Preface

This text in applied probability is designed for senior engineering, mathematics and systems science students. In addition I have used the optional, advanced sections as the basis of graduate courses in quality control and queueing. It is assumed the students have had a first course in probability but that some need a review. Discrete models are emphasized and examples have been chosen from the areas of quality control and telecommunications. The text provides correct, modern mathematical methods and at the same time conveys the excitement of real applications.

No physical measurement is infinitely precise and so, at some scale, is a discrete measurement. Here we take the point of view that the most interesting concepts in applied probability are discrete in nature and hence the description should not be complicated by measurability conditions implicit in a continuous model. The discrete model also has tremendous advantages. The complexity of conditioning continuous random variables disappears. Conditioning on the past of a random sequence becomes a simple application of Bayes' formula rather than a projection onto an L^2 space! Moreover, the discrete model allows one to do coupling in a transparent way and coupling methods are used throughout the book. Of course, continuous approximations may offer simplified descriptions and easier computations so naturally we will use this tool. We do not, however, pursue the theory to cover the continuous case. On the other hand, within the constraints of the discrete model, the most modern methods are presented.

Painful experience over the years has shown that the abstract model and especially the definition of σ-fields on probability spaces given in Chapter 2 is not everyone's cup of tea. The probability primer in Chapter 1 provides an overview of Chapter 2 by giving an equiprobability model describing a random experiment associated with a no-frills example. In some cases it may therefore be advisable to assign the primer as background reading and then skip directly to Chapter 3. The results in Chapter 2 are then referenced as needed. A first course might then be completed by covering Chapter 3 and the first few sections of Chapters 4, 5 and 7 or Chapter 4, 5 and 8. Proofs are kept to a minimum in these sections but the main computational tools are given. This results in the condensed version of the course described as the Systems Science course in the following diagram. The sections which are marked with a star give the proofs and more advanced material.

An advanced class would read Chapter 1 for the background on the "information highway" but the instructor would start in Chapter 2. Following the Flow Chart for the Mathematics Course below the instructor might complete most of the book in two quarters or perhaps one semester. The sections marked with a star give the proofs and advanced material while those marked with two stars are more advanced or on special topics.

On-line quality control procedures are emphasized and the Cusum is treated including a proof of optimality to cap off the last chapter. The "information highway" is described in the introductory Chapter 1 and used as an example throughout the book. Some examples are worked out using *Mathematica* and the commands are given in the text. These topics are received enthusiastically by the students and while some students don't have access to *Mathematica*, I think it essential to illustrate the interplay between the theory and the enormous computational power available today.

This book is my best effort at trying to sell the subject of applied probability to a rather diverse audience. I believe the result is a course which is modern and mathematically sound but without too many prerequisites. It is my hope that this text will provide engineering, mathematics and systems science students with an accessible introduction to modern techniques in quality control and the performance analysis of computer and telecommunication systems.

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Ottawa, 2003