CHAPTER I
INTRODUCTION

1.1 Introduction:

Fertility is one of the most important characteristics in everyone's life. Fertility refers to actual number of live births in the population and fecundity refers to ability or capacity to reproduce children. Both vary due to geographical area (where they are living, because of climate and weather conditions), religion (the food habits and culture), wealth index (the life style changes depending on their income), rural or urban, educational level, hobbies and habits, etc. Fertility increases if parents have preferences towards a particular child. The reasons for sex preference, its impact on fertility, are studied by many. It is important to study fertility trends also. The analysis of fertility and its trends may help us to know the life expectancy and project the population more efficiently. Compared to earlier population now a days lot of changes in human activities and changes in nature (climate and weather conditions), may be because of advancement of science or due to human negligence towards nature. The effect of educational level, economic conditions, geographical locations, religion, etc on fertility trends can be answered by multiple regression models. To some extent, parents also play a role in fertility, i.e. if the parents have high fertility their
children may also have high fertility, and it may be true for low and moderate fertility cases also. Mortality and life expectancy also influence on fertility, where mortality is directly proportional with fertility and life expectancy is inversely proportional. It is observed that the countries with less life expectancy have more fertility, and the countries with more life expectancy have less fertility. Child mortality is decreasing because of advancement of science, which is also one of the major aspects in decreasing fertility.

There is a saying, that womanhood is never complete without attaining motherhood. In a tradition-ridden country like India and elsewhere in the world, woman is expected to bear issues and incase she does not conceive and give birth to at least one baby, she fails to get due respect in her family. An issueless woman becomes an issue of hot debate under the dogmas of the spiritual scriptures. A barren woman is often synonymous with a thrown away plantain leaf after a meal. Marriage should invariably add an issue irrespective of a spouse's health. But unfortunately, some married women remain barren due to physiological defects. In the case of women who are fit be prospective mothers, things may be slightly different. But so far as their health is concerned during the ripened period of pregnancy, enigmatic issues suddenly crop up.
Fertility of a woman during her menstrual cycle depends on her uterus, ovaries and other physical factors. A normally healthy woman has a very high chance of giving birth to issues till she reaches her menopause. If birth control methods are not strictly followed, such healthy females in underdeveloped countries where ignorance rules the roost can simply go on adding numbers not only to her family, but also to the population of the country. But in advanced countries it is the literacy and economic status that usually become the predominant factor in deciding the fertility factor. It is over indulgence and excessive unnatural birth control methods which adversely affect the fertility of a woman. There are families which go in for sensuous pleasure adopting various methods of birth control which often prove detrimental. Living together concept and gay marriages which were unheard in the past have become the talk of the day. Affluent persons with their own whimsical ideas are prone to adopt some unscientific ways. In such a social milieu, even fertile persons by their regressive methods find a place of prominence in the statistical analysis how fertility as below as 1.5 births per woman is achieved by the conscious people and the governmental mandatory policies are given a go by. Couple's decisions to delay to get issues may sometimes boomerang later as unilateral decisions may end up
in baroness. Births delayed may be births denied totally. Even the strongest intentions to get babies can fade away with the changes of life circumstances of the couple.

If a low fertility level i.e. 1.3 births per woman is maintained constantly over a considerable length of time, a country's population will not show an alarming increase. In the western countries like Germany, Spain and England the population has not shown a significant growth over the last few decades. But quite against this western trend, in the oriental countries like India, China, in spite of mandatory policies, population is increasing by leaps and bounds.

**Education and Fertility**

Education is one of the most important aspects of fertility. Education plays important role in childbearing, the use of birth control, and mortality. Education lowers early age marriage, early births, child mortality. Earlier the child mortality was high, due to illiteracy of the parents and lack of medical facilities. Thus the parental education has a strong effect on the reduction of fertility and child mortality. The role of education is very important in reproductive behaviour. Higher levels of education, especially of women, are strong predictors of lower fertility, because education
provides knowledge and also increases the awareness of family planning and birth control devices. The difference in fertility outcomes between women with no education and even a few years of formal schooling make a difference. There is a strong relationship between female education and age at first marriage; the higher a women's educational attainment, the later she marries. It is also evident that the age at marriage in the urban women is more compared to the rural women.

Family planning and birth control

Family planning is the planning of when to have children and the use of birth control and other techniques to implement such plans. Birth control is an umbrella term for several techniques and methods used to prevent fertilization or to interrupt pregnancy at various stages. Family planning is sometimes used as synonym for the use of birth control. It is most usually applied to a couple who wish to limit the number of children they have and / or to control the timing of pregnancy (also known as spacing children).

Sex preference and fertility

It is generally believed that parental sex preferences have little impact on fertility and other aspects of household behaviour. Even
though sex preferences may be weak, its existence itself is sufficient to warrant the attention of policy makers. There are differences in the economic costs or benefits associated with boys and girls. The fact that parents care about the sex of their children is established by showing dependence of the tendency to have more children and the sex composition of earlier children. Sex preferences are demonstrated in less developed countries through relationships between length of birth intervals and the child sex. The "Parental preference of sex affects divorce, child custody, marriage, shotgun marriage when the sex of the child is known before birth, child support payments, and the decision of parents not to have any more children." In families with at least two children, they find, the probability of parents deciding on having another child is higher for all-girl families than for all-boy families. The magnitude of the effect increases for families with at least three children.

Socio-economic and fertility

It is true that poor societies tend to have higher fertility and the rich countries are characterised by low fertility. At the same time, cross country correlation between the TFR and indicators of economic output per capita (such as GNP per capita), or measures of incidence of absolute poverty (such as the percentage of the
population living on less than one dollar per day) are weak though statistically significant. It is also understood that the fertility is lower in urban areas and most often is lowest in the larger cities. In spite of this, the relationship between urbanization and fertility is not as strong. (This may be due in part to widespread differences in national definition of an urban settlement). On the other hand, the association between 'human capital' indicators and fertility is strong. Child (survival) mortality (and women education are) is highly inversely correlated with the TFR. These correlations reflect socio-economic relationship with TFR.

1.2 Review of Literature:

Every couple eagerly waits for its child after conception and usually it is more eager to know the sex of the child. Now a days sex detection is banned. The couple doesn't have any choice to wait until birth occurs. It affects a lot on fertility and the number of children that a family has. Some may go for births until they get the required sex. It may cause the health of the mother, financial status of family, etc. Some prefer boy some prefer girl and for some says doesn't matter whether boy or girl. Our study is concerned to the time required to get the preferred child (male/female). It is generally believed that parental sex preferences have little impact on fertility.
and other aspects of household behaviour. Even though sex preferences may be weak, its existence itself is sufficient to warrant the attention of policy makers. Boys and young men are expected to contribute more than girls. This may be the reason for preferring boys to girls. Sex preferences affect fertility in a statistically significant way (Ben-Porath and Welch, 1976). Decline in fertility is due to the control of sex (in the presence of sex preference and gender detection tests). We find higher fertility among those who did not get the preferred sex composition. When gender detection tests become more affordable, women are more likely to have sex-selective abortions (childbirths) than having unselective abortions or undergoing childbirths without gender detection tests. The authors Kim (2005), Leung (1994) and Davies and Zhang (1997), using static quantity-quality models of fertility, showed that the availability of gender control may increase fertility because women are better off with their expanded choice sets (wealth effects). Ben-Porath and Welch (1976, 1980) studied the parental sex preferences and analyzed the various effects of parental sex preferences on fertility. Regassa (2007) highlighted the role of son preferences in sustaining high fertility levels. Leung (1991) developed a model for the parental sex preferences and fertility. Gupta and Bhat (1997) explored the
relations between fertility decline and the net manifestation of sex bias in India. Singh (1964) developed the waiting time distribution for the first birth. Biswas and Srestha (1985) obtained the modified waiting time distribution for the first and subsequent births.

It is true that the families having more than two children with first two children as boys is less than the number of families having more than two children with first two children as girls. Therefore, male preference plays an important role in sex ratio. It is also important to know the influence of male preference on the family size. A considerable earlier literature (Repetto, 1972; Hatzold, 1974; Sheps, 1963 and McDonald, 1973) analyzed the magnitude of the effect of sex-preference and assessed by how much is the ability to control the sex of children to lower the birth rate. Falk and Ayala (1971) found that the sex of the first two children had no influence. However in some populations where the sex of the two first children had no influence on the family size, the frequency of families having more than three children was greater when the three first children were of the same sex than in the opposite case. Thus, it seems that the failure to have the desired sex distribution in the progeny affects the probability of having additional children (Medina 1977; Das 1987; EI-Gilani and Shady 2007).
Environmental exposures may affect human reproduction by many diverse mechanisms. Infecundability (i.e. physiological inability of a woman in a child bearing age to conceive or carry a pregnancy to a term) occurs for reasons unrelated to births (infections, blocking of fallopian tubes, etc.). Even if a woman is fecund she may not be at risk of pregnancy because she is not sexually active, by choice or by external constraints. The longer time may be required on an average for affected couples to achieve pregnancy. Weinberg and Gladen (1986) give a modelling the number of menstrual cycles required to achieve pregnancy. Ridout and Morgan (1991) considered extensions of the model developed by Weinberg and Gladen (1986), in which individuals misreport their durations (i.e. menstrual cycles).

Potter and Parker (1964) treated conception delays as a waiting time problem by assuming that the monthly chance of conception in the absence of contraception varies among couples but remains constant from month to month until pregnancy for individual couples. They fitted the model by considering that the fecundabilities are distributed among couples as Type I curve. Sheps (1964) developed the distributions of waiting times for delays in conception. In homogeneous population, the time required for conception is distributed geometrically, whereas in case of
heterogeneous population, the waiting time for conception is
distributed as compound geometric distribution. Under the assumption
of constant fecundability for a given woman, the relationship
between delays until each of the two conceptions is explained.

Rao et al. (1973) considered family size as a random variable
following negative binomial distribution. They developed the more
general expression for the correlation between the types
children in a family. Using the data of Reed and Reed (1965),
they obtained the empirical and theoretical correlation co-
nt between the two types of children as 0.3436 and 0.3708 respect-

Hamdan (1975) obtained the correlation between the two types
children in a family with truncated negative binomial dis-
excluding the childless families from the data of Reed and
(1965). Janardan (1982) obtained the correlation between
number of two types of children in a family using the Markov-
model. Rao (1981) obtained the correlation between the numbers
two types of children in a family using modified power serie
distribution.

Wang and Famoye (1997) have developed generalized Poisson
regression (GPR) model to study household fertility data set. The
same model has been used to model injury data (Wulu et al. 2002).
Lambart (1992) explained the zero-inflated Poisson (ZIP) regression models with the application of manufacturing defects and Lee et al. (2001) applied the same model to accommodate the extent of individual exposure. Gupta et al. (1996) fitted zero-adjusted (inflated or depleted) GP model with fetal movement data and the death notice data of London times. Lee et al. (2006) developed multi-level ZIP regression model for the correlated count data with excess zeros.

McDonald (2008) addressed the issue of very low fertility in countries with advanced economies including its consequences and its causes. This paper highlights the trends on Fertility, Mortality, Nutrition and Health Indicators. Schoumaker (2004) used the power regression models to study the socio-economic determinants of fertility levels and trends. Schoumaker and Tabutin (2008) analyzed the fertility transition in sub-Saharan Africa. Atrash et al. (1982) examined the relationship among the fertility rate, the use of family planning services and the abortion rate in Tennessee for the years 1975 and 1978. Borrero et al. (2009) studied the impact of race and ethnicity on receipt of family planning services in the United States.
1.3 **Objectives of the Study:**

In the present study we focus on fertility analysis and its changes due to various socio-economic and demographic characteristics. We develop stochastic models for waiting time based on parental sex-preference and also for fecundity analysis and make comparison. We consider the effect of family planning and birth control devices, parental sex-preference and sex-preference stopping rules etc. on fertility. We also consider fertility control (or birth control) by means of contraception and abortion.

1.4 **Plan of Thesis:**

Chapter-wise summary of the Thesis is as under. The Thesis consists of seven chapters. Chapter I, being introductory, explains the importance of this work, brief review of literature on fertility and its analysis, objectives of the study and summary of the thesis.

Chapter II deals with waiting time distribution of birth for a preferred sex. In this Chapter we have developed probability model to study the time required to get a birth of preferred child after marriage. The validity of the model is verified by Chi-square test. The model gives good fit.
Chapter III deals with male preferring stopping rule and its effect on birth rate. When stopping rule depending on sex of the child is discussed, it implies that the last child should be of a desired sex. That is, if we follow stopping rule by considering male child, we should allow birth to girl children until we get a boy or until desired number of boys. Many stop childbearing as soon as they get the desired child irrespective of number of children they had planned. To study whether the sex preference changes with education, religion, living status, geographical area etc, we developed a mixed model using negative binomial distribution and beta distribution and validity of the model is verified with two sets of data for rural and urban.

Chapter IV deals with the fitting of probability models to distribution of number of births and estimation of correlation coefficient between the two types of children (Male & Female) in a family. The purpose of this Chapter is to give a good fit to the distribution of births considering negative binomial distribution (NBD), zero-truncated negative binomial (ZTNBD), truncated negative binomial and beta-geometric distributions and check their adequacy to the data. And also to obtain the correlation coefficient between the two types of children in a family using the above
distributions. Empirical statistics shows that both the zero-truncated negative binomial and negative binomial distribution give a good fit. Comparing with Chi-square values the human family size fits better with a zero-truncated negative binomial distribution than with a negative binomial distribution.

Chapter V deals with Zero-truncated Poisson regression distribution and it's fitting to Cesarean (C-section) data. Data set consists of annual total births, hospital type (private and public) and C-sections. The response variable y denotes the number of C-sections which do not have any zero values. There are 301 C-section births vary from hospital to hospital and also by type of hospital. Normally births by C-section are said to be more frequent in private (fee paying) hospitals as compared to public (non fee paying) hospitals. The analysis of data about total annual births and the number of C-section births were carried out considering from the records of 4 private hospitals and 16 public hospitals. A measure of goodness of fit of the ZTGP $(\alpha, \lambda_i)$ regression model is used on the log-likelihood statistic. The ZTGP regression model reduces of the ZTP regression model when the dispersion parameter $\alpha=0$. To test for the adequacy of the ZTGP model over the ZTP regression model, we have considered the testing of hypothesis $H_0: \alpha=0$ vs $H_1: \alpha\neq0$. 

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Chapter VI deals with assessing fertility trends using multiple regression models. In this Chapter we have characterized the countries in four categories according to total number of children per woman in her life time (TFR) as countries with (I) above 5, (II) between 3-5 (III) 1.5 to 3 and (IV) less than or equal to 1.5 children per woman. Typically, almost all countries in sub-Saharan Africa and Afghanistan in South Asia are included in Category I. Almost all European countries are included in category IV. Majority of North and South American countries are included in Category III. Asian countries and some of the African countries are included in Category II. The input data for this study is taken from various secondary sources such as CIA (2008), UNICEF (2006 a), UNICEF (2006 b), The World Bank (2011), UN report (2006). In order to make estimation of fertility of different countries (category wise very low fertility and high fertility), we consider under 5 year mortality, economic condition (GDP), Education (Literacy level) etc. as independent variables. To examine the relative importance of each independent variable to the dependent variable, multivariate regression model is employed. In the present Chapter, three independent variables (predictors) are considered in the model, the selection of independent variables is based on the theoretical background and
the best fit model criteria (also priori information about the relationship between dependent variable and each independent variable).

**Chapter VII** deals with the impact of family planning and birth control process on fertility and is studied through regression analysis. Family planning is one of the most important demographic aspects that every family thinks. We consider three types of birth control methods viz Contraceptive use, Abortion and Sterilization. It is important to note that all have their respective side effects. Before going for these, it is better to have complete knowledge of these and their failure rates. Most importantly, family planning helps to maintain good health of partners, good education to their children and control population to some extent. An attempt is made to answer these questions using a multiple regression analysis.