

Preface

The aim of this book is to outline the recent development of Markov chain models and their applications in queueing systems, manufacturing systems, remanufacturing systems, inventory systems, ranking the importance of a web site, and also financial risk management.

This book consists of eight chapters. In Chapter 1, we give a brief introduction to the classical theory on both discrete and continuous time Markov chains. The relationship between Markov chains of finite states and matrix theory will also be highlighted. Some classical iterative methods for solving linear systems will be introduced for finding the stationary distribution of a Markov chain. We then give the basic theories and algorithms for hidden Markov models (HMMs) and Markov decision processes (MDPs).

Chapter 2 discusses the applications of continuous time Markov chains to model queueing systems and discrete time Markov chains for computing the PageRank, a ranking of the importance of a web site in the Internet. Chapter 3 studies Markovian models for manufacturing and remanufacturing systems. We present closed form solutions and fast numerical algorithms for solving the captured systems. In Chapter 4, we present a simple hidden Markov model (HMM) with fast numerical algorithms for estimating the model parameters. We then present an application of the HMM for customer classification.

Chapter 5 discusses Markov decision processes for customer lifetime values. Customer lifetime values (CLV) is an important concept and quantity in marketing management. We present an approach based on Markov decision processes for the calculation of CLV using real data.

In Chapter 6, we consider higher-order Markov chain models. In particular, we discuss a class of parsimonious higher-order Markov chain models. Efficient estimation methods for model parameters based on linear programming are presented. Contemporary research results on applications to demand predictions, inventory control, and financial risk measurement are presented. In Chapter 7, a class of parsimonious multivariate Markov models is introduced. Again, efficient estimation methods based on linear programming are presented. Applications to demand predictions, inventory control policy, and modeling credit ratings data are discussed.

In Chapter 8, we revisit hidden Markov models. We propose a new class of hidden Markov models with efficient algorithms for estimating the model parameters. Applications to modeling interest rate, credit ratings, and default data are discussed.

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