

## Preface

This book contains a carefully chosen and coordinated series of lecture notes at the China-Canada Joint Program on Infectious Disease Modeling, held in Xi'an Jiaotong University, May 10-29, 2006. The joint program consists of a summer school attended by over 100 students from a variety of backgrounds, and a workshop participated by invited speakers from both academic institutes and public health agencies such as US Centers for Disease Control and Prevention (CDC) and Public Health Agency of Canada (PHAC).

These contributions are grouped into three categories: lectures notes that briefly introduce the basic concepts and techniques; survey articles that provide reviews on some specific diseases or issues; and research papers dedicating to some important problems of current interest in the epidemiological modeling. There are also two articles describing some recent progresses by a Chinese and a Canadian team.

The aim of this book is to provide fundamental methods and techniques for students who are interested in epidemiological modeling, and to guide junior research scientists to some frontiers in the interface of mathematical modeling and public health. Contributions are provided from different and complementary angles, with the balance between the theory and applications, between mathematical modeling and its applications to public health policy. It is hoped that this book can help in increasing the awareness of the importance of mathematical modeling in the study of infectious disease transmission, and in bridging the gap between mathematical modelers in basic theoretical research and medical scientists and public health policy makers working in health research institutes.

There has been a long history of mathematical epidemiology and there are many successful stories in applying mathematical modeling to optimal design of feasible public health policy for disease prevention, control and management. Some emerging and re-emerging infectious diseases such as HIV, FMD, SARS and pandemic influenza have generated substantial renewed interest, and have been continuing to challenge modelers for effective mathematical and computational models. Covering a comprehensive range of topics, this book hopefully provides an alternative and additional textbook for graduate students in applied mathematics, health informatics, applied statistics and qualitative public health, and a useful resource for researchers in these areas.

The book provides complementary approaches from deterministic, to statistical, to network modeling, and it seeks view points of the same issues from different angles from mathematical modeling, to statistical analysis, to computer simulations, and to concrete applications. For example, we have included a chapter that introduces the network models describing the beginning of a disease outbreak in terms of the degree distribution of a branching process, in comparison with the chapter that introduces the basic deterministic models along with the instructions how to calculate the basic reproduction number and the final size of an epidemic. Other chapters deal with mathematical analysis for disease transmission involving structured population; a chapter develops mathematical approaches for analysis of epidemic models with time delays; a chapter for age structured population models with applications to epidemiology, and age structured epidemic models; and a chapter deals with the uniqueness and global stability of endemic equilibria of multi-group epidemic models of SEIR type.

Disease spread in a heterogeneous environment is an important issue addressed in a chapter which uses metapopulation models consisting of graphs, with systems of differential equations in each vertex, to address the issue of spatial dispersal of diseases. This is further complemented by a chapter that deals with various issues involving stochastic processes for disease spread. A chapter is also included to detail two complimentary mathematical approaches for incorporating evolution into epidemiological models, and a chapter is dedicated to the investigation of the effects of the reservoir on the time course of the disease and on endemic states. The coexistence of a vertically and a horizontally transmitted parasite strain under complete cross protection is addressed as well.

Various chapters deal with the evaluation of different control measures. For instance, there is a chapter that studies the effectiveness of quarantine and isolation as control measures for the spread of infectious diseases, and general integral equation models which assumes an arbitrarily distributed disease stage for both the latent and the infectious stages. Another chapter discusses the pulse vaccination SIR model with periodic infection rate.

Other chapters deal with specific diseases of current interest. One such chapter describes the estimation of congenital rubella syndrome from disease or serological surveillance and demographic, and possible strategies for mitigating the burden of congenital rubella syndrome. Another chapter examines the estimate of turning points and case numbers of the 2003 severe acute respiratory syndrome outbreaks in Taiwan, Beijing, Hong Kong, Toronto, and Singapore. Added to these materials are the chapter that studies HIV transmission and disease progression, and a detailed case study of the West Nile Virus in Southern Ontario Canada. The book also contains a contribution that depicts the man-

ner in which the pandemic develops in a specific community, and the affection of antiviral treatment. This is supplemented by two chapters that briefly summarizes progresses and adventure of the Xi'an Jiatong University group, and a MITACS team for HIV, SARS, West Nile Virus, pandemic influenza and other emerging infectious diseases.

We wish to thank all contributors for their excellent contributions without which this book is impossible, we wish to express our sincere appreciation to the staff members and students of the Xi'an Jiatong University for their hospitality and hard working that made the Canada-China program a successful event and an enjoyable experience. We wish to thank Professor Ta-Tsien Li for encouraging us to include this book in the Series in Contemporary Applied Mathematics by Higher Education Press, and would like to acknowledge the support of Mathematics for Information Technology and Complex Systems (MITACS) for the Canada-China Joint Program.

Zhien Ma and Yicang Zhou, Xi'an Jiaotong University  
Jianhong Wu, York University