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Volume 52

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Christos H. Skiadas • Charilaos Skiadas
Editors

Quantitative Methods in Demography

Methods and Related Applications in the Covid-19 Era

Springer

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Preface

Demography: Demographic Data. Data collection was a primary issue for countries and societies since their first steps toward social organization. Families, births and deaths, injuries and diseases, property occupation, villages and cities, small territories and huge landscapes, and insurance and risk covering came as aftereffects of the old and modern societal needs.

As data collection became more accurate and important for an organized society, data analysis methods and techniques became important tools. Prior to that, the invention or introduction of writing, reading, and numbering took societies to the next step of social organization. As the writing, reading, and numbering tools evolved, data storage and analysis required organization; this necessitated the formation of registry offices, notaries, and other organizational structures for the benefit of society, especially when money in any type and form was invented and introduced.

The main part of these forms, quantifying **Demography**, introduced and accepted hundreds and even thousands of years ago and are so strong that form the basis of our societies. It looks like that writing, reading, and numbering dominate our societies and our everyday life.

Some interesting features of numbers and numbering were discovered and developed during the past centuries. The discovery of algebra, number theory, geometry, and other mathematical forms and tools opened new horizons to that we call as data analysis in demography and population studies.

Probability, an important element of demographic and population analysis, was developed late after the Middle Ages as a scientific tool (Girolamo Gardano, 1564). It remained to explore a good data series for births and deaths to form the Life Table ((J. Graunt, 1665) and (E. Halley, 1693)). Pierre de Fermat and Blaise Pascal (1654) and Christiaan Huygens (1657) had done important work on the scientific basis of probability supporting quantitative demographic analysis.

It took a few centuries for the advent of actuarial science, until 1825, when Gompertz proposed the famous model for insurance estimated by the actuaries. From then onward, actuarial science developed. Important for the use of the Gompertz model was the introduction of the Tables of Logarithms. The famous

Verhulst model (1838), also known as the Logistic, was introduced to estimate and forecasts population size.

Around 1900, the Runge–Kutta method for estimating differential equations provided new approaches of using data analysis tools in demography and population analysis.

During the same period, Luis Bachelier proposed the theory of speculation in his PhD dissertation, the theory of stochastic processes that came to be an important part of many developments in the twentieth century.

The ***stochastic theory*** is important to estimate the health state of a population as well as the healthy life years lost and the healthy life expectancy estimation. Jacques Janssen and Christos Skiadas (1995) introduced stochastic modeling to life table data sets with applications to France and Belgium. Later on, stochastic modeling was further developed and applied to find the healthy life years lost and the healthy life expectancy (see Skiadas C.H., Skiadas C. (2020) Preliminary Notes. In: Skiadas C.H., Skiadas C. (eds) Demography of Population Health, Aging and Health Expenditures. The Springer Series on Demographic Methods and Population Analysis, vol 50. Springer, Cham. https://doi.org/10.1007/978-3-030-44695-6_1). The stochastic theory, even though certain difficulties arise in theory and applications, is a very important tool, thus providing demography and population analysis a methodology to do stochastic simulations to make estimates for the healthy life years lost and the healthy life expectancy (HLE). The latter confirmed with successful comparisons with the HALE estimates from the World Health Organization (WHO).

According to WHO: HALE is an estimate of the average number of years that a person can expect to live in "full health" by taking into account years lived in less than full health due to disease and/or injury.

Following this definition, we have explored the average measures of mortality from a life table. The averaging form $xm_x/sum(m_0{:}m_x)$ was proven to be very successful in providing the healthy life years lost (HLYL) and then the HLE = LE-HLYL, where (LE) is the life expectancy. The importance of this measure coming directly from life tables is that we estimate the HLE in the past as far as life tables are provided. No information on the health status of a population is required. The influence of diseases and injuries and their aftereffects are included in the averaging formula. The HLE years resulting from this method are similar to HALE. For further information, see the above references at https://doi.org/10.1007/978-3-030-44695-6_1.

However, the quantitative methods in demography and population analysis and health state estimates were mainly developed with the aid of **informatics and computing** and received special attention in the last decades of the twentieth century. Further developments and applications continue in the first part of the twenty-first century. These methods already have ushered considerable changes in various scientific fields and of course in estimating vital aspects of demography, health, insurance, social development, life expectancy, and population changes.

Mortality, population aging, and data analysis are further developed, and the tools used are friendly to the end user. People are "ready" to understand and apply the new

tools. A fast-growing literature, both theoretical and applied, and many "computer packages" and visual observation are ready to support the very many applications.

Interdisciplinary works are an important task of the new era, and new fields like data science and big data analysis, important to handle large data sets familiar in international studies in demography, health sciences, and population, are developed.

The twenty-first century is already characterized by an optimistic way of data analysis approaches. Large number of people are educated and trained to collect and store data sets. Large and expanded networks disseminate information. Demography, health, and population studies have benefited the most, and more developments are in underway.

This book provides quantitative material in the Covid-19 era exploring important issues in demography, population studies, and health state estimates along with the healthy life expectancy calculation in the past for the World Health Organization members. Even more, mortality and survival data analysis was done, followed by various methodologies performed and applications in several issues, including society, economy, insurance, and classification, important in demographic studies.

Quantitative and applied methodologies in demography are included as the use of full life tables for developing countries to estimate the healthy life years lost. This book is a valuable guide for researchers, theoreticians, and practitioners in various scientific fields.

This Book Includes Five Parts

- The **first part** with six chapters is related to the Covid-19 pandemic. The death/cases development, chaotic forms present, socioeconomic and health issues, and life expectancy loss are targets of the chapters.
- The **second part** on global health and longevity includes four chapters on the estimation of healthy life years lost and the healthy life expectancy in the far past and the global health and longevity: an analysis of post-World War II data in the WHO countries.
- The **third part** on mortality–survival includes ten chapters related to mortality and survival in the Czech Republic, Greece, Nigeria, Brazil, and Russia.
- The **fourth part**, with four chapters on special methods, includes America's Zika virus and its similarities with African and Asian lineages, and a relative entropy measure in labor market outcomes by educational attainment. Also, the intergenerational educational mobility in European countries and a different approach in grouping European countries in terms of mortality.
- The **fifth part** includes nine chapters on insurance, risk and health risk, social change indicators, the performance of socio-economic classification in Europe, life expectancy and the Chinese retirement plan, and life expectancy and population loss due to mental disorder in Russia.

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Contents