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Probability Models for Tracking the Changes in the Pattern of Infant Mortality in Egypt during the Period 1980- 2005

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I hope that **Allah** *will accept this work as a" useful knowledge"*

Then, I hope this work will bring a little joy to my father and my mother

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Abstract

Infant mortality rate is considered a sensitive index that can be used to monitor the improvements or changes in the level of health status and standard of living in a specific country and to make cross-country comparisons of these measures. The main objective of this thesis is to search for the probability model(s) that best describes the distribution of infant deaths -by age at death- in Egypt during the period (1980-2005). Using the mixture distribution analysis, the pattern of infant mortality in Egypt is studied. Three mixture models are applied; a mixture of Weibull and gamma distributions, a mixture of two Weibull distributions, and a mixture of two gamma distributions. The main result of the thesis is that there is a remarkable change in the pattern of infant mortality during the period of interest, however much more efforts should be done. The achieved situation could be considered comparable to the situation in developed countries in the mid-seventies.

Key words

Infant mortality rate
Mixture distribution
Post-neonatal mortality rate
Mixdist package
Neonatal mortality rate
pattern of infant mortality

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Summery of the thesis:

Children under one year of age are considered "infants", and deaths among children during the first year of life are called "infant mortality". Infants, more than any group of the population, are more vulnerable to the health and environmental conditions of the society. Thus, Infant mortality rate is considered an excellent summary for the improvements or changes in the level of health status, standard of living, and even the cultural status in a specific country.

Infant mortality is attributed to both endogenous and exogenous causes affecting infants' health at different stages of their life span. Endogenous causes such as congenital malformations, birth injuries and premature deliveries. Endogenous deaths occur in the first month of birth and the term neonatal mortality is used to describe deaths in this period. Exogenous causes are infections and accidents. Exogenous deaths take place in the ages 2-11 months and the term post neonatal mortality is used to describe deaths during this period (Pollard et al., 1991).

Infant mortality witnessed major changes in Egypt during the last two decades. The level of infant mortality significantly declined by almost 50 percent during the eighties: from a high level of 76 infant deaths per 1000 live births in 1980 to 38 infant

deaths per 1000 live births in 1990. By the mid-nineties, infant mortality rate was slightly over 30 infant deaths per 1000 live births and fluctuated around this level until the year 2000. After the year 2001 infant mortality rate declined to reach nearly 18 infant deaths per 1000 live births by the year 2007 (according to vital registration data). Moreover, the changes in the measures of the pattern of infant mortality such as the ratio of neonatal to post-neonatal mortality were also noticeable.

The main objective of this thesis is to answer the question whether the observed change in the pattern of infant mortality in Egypt during the period (1980 – 2007), is a real change paralleled by a change either in the mathematical model that best fits the data or a change in the parameters of the same model. The results would also indicate the changes in the relative significance of the two main underlying causes of infant deaths (endogenous and exogenous).

In order to achieve our objective, the thesis is divided into two main parts: the *first part* is a description of the trend in the level and pattern of infant mortality in Egypt during the specified period. In *the second part* a mixture model is used to validate the detected change in the pattern of infant mortality.

The thesis included five chapters, three appendices, and a list of references

Chapter one: Introduction

This chapter is an introduction about infant mortality, and a quick overview of the situation of infant mortality in the world, in Arab countries, and in Egypt. Statement of the thesis's problem is presented.

Chapter two: Developments in the level of IMR in Egypt during the period (1980-2007)

In this chapter the main features of the two sources of data that are used in this thesis and the problems that affect the quality of data from both sources were discussed. Also, the trend in the level of infant, neonatal, and post-neonatal mortality from vital registration

data and from the Demographic and Health Surveys data during the period 1980 – 2007 were discussed.

Chapter three: Developments in the pattern of IMR in Egypt during the period (1980-2007)

In this chapter the trend in the pattern of infant, neonatal, and post-neonatal mortality from vital registration data and Egypt Demographic and Health Surveys data in Egypt during the period 1980 – 2007 were identified.

Chapter four: Probability distributions relevant to the study of infant mortality

In this chapter the main concepts and definitions that were used in constructing the specified model(s) are presented. Also, a review of the previous suggested models that best fit infant mortality data in Egypt, and the main findings of each suggested model were reviewed.

Chapter five: Fitting Mixture Distributions to the data of infant mortality in Egypt during 1980-2007

In this chapter the results of fitting the model proposed by Karara (1983) with the modification made by Ishak (1985) (a mixture of Weibull and gamma distributions) and the results of fitting the two other suggested models (a mixture of two Weibull distributions and a mixture of two gamma distributions) are discussed in details. The three models are applied to the data of infant mortality in Egypt during the period 1980-2001. Also, a suggested method to study the pattern of infant mortality for the years following 2001 is proposed. Finally, overall conclusions and recommendations that may help to improve the present situation of infant mortality in Egypt are presented.

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Chapter 1

Introduction

1.1 Background

The future of any society depends to a large extent on the children of that society; children of today are men and women of tomorrow. From that point of view, a healthy start is important to every newborn baby. Accordingly, all nations invest serious efforts to ensure the well being of their children. The level of interest may differ, however, from one country to another, especially in the first year of life. Children under one year of age are considered "infants".

Infants, more than any group of the population, are more vulnerable to the health and environmental conditions of the society. To monitor the improvements or changes in the level of health status and standard of living in a specific country and to make cross-country comparisons of these measures, infant mortality rate is considered a sensitive index that can be used to achieve this goal.

Infant mortality rate- as mentioned previously- is considered a sensitive index and an excellent summary of the standard of living and socioeconomic development in any country (UNFPA, 2003). It is also, one of the important measures of the well-being of infants, children, and pregnant women.

Infant mortality rate reflects the prevalence and quality of the health care programs provided to the children in their first year of life, such as: the immunization campaigns adopted by the government (El-Zanaty, 2006). Lower levels of infant mortality rates can be achieved as more children health-related programs are proposed and access to these programs is increased.

On the other hand, El Deeb (2005) pointed out the negative effects of high infant mortality on mothers' health. As a result of short spacing between births due to infant deaths, mothers become more vulnerable to anemia and to deficiency in calcium and other important micronutrients.

Moreover, Infant mortality rate is useful in identifying the level of health care provided to mothers during and after pregnancy (El-Zanaty, 2006). Also, the level of

infant mortality has an impact on maternal health (UNFPA, 2003). Many international summits and conferences were convened to mobilize efforts to improve children's health and to reduce infant mortality. The fourth target of the Millennium Development Goals is to reduce under-five mortality rate by two-thirds between 1990 and 2015, and infant mortality rate (IMR) is on the list of indicators to follow-up progress in achieving this goal.

1.2 Infant mortality

Infant Mortality Rate (IMR) can be defined as the number of infant deaths who did not complete the first year of life during a given year per 1000 live births in the same year. At this point, it is worthwhile to mention that infant mortality is actually a ratio not a rate. The difference between the two of them is that a rate relates the number of deaths during a specified period of time to the average population during that period of time (the population at risk) while a ratio is simply one number divided by another (David et al, 1990)

Infant mortality is attributed to both endogenous and exogenous causes affecting infants' health at different stages of their life span, and differs by the level of development of the country. In developed countries, characterized by high level of health status and health programs, attention now is directed to reducing the causes of neonatal infant mortality (i.e. endogenous causes). The situation is different in developing countries, where high-level of infant mortality is still prevailing, attempts are made to reduce the level of post neonatal mortality (i.e. exogenous causes), and accordingly reduce overall IMR.

Assessing the level of infant mortality for the world as a whole and its related health, socioeconomic and environment conditions is necessary to evaluate where Egypt stands and what efforts should be presented.

The following is a quick overview of the situation of infant mortality in the world, in Arab countries, and in Egypt.