Advanced Techniques for Modelling Maternal and Child Health in Africa

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Advanced Techniques for Modelling Maternal and Child Health in Africa

Springer

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This book is firstly dedicated to the memory of my late son, Hendrick Kandala, who two months before his tragic death in London attended the 58th Congress of the International Statistical Institute (ISI) in Dublin, Ireland, August 21–26, 2011, and shared many wonderful things prior to his untimely death . . .

Then to my daughters, Catherine and Rose, God's blessings to me during good times and bad, whose unconditional and steadfast love has allowed me to get strength, and whom I will always love and cherish . . .

Summary

The estimation of levels, trends, and differentials in demographic and health outcomes in developing countries has, over the years, relied heavily on indirect methods that were devised to suit limited or deficient data. In recent decades, some worldwide surveys like the World Fertility Survey and its successor, the Demographic and Health Survey (DHS), have played an important role in filling the gap in the availability of survey data in developing countries. These surveys, conducted at enormous costs, are aimed at enabling investigators to make in-depth analyses that could guide policy intervention strategies. However, their utilization remains suboptimal, because optimal analyses of such data demand advanced statistical techniques.

Since the use of DHS data in developing countries, many developments in statistical modelling based on hierarchical models have been published, and our primary aim is to bring together the various methodological advances. Naturally, the choice of these recent developments reflects our own teaching and research interests.

We try to motivate and illustrate concepts with examples using real data from the DHS, and the data sets are available on http://www.measuredhs.com. We could not treat all recent developments in the area of health and survival in Africa in this book, and in such cases we point to references at the end of each chapter.

The book presents both theoretical contributions and empirical applications of such advanced techniques. We cover a range of new developments from both the classical and Bayesian approaches. In the Bayesian framework, Monte Carlo techniques, in particular MCMC, and their application to spatial and spatio-temporal data are covered. These include techniques such as geoadditive semi-parametric models that link individual health outcomes with area variables to account for spatial correlation; latent modelling that deals with the impact of spatial effects on latent, unobservable variables like "health status" or "frailty"; spatial modelling of multiple diseases that enables quantifying the correlation between relative risks of each disease as well as mapping of disease-specific residuals; and Bayesian structured geostatistical regression modelling that permits a joint estimation of the usual linear effects of categorical covariates, non-linear effects of continuous covariates and small-area district effects on health outcomes within a unified structured additive Bayesian framework.

Within the classical approach, we describe multilevel models which address issues of clustering within families and households; multiprocess models which account for interdependencies over life-course events and non-random utilization of health services; and flexible parametric alternatives to existing intensity models.

The techniques are illustrated mainly through modelling maternal and child health in the African context using data from the DHS in several countries in the continent. But the methods presented are universally applicable to other phenomena and geographical areas with similar data sets.

The book is coherently organized and clearly written so that readers can follow its contents without having to master the technical parts.

There are two parts to this book: (I) modelling child health and survival in Africa and (II) modelling maternal health and survival in Africa.

Part I covers recent developments in child health modelling techniques. We discuss the formulation of models using flexible geoadditive predictors accounting for the effects of different types of covariates. Such formulation embraces the usual famous regression models such as generalized additive models (GAM), generalized additive mixed models (GAMM), generalized geoadditive mixed models (GGAMM), and stepwise regression models, among others. We emphasize the modelling process and policy implications rather than explicit use of the techniques (which can be found in other textbooks).

Part II introduces modelling of maternal health outcomes. Readers are guided through these techniques with alternative software packages, such as WinBUGS and BayesX. Many of the applications of this part relate directly to the models discussed in Part I.

Although few authors worked on this text, it could not have been written without the support from various sources. We would particularly like to thank all participants of our session at the 57th Congress of the International Statistical Institute in Durban, South Africa, 2009, where the idea to write this book originated. We are also very grateful to the University of Aachen, Germany, for providing the environment and the financial support to run our subsequent workshop in 2010. In particular, we express our thanks to Professor Thomas Kraus, the head of the Institute of Occupational and Social Medicine, University of Aachen, who hosted and facilitated the workshop. Thanks to Professor Clifford Odimegwu of the University of Witwatersrand for valuable comments on earlier versions of this text. We also thank Professor Daniel Thorburn, Department of Statistics, Stockholm University, for reading parts of the manuscript and coming up with valuable comments. Our thanks also go to the anonymous reviewers from Springer who read and commented on the first draft of our manuscript. We also thank Diana Kandala for helping in copy-editing of the manuscript. Ngianga-Bakwin Kandala acknowledges the financial support he received from the British Council under the Development Partnership in Higher Education (DelPHE) scheme, Grant No. 788. Last, but by no means least, Gebrenegus Ghilagaber would like to thank his children Astér, Millen, and Simon for their unconditional love, patience, and understanding during the preparation of the book whose value may not have been clear to them at the time.

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*Unfortunately, two contributors did not live long to see the end product of their efforts. **Stephen Obeng Gyimah** died on 11 May 2012 while **Olaronke Ladipo** died on 31 October 2012. Our thoughts will always be with their families, close friends and colleagues who are affected by their untimely death.