD	$\eta_{xt} = \kappa_t^{(1)} + (x - \bar{x})\kappa_t^{(2)}$
APC	$\eta_{xt} = \alpha_x + \kappa_t^{(1)} + \gamma_{t-x}$
RH	$\eta_{xt} = \alpha_x + \beta_x^{(1)}\kappa_t^{(1)} + \gamma_{t-x}$
M7	$\eta_{xt} = \kappa_t^{(1)} + (x - \bar{x})\kappa_t^{(2)} + \left((x - \bar{x})^2 - \hat{\sigma}_x^2\right)\kappa_t^{(3)} + \gamma_{t-x}$
PLAT	$\eta_{xt} = \alpha_x + \kappa_t^{(1)} + (\bar{x} - x)\kappa_t^{(2)} + \gamma_{t-x}$

Similarities and Disparities Between the Four Projection Models

In this section we are going to examine the various similarities of the models discussed in the study and by so doing we will adapt the use of a pictorial concept map depicting the similarities between two or more of the models under consideration.

DIFFERENCES BETWEEN LEE CARTER AND CBD FAMILY

LEE CARTER	**CBD**
Common Age Effect	Two population CBD (MS)
Augmented-Common Factor model	Two population M6
Relative Lee Carter Cohorts	Two population M7

3.9 Hotelling's T^2 Test

Let μ_g be the mean absolute difference between the actual life expectancy and the projection models (Lee Carter, CBD, APC, Plat) life expectancy where $g=1,2,3,4$

Hypotheses

$$H_0: \mu_g = 0, \quad g = 1,2,3,4$$
$$H_1: \mu_g \neq 0, \quad for\ at\ least\ one\ g$$

Test Statistic

$$T^2 = \left(\bar{x}-\mu_0\right)' \left(\frac{1}{n} S^{-1}\right) \left(\bar{x}-\mu_0\right)$$

$$= n\left(\bar{x}-\mu_0\right)' S^{-1} \left(\bar{x}-\mu_0\right) \qquad (9)$$

Where

$$\bar{x} = \frac{1}{n}\sum x_i \quad S = \frac{1}{n-1}\sum \left(x_i-\bar{x}\right)\left(x_i-\bar{x}\right)' \text{ and } \mu_0 = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

Decision Rule

Reject H_0 at α the level of significance if

$$T^2 > \frac{(n-1)p}{(n-p)} F_{g,n-g}(\alpha)$$

3.10 Log-Rank Test

Let $e_{1,j}$ be the expected cell counts for male and $e_{1,j}$ be the expected cell counts for female

$$e_{1j} = \left(\frac{n_j}{n_{1j} + n_{2j}}\right) \times \left(m_{1j} + m_{2j}\right)$$

Where $\left(\frac{n_j}{n_{1j} + n_{2j}}\right)$ represent the proportional in the risk set and

$\left(m_{1j} + m_{2j}\right)$ represent the death of both genders, If

$O_i - E_i = \sum_{j=1}\left(m_{ij} - e_{ij}\right)$ then the Log-Rank can be computed as

$$\frac{\left(O_2 - E_2\right)^2}{\operatorname{var}(O_2 - E_2)}$$

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION

4.0 Introduction

This chapter entails the systematic presentation of the analysis of the data collected based the life expectancy of individuals in the Accra Metropolitan Area and the application of four major forecasting models. The analysis includes construction of a Life Table and modelling the life expectancy.

4.1 Construction of life tables

The construction of life table was done in abridged method with all the selected parameters of the abridged life table. This gave a true definition of the life expectances on board.

4.2 Abridge Life Table

An abridge life table was constructed for males and females in order to determine the probability of dying and the expected life for each age interval and gender. The results were presented as follows

4.2.1: Abridge Life Table for Males in 2013

Table 4.1A below represents the abridge life table for males in 2013, the life expectancy (ex) was computed with reference to equation (3.5). For example, in calculating for the life expectancy for ages between 0 and below, $T_x/l_x = 716390.2/10000 = 71.63902$. It was revealed that the life expectancy at birth was 71.64. The highest life expectancy record was 71.64 and it was in the age group of 0 and below. Then the life expectancy begins to decrease as the age group increase. However, from 1-4 years onwards the life expectancy started decreasing. With regards to the probability of dying q_x, from the Table 4.1A, the probability that a male child at birth will not survive to the next year was 0.0081703. Then in the year group of 1 to 4 years the probability of the child dying decreases to 0.0005212. However, in the age group of 5 to 9 years the probability of the male child dying decreases. This implies that at early stage of life the probability a child will die in the age of 0 and below years is very high but when she passes that stage the probability that he will survive increases. According to Marmot (2005) children under 5 years are vulnerable to many deaths due to the fact that their immune system are not well adapted to the environment.

Observing the probability of the people of the old age, it was found that, the probability of dying of them increases rapidly and their life expectancy also decreases. For instance, at age group 70 year above the number of years expected for a female to live is 2.5 years and the probability that she will not survive from the age group is 1.

Table 4.1A: Abridge Life Table for Males in 2013

Age Group	MALE		m_x	q_x	p_x	l_x	d_x	L_x	T_x	e_x
	Pop.	Death								
0 n below	22355	184	0.0082	0.0082	0.9918	10000.0000	81.70	9959.15	716390.19	71.64
1 - 4 Years	67065	35	0.0005	0.0005	0.9995	9918.2970	5.17	39662.85	706431.04	71.23
5 - 9 Years	74890	16	0.0002	0.0002	0.9998	9913.1276	2.12	49560.34	666768.19	67.26
10-14 Years	70666	10	0.0001	0.0001	0.9999	9911.0091	1.40	49551.54	617207.85	62.27
15- 19Years	75309	5	0.0001	0.0001	0.9999	9909.6067	0.66	49546.39	567656.31	57.28
20 - 24Years	98253	13	0.0001	0.0001	0.9999	9908.9487	1.31	49541.47	518109.92	52.29
25-29 Years	92053	16	0.0002	0.0002	0.9998	9907.6378	1.72	49533.88	468568.45	47.29
30-34 Years	73313	19	0.0003	0.0003	0.9997	9905.9158	2.57	49523.16	419034.57	42.30
35-39 Years	56917	34	0.0006	0.0006	0.9994	9903.3482	5.92	49501.94	369511.41	37.31
40-44 Years	45144	36	0.0008	0.0008	0.9992	9897.4310	7.90	49467.41	320009.47	32.33
45-49 Years	31744	50	0.0016	0.0016	0.9984	9889.5348	15.59	49408.70	270542.06	27.36

50 -54 Years	27607	35	0.0013	0.0013	0.9987	9873.9459	12.53	49338.41	221133.36	22.40
55-59 Years	19576	45	0.0023	0.0023	0.9977	9861.4198	22.70	49250.36	171794.95	17.42
60- 64Years	15104	30	0.0020	0.0020	0.9980	9838.7248	19.56	49144.72	122544.59	12.46
65-69 Years	9688	48	0.0050	0.0050	0.9950	9819.1634	48.77	48973.89	73399.87	7.48
70 Yrs Above	21000	89	0.0042	1.0000	0.0000	9770.3926	9770.39	24425.98	24425.98	2.50

4.2.2 Abridge Life Table for Females in 2013

Table 4.1B below represents the abridge life table for females in 2013, the life expectancy (ex) was computed for example, in calculating for the life expectancy for ages between 0 and below, $T_x/l_x = 710848.5/10000 = 71.0848.5$. It was revealed that the life expectancy at birth was 71.08. The highest life expectancy record was 71.08 and it was in the age group of 0 and below. Then the life expectancy begins to decrease as the age group increase. However, from 1-4 years onwards the life expectancy started decreasing with regards to the probability of dying q_x, from the Table 4.1B below, the probability that a female child at birth will not survive to the next year was 0.0069767. Then in the year group of 1 to 4 years the probability of the child dying decreases to 0.0017.

Table 4.1B: Abridge Life Table for Females in 2013

Age Group	FEMALE		m_x	q_x	p_x	l_x	d_x	L_x	T_x	e_x
	Pop.	Death								
0 n below	21935	154	0.0070	0.0070	0.9930	10000.0000	69.77	9965.12	710848.48	71.0848
1 - 4 Years	65805	28	0.0004	0.0017	0.9983	9930.2330	16.88	39687.17	700883.36	70.5808
5 - 9 Years	75482	3	0.0000	0.0002	0.9998	9913.3516	1.97	49561.84	661196.19	66.6975
10-14 Years	79379	5	0.0001	0.0003	0.9997	9911.3818	3.12	49549.11	611634.35	61.7103
15- 19Years	88273	4	0.0000	0.0002	0.9998	9908.2607	2.24	49535.70	562085.24	56.7290
20 - 24Years	108762	23	0.0002	0.0011	0.9989	9906.0165	10.47	49503.90	512549.54	51.7412
25-29 Years	98870	24	0.0002	0.0012	0.9988	9895.5439	12.01	49447.70	463045.64	46.7933
30-34 Years	75111	26	0.0003	0.0017	0.9983	9883.5346	17.10	49374.91	413597.94	41.8472
35-39 Years	59223	20	0.0003	0.0017	0.9983	9866.4302	16.66	49290.51	364223.03	36.9154
40-44 Years	47376	26	0.0005	0.0027	0.9973	9849.7727	27.02	49181.30	314932.52	31.9736
45-49 Years	36903	36	0.0010	0.0049	0.9951	9822.7479	47.91	48993.97	265751.22	27.0547
50 -54 Years	31960	25	0.0008	0.0039	0.9961	9774.8413	38.23	48778.64	216757.25	22.1750
55-59 Years	21741	34	0.0016	0.0078	0.9922	9736.6149	76.12	48492.76	167978.61	17.2523
60- 64Years	16640	23	0.0014	0.0069	0.9931	9660.4901	66.76	48135.56	119485.85	12.3685

65-69 Years	11141	28	0.0025	0.0126	0.9874	9593.7332	120.54	47667.31	71350.29	7.4372
70 Yrs Above	26872	91	0.0034	1.0000	0.0000	9473.1899	9473.19	23682.98	23682.98	2.5000

4.2.3 Abridge Life Table for Males in 2014

Table 4.2A below represents the abridge life table for males in 2014, the life expectancy (ex) was computed for example, in calculating for the life expectancy for ages between 0 and below, $T_x/l_x = 703068.21/10000 = 70.3068206$. It was revealed that the life expectancy at birth was 70.31. The highest life expectancy record was 70.31 and it was in the age group of 0 and below. Then the life expectancy begins to decrease as the age group increase. However, from 1-4 years onwards the life expectancy started decreasing. With regards to the probability of dying q_x, from the Table 4.2A below, the probability that a male child at birth will not survive to the next year was 0.00878703. Then in the year group of 1 to 4 years the probability of the child dying decreases to 0.00160855. However, in the age group of 5 to 9 years the probability of the male child dying decreases.

Table 4.2A: Abridge Life Table for Males in 2014

Age Group	MALE		m_x	q_x	p_x	l_x	d_x	L_x	T_x	e_x
	Pop.	Death								
0 n below	22355	198	0.0089	0.0088	0.9912	10000.0000	87.87	9956.06	703068.21	70.31
1 - 4 Years	67065	27	0.0004	0.0016	0.9984	9912.1297	15.94	39616.63	693112.14	69.93
5 - 9 Years	74890	11	0.0001	0.0007	0.9993	9896.1854	7.27	49462.76	653495.51	66.04
10-14 Years	70666	10	0.0001	0.0007	0.9993	9888.9203	6.99	49427.11	604032.75	61.08
15- 19Years	75309	8	0.0001	0.0005	0.9995	9881.9259	5.25	49396.51	554605.63	56.12
20 - 24Years	98253	23	0.0002	0.0012	0.9988	9876.6791	11.56	49354.51	505209.12	51.15
25-29 Years	92053	27	0.0003	0.0015	0.9985	9865.1232	14.46	49289.46	455854.62	46.21
30-34 Years	73313	30	0.0004	0.0020	0.9980	9850.6608	20.15	49202.94	406565.16	41.27
35-39 Years	56917	31	0.0005	0.0027	0.9973	9830.5136	26.76	49085.66	357362.22	36.35
40-44 Years	45144	46	0.0010	0.0051	0.9949	9803.7490	49.93	48893.94	308276.56	31.44
45-49 Years	31744	55	0.0017	0.0087	0.9913	9753.8191	84.47	48557.94	259382.62	26.59
50 -54 Years	27607	53	0.0019	0.0096	0.9904	9669.3523	92.78	48114.82	210824.68	21.80
55-59 Years	19576	63	0.0032	0.0161	0.9839	9576.5701	154.04	47497.76	162709.85	16.99

60- 64Years	15104	44	0.0029	0.0146	0.9854	9422.5289	137.20	46769.67	115212.09	12.23
65-69 Years	9688	50	0.0052	0.0258	0.9742	9285.3338	239.52	45827.88	68442.42	7.37
70 Yrs Above	21000	84	0.0040	1.0000	0.0000	9045.8125	9045.81	22614.54	22614.54	2.50

4.2.4 Abridge Life Table for Females in 2014

Table 4.2B below represents the abridge life table for males in 2013, the life expectancy e_x was computed for example, in calculating for the life expectancy for ages between 0 and below, $T_x/l_x = 706814.87/10000 = 70.6814868$. It was revealed that the life expectancy at birth was 70.68. The highest life expectancy record was 70.68 and it was in the age group of 0 and below. Then the life expectancy begins to decrease as the age group increase. However, from 1-4 years onwards the life expectancy started decreasing. With regards to the probability of dying q_x, from the Table 4.2B, the probability that a male child at birth will not survive to the next year was 0.00679656. Then in the year group of 1 to 4 years the probability of the child dying decreases to 0.00212433.

Table 4.2B: Abridge Life Table for Females in 2014

Age Group	FEMALE		m_x	q_x	p_x	l_x	d_x	L_x	T_x	e_x
	Pop.	Death								
0 n below	21935	150	0.0068	0.0068	0.9932	10000.0000	67.97	9966.02	706814.82	70.68
1 - 4 Years	65805	35	0.0005	0.0021	0.9979	9932.0344	21.10	39685.94	696848.81	70.16
5 - 9 Years	75482	12	0.0002	0.0008	0.9992	9910.9355	7.88	49534.99	657162.87	66.31
10-14 Years	79379	5	0.0001	0.0003	0.9997	9903.0605	3.12	49507.51	607627.88	61.36
15- 19Years	88273	9	0.0001	0.0005	0.9995	9899.9420	5.05	49487.10	558120.37	56.38
20 - 24Years	108762	29	0.0003	0.0013	0.9987	9894.8965	13.18	49441.53	508633.27	51.40
25-29 Years	98870	33	0.0003	0.0017	0.9983	9881.7135	16.48	49367.37	459191.75	46.47
30-34 Years	75111	38	0.0005	0.0025	0.9975	9865.2360	24.92	49263.87	409824.37	41.54
35-39 Years	59223	37	0.0006	0.0031	0.9969	9840.3126	30.69	49124.84	360560.50	36.64
40-44 Years	47376	43	0.0009	0.0045	0.9955	9809.6216	44.42	48937.07	311435.67	31.75
45-49 Years	36903	47	0.0013	0.0063	0.9937	9765.2047	61.99	48671.05	262498.60	26.88
50 -54 Years	31960	34	0.0011	0.0053	0.9947	9703.2168	51.48	48387.39	213827.55	22.04
55-59 Years	21741	50	0.0023	0.0114	0.9886	9651.7409	110.35	47982.83	165440.15	17.14
60- 64Years	16640	34	0.0020	0.0102	0.9898	9541.3898	96.98	47464.45	117457.33	12.31

65-69 Years	11141	40	0.0036	0.0178	0.9822	9444.4071	168.03	46801.95	69992.88	7.41
70 Yrs Above	26872	119	0.0044	1.0000	0.0000	9276.3721	9276.37	23190.93	23190.93	2.50

4.2.5 Abridge Life Table for Males in 2015

Table 4.3A below represents the abridge life table for males in 2015, the life expectancy $e_x$was computed for example, in calculating for the life expectancy for ages between 0 and below, $T_x/l_x = 711606.4/10000 = 71.1606.4$. It was revealed that the life expectancy at birth was 71.16. The highest life expectancy record was 71.16 and it was in the age group of 0 and below. Then the life expectancy begins to decrease as the age group increase. However, from 1-4 years onwards the life expectancy started decreasing. With regards to the probability of dying q_x, from the Table 4.3B, the probability that a male child at birth will not survive to the next year was 0. Then in the year group of 1 to 4 years the probability of the child dying increases to 0.001668.

Table 4.3A: Abridge Life Table for Males in 2015

Age Group	MALE		m_x	q_x	p_x	l_x	d_x	L_x	T_x	e_x
	Pop.	Death								
0 n below	22355	0	0.0000	0.0000	1.0000	10000.0000	0.00	10000.00	711603.99	71.16
1 - 4 Years	67065	28	0.0004	0.0017	0.9983	10000.0000	16.68	39966.64	701603.99	70.16
5 - 9 Years	74890	10	0.0001	0.0003	0.9997	9983.3200	3.33	49908.27	661637.35	66.27
10-14 Years	70666	6	0.0001	0.0005	0.9995	9979.9856	4.94	49887.58	611729.08	61.30
15- 19Years	75309	8	0.0001	0.0007	0.9993	9975.0455	6.62	49858.68	561841.50	56.32
20 - 24Years	98253	12	0.0001	0.0010	0.9990	9968.4220	10.14	49816.77	511982.82	51.36
25-29 Years	92053	13	0.0001	0.0021	0.9979	9958.2842	20.53	49740.09	462166.05	46.41
30-34 Years	73313	25	0.0003	0.0024	0.9976	9937.7502	23.69	49629.52	412425.96	41.50
35-39 Years	56917	33	0.0006	0.0032	0.9968	9914.0586	31.31	49492.03	362796.44	36.59
40-44 Years	45144	37	0.0008	0.0043	0.9957	9882.7500	42.59	49307.28	313304.41	31.70
45-49 Years	31744	42	0.0013	0.0063	0.9937	9840.1553	61.81	49046.28	263997.13	26.83
50 -54 Years	27607	47	0.0017	0.0078	0.9922	9778.3493	75.86	48702.13	214950.85	21.98
55-59 Years	19576	50	0.0026	0.0112	0.9888	9702.4889	108.43	48241.42	166248.72	17.13
60- 64Years	15104	20	0.0013	0.0099	0.9901	9594.0636	94.81	47733.32	118007.30	12.30
65-69 Years	9688	35	0.0036	0.0204	0.9796	9499.2550	194.10	47011.04	70273.98	7.40
70 Yrs Above	21000	101	0.0048	1.0000	0.0000	9305.1568	9305.16	23262.94	23262.94	2.50

4.2.6 Abridge Life Table for Females in 2015

Table 4.3B below represents the abridge life table for males in 2015, the life expectancy e_x was computed for example, in calculating for the life expectancy for ages between 0 and below, $T_x/l_x = 712686.5/10000 = 71.2686.5$. It was revealed that the life expectancy at birth was 71.27. The highest life expectancy record was 71.27 and it was in the age group of 0 and below. Then the life expectancy begins to decrease as the age group increase. However, from 1-4 years onwards the life expectancy started decreasing. With regards to the probability of dying q_x, from the Table 4.3B, the probability that a male child at birth will not survive to the next year was 0. Then in the year group of 1 to 4 years the probability of the child dying increases to 0.0017.

Table 4.3B: Abridge Life Table for Females in 2015

Age Group	FEMALE		m_x	q_x	p_x	l_x	d_x	L_x	T_x	e_x
	Pop.	Death								
0 n below	21935	0	0.0000	0.0000	1.0000	10000.0000	0.00	10000.00	712686.46	71.27
1 - 4 Years	65805	28	0.0004	0.0017	0.9983	10000.0000	17.00	39966.00	702686.46	70.27
5 - 9 Years	75482	5	0.0001	0.0003	0.9997	9983.0000	3.30	49906.74	662720.46	66.38
10-14 Years	79379	7	0.0001	0.0004	0.9996	9979.6956	4.40	49887.47	612813.72	61.41
15- 19Years	88273	10	0.0001	0.0006	0.9994	9975.2946	5.65	49862.35	562926.25	56.43
20 - 24Years	108762	20	0.0002	0.0009	0.9991	9969.6486	9.16	49825.33	513063.90	51.46
25-29 Years	98870	38	0.0004	0.0019	0.9981	9960.4865	19.12	49754.61	463238.57	46.51
30-34 Years	75111	35	0.0005	0.0023	0.9977	9941.3623	23.13	49648.97	413483.96	41.59
35-39 Years	59223	36	0.0006	0.0030	0.9970	9918.2288	30.10	49515.88	363834.99	36.68
40-44 Years	47376	39	0.0008	0.0041	0.9959	9888.1269	40.62	49339.09	314319.11	31.79
45-49 Years	36903	40	0.0011	0.0054	0.9946	9847.5065	53.23	49104.49	264980.02	26.91
50 -54 Years	31960	43	0.0013	0.0067	0.9933	9794.2808	65.67	48807.26	215875.53	22.04
55-59 Years	21741	44	0.0020	0.0101	0.9899	9728.6101	97.95	48398.22	167068.27	17.17
60- 64Years	16640	30	0.0018	0.0090	0.9910	9630.6625	86.43	47937.28	118670.05	12.32
65-69 Years	11141	40	0.0036	0.0178	0.9822	9544.2369	169.81	47296.69	70732.77	7.41
70 Yrs Above	26872	116	0.0043	1.0000	0.0000	9374.4258	9374.43	23436.08	23436.08	2.50

4.2.7 Abridge Life Table for Males in 2016

Table 4.4A below represents the abridge life table for males in 2016, the life expectancy (ex) was computed for example, in calculating for the life expectancy for ages between 0 and below, $T_x/l_x = 703101.9/10000 = 70.3101.9$. It was revealed that the life expectancy at birth was 70.31. The highest life expectancy record was 70.31 and it was in the age group of 0 and below. Then the life expectancy begins to decrease as the age group increase. However, from 1-4 years onwards the life expectancy started decreasing. With regards to the probability of dying q_x, from the Table 4.4A, the probability that a male child at birth will not survive to the next year was 0.0080691. Then in the year group of 1 to 4 years the probability of the child dying decreases to 0.0020. Observing the probability of the people of the old age, it was found that, the probability of dying of them increases rapidly and their life expectancy also decreases. For instance, at age group 70 year above the number of years expected for a male to live is 2.5.

Table 4.4A: Abridge Life Table for Males in 2016

Age Group	MALE		m_x	q_x	p_x	l_x	d_x	L_x	T_x	e_x
	Pop.	Death								
0 n below	22355	193	0.0086	0.0081	0.9919	10000.0000	80.69	9959.65	703101.89	70.31
1 - 4 Years	67065	34	0.0005	0.0020	0.9980	9919.3090	20.09	39637.06	693142.24	69.88
5 - 9 Years	74890	12	0.0002	0.0008	0.9992	9899.2224	7.93	49476.27	653505.18	66.02
10-14 Years	70666	8	0.0001	0.0006	0.9994	9891.2882	5.60	49442.44	604028.91	61.07
15- 19Years	75309	12	0.0002	0.0008	0.9992	9885.6877	7.88	49408.74	554586.47	56.10
20 - 24Years	98253	12	0.0001	0.0006	0.9994	9877.8088	6.03	49373.96	505177.73	51.14
25-29 Years	92053	18	0.0002	0.0010	0.9990	9871.7745	9.66	49334.73	455803.77	46.17
30-34 Years	73313	24	0.0003	0.0016	0.9984	9862.1179	16.16	49270.20	406469.04	41.22
35-39 Years	56917	30	0.0005	0.0026	0.9974	9845.9618	25.98	49164.85	357198.84	36.28
40-44 Years	45144	45	0.0010	0.0050	0.9950	9819.9793	49.07	48977.24	308033.99	31.37
45-49 Years	31744	65	0.0020	0.0103	0.9897	9770.9138	100.55	48603.20	259056.75	26.51
50 -54 Years	27607	60	0.0022	0.0109	0.9891	9670.3652	105.66	48087.69	210453.55	21.76
55-59 Years	19576	64	0.0033	0.0165	0.9835	9564.7077	157.63	47429.48	162365.86	16.98
60- 64Years	15104	42	0.0028	0.0140	0.9860	9407.0794	131.70	46706.15	114936.38	12.22
65-69 Years	9688	55	0.0057	0.0288	0.9712	9275.3775	267.02	45709.34	68230.23	7.36
70 Yrs Above	21000	129	0.0061	1.0000	0.0000	9008.3533	9008.35	22520.89	22520.89	2.50

4.2.8 Abridge Life Table for Females in 2016

Table 4.4B below represents the abridge life table for females in 2016, the life expectancy (ex) was computed for example, in calculating for the life expectancy for ages between 0 and below, $T_x/l_x = 710088.5/10000 = 71.00885$. It was revealed that the life expectancy at birth was 71.00. The highest life expectancy record was 71.00 and it was in the age group of 0 and below, then the life expectancy begins to decrease as the age group increase. However, from 1-4 years onwards the life expectancy started decreasing. With regards to the probability of dying q_x, from the Table 4.4B, the probability that a male child at birth will not survive to the next year was 0.0065263. Then in the year group of 1 to 4 years the probability of the child dying decreases to 0.001397. However, in the age group of 5 to 9 years the probability of the female child dying decreases. With regards to the aged group, it was found that, the probability of dying of them increases rapidly and their life expectancy also decreases. For instance, at age group 70 year above the number of years expected for a female to live is 2.5 years.

Table 4.4B: Abridge Life Table for Females in 2016

Age Group	FEMALE		m_x	q_x	p_x	l_x	d_x	L_x	T_x	e_x
	Pop.	Death								
0 n below	21935	144	0.0066	0.0065	0.9935	10000.0000	65.26	9967.37	710088.52	71.01
1 - 4 Years	65805	23	0.0003	0.0014	0.9986	9934.7370	13.88	39766.70	700121.15	70.47
5 - 9 Years	75482	11	0.0001	0.0007	0.9993	9920.8582	7.23	49724.95	660354.45	66.56
10-14 Years	79379	4	0.0001	0.0003	0.9997	9913.6318	2.50	49700.57	610629.50	61.59
15- 19Years	88273	4	0.0000	0.0002	0.9998	9911.1346	2.24	49688.68	560928.93	56.60
20 - 24Years	108762	14	0.0001	0.0006	0.9994	9908.8897	6.38	49667.07	511240.25	51.59
25-29 Years	98870	24	0.0002	0.0012	0.9988	9902.5143	12.01	49620.97	461573.18	46.61
30-34 Years	75111	36	0.0005	0.0024	0.9976	9890.5026	23.67	49531.51	411952.21	41.65
35-39 Years	59223	28	0.0005	0.0024	0.9976	9866.8287	23.30	49413.75	313006.95	31.72
40-44 Years	47376	42	0.0009	0.0044	0.9956	9843.5311	43.54	49246.20	263760.75	26.80
45-49 Years	36903	50	0.0014	0.0068	0.9932	9799.9951	66.17	48971.18	214789.57	21.92
50 -54 Years	31960	50	0.0016	0.0078	0.9922	9733.8295	75.84	48615.16	166174.41	17.07
55-59 Years	21741	51	0.0023	0.0117	0.9883	9657.9854	112.62	48142.69	166174.41	17.21
60- 64Years	16640	30	0.0018	0.0090	0.9910	9545.3675	85.66	47645.61	118031.72	12.37
65-69 Years	11141	36	0.0032	0.0160	0.9840	9459.7074	151.61	47050.77	70386.11	7.44
70 Yrs Above	26872	155	0.0058	1.0000	0.0000	9308.0957	9308.10	23335.34	23335.34	2.51

4.2.9 Abridge Life Table for Males in 2017

Table 4.5A below represents the abridge life table for males in 2017, the life expectancy (ex) was computed for example, in calculating for the life expectancy for ages between 0 and below, $T_x/l_x = 702093.9/10000 = 70.20939$. It was revealed that the life expectancy at birth was 70.21. The highest life expectancy record was 70.21 and it was in the age group of 0 and below, then the life expectancy begins to decrease as the age group increase. However, from 1-4 years onwards the life expectancy started decreasing. With regards to the probability of dying q_x, from the Table 4.1A, the probability that a male child at birth will not survive to the next year was 0.007244. Then in the year group of 1 to 4 years the probability of the child dying decreases to 0.00143. However, in the age group of 5 to 9 years the probability of the male child dying decreases.

Table 4.5A: Abridge Life Table for Males in 2017

Age Group	MALE		m_x	q_x	p_x	l_x	d_x	L_x	T_x	e_x
	Pop.	Death								
0 n below	22355	163	0.0073	0.0072	0.9928	10000.0000	72.44	9963.78	702093.91	70.21
1 - 4 Years	67065	24	0.0004	0.0014	0.9986	9927.5600	14.20	39681.85	692130.13	69.72
5 - 9 Years	74890	5	0.0001	0.0003	0.9997	9913.3636	3.31	49558.55	652448.28	65.82
10-14 Years	70666	2	0.0000	0.0014	0.9986	9910.0525	14.07	49546.77	602889.73	60.84
15- 19Years	75309	9	0.0001	0.0006	0.9994	9895.9803	5.91	49528.47	553342.96	55.92
20 - 24Years	98253	18	0.0002	0.0009	0.9991	9890.0724	9.06	49491.01	503814.49	50.94
25-29 Years	92053	22	0.0002	0.0012	0.9988	9881.0130	11.80	49438.80	454323.48	45.98
30-34 Years	73313	35	0.0005	0.0024	0.9976	9869.2151	23.53	49350.36	404884.68	41.03
35-39 Years	56917	30	0.0005	0.0026	0.9974	9845.6869	25.91	49226.59	306307.73	31.11
40-44 Years	45144	60	0.0013	0.0066	0.9934	9819.7731	65.04	48998.92	257308.81	26.20
45-49 Years	31744	76	0.0024	0.0119	0.9881	9754.7367	116.08	48545.55	208763.26	21.40
50 -54 Years	27607	64	0.0023	0.1152	0.8848	9638.6553	1110.76	47976.93	160786.33	16.68
55-59 Years	19576	70	0.0036	0.0177	0.9823	8527.8967	151.12	47276.24	160786.33	18.85
60- 64Years	15104	62	0.0041	0.0203	0.9797	8376.7738	170.18	46377.68	113510.09	13.55
65-69 Years	9688	74	0.0076	0.0375	0.9625	8206.5913	307.55	45041.64	67132.41	8.18
70 Yrs Above	21000	125	0.0060	1.0000	0.0000	7899.0411	7899.04	22090.77	22090.77	2.80

4.2.10 Abridge Life Table for Females in 2017

Table 4.5B below represents the abridge life table for males in 2017, the life expectancy (ex) was computed for example, in calculating for the life expectancy for ages between 0 and below, $T_x/l_x = 706748.6/10000 = 70.67486$. It was revealed that the life expectancy at birth was 70.67. The highest life expectancy record was 70.67 and it was in the age group of 0 and below, then the life expectancy begins to decrease as the age group increase. However, from 1-4 years onwards the life expectancy started decreasing. With regards to the probability of dying q_x, from the Table 4.5B, the probability that a female child at birth will not survive to the next year was 0.006526. Then in the year group of 1 to 4 years the probability of the child dying increases to 0.001093. However, in the age group of 5 to 9 years the probability of the female child dying decreases.

Table 4.5B: Abridge Life Table for Females in 2017

Age Group	MALE		m_x	q_x	p_x	l_x	d_x	L_x	T_x	e_x
	Pop.	Death								
0 n below	21935	144	0.0066	0.0065	0.9935	10000.0000	65.26	9967.37	706748.63	70.67
1 - 4 Years	65805	18	0.0003	0.0011	0.9989	9934.7400	10.86	39717.22	696781.26	70.14
5 - 9 Years	75482	5	0.0001	0.0003	0.9997	9923.8813	3.28	49611.16	657064.04	66.21
10-14 Years	79379	2	0.0000	0.0001	0.9999	9920.5965	1.25	49599.82	607452.88	61.23
15- 19Years	88273	9	0.0001	0.0005	0.9995	9919.3465	5.06	49584.06	557853.06	56.24
20 - 24Years	108762	21	0.0002	0.0010	0.9990	9914.2877	9.57	49547.50	508269.00	51.27
25-29 Years	98870	19	0.0002	0.0010	0.9990	9904.7204	9.51	49499.81	458721.50	46.31
30-34 Years	75111	37	0.0005	0.0025	0.9975	9895.2118	24.34	49415.17	409221.69	41.36
35-39 Years	59223	39	0.0007	0.0033	0.9967	9870.8696	32.45	49273.19	310533.33	31.46
40-44 Years	47376	50	0.0011	0.0053	0.9947	9838.4241	51.78	49062.62	261470.71	26.58
45-49 Years	36903	60	0.0016	0.0081	0.9919	9786.6444	79.24	48735.08	212735.63	21.74
50 -54 Years	31960	49	0.0015	0.0076	0.9924	9707.4020	74.14	48351.66	164383.97	16.93
55-59 Years	21741	60	0.0028	0.0137	0.9863	9633.2666	132.01	47836.29	164383.97	17.06
60- 64Years	16640	40	0.0024	0.0119	0.9881	9501.2523	113.51	47222.46	116547.68	12.27
65-69 Years	11141	52	0.0047	0.0231	0.9769	9387.7408	216.56	46397.28	69325.22	7.38
70 Yrs Above	26872	142	0.0053	1.0000	0.0000	9171.1844	9171.18	22927.94	22927.94	2.50

4.3 Life Expectancy for Males (2013 – 2017)

Table 4.6A below shows a summary of the life expectancy of males from the year 2013-2017 and it can be seen that the life expectancy for the males for the age category of 1 year and below recorded the highest life expectancy with 71.63902 from 2013 and then decreased to 70.30682 in 2014 and then increased to 71.16064 in 2015 then decreased again for the subsequent years of 2016 and 2017 with 70.31019 and 70.20939 respectively. The year 2013 recorded a high life expectancy for the males. However, from 1 year onwards the life expectancy started decreasing within each year with regards to the probability of dying (q_x), from the table 4.1A to table 4.5B, the probability that a female child at birth will not survive to the next year was 0.02920. Then in the year group of 1 to 5 years the probability of the child dying increases to 0.10150. However, in the age group of 5 to 10 years the probability of the female child dying decreases.

Tables 4.6A: Life Expectancy for Males (2013 – 2017)

AGE GROUP	LIFE EXPECTANCY				
MALE	2013	2014	2015	2016	2017
Below 1	71.63902	70.30682	71.16064	70.31019	70.20939
1 - 4 Years	71.22503	69.92565	70.16064	69.87808	69.71804
5 - 9 Years	67.26113	66.03509	66.27452	66.01581	65.81502
10-14 Years	62.27497	61.08177	61.29582	61.06676	60.83616
15- 19Years	57.28343	56.12323	56.32494	56.09994	55.84441
20 - 24Years	52.28707	51.15172	51.36069	51.14269	50.8763
25-29 Years	47.29366	46.20871	46.41045	46.17243	45.92063
30-34 Years	42.30145	41.27288	41.50117	41.21519	40.97255
35-39 Years	37.31177	36.35235	36.59438	36.27871	36.06449
40-44 Years	32.33258	31.44475	31.70237	31.36809	31.15307
45-49 Years	27.3564	26.59292	26.82879	26.51305	26.34411
50 -54 Years	22.39564	21.80338	21.98255	21.76273	21.63126
55-59 Years	17.42092	16.9904	17.13487	16.97551	16.85431
60- 64Years	12.45533	12.2273	12.30027	12.21807	12.11327
65-69 Years	7.475166	7.371022	7.398088	7.356057	7.31262
70 Yrs Above	2.5	2.5	2.500259	2.5	2.5

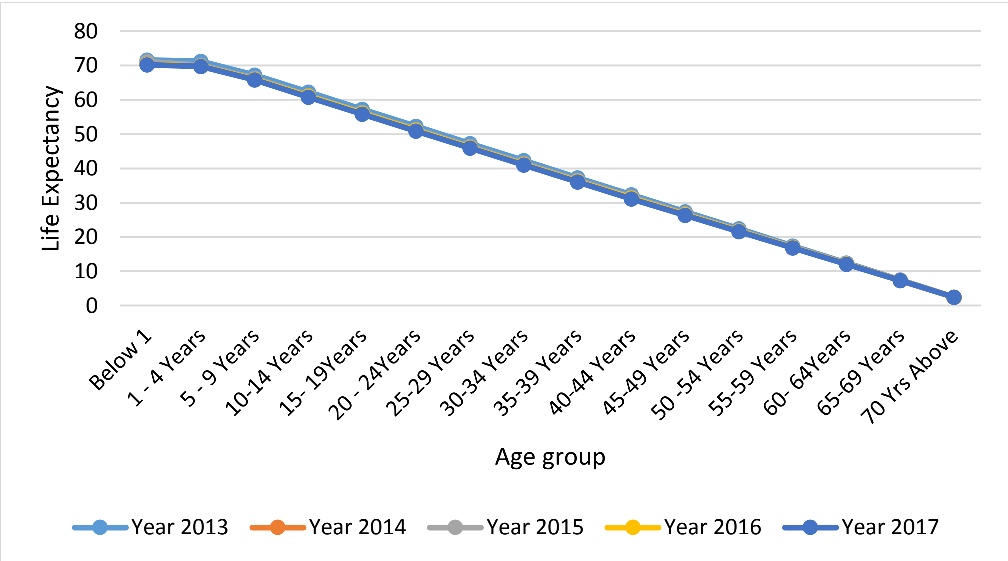

Figure 4.1: Life Expectancy chart for males

4.4 Life Expectancy for Females (2013 – 2017)

Table 4.6B below shows a summary of the life expectancy of males from the year 2013-2017 and it can be seen that the life expectancy for the females was highest for the age category of 1year and below with 71.08485 from 2013 and then decreased to 70.68149 in 2014 and then increased to 71.26865 in 2015 then for the subsequent years of 2016 and 2017 with 71.00885 and 70.67486 respectively. The year 2015 recorded a high life expectancy for the females.

Table 4.6B : Life Expectancy for Females (2013 – 2017)

AGE	LIFE EXPECTANCY				
FEMALE	2013	2014	2015	2016	2017
below 1	71.08485	70.68149	71.26865	71.00885	70.67486
1 - 4 Years	70.58075	70.16174	70.26865	70.47204	70.13585
5 - 9 Years	66.69754	66.30685	66.3849	66.37654	66.21043
10-14 Years	61.7103	61.35759	61.40606	61.4231	61.23153
15- 19Years	56.72895	56.37613	56.43204	56.43794	56.23893
20 - 24Years	51.74123	51.4036	51.4626	51.45017	51.26633
25-29 Years	46.79335	46.46884	46.50764	46.48168	46.31344
30-34 Years	41.84717	41.54228	41.59229	41.5351	41.35556
35-39 Years	36.91538	36.64117	36.68347	36.62875	36.45138
40-44 Years	31.97358	31.74798	31.78753	31.70953	31.56335
45-49 Years	27.05467	26.88102	26.90832	26.83929	26.71712
50 -54 Years	22.17501	22.03677	22.04097	22.00474	21.9148
55-59 Years	17.25226	17.14097	17.17287	17.15791	17.0642
60- 64Years	12.36851	12.3103	12.3221	12.33084	12.26656
65-69 Years	7.437176	7.41104	7.41104	7.419865	7.38466
70 Yrs Above	2.5	2.5	2.5	2.5	2.5

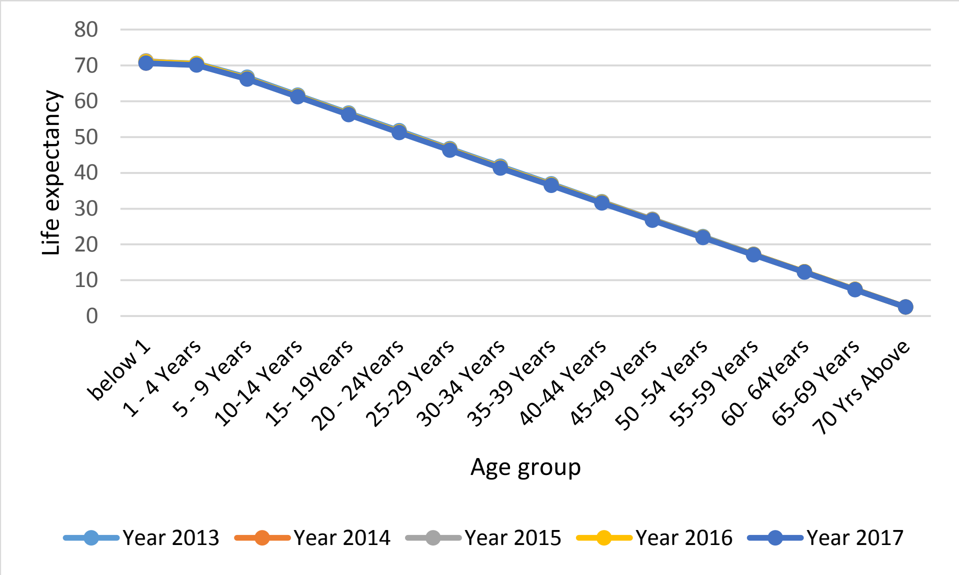

Figure 4.2: Life Expectancy chart for females

4.5 Projection Models

This section presents the life expectancy of the projected models namely APC, CBD, Lee Carter, Plat model.

4.5.1 APC Model

Male Life expectancy Projection Using APC Model

The projection of males' life expectancy was computed and its presented in Table 4.7, for details see appendix A. From Table 4.7A below shows a summary of the life expectancy of males from the year 2013-2017 and it can be seen that the life expectancy for the males for the age category of 0 and below recorded the highest life expectancy with 63.7533 from 2013 and then decreased to 63.3499 in 2014 whilst 2017 recorded the lowest life expectancy of 63.3433 for the males.

Table 4.7A: Male Life expectancy Projection Using APC Model

AGE GROUP MALE	LIFE EXPECTANCY 2013	2014	2015	2016	2017
Below 1	63.7533	63.3499	63.6471	63.6773	63.3433
1 - 4 Years	63.2492	62.8302	62.9671	63.1405	62.8043
5 - 9 Years	59.3660	58.9753	59.0534	59.0450	58.8789
10-14 Years	54.3788	54.0260	54.0745	54.0916	53.9000
15- 19Years	49.3974	49.0446	49.1005	49.1064	48.9074
20 - 24Years	44.4097	44.0721	44.1311	44.1186	43.9348
25-29 Years	39.4618	39.1373	39.1761	39.1501	38.9819
30-34 Years	34.5156	34.2107	34.2607	34.2036	34.0240
35-39 Years	29.5838	29.3096	29.3519	29.2972	29.1198
40-44 Years	24.6420	24.4164	24.4560	24.3780	24.2318
45-49 Years	19.7231	19.5495	19.5768	19.5077	19.3856
50 -54 Years	14.8435	14.7052	14.7094	14.6732	14.5833
55-59 Years	9.9207	9.8094	9.8413	9.8264	9.7327
60- 64Years	5.0370	4.9788	4.9906	4.9993	4.9350
65-69 Years	0.1056	0.0795	0.0795	0.0883	0.0531
70 Yrs Above	1.2700	1.2700	1.2700	1.2700	1.2700

Female Life expectancy Using APC Model

The projection of females' life expectancy was computed and its presented in Table 4.8, for details see appendix A.

Table 4.6A below shows a summary of the life expectancy of males from the year 2013-2017 and it can be seen that the life expectancy for the males for the age category of 0 and below recorded the highest life expectancy with 71.63902 from 2013 and then decreased to 70.30682 in 2014 and then increased to 71.16064 in 2015 then decreased again for the subsequent years of 2016 and 2017 with 62.9786 and 62.8778respectively. The year 2013 recorded a high life expectancy for the females and 62.8778 recorded the lowest life expectancy.

Table 4.7B: Female Life expectancy Projection Using APC Model

AGE GROUP	LIFE EXPECTANCY				
FEMALE	2013	2014	2015	2016	2017
Below 1	64.3075	62.9753	63.9291	62.9786	62.8778
1 - 4 Years	63.8935	62.5941	62.8291	62.5465	62.3865
5 - 9 Years	59.9296	58.7035	58.9430	58.6843	58.4835
10-14 Years	54.9434	53.7502	53.9643	53.7352	53.5046
15- 19Years	49.9519	48.7917	48.9934	48.7684	48.5129
20 - 24Years	44.9555	43.8202	44.0291	43.8111	43.5448
25-29 Years	39.9621	38.8772	39.0789	38.8409	38.5891
30-34 Years	34.9699	33.9413	34.1696	33.8836	33.6410
35-39 Years	29.9802	29.0208	29.2628	28.9472	28.7329
40-44 Years	25.0010	24.1132	24.3708	24.0365	23.8215
45-49 Years	20.0249	19.2614	19.4972	19.1815	19.0126
50 -54 Years	15.0641	14.4718	14.6510	14.4312	14.2997
55-59 Years	10.0894	9.6589	9.8033	9.6440	9.5228
60- 64Years	5.1238	4.8958	4.9687	4.8865	4.7817
65-69 Years	3.1436	3.0395	3.0665	3.0245	2.0189
70 Yrs Above	1.2700	1.2700	1.2700	1.2700	1.2700

4.5.2 CBD Model

Male Life expectancy Using CBD Model

The projection of males' life expectancy was computed and its presented in Table 4.8, for details see appendix A.

Table 4.8A below shows a summary of the life expectancy of males from the year 2013-2017 and it can be seen that the life expectancy for the males for the age category of 0 and below recorded the highest life expectancy with 71.63902 from 2013 and then decreased to 70.30682 in 2014 and then increased to 71.16064 in 2015 then decreased again for the subsequent years of 2016 and 2017 with 70.31019 and 70.20939 respectively.

Table 4.8A: Male Life expectancy Projection Using CBD Model

AGE GROUP	LIFE EXPECTANCY				
MALE	2013	2014	2015	2016	2017
Below 1	69.2520	68.8486	69.4358	69.1760	68.8420
1 - 4 Years	68.7479	68.3289	68.4358	68.6392	68.3030
5 - 9 Years	64.8647	64.4740	64.5520	64.5437	64.3775
10-14 Years	59.8774	59.5247	59.5732	59.5902	59.3986
15- 19Years	54.8961	54.5432	54.5992	54.6051	54.4060
20 - 24Years	49.9083	49.5707	49.6297	49.6173	49.4334
25-29 Years	44.9605	44.6360	44.6748	44.6488	44.4806
30-34 Years	40.0143	39.7094	39.7594	39.7022	39.5227
35-39 Years	35.0825	34.8083	34.8506	34.7959	34.6185
40-44 Years	30.1407	29.9151	29.9546	29.8766	29.7305
45-49 Years	25.2218	25.0481	25.0754	25.0064	24.8842
50 -54 Years	20.3421	20.2039	20.2081	20.1719	20.0819
55-59 Years	15.4194	15.3081	15.3400	15.3250	15.2313
60- 64Years	10.5356	10.4774	10.4892	10.4980	10.4337
65-69 Years	5.6043	5.5782	5.5782	5.5870	5.5518
70 Yrs Above	1.5000	1.5000	1.5000	1.5000	1.5000

Female Life expectancy Using CBD Model

The projection of females' life expectancy was computed and its presented in Table 4.9, for details see appendix A.

Table 4.8B below shows a summary of the life expectancy of females from the year 2013-2017 and it can be seen that the life expectancy for the females for the age category of 0 and below recorded the highest life expectancy with 69.8061 from 2013 and then decreased to 68.4739 in 2014 and then increased to 69.3278 in 2015 then decreased again for the subsequent years of 2016 and 2017 with 68.3773and 68.3065 respectively.

Table 4.8B: Female Life expectancy Projection Using CBD Model

AGE GROUP	LIFE EXPECTANCY				
FEMALE	2013	2014	2015	2016	2017
Below 1	69.8061	68.4739	69.3278	68.3773	68.3065
1 - 4 Years	69.3921	68.0928	68.3278	68.0452	67.8852
5 - 9 Years	65.4282	64.2022	64.4416	64.1829	63.9821
10-14 Years	60.4421	59.2489	59.4629	59.2339	59.0033
15- 19Years	55.4505	54.2903	54.4921	54.2671	54.0115
20 - 24Years	50.4542	49.3188	49.5278	49.3098	49.0434
25-29 Years	45.4608	44.3758	44.5776	44.3395	44.0877
30-34 Years	40.4686	39.4400	39.6683	39.3823	39.1397
35-39 Years	35.4789	34.5195	34.7615	34.4458	34.2316
40-44 Years	30.4997	29.6119	29.8695	29.5352	29.3202
45-49 Years	25.5235	24.7600	24.9959	24.6802	24.5112
50 -54 Years	20.5628	19.9705	20.1497	19.9298	19.7984
55-59 Years	15.5880	15.1575	15.3020	15.1426	15.0214
60- 64Years	10.6224	10.3944	10.4674	10.3852	10.2804
65-69 Years	5.6423	5.5381	5.5652	5.5232	5.4797
70 yrs Above	1.5000	1.5000	1.5000	1.5000	1.5000

4.5.3 Lee Carter Model

Male Life expectancy Using Lee Carter Model

The projection of males' life expectancy was computed and its presented in Table 4.9, for details see appendix A.

Table 4.9A below shows a summary of the life expectancy of males from the year 2013-2017 and it can be seen that the life expectancy for the males for the age category of 0 and below recorded the highest life expectancy at birth with 67.4191 from 2013 and then decreased to 67.0157 in 2014 and then increased to 67.6029 in 2015 then decreased again for the subsequent years of 2016 and 2017 with 67.3431 and 67.0091 respectively.

Table 4.9A: Male Life expectancy Projection Using Lee Carter Model

AGE GROUP	LIFE EXPECTANCY				
MALE	2013	2014	2015	2016	2017
Below 1	67.4191	67.0157	67.6029	67.3431	67.0091
1 - 4 Years	66.9150	66.4960	66.6029	66.8063	66.4701
5 - 9 Years	63.0318	62.6411	62.7191	62.7108	62.5447
10-14 Years	58.0445	57.6918	57.7403	57.7573	57.5658
15- 19Years	53.0632	52.7104	52.7663	52.7722	52.5732
20 - 24Years	48.0755	47.7378	47.7968	47.7844	47.6006
25-29 Years	43.1276	42.8031	42.8419	42.8159	42.6477
30-34 Years	38.1814	37.8765	37.9265	37.8693	37.6898
35-39 Years	33.2496	32.9754	33.0177	32.9630	32.7856
40-44 Years	28.3078	28.0822	28.1218	28.0438	27.8976
45-49 Years	23.3889	23.2152	23.2425	23.1735	23.0513
50 -54 Years	18.5092	18.3710	18.3752	18.3390	18.2490
55-59 Years	13.5865	13.4752	13.5071	13.4921	13.3984
60- 64Years	8.7027	8.6445	8.6563	8.6651	8.6008
65-69 Years	3.7714	3.7453	3.7453	3.7541	3.7189
70 Yrs Above	1.5000	1.5000	1.5000	1.5000	1.5000

Female Life expectancy Using Lee Carter Model

The projection of females' life expectancy was computed and its presented in Table 4.9, for details see appendix A. Table 4.9B below shows a summary of the life expectancy of females from the year 2013-2017 and it can be seen that the life expectancy for the females for the age category of 0 and below recorded the highest life expectancy at birth with 67.9732 from 2013 and then decreased to 66.6410 in 2014 and then decreased again for the subsequent years of 2016 and 2017 with 70.31019 and 66.5436 respectively.

Table 4.9B: Female Life expectancy Projection Using Lee Carter Model

AGE GROUP	LIFE EXPECTANCY				
FEMALE	2013	2014	2015	2016	2017
Below 1	67.9732	66.6410	67.4949	66.6444	66.5436
1 - 4 Years	67.5593	66.2599	66.4949	66.2123	66.0523
5 - 9 Years	63.5954	62.3693	62.6087	62.3500	62.1492
10-14 Years	58.6092	57.4160	57.6300	57.4010	57.1704
15- 19Years	53.6177	52.4575	52.6592	52.4342	52.1786
20 - 24Years	48.6213	47.4859	47.6949	47.4769	47.2105
25-29 Years	43.6279	42.5429	42.7447	42.5067	42.2549
30-34 Years	38.6357	37.6071	37.8354	37.5494	37.3068
35-39 Years	33.6460	32.6866	32.9286	32.6129	32.3987
40-44 Years	28.6668	27.7790	28.0366	27.7023	27.4873
45-49 Years	23.6906	22.9271	23.1630	22.8473	22.6783
50 -54 Years	18.7299	18.1376	18.3168	18.0970	17.9655
55-59 Years	13.7551	13.3246	13.4691	13.3097	13.1885
60- 64Years	8.7896	8.5615	8.6345	8.5523	8.4475
65-69 Years	3.8094	3.7053	3.7323	3.6903	3.6468
70 Yrs Above	1.5000	1.5000	1.5000	1.5000	1.5000

4.5.4 Plat Model

Male Life expectancy Using Plat Model

The projection of males' life expectancy was computed and its presented in Table 4.10A, for details see appendix A. Table 4.10A below shows a summary of the life expectancy of males from the year 2013-2017 and it can be seen that the life expectancy for the males for the age category of 0 and below recorded the highest life expectancy with 71.63902 from 2013 and then decreased to 70.30682 in 2014 and then increased to 71.16064 in 2015 then decreased again for the subsequent years of 2016 and 2017 with 70.31019 and 70.20939 respectively.

Table 4.10A: Male Life expectancy Projection Using PLAT Model

AGE GROUP	LIFE EXPECTANCY				
MALE	2013	2014	2015	2016	2017
Below 1	65.5862	65.1828	65.7700	65.5102	65.1762
1 - 4 Years	65.0821	64.6631	64.7700	64.9734	64.6372
5 - 9 Years	61.1989	60.8082	60.8862	60.8779	60.7118
10-14 Years	56.2116	55.8589	55.9074	55.9244	55.7329
15- 19Years	51.2303	50.8775	50.9334	50.9393	50.7403
20 - 24Years	46.2426	45.9049	45.9639	45.9515	45.7677
25-29 Years	41.2947	40.9702	41.0090	40.9830	40.8148
30-34 Years	36.3485	36.0436	36.0936	36.0364	35.8569
35-39 Years	31.4167	31.1425	31.1848	31.1301	30.9527
40-44 Years	26.4749	26.2493	26.2889	26.2109	26.0647
45-49 Years	21.5560	21.3824	21.4097	21.3406	21.2185
50 -54 Years	16.6764	16.5381	16.5423	16.5061	16.4161
55-59 Years	11.7536	11.6423	11.6742	11.6593	11.5655
60- 64Years	6.8699	6.8116	6.8234	6.8322	6.7679
65-69 Years	1.9385	1.9124	1.9124	1.9212	1.8860
70 Yrs Above	1.3500	1.3500	1.3500	1.3500	1.3500

Female Life expectancy Using Plat Model

The projection of females' life expectancy was computed and its presented in Table 4.10B, for details see appendix A. From Table 4.10B below shows a summary of the life expectancy of males from the year 2013-2017 and it can be seen that the life expectancy for the males for the age category of 0 and below recorded the highest life expectancy with 71.63902 from 2013 and then decreased to 70.30682 in 2014 and then increased to 71.16064 in 2015 then decreased again for the subsequent years of 2016 and 2017 with 70.31019 and 70.20939 respectively.

Table 4.10B: Female Life expectancy Projection Using PLAT Model

AGE GROUP FEMALE	LIFE EXPECTANCY 2013	2014	2015	2016	2017
Below 1	66.1404	64.8082	65.6620	64.8115	64.7107
1 - 4 Years	65.7264	64.4270	64.6620	64.3794	64.2194
5 - 9 Years	61.7625	60.5364	60.7759	60.5172	60.3164
10-14 Years	56.7763	55.5831	55.7972	55.5681	55.3375
15- 19Years	51.7848	50.6246	50.8263	50.6013	50.3458
20 - 24Years	46.7884	45.6531	45.8620	45.6440	45.3776
25-29 Years	41.7950	40.7101	40.9118	40.6738	40.4220
30-34 Years	36.8028	35.7742	36.0025	35.7165	35.4739
35-39 Years	31.8131	30.8537	31.0957	30.7801	30.5658
40-44 Years	26.8339	25.9461	26.2037	25.8694	25.6544
45-49 Years	21.8577	21.0943	21.3301	21.0144	20.8455
50 -54 Years	16.8970	16.3047	16.4839	16.2641	16.1326
55-59 Years	11.9223	11.4917	11.6362	11.4769	11.3557
60- 64Years	6.9567	6.7286	6.8016	6.7194	6.6146
65-69 Years	1.9765	1.8724	1.8994	1.8574	1.8140
70 Yrs Above	1.3500	1.3500	1.3500	1.3500	1.3500

4.6 Testing for the equality of survivor functions among Gender

In testing for the first hypothesis, the study employed the log rank equality of survivor to test if in deed the mortality or the survival for the gender significantly differ.

Table 4.11: Log-rank test

Gender	Death observed	Death expected
Male	3534	3720.32

Female	3245	3354.72
Total	6779	7075.04
Chi-square (1)	= 27.53	
P-value	= 0.0000	

From Table 4.11, it can be seen that the mortality observed for males are higher than that on the females. The long-rank test revealed that the survival curves for male and female are significantly different ($p = 0.00$). This implies that the mortality of the male is really greater than the females.

4.7 Testing for the difference between Actual Life Expectancy and Projection of Life Expectancy among Male and Female.

The deference between the actual life expectancy amd the life expectancies for the projection models were computed for both male and females. This implies that we have two response male expectancy and female expectancy and the four groups are the difference obtained in Lee Cater, CBD, APC and Plat. Hence, Hotelling's T^2 was used to test if the difference between actual life expectancy and projection of life expectancy among male and female are different from zero.

Hotelling's T^2 Test

Table 12: Hotelling's T^2 Test

Gender	Hotelling's T^2	Critical Value	P-value
Male	258.25	22.22	0.000
Female	245.35	22.22	0.000

Hotelling's T^2 test was used to assess if the actual life expectancy is significantly difference from the projection life expectancy (Lee Cater, CBD, APC and Plat). The null hypothesis state that the mean of the absolute difference between actual life expectancy and projection life expectancy (Lee Cater, CBD, APC and Plat) is equal to zero, whiles the alternative state that at least one of the mean of the absolute difference of at least one of the projection life expectancy (Lee Cater, CBD, APC and Plat) are significantly different from zero. From Table 4.8, it can be seen that the p-value for males $\left(T^2 = 258.25; p-value = 0.000\right)$ and $\left(T^2 = 245.35; p-value = 0.000\right)$ females were all less than 0.05. This implies that we reject the null hypothesis state that the mean of the absolute difference of at least one of the projection life expectancy (Lee Cater, CBD, APC and Plat) is equal to zero.

Table 13: Identifying Which Projection Models Significantly Differs from Zero

Gender	Models	Mean	T-value	P-value
Male	Lee Cater	5.85	42.38	0.000
	CBD	1.78	28.51	0.000
	APC	6.93	48.20	0.000
	Plat	5.23	44.13	0.000
Female	Lee Cater	6.80	42.31	0.000
	CBD	1.75	28.02	0.000
	APC	6.90	46.31	0.000
	Plat	4.68	38.14	0.000

In order to identify which of the absolute difference of the projection models are significantly differs from zero, independent t-test was done for the absolute difference of each projection models. The null hypothesis of states that the absolute difference is equal to zero, whiles the alternative state that the absolute difference is significantly different from zero. From Table 13, it can be seen that the all the p-value for both male and female in all the projection models were less than 0.05. Therefore, we reject the null hypothesis that the absolute error mean is equal to zero. This implies that all the projection life expectancy using Lee Cater, CBD, APC and Plat of both males and females are significantly different from the actual.

From observe from the analysis that the APC model recorded the highest absolute mean difference of the life expectancy in the catchment area since the model encountered several errors in the model. Comparing the two other models the CBD and the Lee Carter Model the absolute difference of CBD model was lower and it is considered the best model among the the four models in projection the life expectancy of the catchment area.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.0 Introduction

This chapter presents the summary, conclusions and recommendations of the research work under study which is entitled probability projection of male and female Life Expectancy in the Accra Metropolitan Area.

5.1 Summary

For quite some few decades the urge to find out the various Life Expectancies of both gender around the entire globe has been a matter of urgency for both the economic world and the entire populace as a whole. It was realised that such data leading to the knowledge of the welfare of human resource, availability of human resource and also capacity of the work populace has been a thing of such negligence of both data experts and even the working environment as a whole. This however has been the major concern of this research work in totality, thus finding out the benefits one stands to achieve with the given data at hand in terms of finding out the Life Expectancies of male and female indigenes of the area under study. Data was taken based on the gender corresponding to their various death rates and populations at a given year interval. The data was analysed based on gender with the use of two main Statistical software namely the R and Excel.

5.2 Summary of Findings

After going through thorough research work, we finally came out with the following conclusions based on the final analysis drawn. From the study conducted it was realised that in 2013 there were high neonatal death of about 184 for a population of about 22,355.

This however produced a life expectancy of about 71.6 years. The lowest recorded life expectancy was 2.5 which corresponded with ages 70 years and above. However, for middle year ages of about 30 years to 54 years it was realised that life expectancy was on the ranged from about 52.3 and 22.8. This is an observation made for all the males in the Accra metropolitan area. For the findings of their female counterparts we realise that there was a record of 154 deaths for ages 1-4 years corresponding to a population of about 21935 in the year 2013.

Comparing the life expectancies year by year it can be realised that it falls drastically within the years ranging from 2013, 2014 through to 2017. It falls from figures 71 to 2.5 without any rise in life expectancy, this however denotes that the life expectancy of children aged 0 to 4 years have high chances of survival and live longer than people who are 70 years and above.

The study finds out that the mortality of the male is really greater than the females. Also, that all the projection life expectancy using Lee Cater, CBD, APC and Plat of both males and females are significantly different from the actual.

5.3 Conclusion

From rigorous study made on the probabilistic projection of male and female life expectancy we conclude that, for the five-year period ranging from 2013, 2014 through to 2017 male and female life expectancy is said to be almost the same. We observe from the analysis that the APC model did not fit better in modelling the life expectancy of the people in the catchment area since the model encountered several errors in the model. It was notice that among the projections model, APC recorded the highest difference form the actual life expectancy and CBD was the lowest. It realised from the study that much is required of the APC and the Lee Carter which did not do well in the projections whereas the CBD did marvellously well and proved its standard. The Lee Carter though it has stayed well in the system for long and can be managed failed the analysis due certain errors which when discussed could lead to another research evolving. This work could be applied to any country, state, region or district at all to predict the life expectancy of the population with regards to the type of age whether in the middle age, young age or old age. Another study could evolve to find out the life expectancy among the youth using the three main projection models.

5.4 Recommendation

Government should try and consider the various probability projection models in trying to project life expectancy in determining the various work force and preferable one to use in Ghana settings is CBD. The various health agencies should also contact the various statistical agencies to be able to predict the various health status of a person.

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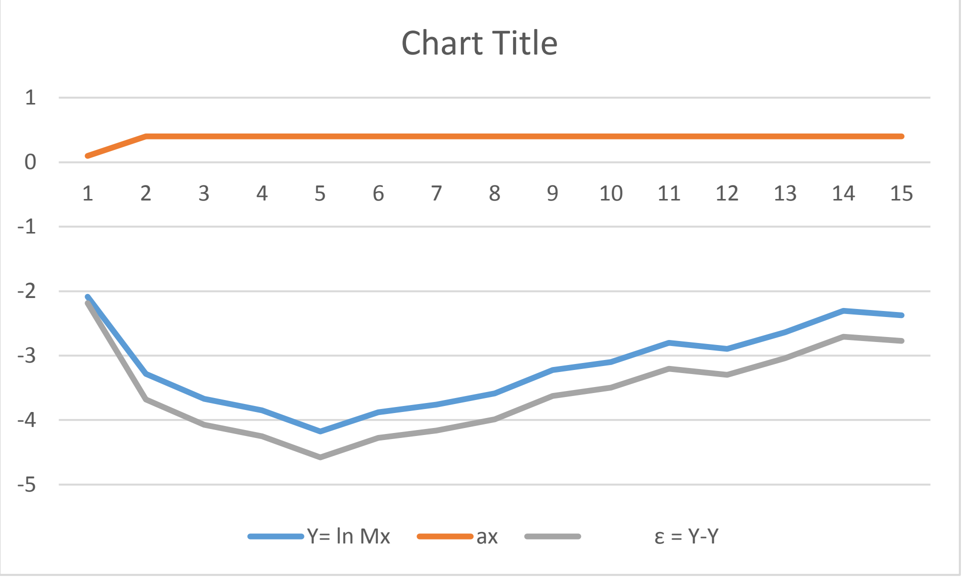
Appendix A

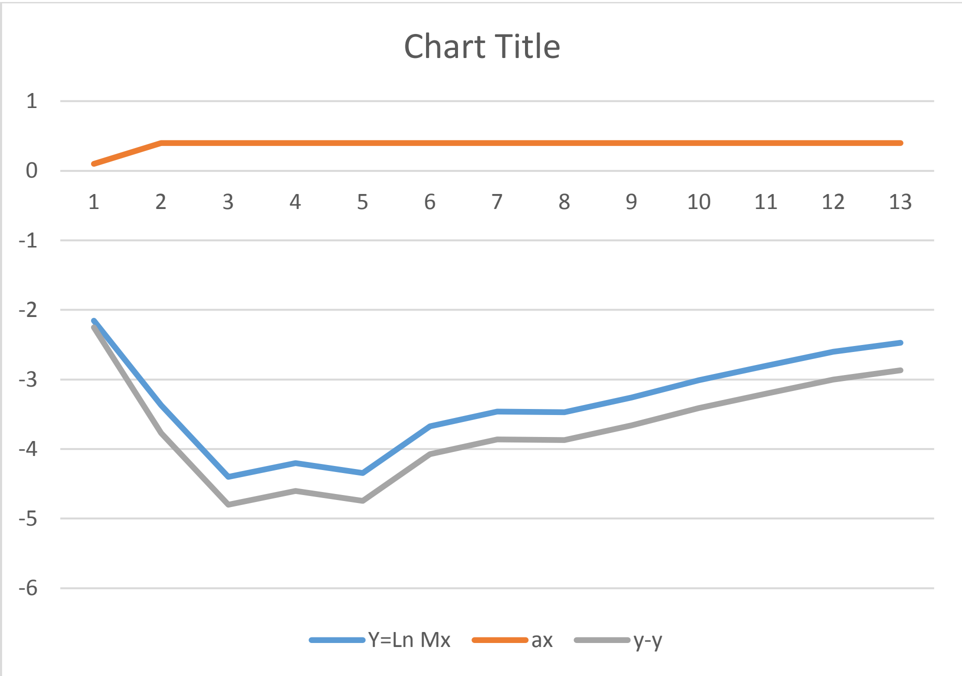
THE LEE CARTER MODEL

THE LEE CARTER METTHOD		
Y= ln Mx	ax	ε = Y-Y
-2.08455	0.1	-2.1845474
-3.28243	0.5	-3.7824279
-3.6703	0.5	-4.1703038
-3.84921	0.5	-4.3492105
-4.17788	0.5	-4.6778769
-3.8784	0.5	-4.3784025
-3.75992	0.5	-4.259918
-3.58643	0.5	-4.0864274
-3.22376	0.5	-3.7237631
-3.0983	0.5	-3.5982975
-2.80269	0.5	-3.3026916
-2.89695	0.5	-3.3969512
-2.63851	0.5	-3.1385114
-2.30499	0.5	-2.8049929
-2.37283	0.5	-2.8728293



FEMALE PROJECTON MODEL FOR 2013

Y=Ln Mx	ax	y-y
-2.15362	0.1	-2.25362
-3.3711	0.5	-3.8711
-4.40072	0.5	-4.90072
-4.20074	0.5	-4.70074
-4.34377	0.5	-4.84377
-3.67475	0.5	-4.17475
-3.46073	0.5	-3.96073
-3.47146	0.5	-3.97146
-3.26059	0.5	-3.76059
-3.01076	0.5	-3.51076
-2.8058	0.5	-3.3058
-2.59977	0.5	-3.09977
-2.47026	0.5	-2.97026



MALE LEE CARTER PROJECTON MODEL FOR 2014

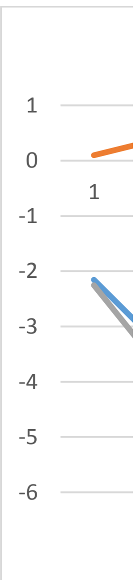
Y=Ln Mx	ax	y-y
-2.16504638	0.1	-2.26504638
-3.27419085	0.5	-3.674190849
-3.79866215	0.5	-4.198662153
-4.20073562	0.5	-4.600735619
-3.99158538	0.5	-4.391585377

FEMALE LEE CARTER PROJECTON MODEL FOR 2014

Y=Ln Mx	ax	y-y
-2.05271	0.1	-2.15270948
-3.39513	0.5	-3.89513216
-3.83303	0.5	-4.33303115
-3.84921	0.5	-4.34921051
-3.97376	0.5	-4.47375689
-3.63062	0.5	-4.13061798
-3.53267	0.5	-4.03267418
-3.38806	0.5	-3.88805974
-3.26388	0.5	-3.76388031
-2.99184	0.5	-3.49184221
-2.7613	0.5	-3.26129896
-2.71674	0.5	-3.21674335
-2.49238	0.5	-2.99238341

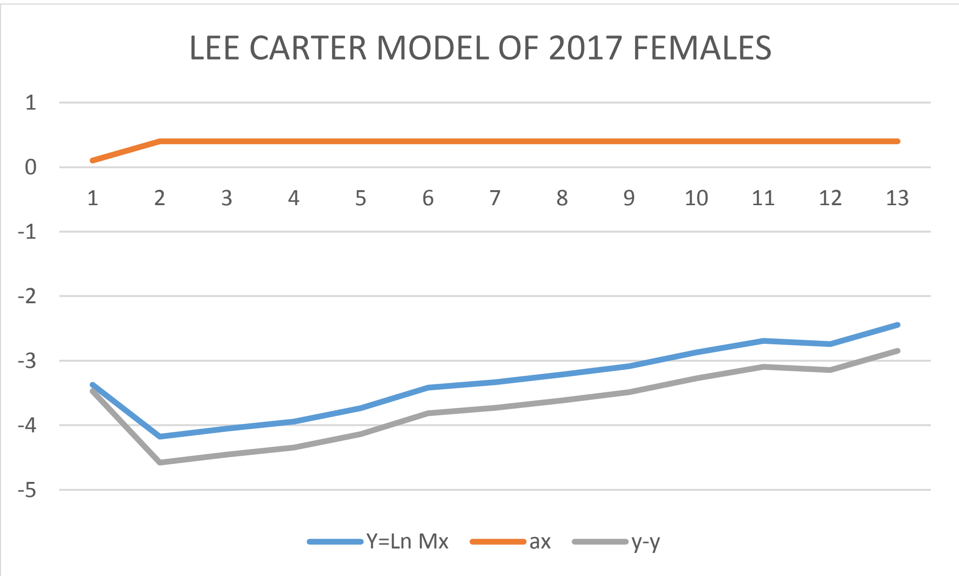
-3.57407919	0.5	-3.974079187
-3.47655059	0.5	-3.876550594
-3.29591995	0.5	-3.695919947
-3.20428868	0.5	-3.604288679
-2.89496382	0.5	-3.294963815
-2.97312785	0.5	-3.373127854
-2.63830951	0.5	-3.038309512
-2.6896744	0.5	-3.089674405

Y=Ln Mx	ax	y-y
0	0.1	-0.1
-3.37110086	0.5	-3.771100862
-4.17887339	0.5	-4.578873395
-4.05460758	0.5	-4.454607583
-3.94582789	0.5	-4.345827887
-3.73544719	0.5	-4.135447189
-3.41528094	0.5	-3.815280938
-3.3316355	0.5	-3.7316355
-3.2161879	0.5	-3.616187902
-3.08449378	0.5	-3.484493783
-2.96500168	0.5	-3.365001682
-2.87113832	0.5	-3.271138315
-2.69382684	0.5	-3.09382684



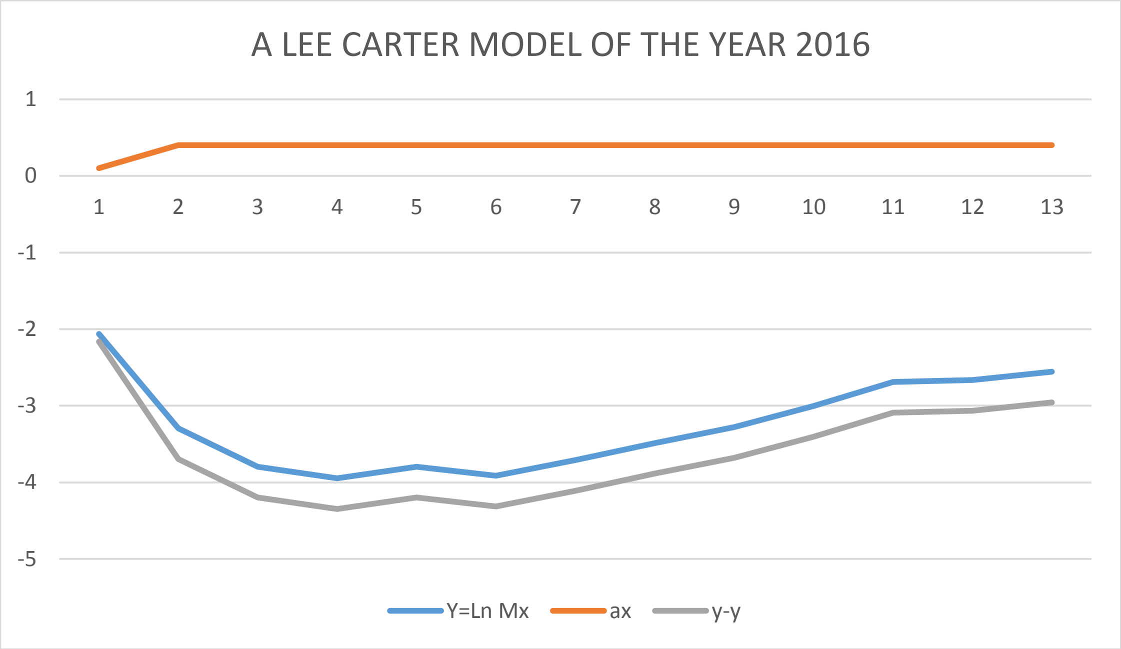
FEMALE PROJECTON MODEL FOR 2015

Y=Ln Mx	ax	y-y
-3.3711	0.1	-3.4711
-4.17887	0.5	-4.57887
-4.05461	0.5	-4.45461
-3.94583	0.5	-4.34583
-3.73545	0.5	-4.13545
-3.41528	0.5	-3.81528
-3.33164	0.5	-3.73164
-3.21619	0.5	-3.61619
-3.08449	0.5	-3.48449
-2.87114	0.5	-3.27114
-2.69383	0.5	-3.09383
-2.74403	0.5	-3.14403
-2.44486	0.5	-2.84486



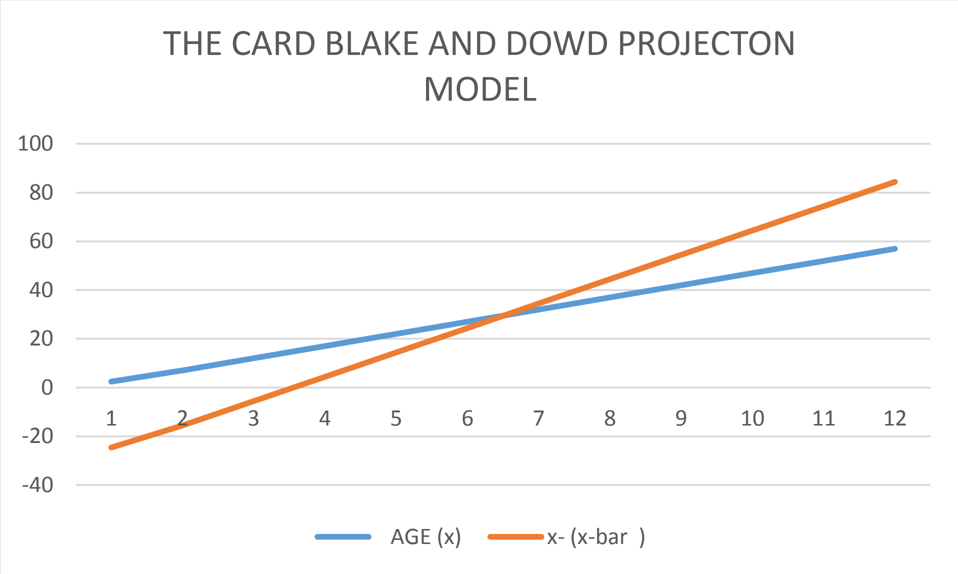
A LEE CARTER MODEL OF THE YEAR 2016

Y=Ln Mx	ax	y-y
-2.06382	0.1	-2.16382
-3.29502	0.5	-3.69502
-3.79524	0.5	-4.19524
-3.94612	0.5	-4.34612
-3.79767	0.5	-4.19767
-3.91316	0.5	-4.31316
-3.70877	0.5	-4.10877
-3.48497	0.5	-3.88497
-3.27812	0.5	-3.67812
-3.00139	0.5	-3.40139
-2.68875	0.5	-3.08875
-2.66287	0.5	-3.06287
-2.55584	0.5	-2.95584



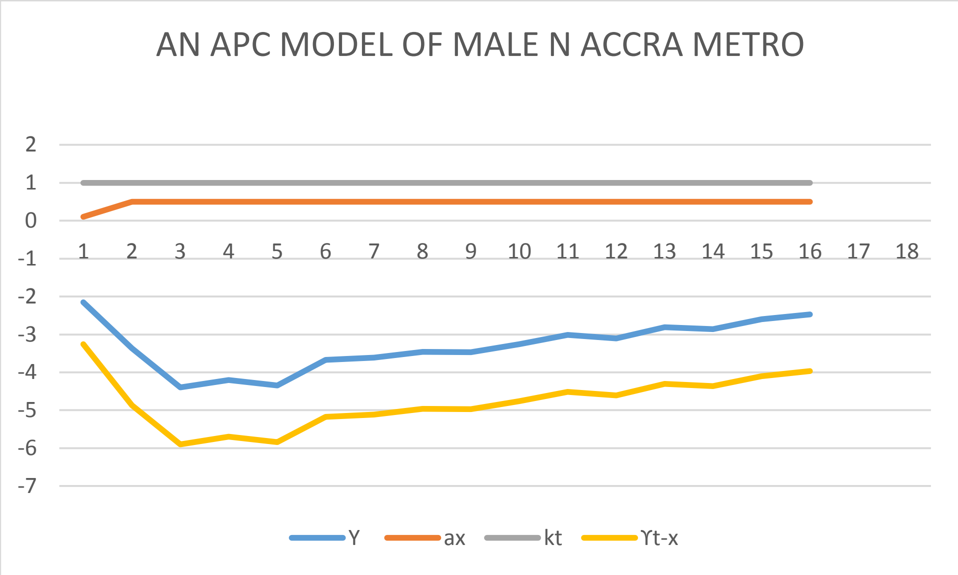
THE CBD MODEL OF MORTALITY MODEL

AGE(x)	x- (x-bar)
2.5	-27.0417
7	-22.5417
12	-17.5417
17	-12.5417
22	-7.54167
27	-2.54167
32	2.458333
37	7.458333
42	12.45833
47	17.45833
52	22.45833
57	27.45833



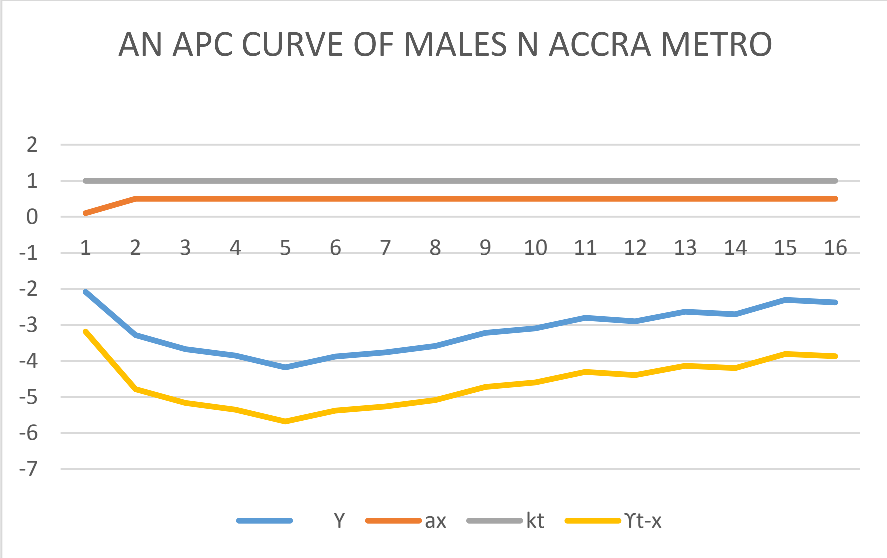
THE APC MODEL FEMALE LIFE EXPECTANCY

Y	ax	kt	ϒt-x
-2.15362	0.1	1	-3.25362
-3.3711	0.5	1	-4.8711
-4.40072	0.5	1	-5.90072
-4.20074	0.5	1	-5.70074
-4.34377	0.5	1	-5.84377
-3.67475	0.5	1	-5.17475
-3.61485	0.5	1	-5.11485
-3.46073	0.5	1	-4.96073
-3.47146	0.5	1	-4.97146
-3.26059	0.5	1	-4.76059
-3.01076	0.5	1	-4.51076
-3.10667	0.5	1	-4.60667
-2.8058	0.5	1	-4.3058
-2.85943	0.5	1	-4.35943
-2.59977	0.5	1	-4.09977
-2.47026	0.5	1	-3.97026



THE APC MODEL MALE LIFE EXPECTANCY

Y	ax	kt	Ɣt-x
-2.08456	0.1	1	-3.18456
-3.28243	0.5	1	-4.78243
-3.6703	0.5	1	-5.1703
-3.84921	0.5	1	-5.34921
-4.17788	0.5	1	-5.67788
-3.8784	0.5	1	-5.3784
-3.75992	0.5	1	-5.25992
-3.58643	0.5	1	-5.08643
-3.22376	0.5	1	-4.72376
-3.0983	0.5	1	-4.5983
-2.80269	0.5	1	-4.30269
-2.89695	0.5	1	-4.39695
-2.63851	0.5	1	-4.13851
-2.70197	0.5	1	-4.20197
-2.30499	0.5	1	-3.80499
-2.37283	0.5	1	-3.87283


AN APC CURVE OF MALES N ACCRA METRO
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