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Declaration

Declaration by the Candidate

I the undersigned declare that this dissertation is my original work and to the best of my knowledge has not been presented for the award of a degree in any other university.

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REG. NO: I56/68359/2013

Signature. . . . . Date:. . . . . . / . . . . . . /2016

Declaration by the Supervisor

This dissertation has been submitted for examination with my approval as the university supervisor.

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Dedication

I devote this study project mainly to the Lord Almighty for giving me the chance and the grace to come all this far. To my dear wife Mercy Nangila and my lovely son John Pharrell Randy for your much support during the course of my study. I also appreciate my extended family too. Thank you for your moral support you accorded me during my whole course. I wish you all the best in all your endeavors and especially your future plans. God bless you.

Acknowledgement

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Abstract

Fertility transition has been identified to be affected by numerous factors. This research aimed at investigation of the most effective factors affecting fertility transition in Kenya. These factors were firstly extracted from literature, convened into demographic features, social economic features, social cultural features, reproductive features and modernization features. All these factors had 23 parameters identified for this study. Principal component analysis (PCA) was utilized using 23 parameters; Principal component analysis conveyed religion, region, education and marital status as the factors. PC scores were calculated for every point. The identified principal components were utilized as forecasters the multiple regression model with the fertility level as the response variable. The four components were found to be affecting fertility transition differently. It was found that fertility is affected positively by factors region and marital status and negatively by factors religion and education. These four factors can be considered in the planning policy in Kenya.

Abbreviations and Notations

KDHS	Kenya Demographic Health Survey.
PCA	Principal Component Analysis.
β	Coefficient estimate.
δ^2	Variance.
μ	Population mean.
R	Correlation matrix.
S	Covariance matrix.
λ	Eigen value.

Chapter 1

General Introduction

1.1 Background of the study

Long before the beginning of demographic transitions, life expectancy was short, birth rates were high, and Population was young characterized by slow growth rates. During the transition, first mortality and then fertility declined, making population growth rates first to accelerate and then to slow down again, moving toward low fertility, increased life expectancy and old population (Lee, 2003). The transition started around 1800 with declining mortality in Europe and later started to spread to all parts of the world and is projected to be completed by the year 2100. This global transition in population has brought about significant changes and in turn reshaping the economic and demographic life cycles of individuals and restructuring population (Lee, 2003).

In the past decades, a good number of developing nations have experienced fast fertility declines. According to United Nations (2007), the overall, total fertility rate of developing nations dropped from 6 births per woman in the late 1960s to 2.9 children in 2000-2005. Declines in fertility have been most rapid in Asia, North Africa, and Latin America, regions where social and economic development has also been relatively fast. Sub-Saharan Africa nations also experienced significant declines during this period despite the region's lagging development. On average, these changes occurred more rapidly than demographers had expected earlier. This is evident based on fertility projections made during the 1970's and 1980's which were generally higher than the subsequent trends (NCPD, 2005). Projections indicate that the fertility levels of countries that are in transition will continue their decline until the fertility drops slightly the replacement level (United Nations, 2007).

This kind of demographic transition, observed in the form of fertility decline, has been largely present in the developed world especially in North America, Western Europe and the Oceania from the late 19th century to the start of the 20th century (Galor, 2012, Guinnane, 2011). Fertility trends in the developing world however, haven't experienced a significant decline until after World War II when technology, science and living standards started to rise in developing nations.

1.2 Problem statement

Measurement of fertility transition has been based on the trends in the Kenyan birth rate. Most researchers in this field have identified factors that are either related to other research findings or are entirely different in wordings but same in effect to fertility transition. Using the already identified factors affecting fertility transition in Kenya and the same time reducing them to the most effective ones can help in better understanding of the underlying factors that influence the fertility transition in Kenya.

1.3 Research objectives

1.3.1 Primary objectives

To model the factors affecting fertility transition using principal component analysis and multiple regression

1.3.2 Secondary Objectives

- To determine the factors contributing to fertility transition in Kenya using principal component analysis.
- To determine the effect of factors that contributes to fertility transition through regression

1.3.3 Research Questions

- Does data describe the problem using multivariate and principal component analysis?

- Does principal component analysis help to identify the factors contributing to fertility transition in Kenya?
- What are the effects of factors that contribute to fertility transition?

1.4 Justification and Significance of the Study

This project summarizes other works done on effects of fertility transition. The technique aims at creating the best model that captures as many factors as possible. Modeling fertility transition using principal component analysis (PCA) creates ranks on the factors thus this can be used to advice fertility policy makers on effective transition program since this model can be used reliably in setting policies in areas of interest.

Chapter 2

Literature Review

2.1 Introduction

According to Dyson (2010), the last 300 years have seen three remarkable changes in human society. One is the demographic transition ,reductions in mortality rates made the population to explode, followed by reductions in fertility that are led to a more stable and declining population numbers. Second is economic growth, the emergence of growth in income per capita. The third is an increase social-political balance, particularly in all genders, with the adoption of democracy and universal adult franchise.

Continents such as Asia, Africa and Latin America have marked demographic transition that has been largely present in the developed world such as North America, Western Europe (Galor, 2012, Guinnane, 2011).Developing nations haven't experienced a much decline until after 1945, during this time science, technology and living standard began to rise in the developing countries. Researchers from the developed world began to investigate the causes of decline, thus this led to demographic transition theories.

The theories constitute that of Solow and Malthus, who treated population as exogenous to the economy. Recent studies suggest that fertility is most likely endogenous hence many other potential growth determinants can take effect on economic development (Lucas, 2002, Galor, 2005). This chapter seeks to give an empirical literature review of what causes the fertility transition with a focus on the Sub-Saharan region and also the theoretical reviews on fertility transition.

2.2 Fertility transition status in sub saharan Africa

Fertility decline in the Sub Saharan Africa is characterized with significant changes where some of them have shown a decline in fertility rates in the past decades. According to Ezeh et al (2009) pointed out that as opposed to the predictions made pertaining to the decline in total fertility rates in the region, there has however been a distortion in the fertility rates decline which is noted to have experienced a stall from the second half of 1990 and early 2000 in some countries in the region. Fertility transition has stall at over five children per woman in a third of the countries in the region. While a considerable fraction of the countries in the region are still at the early pre-transition stage of fertility transition (Ezeh et al, 2009).

Literature shows that total fertility rate in Sub Saharan Africa from 1975 to 1980 stood at an estimate of 6.6 children per woman (Boogaarts, 1996). This was the average total fertility rates that prevailed in most countries (Boogaarts et al 1996). Malmberg (2008) indicated that before, women in Sub Sahara Africa averagely gave birth to 7 children during their fertile years. During 1980s, fertility rates were highest in East and West Africa, while rates were lower in central Africa. Variation in fertility rates between countries in the Sub Saharan sub continent can be seen between Kenya and Gabon. The former had fertility rates of 8.1 children per woman while the latter was 4.1. This portrays a substantial difference (Malmberg 2008). It is imperative to highlight that variation in fertility rates is not solely limited at country levels, but also within countries, marked by variation between socioeconomic groups (educated and uneducated, and between regions that is urban and rural. Presently in most sub Saharan African countries the average number of child birth is 5.1 children a woman gives birth to during her child bearing age. Amongst the factors identified for the decline is the changing attitudes vis-a-vis family size, changes in the levels of contraceptive usage and socio economic development (embodies issues relating to women's education, infant and child mortality.

Adebusoye's (2001) assessment of fertility rates in the Sub Saharan Africa grouped the Nations according to their fertility rates. Fertility decline in the sub-continent is characterized with variation. Most countries have Category I countries: Cote d'ivoire, Ghana, Kenya, Botswana, Zambia, Rwanda, and Zimbabwe. Category II countries: this embodies countries that have witnessed small decline in their fertility rates between 0.5 and 0.9 every 10 years. The countries in this category include: Benin, Mauritania, Tanzania, Cameroon, Central African Republic, Malawi, Cameroon and Swaziland. Category

III countries: This category constitutes countries whose total fertility rates have stabilized around the peak of almost 6 children and above. Countries found in this category are; Liberia, Burkina Faso, Mali, Togo, Burundi, Ethiopia, Madagascar, Mozambique, Uganda, Niger, Angola, Congo and democratic republic of Congo. These countries have not yet entered the demographic transition phase (Adebusoye 2001).

The decline in fertility recorded in category I countries is cited to stem from the desire for smaller family sizes. While in category III countries, high fertility rates stems from the fact that fertility decisions do not rest solely on individual's choices. Factors that contribute to decline in category I countries have been rooted in family planning (Adebusoye, 2001). The nations in this category have as well recorded a significant fall in mortality rates of under 5. Thus, they have relatively lower under 5 mortality and higher contraceptive use than countries in category II and III. This can also be understood to be the reason for its lower fertility rates. Another factor that has been identified to have led to lower fertility in the category I countries has been contraceptive use (Adebusoye, 2001).

These countries have also witnessed a fall in age at marriage. Malmberg (2008) made an assessment of fertility rates in the region which led him to categorize the countries in to four groups. He reckoned that presently, countries in southern Africa notably south Africa, Zimbabwe, Botswana and Namibia are a step further in fertility transition. These countries are presently having fertility rates that are below 3.5 children per woman. The second group of countries constitutes countries that are having fertility rates below 5 children per woman. These include eastern African countries, Cameroon, Congo Brazzaville, Central African Republic, Ghana, Cote d'ivoire and northern Eastern Africa (Djibouti, Sudan). The third group of countries is those that are in the early stages of their fertility decline. This includes; Nigeria, Mozambique, Ethiopia, Eritrea. In these countries fertility rates have fallen below six children. The fourth category constitutes countries whose fertility decline has just merely commenced. This embodies four sahelian countries (Mali, Burkina Faso, Niger and Chad) west Africa countries (Sierra Leone, Guinea-Bissau) central African countries (Congo, Burundi), Uganda and Somalia in East Africa.

Ezeh et al (2009) mentioned that total fertility rates in Uganda and Tanzania are still quite high of 6.7 children per woman in Uganda and 5.7 children per woman in Tanzania. Both countries are experiencing a yearly percentage change in their TFR of 0.5 and 0.7 respectively. The situation is different in Kenya and Zimbabwe that have an annual fertility decline rate of 2.5 to 3.8 times larger. Fertility decline in Uganda surface only in current periods, it is noted to be still at the pre-transition phase of 6.7 children per woman as of 2007 (Ezeh et al 2009). Study of fertility rates in Sub Saharan Africa in the eastern part of sub continent, portrayed that Uganda is still at the pre transition phase of its fertility transition, Kenya and Tanzania are experiencing a stall but have entered the transition phase much earlier, while Zimbabwe is encountering progressive decline in its fertility rate.

Therefore, it can be discerned from the aforementioned data that even though the region is renowned for its high fertility levels, a closer examination shows that fertility rates tend to vary across the countries in the sub continent. Some of the countries are already further ahead in the fertility transition process; others are at the early phase, while some are still entering the process. Malmberg (2008) identified the central factor responsible for the variation to be based on differences in infant mortality rates between the countries. Countries that are encountering infant mortality rates that stand above 100 dead infant per 1000 births tend to experience higher fertility rates, while infant mortality below 100 then to experience fertility decline below 6 children per woman. And if infant mortality is 50, fertility rates fall to three children per woman (Malmberg 2008).

2.3 Determinants of *Fertility Transition*

2.3.1 Changes in reproductive behavior

It has been the general consensus amongst African scholars that family planning programmes act as the nexus of fertility decline. Changes in fertility trends has been cited to stem from a number of factors ranging from changes in reproduction preferences, changing behavior of women, institutional policy programme changes marked by the creation of conditions that constrain the reproduction of women, changes in the socio economic status of women. John Caldwell and Pat Caldwell (1992) pointed out that women in general (even educated women) in most African nations perceive their reproduction to lie in the hands of their husbands and their husbands' families. The attempt by women to limit their reproduction is shun upon by their in-laws who considered the act of limiting childbirth to be monstrous. The reproductive model mentioned above puts forth the argument that changes in reproductive behavior accounts for changes in fertility rates. One of the behavioral changes or preferences that form the tenet of this model is contraceptive use, which is noted to forge fertility decline. Sub Saharan Africa still has relative low level of contraceptive use (Merrick 2002) Prior to the introduction of contraceptives through family planning programmes, fertility levels in most areas in the region was controlled through traditional postpartum practices such as breastfeeding and abstinence (Canning, 2011).

Most African countries are progressively introducing national family planning programmes which have the motive of promoting contraceptive usage but this has been daunting. However, over the years, contraceptive usage has garnered momentum in most modern sub Saharan African countries. According to Adebusoye, (2001) the usage of contraceptive is dependent on which facet its use is comprehended, that is if it is viewed as means of limiting family size or if it is used to promote birth spacing. Before, contraceptive use had been rather low with the reason identified for this being that most people in the region still desire large families. According to Walle et al (1994), the demand for children is connected with family relationships and the position of women. Caldwell et al. (1987) remarked that contraceptive use is lower in the sub continent than elsewhere in the world. A great proportion of women in the region have been utilizing sexual abstinence as the only method of controlling reproduction. The prime reason put forth for the low contraceptive use has being blame on low demand and inadequate supply. However, the practice of postpartum is common. Community leaders in African societies were at beginning apprehensive on the discourse surrounding the promotion of modern contraceptive; they raised the argument that Africa has its own system that is centered on female sexual abstinence (Caldwell et al., 1987). Usage of modern contraceptives was perceived as distorting the natural process of procreation (Adebusoye, 2001).

Contraceptive use in contemporary societies in sub Saharan Africa has significantly risen (Mbacke, 1994). This can be attributed to stem from the rise in women's education pursuit, as well as by the emergence of HIV/AIDS. Ezeh et al (2009) adhere to the fact that the availability of contraceptives, tends to provide a means of checking and controlling reproduction. There is a relatively lower contraceptive usage in countries in western and central Africa, this has inherently accounted for the high fertility rates prevailing in these regions (Adebusoye 2001). This information has shown that the introduction of modern contraceptive was at first was beset with resistance and apprehension that accounted for its low usage by the population. However, presently modern contraceptive methods usage has witnessed an increase in scale in most Sub Saharan countries.

2.3.2 Modernization

Increase in modernization through processes like urbanization account for changes in family values, notably with regards to the perception of children as source of wealth as postulated by the socio-economic model. This has a great role to play in the decline of fertility rates. The advent of industrialization and urbanization has distorted this reasoning in Europe (Becker 1991). Fertility rates and family values change due to urbanization and modernization. The modernization theory stipulates that modernization reduces the demand for children marked by the trend of the movement from large extended families to smaller units. The theory propagates the notion that the advent of industrialization has unleashed tremendous economic changes that forces societies to alter traditional institutions. In traditional societies, fertility and mortality are high, while in modern societies fertility and mortality are low (Canning, 2011)

The advent of urbanization in sub Saharan Africa has set the pace for the emergence of new lifestyles that are identified to be associated with practices that for the reduction in fertility like contraceptive usage. An in-depth glimpse of the impact urbanization exerts on fertility can be discerned by comparing fertility rates of urban and rural areas. There exists a great disparity in fertility rates between both regions. Fertility rates are much higher in rural areas than in urban areas. The main issue responsible for this as outlined by Bloom et. al (2009) is that in rural areas in sub Saharan Africa, cultural practices and social institutions are still deeply entrenched. Rural areas are also plagued with less educational opportunities and limited contraceptive accessibility. This thus accounts for the higher fertility rates in rural areas than in urban areas.

2.3.3 Women's Social Networks

Two ways in which women's social networks are related to fertility are the extent of collaboration among network partners, and its nature. First, the level of competition and collaboration between co-resident women within a 45 household is important in determining fertility and child survivorship outcomes(Madhavan 2001). This is likely to affect fertility through spacing and stopping behaviour. The extent of collaboration could also be a factor in child survival, as is that of culture – higher fertility is found to prevail in ethnic groups among which there are cooperative women in the extended household to assist in childrearing.

Research on female collaboration and conflict is therefore timely in countries well into the fertility transition such as Zimbabwe, Botswana, and Kenya. Secondly, that demographic phenomena occur within a social context is not in doubt, the problem is how to conceptualize and measure this social world within which individuals live. Results from a quantitative survey conducted among Bamanan women in Mali permit exploration of the social networks of these women and their effects on fertility decisions.The study also adopted the use of ordinary least squares and logistic regression models. Results showed that while household characteristics have a significant effect on women network. Inclusion of conjugal kin in the network reduces the number of children a woman has ever had; but when the husband or unrelated older women form part of the group, the woman has fewer children. Ever-use of contraception increases if the woman participates in a credit scheme; it also rises as the number of network members situated outside the village increases. When the number of network members who are conjugal kin increases, ever use of contraception increases, it also increases with the presence of the woman's mother. Network effects on fertility are more significant on women who are aged at least 30 years than amongst those who are younger. The effects are also different for older and younger women. Programs should therefore focus on women's individual and household characteristics and equally their broader social networks (Madhavan et al., 2003).

2.3.4 Women Education

The theory of economics portrays ways in which education is a factor that affects fertility choices. One explanation is that education is a key especially in labor market Participation thereby, increasing the opportunity cost of time-intensive activities (Becker et al, 2009; Schultz, 2008). As a result, women might substitute time-intensive activities, such as childbearing and child rearing, in order to devote more time to the labor market participation. Therefore, education might result in fewer children for women. Also, education may affect fertility preferences–for instance, most of the educated women prefer less and healthier children (Becker and Lewis, 1973).Good health of children which is due to female education can lead to reduced child mortality, hence, lowering fertility since fewer births are required to achieve the same family size (Lam and Duryea, 1999; Schultz, 1993).Increased knowledge about contraceptives and their effective use which is due to increased women education, has also reduced the fertility (Schultz, 1985, 1989).Education can increase women's chances of being equal to men in the household, thereby, increasing women's participation in decision making (Mason, 1992). In addition, staying in school longer might postpone childbearing if having children impedes upon attending school.

Economic theory points to a number of mechanisms in which education influences fertility; however, according to the demography literature, the relevance of these mechanisms is highly dependent on a country's stage of demographic transition. Changes in fertility behavior, including the adoption of birth control methods and preferences for smaller households, which is due to the new technology spread of information, But also family planning programs, etc., accounted for changes marked by the decreased fertility rate in the first stages of transition. However, as a country approaches the later stages of the transition, fertility becomes more closely tied to the level of socioeconomic development (Bongaarts, 2002).Decrease in fertility, may be due to the presence of socioeconomic conditions such as education with child care (Bongaarts, 2001). Therefore, increases in female education, may lead to decrease in fertility. Many developing countries have experienced lower fertility rates since the year 1960s; nevertheless, the decrease slowed in a number of nations such as Turkey in the 1990s (Bongaarts, 2006). Causal evidence that policies can influence fertility at later stages, however, is absent.

2.4 Theories of Fertility Transition

These theories are based on three time scales, and which scale is chosen can influence the way and achievements of such theory (Mason, 1992).Millennial time scale, the focus is on why fertility decreased for the past 200 years instead of, say, five centuries earlier or five centuries later. On a centennial scale, the question is why fertility transitions in various nations or places have ensued in a given season or period of time, why it happened majorly in European region and its colonies. Nearly one century later, mostly in Asia and South America, and lately in most of sub-Saharan Africa and the Arab Middle East. Lastly, on a decadal scale, the question is why fertility weakening arose in one period than the other, for instance in the early 1880s fairly than in the 1890s. Thus this is the interval scale engaged in Princeton's European Fertility Project a project that has strongly influenced thinking about fertility declines. In this sub-section, I will give a review of six major theories of fertility transitions (Coale and Watkins 1986).

2.4.1 Classic demographic transition theory

According to Thompson (1930) and Notestein (1953), this theory attributes fertility drop to variations in societal lifetime that complement, and are presumed to be caused by, industrial development and suburbanization. These variations firstly yield a weakening in mortality, which sets the stage for-or by itself may convey fertility weakening by accumulating the existence of children and, hence, the size of families. Suburbanization and industrial development also make an approach of lifespan in which rearing more than a few children is expensive enough to discourage most parents from having large families.

Demographers need to use classic transition theory extensively, but they have similarly condemned it bitterly (Cleland and Wilson 1987; Coale and Watkins 1986; Knodel and McDonald 1993). Transition philosophy is likely to be on a optimistic scale, but as noted earlier, any theory consistent with the account of the West is in the same way acceptable. When convincing on a decadal measure, the theory is frequently contradicted. In both Europe(Coale and Watkins 1986) also the emerging countries (Bongaarts and Watkins 1996), correlations between close of suburbanization or industrial development and the period in which nations or provinces first experience a fertility decline are weak.

2.4.2 Classic transition theory

At centenary level, typical transition philosophy is further successful but still needs obvious modification. That the principal established transitions happened in the West roughly 100 years before the second set occurred in Asia and South America outbursts equally well with the account of suburbanization, industrialization, and mortality decline in these world sections. Less reliable with the philosophy, nevertheless, exists the demographic history of particular countries. For example, several countries in Asia (e.g., Bangladesh: Amin, Cleland, Phillips, and Kamal, 1995) and Latin America (Zavala de Cosio, 1996) that remain presently experiencing the fertility transition are agrarian and underdeveloped, seeming inconsistency to the impression that growth and modernization bring about fertility declines. Thus, demographic transition philosophy takes notions that are rigid to overlook and that live on despite the barrage of criticism to which the theory has been subjected. In its original form, however, the theory is incomplete.l.

2.4.3 Wealth Flow Theory

Caldwel (1982) through his Wealth flow theory attributed fertility decline to the emotional nucleation of the family, a variation that could stand initiated by whichever financial or else social forces. At the heart of the theory is the idea that nucleation marks children, not close relative, the remaining financial benefactors of family life, a process that Caldwell calls the reversal of interfamilial "prosperity drifts." Caldwell's philosophy might relate to sub-Saharan African, where Caldwell conducted much of the research that produced the philosophy and where prolonged families are resilient and heredity elders are expected to detriment from great fertility (Lesthaeghe, 1980). The theory has been reviewed by selected researchers appealing that it ensures no work as well in numerous portions of East Asia, wherever fertility has declined with little apparent change in extended family relationships (Thornton and Fricke 1987). Equally problematic is its applicability to Western Europe, where family nucleation existed for centuries before fertility decline.

2.4.4 Neoclassical microeconomic theory

Emphasizes three proximate determinants of couples' fertility choices: the relative costs of children versus other goods, the pair's revenue, and their favorites for children versus competing forms of consumption.This theory provides a measurable context for studying fertility variation, but as a theory is silent about the environmental and institutional conditions that alters costs, revenue and thereby activate fertility declines. Thus, in addition to problems in the theory's internal logic recently elaborated by Robinson (1997), the microeconomic theory of fertility decline can be faulted for adding little to classical demographic transition theory when it comes to insight into the institutional conditions conducive to fertility transitions.

2.4.5 Microeconomic Fertility Theory

This theory elaborates fertility transition by adding to it a sociological variable, the supply of children. It explains fertility in terms of three proximate determinants: the supply of children, that is, the number of children that parents would bear in the absence of deliberate fertility limitation; the demand for children, or amount of living children they would like to have; and the costs of fertility regulation, where "expenses" are psychic, communal, and financial costs. This concept has been useful for organizing thinking about fertility decline.

2.4.6 Ideational Theory

Enunciated by Cleland and Wilson (1987), this theory attributes the timing of fertility transition to the diffusion of information and new social norms about birth control (previous mortality decline may also be a necessary precondition for the transition). Although this theory adds an important element to earlier theories, Cleland and Wilson recognize that Africa poses a difficult case for a pure diffusion theory. In Africa, parents want large numbers of surviving children (Caldwell, 1982). Under these conditions, the diffusion of birth-control in-formation is unlikely to result in a fertility decline, although birth control may be adopted to achieve desirable birth spacing (Caldwell, Orubuloye, and Caldwell 1992). Diffusion of ideas and the processes through which diffusion occurs-namely, social interaction and influence are increasingly recognized as important for the timing of fertility declines, especially on a decadal time scale (Bongaarts and Watkins 1996; Hirschman 1994). Like all of the other theories re-viewed here, however, the ideational theory as enunciated by Cleland and Wilson is incomplete.

In summary, although there are many theories of fertility transition, each containing important ideas, none provides a complete explanation for all known fertility declines. Moreover, those theories that are specific enough to be tested in a meaningful manner have been contradicted by the evidence.

Chapter 3

Methodology

This chapter involves the explanations of the model to be used. This research investigates the factors affecting fertility transition by use of Multivariate analysis which is mainly Principal component analysis (PCA) and hence the multiple linear regressions.

3.1 Research Design

The data for this study are from the Kenya Demographic and Health Surveys (KDHS) conducted in 1999-2003 and 2003-2008/9.The data is continuous and it involves the mean birth order for the ten period.KDHS used descriptive survey design since it is useful in collecting information on fertility, marriage, fertility preferences and breastfeeding. The survey method is appropriate for collecting data aimed at evaluation and decision-making. It is thus most appropriate for collecting data that evaluate social systems.

3.2 Study population

In this study all women aged 16-49 in the entire region of Kenya were the target population. The regions were inclusive of: Nairobi, Central, Western, Rift Valley, Nyanza, North Eastern, Coast, and Western. Nationally representative sample populations of 16639 women were interviewed in this particular study.

Two models were used in this project; these are multivariate analysis models which are specifically principal component analysis and eventually multiple linear regressions.

3.3 Multivariate analysis

This involves the analysis which is concerned with techniques of analyzing continuous quantitative measurements on several random variables.Taking a sample of 10 individuals and each of these 10 individuals we measure 23 variables. This means that we have 10 samples of 23 variables. For the ith individual, we record the 23 measurements as a vector;

$$X = [x_1, x_2, ..., x_{23}]^T$$

Where T=Transpose

X is 23×1 vector matrix. Then the means of 23×1 is vector of means which can be expressed;

$$\mu = \frac{1}{23}\left[\overline{x}_1 + ... + \overline{x}_{23}\right]^T$$

$$E(X) = \mu = \begin{pmatrix} Ex_1 \\ . \\ . \\ . \\ Ex_{23} \end{pmatrix} = \int xf(x)dx = \begin{pmatrix} \int x_1 f(x_1) \\ . \\ . \\ . \\ \int x_{23} f(x_{23}) \end{pmatrix}$$

and

$$E(X) = [E(x_1), E(x_2), ..., E(x_{23})]^T$$

It's advisable to re-centre the data so that the mean is zero (their centre of mass is at the origin).Thus the X matrix of the centered data will be in the form,

$$X = [(x_1 - \mu_1), ..., (x_{23} - \mu_{23})]^T$$

Covariance in random variables:,When measuring two variables in a population, then it's natural to check if they are related. Covariance is an evaluation of dependence between two random variables for example variables X and Y (Hardle and Simar, 2003).Therefore the covariance of X and Y where,

$$X\tilde{}\left(\mu_X, \sum\nolimits_{XX}\right)$$

and

$$Y^{\sim}\left(\mu_Y, \sum\nolimits_{YY}\right)$$

is a $m \times k$ matrix of the form;

$$\sum\nolimits_{XY} = cov(X,Y) = E(X-\mu_X)(Y-\mu_Y)^T$$

Therefore the covariance matrix of a random vector X is an (23 by 23) square matrix defined by;

$$S_X = E\left([X-E(X)]\left[E-E(X)\right]^T\right) = E\left([X-\mu_X]\left[X-\mu_X\right]^T\right)$$

$$S_X = E\left[(X-\mu_X)(X-\mu_X)^T\right]$$

$$S_X = \frac{1}{n-1}XX^T$$

Where n=10,Then

$$S_X = \begin{bmatrix} \delta_{11} & \delta_{12} & . & . & . & \delta_{123} \\ \delta_{21} & \delta_{22} & . & . & . & \delta_{223} \\ . & \ddots & & & & . \\ . & & & & & . \\ . & & & & . & . \\ \delta_{231} & \delta_{232} & . & . & . & \delta_{2323} \end{bmatrix}$$

Where

$$\delta_{ij} = cov(x_i x_j) = E([x-E(x_i)]\left[E-E(x_j)\right])$$

But,

$$\delta_{ii} = \delta_i^2 = E([x-E(x_i)]^2 = var(x_i)$$

If we have A such that $A = \binom{X}{Y}$, then A is a covariance matrix which takes the form,

$$\sum\nolimits_{AA} = \begin{pmatrix} cov(X,X) & cov(X,Y) \\ cov(Y,X) & cov(Y,Y) \end{pmatrix} = \begin{pmatrix} \sum_{XX} & \sum_{XY} \\ \sum_{YX} & \sum_{YY} \end{pmatrix}$$

The main diagonal shows the variances for any given dimension.Since the matrix $cov(X,Y) = cov(Y,X)$ the matrix is symmetrical about the main diagonal.If the $cov(X,Y)$ =0 then this implies that X and Y are independent and if $cov(X,Y)$=1, then this implies that they are dependent. Then the diagonal elements of $\sum_{AA}$ must be non-negative and the matrix should be positive definite matrix (Timm, 2002).

Eigen value and Eigenvectors: Since X is matrix of real numbers, and it is symmetric i.e $X = X^T$ Then X is orthogonally diagonalizable and has real eigenvalues $\lambda_1, \lambda_2, ..., \lambda_{23}$with their corresponding orthogonal, non-zero vectors $x_1, x_2, ..., x_{23}$ .Such that for each $i = 1, 2, 3, ..., 23$.But not every square matrix has eigenvectors.

$$X\underline{\mathrm{x}}=\lambda\underline{\mathrm{x}}$$

This can be re arranged as,

$$(X - \lambda I)\,\underline{\mathrm{x}}=0$$

If we manipulate S_X and define it as S_Y and some orthonormal matrix P where $Y = PX$ such that;

$$\begin{aligned}
S_X &= \frac{1}{1-n}YY^T \\
S_X &= \frac{1}{1-n}(PX)(PX)^T \\
S_X &= \frac{1}{1-n}P(XX^T)P^T \\
S_X &= \frac{1}{1-n}PAP^T
\end{aligned}$$

Where $A = XX^T$.

The main aim is to demonstrate that the symmetric matrix is diagonalized by an orthogonal eigenvectors. We can say,

$A = EDE^T$

Where D a diagonal matrix and E is a matrix of eigenvectors of A arranged in columns. Thus matrix A has orthonormal eigenvectors $k < 23$ where k is the rank of the matrix. Maintaining the constraint of orthogonality, we can select $23 - k$ additional orthonormal vectors to fill up the matrix E. These additional do not affect the final solution since these additional vectors have zero variances. We select a matrix P with the row p_i which is an eigenvector of XX^T .Then $P \approxeq E^T$

Substituting XX^T.

$$\begin{aligned}
A &= P^T DP \\
A(P^{-1} &= P^T) \\
S_Y &= \frac{1}{1-n} PAP^T \\
S_Y &= \frac{1}{1-n} P(P^T DP)AP^T \\
S_Y &= \frac{1}{1-n} PP^T DPP^T \\
S_Y &= \frac{1}{1-n} (PP^{-1})D(PP^{-1}) \\
S_Y &= \frac{1}{1-n} D
\end{aligned}$$

We have shown that P diagonalizes S_Y.The principal components of X are the eigenvectors of XX^Tor the rows of P. The i^{th} diagonal value of S_Y is the variance of X along p^i.

3.4 Meaning of principal component analysis

Principal component is a direct arrangement of optimally weighted observed variables (Hatcher and O'Rourke 2013).It is a variable lessening procedure which is suitable when data on a number of variables (possibly a large number of variables), which are thought to have a number of redundancy in individuals variables. The variable weights are well described by the subject scores on a given principal component computed (artificial variables). Taking the example in the above fictitious study, each subject would have scores on the two components, one score on level of education and one score on religion effect on fertility transition. The subject's actual scores on the five questions would be weighted and their sum will compute their scores on a given component. For example the scores on the first component extracted can generally be computed as;

$$y_1 = e_{12}x_2 + \ldots + e_{1j}x_j$$

Where y_1 the subject's score on the first principle component,e_{1j} is the regression coefficient for the observed variable j,and x_j is the subject scores on the observed variable j

3.4.1 The Principal Component Analysis Concept.

PCA is a variable reduction procedure on facts with bulky quantity of variables which are thought to posses some redundancy (Susan et al., 2013) .In PCA we extract a small number of artificial variables $y_1,\ y_2, ..., y_k$ from a large number of redundant observed variables $x_1,\ x_2, ..., x_k$.The artificial variables are thus called the principal components where the first few principal components preserve the highest level of variations present in the original set of variables. Then the extracted artificial variables are used as predictor variables.

3.4.2 Explanation of Principal Component Analysis

The first component y_1

This is a linear combination of the optimally weighted observed variable which accounts for the highest amount of the total variation in the observed variables. It must have correlated with many of the observed variables.

$$y_1 = a_{11}x_1 + a_{12}x_2 + \ldots + a_{1k}x_k = \underline{\mathrm{a}}_1^T \underline{\mathrm{x}}$$

The second component y_2

This is a linear combination of the observed variables that account for the greatest quantity of variance in the experimental variables that were not accounted for by . The second component is given in the equation below;

$$y_2 = a_{21}x_1 + a_{22}x_2 + \ldots + a_{2k}x_k = \underline{\mathrm{a}}_2^T \underline{\mathrm{x}}$$

The first component is uncorrelated with the second component,thus;$\underline{\mathrm{a}}_2^T a_1 = 0$

The kth principal component y_k

This is a linear arrangement of observed variables that interprets for the highest amount variance that was not accounted for by the previous components.

$$y_k = a_{k1}x_1 + a_{k2}x_2 + \ldots + a_{kk}x_k = \underline{\mathrm{a}}_k^T \underline{\mathrm{x}}$$

and $\mathrm{a}_k^T \mathrm{a}_k = 1$,$\mathrm{a}_k^T \mathrm{a}_k = 0$

$$i \leq k$$

Let S be the sample covariance matrix, then if the Eigen values of S are $\lambda_1,\ \lambda_2, ..., \lambda_m$ and since $a_k^T a_k = 1$ Then the total variance of the k^{th} principal component is equal to the total variance of the original variables.Thua S is a sample covariance matrix with eigenvalues, eigenvectors in pairs;$(\lambda_1, e_1), (\lambda_2, e_2), \ldots, (\lambda_m, e_m)$ then $S = S_{im}$ and its m^{th} sample principal component is given as;

$$y_i = e_{i1}x_1 + e_{i2}x_2 + \ldots + a_{im}x_m = \mathrm{e}_i\underline{\mathrm{x}}$$

Where all the eigenvalues in S are positive and x is any observed variable $x_1, x_2, ..., x_m.where, m =$ 23.

3.4.3 How to Calculate Principal Components.

Given a set of data on 23 variables, PCA finds a linear subspace of the dimension k lower than 23 meaning that points lie mainly on this linear subspace. The linear subspace is specified by orthogonal vectors that form a new coordinate system which is now the principal components. The principal components are the orthogonal linear transformations of the original data. The $k < 23$ principal components approximates the subspace spanned by the m original data (they maximize the variance retained in the projections).

Letting y_k to be the k^{th} principal component which is the linear combination of the observed X's with the maximum possible variance. Given that all the highlighted observations are piled into the columns of an 23 by 10 matrix X, where each column corresponds to the 23 variables of the observations and there are 10 observations, Since y_k is the k^{th} principal component which is the linear combination of the observed X defined by coefficients or weights $a_k^T = (a_1, ..., a_{23})$.

$$y_k = \sum_{i=1}^{23} a_{ki}x_i$$

In matrix form; $y_k = a_k^T X$.Where a_k is the eigenvector of S corresponding to the k^{th} largest eigenvalue λ_k.If a_k is chosen to have the unit length i.e $a_k^T a_k = 1$,then,$var(y_k) = \lambda_k$

We are looking for $a_k^T X$ that maximizes $var(y_k) = var(a_k^T X) = a_k^T var(X) = a_k^T S a_k$,

Where S is the 23 by 23 sample covariance matrix of X.var(y_k) can be made randomly big by increasing the amount of a_k,therefore we choose a_k to maximize $a_k^T S a_k$ while constraining a_k to have a unit length.The constraint is that, $a_k^T a_k = 1$ is a unit length vector.

Maximize $a_k^T S a_k$

Subject to $a_k^T a_k = 1$

Let $f(a_k) = a_k^T S a_k$ be the function that we want to maximize and $g(a_k) = c$ where $g(a_k) = a_k^T a_k$ and c=1

We rearrange the constraint equation $g(a_k) - c = 0$

To solve this optimization problem, the lagrange multiplier λ_k is introduced,

$$L(a_k, \lambda_k) = f(a_k) - \lambda_k g(a_k) - c$$

is now the new objective function.

$$L(a_k, \lambda_k) = a_k^T S a_k - \lambda_k (a_k^T a_k - 1)$$

Differentiating the objective function with respect to a_k,

$$\frac{d}{da_k} L(a_k, \lambda_k) = \frac{d}{da_k}(a_k^T S a_k - \lambda_k (a_k^T a_k - 1)) = 0$$

$$\frac{d}{da_k} L(a_k, \lambda_k) = \frac{d}{da_k}(a_k^T S a_k) - \frac{d}{da_k}(\lambda_k a_k^T a_k) - \frac{d}{da_k}(\lambda_k) = 0$$

$$\frac{d}{da_k} L(a_k, \lambda_k) = S a_k - \lambda_k a_k - 0 = 0$$

$$S a_k - \lambda_k a_k = 0$$

$$S a_k = \lambda_k a_k$$

Now $a_k$becomes the eigenvector of S and λ_k the associated eigenvalue.

When choosing the eigenvector,we need to recognize that the quantity to be maximized,

$$a_k^T S a_k = a_k^T \lambda_k a_k = \lambda_k a_k^T a_k = \lambda_k$$

This implies that we choose λ_k to be as big as possible.Thus taking $\lambda_1$to be the largest eigenvalue of S and $a_1$the corresponding eigenvector,then $S a_1 = \lambda_1 a_1$ is the first principal omponent of X and in general a_k will be the k^{th} principal omponent of X and $var(y_k) = \lambda_k$ and $a_k^T a_k$=1.

From the above,the first principal component is specified by the normalized eigenvector with the principal related eigenvalue of the sample covariance matrix S.The second principal component a_2^TX maximizes $a_2^TSa_2$ subject to being uncorrelated with a_1X.The uncorrelated constraint can be expressed,

$$cov(a_1^TXa_2^T) = a_1^TSa_2 = a_2^TSa_1 = a_2^T\lambda_1 a_1 = \lambda_1 a_2^Ta_1 = \lambda_1 a_1^Ta_2 = 0$$

Then the lagrangian will be

$$L(a_2, \lambda_2) = a_2^TSa_2 - \lambda_2(a_2^Ta_2 - 1) - \phi a_2^Ta_1$$

Differentiating with respect to $a_2$and equating to zero.

$$\frac{d}{da_2}L(a_2, \lambda_2) = \frac{d}{da_2}(a_2^TSa_2) - \frac{d}{da_2}(\lambda_2 a_2^Ta_2) - \frac{d}{da_2}(\phi a_2^Ta_1) = 0$$

$$Sa_2 - \lambda_2 a_2 - \phi a_1 = 0$$

Mulplying both sides by a_1^T.

$$a_1^TSa_2 - \lambda_2 a_1^Ta_2 - \phi a_1^Ta_1 = 0$$

$$0 - 0 - \phi = 0$$

$$\phi = 0$$

We are left with,

$$Sa_2 - \lambda_2 a_2 = 0$$

$$Sa_2 = \lambda_2 a_2$$

Therefore $a_2$is the eigenvector associated with the second largest eigenvalue λ_2.Therefore the second principal component of X is a_2^TX.This process is repeated for $k = 1, ..., 23$ yielding up to 23 eigenvectors of S with their corresponding eigenvalue $\lambda_1, ..., \lambda_{23}$.The variance of each principal components are given by $var(a_k^TX) = \lambda_k$ for $k = 1, ..., 23$

3.4.4 Principal component analysis steps

Principal components analysis involves stepwise procedures involving decisions making at every step as shown;

Step 1:

(a) Initial extraction

This is the first step in extracting a number of principal components. As explained from the earlier equations, the first component accounts for the highest total variance while the succeeding components will account for lower amount of variance progressively. The procedure extracts a number of components and involves extracting a number of principal components which are equivalent to the number of variables involved in the analysis. But only the meaningful components in terms of total variation are required for the analysis. The Eigen values in the steps represent the total of variation accounted for by a specific component.

Step 2: Determination of Principal Components to Extract

In determining the principle components to extract, the researcher decides the number of component to retain for rotation and interpretation. The remaining first few components will explain the vital variation in given research problem (Rencher, 2002) and (Beverly et.,al 2007). This is based on the following criteria:

a.eigenvalue one Criterion

This is based on interpretation of any component with an eigenvalue larger than one.For the reason that every observed variable contributes one unit of variation to the total variation. Consequently every component with an eigenvalue larger than one will account for a greater variance than would be accounted for by one variable. Also components with Eigen value less than one are considered trivial and hence they are eliminated from the model for the sake of variable reduction. This criterion is not subjective given that a component is retained because its Eigen value is greater than one. It's the most efficient criterion when variable communalities are high in some moderate variables. But when communalities are small for a large data set, the criterion can retain the wrong number of components.

b. Scree Test

In scree test the eigenvalues are plotted with their associated component respectively and we look for a "cessation" among the components with comparatively huge eigenvalues in addition to those with trivial eigenvalues. Components that appear in advance of the cessation are presumed to be significant and are retained for rotation and those appearing after the break are assumed to be meaningless and are not retained. If a scree plot will display several large breaks then in this is case, one should look for the most recent large break before the eigenvalues instigate to flat off. Therefore the components that appear in advance to the last huge cessation need to be held in reserve. Scree check can be anticipated to give equitably correct results, as long as the sample is large and most of the variable communalities are large. Despite being useful in most cases, it is not easy to tell the scree plot break point especially in social science research. Such ambiguity calls for further criterion like eigenvalue one criterion.

c.Proportion of variance accounted for in the model

This involves retaining a component if it accounts for a specified percentage of the variance in the data set. The proportion is obtained by the formula;

$$\textbf{Prportion} = \frac{eigenvalue\ for\ the\ component\ of\ interest}{Total\ eigenvalue\ of\ the\ correlation\ matrix}$$

$$\begin{aligned} \sum_{i=1}^{23} \lambda_i &= Trace(S) \\ p_{23} &= \frac{\sum_{i=1}^{k} \lambda_i}{Trace(S)} \\ \Pr oportion &= \frac{\lambda_i}{T} \end{aligned}$$

$$T = Trace(S) = \lambda_1 + ... + \lambda_{23} = Totalvariance$$

A given proportion e.g. 10% of the total variation accounted by a given component of interest can be enough to retain it. This allows one to retain as many components as one wants to. In PCA total eigenvalues of the relationship matrix" is equivalent to the summation of variables being analyzed this is because each variable contributes one unit of variance to the analysis.

Step 3: Rotation

This is a linear transformation performed on the factor solution for making it easier to interpret. Mainly it is concerned with reviewing the correlations between the variables and the components for using the information to interpret the components. Rotation helps in determining what contrast seems to be measured by component 1, 2, 3 and so forth. The best rotation is varimax rotation, which is an orthogonal rotation that results in uncorrelated components. Its advantage is that it tends to maximize the variance of a column of the factor pattern matrix.

Let A be any $m \times m$ orthogonal matrix where m=23 and by definition $A^T A = I$.Let $L^T = LA^T$ and $Y^T = AY$,then L^T is a $(k \times m) \times (m \times m) = k \times m$ matrix.Also Y^T is a $(m \times m) \times (m \times 1) = m \times 1$ column vector.Also

$$X = \mu + LY + \varepsilon = \mu + LA^T AY + \varepsilon = \mu + L^T Y^T + \varepsilon$$

$$E\left[Y^T\right] = E\left[AY^T\right] = AE\left[Y\right] = A0 = 0$$

$$var(Y^T) = var(AY) = Avar(Y)A^T = AIA^T = AA^T = I$$

$$cov(Y^T, \varepsilon) = Acov(Y, \varepsilon) = A0 = 0$$

If L and Y satisfy the model,then also $L^T$and Y^T.Since there are infinite number of orthogonal matrices A,then there are an infinite number of alternative models.Arotation of the original axes is determined by an orthogonal matrix A with det=1.Thus replacing Y with Y^T is equivalent to rotating the axes.This doesnt change the overal variance explainedby the model,but it changes the distribution of variances among the factors.

Thus $A = (a_{ij})$ which is $m \times m$ rotation matrix with rows representing the observed variables and columns representing new factors.Varimax approach maximizes the difference between the loading factors while maintaining orthogonal axes.

Step 4: Interpreting the rotated solution

This is concerned with determining of what is measured by each of the retained components. It entails identifying the variables that demonstrate high loadings on a given component, and the same time determining what these variables have in common. A brief name is assigned to each retained component that describes its content. Then now at this stage is to decide how large a factor loading must be to be considered. Considering the thumb rule, a loading of above 0.5 is large enough to be retained.

Interpretation of rotated factor pattern

1. Check across the row for the first variable and drop the variables that load on more than one component. If we have such variables, then they do not purely measure any of the constructs. Repeat this process for the remaining variables.

2. Review all the surviving variables with high loadings on component 1 to determine the nature of this component. Repeat this process for the remaining components.

3. Determining if the final solution satisfies the following interpretability criteria:

a) Each component should have at least three variables with substantial loadings going on every reserved component.

b) The variables that load on a given component must share some conceptual meaning.

c) The variable that loads on different components must be measuring different constructs. Because they are conceptually very different

d) The rotated factor pattern must demonstrate a simple structure.

Step 5: Creating Component Score

This involves indicating where the subject stands on the retained components. By doing this, the component, scores could be used either as predictor variables or criterion variables in subsequent analysis. Separate equation with different weights is developed for each of the retained components.

Step 6: Regression of Chosen Principal Components

This is where we regress the chosen principal components against the response variable. Thus dependency between the principal component vector y_j and the original vector X is;

$$cov(X,Y) = \frac{cov(X,Y)}{\sqrt{var(X)var(Y)}}$$

Regress

$$Y = \beta_0 + \beta_1 y_1 + \beta_2 y_2 + \ldots + \beta_q y_q + \varepsilon$$

Since y_1 and y_2 are orthogonal so t-tests for coefficients are easy to interpret.The identified components will be regressed with the level of the fertility transition.

3.4.5 Communality

This is the square of the correlation of variable m with factor i gives the part of the variance accounted for by that factor. The sum of these squares for k factors is the communality, or explained variable for that variable (row).

$$h_m^2 = \sum_{i=1}^{m} S_{mi}^2$$

3.5 Multiple linear regression models

Score values obtained by PC scores are in this case taken as independent variables in the multiple linear regression models and then the predictive power is checked. This technique allows additional variables to enter the study independently thus the outcome of each can be projected on the independent variable. It is valuable for measuring the effect of several simultaneous effects upon a single dependent variable.

The linear model has the form;

$$y = \beta_0 + \beta_1 y_1 + \beta_2 y_2 + \ldots + \beta_q y_q + \varepsilon$$

Parameters $\beta_0, \beta_1, \ldots \beta_q$ are the coefficients and $y_1, y_2, \ldots y_q$ are the model predictors called the principal components and ε is the error term which explains the information on the random variation in the dependent variable which are not explained by the observed variables. These variations could be due to other variations not effectively included in the study. This multiple regression models reviews the effect of each component in the fertility transition level.

Chapter 4

Data Analysis and Results

4.1 Description of variables

The 23 factors affecting fertility transition are summarized and only a number of them will be used in the model due to the limitation of the data available.

A section of the data set

period	FM	NM	Catholic	Protestant	Muslim	Other religions	Transition
1	3.86	4.06	4.56	4.26	7.3	6	6.2
2	3.7	3.9	4.4	4.1	5.7	4.4	5.9
3	2.77	2.97	3.47	3.17	4.8	3.5	5.5
4	5.87	6.07	6.57	6.27	6.05	4.75	6.3
5	7.8	8	8.5	8.2	5.3	4	4.8
6	3.16	3.36	3.86	3.56	4.6	3.3	5.2
7	5.55	5.75	6.25	5.95	6.2	4.9	5.3
8	3.54	3.74	4.24	3.94	7	5.7	4.1
9	6.97	7.17	7.67	7.37	6.6	5.3	6.5
10	8.3	8.5	9	8.7	6.3	5	6.4

Analysis of this data was conducted using SPSS version 20.1 package. Performing PCA on the 23 variables in SPSS, the correlation matrix showed that all of them were correlated and hence there was no need for eliminating any of the variables in the analysis at this stage.

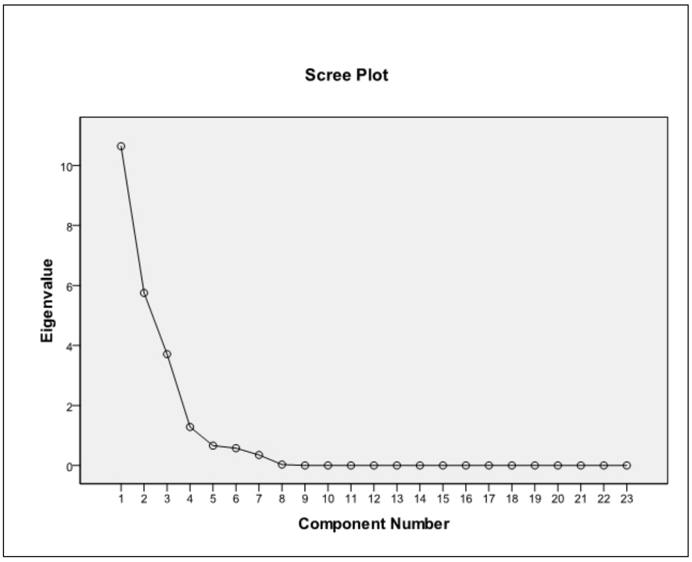

Figure 4.1: A scree plot of the principal components

4.2 PCA extraction using the eigen value criterion and scree plot methods

Eigenvalue for the 23 variables where $\lambda_1 = 10.640$, $\lambda_2 = 5.751$, $\lambda_3 = 3.711$ and $\lambda_4 = 1.283$ with λ_5 to λ_{23} being less than one.

As of the figure above, with the eigenvalue 1 mark on the scree plot, only 4 components have eigenvalues larger than 1.

Hence the proportion of variance accounted for by the four principal components is 92.977%, the components with meaningful cumulative proportions are component 1 to 4 as shown in the figure 4.2 below.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squar Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulati %
1	10.64	46.261	46.261	10.64	46.261	46.261	9.438	41.034	41.034
2	5.751	25.004	71.265	5.751	25.004	71.265	6.523	28.362	69.396
3	3.711	16.134	87.399	3.711	16.134	87.399	3.833	16.665	86.061
4	1.283	5.578	92.977	1.283	5.578	92.977	1.591	6.916	92.977
5	0.66	2.871	95.847						
6	0.575	2.501	98.349						
7	0.349	1.519	99.868						
8	0.03	0.128	99.996						
9	0.001	0.004	100						
10	5.08E-16	2.21E-15	100						
11	4.26E-16	1.85E-15	100						
12	3.35E-16	1.45E-15	100						
13	2.56E-16	1.11E-15	100						
14	1.69E-16	7.33E-16	100						
15	5.03E-17	2.19E-16	100						
16	1.38E-17	5.99E-17	100						
17	-1.97E-19	-8.54E-19	100						
18	-9.95E-18	-4.33E-17	100						
19	-3.93E-17	-1.71E-16	100						

Figure 4.2: Total variance explained

Component Matrix[a]

	Component			
	1	2	3	4
15-24 years	.939			
Nyanza province	.939			
Coast province	.939			
Eastern province	.939			
urban resident	.939			
Western province	.939			
Primary education	.939			
Central province	.939			
Nairobi province	.635	.509		
rural res	.635	.509		
35+ years	-.616	.760		
Formerly married	-.616	.760		
Catholic	-.616	.760		
Never married	-.616	.760		
Currently married	-.616	.760		
Protestant	-.616	.760		
N Eastern province			.878	
Other religions			.840	
Muslim			.840	
Rift valley			.768	
25-34 years			-.610	
Sec education	-.522			-.723
No education				-.587

Extraction Method: Principal Component Analysis.

a. 4 components extracted.

Figure 4.3: Components score

The four extracted components were then explored in the following manner as shown below.

$$y_1 = 0.336x_1 + 0.939x_2 - 0.522x_3 + 0.939x_4 + \dots$$

$$y_2 = 0.166x_1 + 0.310x_2 + 0.268x_3 + 0.310x_4 + \dots$$

$$y_3 = -0.085x_1 - 0.119x_2 + 0.208x_3 - 0.119x_4 + \dots$$

$$y4 = -0.587x_1 - 0.026x_2 - 0.723x_3 + 0.026x_4 + \dots$$

Considering the rule of thumb, we retain all items with structure coefficients with an absolute value of .500 or greater as shown in the following figure 4.4;

Extracted principal components
The extracted components include;

1.
   - **Region as a factor** Urban residence, Coast province, Eastern province, Nyanza province, Central province, Primary education.
   - **Marital status as a factor** Currently married, Formally married, Never married.
   - **Religion as a facto**r of Muslim, Other religion.
   - **Education as a factor** of Sec education, No education.

4.3 Regression of component scores with fertility transition level

The hypothesis to test is;

H_0: The components can be reliably used to describe change in fertility levels (Transition)

H_1: The components cannot be reliably used to describe change in fertility levels (Transition)

Rotated Component Matrix[a]

	Component			
	1	2	3	4
15-24 years	.981			
Nyanza province	.981			
Coast province	.981			
Eastern province	.981			
Urban resident	.981			
Eastern province	.981			
Primary education	.981			
Cent province	.981			
Nairobi province	.747		.510	
Rural res	.747		.510	
35+ years		.980		
Formerly married		.980		
Catholic		.980		
Never married		.980		
Protestant		.980		
Currently married		.980		
Other religions			.927	
Muslim			.927	
N eastern province			.773	
25-34 years			-.692	
rift valley			.631	-.517
Sec education				.764
No education				.659

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Figure 4.4: Rotated scores

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.777[a]	.604	.287	.662

a. Predictors: (Constant), Region, Marital status, Religion, Education

Figure 4.5: Regression model summary

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.345	4	.836	1.908	.247[a]
	Residual	2.191	5	.438		
	Total	5.536	9			

a. Predictors: (Constant), Region, Marital status, Religion, Education

b. Dependent Variable: Transition

Figure 4.6: Analysis of variance

Analysis of variance

The model summary in indicates that R squared= 60.4%.This implies that, the components account for only 60.4 % of change in fertility level. The rest of the percentage 39.6% could be accounted for by other variables that were not considered for this research. With level of significance α=0.05, and a calculated p-value=0.247 meaning that the mean component scores were not significantly different.

The model coefficient estimates.

$$Y = 5.620 + 0.51\,\mathrm{Re}\,gion + 0.333 Maritalstatus - 0.015\,\mathrm{Re}\,ligion - 0.016 Education$$

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	5.620	.209		26.845	.000	5.082	6.158
	Region	.510	.221	.650	2.310	.069	-.057	1.077
	Marital status	.333	.221	.425	1.511	.191	-.234	.901
	Religion	-.015	.221	-.019	-.068	.949	-.582	.552
	Education	-.016	.221	-.021	-.074	.944	-.584	.551

a. Dependent Variable: Transition

Figure 4.7: coefficient estimates

Chapter 5

Summary,Conclusion and Recommendation

5.1 Introduction

This chapter involves the summary of the results collected, the discussions related to those findings and the recommendations this study makes.

5.2 Summary

A change in region will change the number of births by 0.51 units in appositive direction when religion, marital status and education are kept constant. A change in marital status will change the number of births by 0.333 units in appositive direction when religion, region and education are kept constant. A change in religion will change the number of births by 0.015 units in a negative direction when region, marital status and education are kept constant. A change in education will change the number of births by 0.016 units in negative direction when religion, marital status and region are kept constant. The number of births will change by 5.620 units in the positive direction without religion, marital status; education and region are kept constant. These four components accounted for a total variation of 60.4% in fertility transition. It means that, apart from the identified components, fertility transition is affected by many other factors not covered in this research. The factors not covered could be similar to the ones highlighted in the factors affecting fertility transition review in this research.

5.3 Conclusions and recommendations

A key conclusion is that this reflection supports the view that socioeconomic settings and diffusion postulates are vital in explanation of fertility transition in Kenya. Therefore, at the strategy level there is a necessity to advance family planning services throughout the nation. This will help in addressing the matters of family planning and undesirable fertility and therefore lead to a weakening in the entire fertility. The government has already introduced measures to change the position of family planning in Kenya. There is a necessity to advance the socioeconomic situations in the country, identifying that comparative wealth and added education for women are strappingly related with lower fertility. This implies that additional efforts must be directed toward growing GDP per capita and increasing the fraction of women with high education. Education plays a crucial role in altering reproductive approaches and behavior. An enhanced GDP per capita will offer more chances for employment, improved health care, and substitute investments for families as well having children. These enhancements will ultimately have an influence on anticipated family size and lead to a weakening in fertility rates.

Therefore any researcher interested into the area of fertility transition in Kenya should consider the factors identified in the review but were left out in this research due to lack of enough data.

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