Preface to the Second Edition

Compared to the first edition, we have made few changes to the first six chapters. They are intended for a first one semester course in probability with some statistics. It is assumed that the reader has had a calculus course but the book is written so that the calculus difficulties of the students do not obscure the probability content. Since probability concepts are not easy to grasp, we drastically limit the number of topics and concentrate on a few concepts that every student should thoroughly understand in a first probability and statistics course. Statistics are introduced as early as possible in the book in order to provide interesting and useful applications of probability.

The main difference with the first edition is the addition of Sect. 8.4, Chaps. 9 and 10. Chapters 7–10 (with supplements from previous chapters) are now intended for a course in Mathematical Statistics. These last chapters rely heavily on calculus of one and several variables. Chapter 10 requires linear algebra. In Chap. 7, moment generating functions are introduced and used to study sums of random variables and convergence of sequences of random variables. Chapter 8 deals with transformations of random variables (using distribution function). Random vectors are introduced and are used to prove a number of facts regarding expectation, variance, covariance, and normal samples. We added Sect. 8.4 to cover conditional distributions and conditional expectations. The first three sections of Chap. 9 deal with finding estimators (moments, maximum likelihood) and comparing estimators (sufficiency, Rao–Blackwell Theorem). We chose not to cover the most general cases, we instead concentrated on the exponential family of distributions. This provides many interesting examples and the theory applied to it is considerably simpler than the general theory. Section 9.4 provides an introduction to Bayesian statistics. Finally, in Chap. 10 we wrote a brief introduction to multiple regression in which we try to balance applications and theory.
Preface to the First Edition

This book is intended as a text for a first one semester course in probability with some statistics. It is assumed that the reader has had a calculus course. At the University of Colorado, we teach this course to a number of majors, including computer science, electrical engineering, mathematics, and physics. In the last few years, some engineering professional societies have suggested that statistics be taught to students and so we have included statistics in the traditional one semester probability course. My main motivation to write this book was that the many good books on probability and statistics are intended for 1-year courses and are very extensive. Anyone who has taught probability knows that it is a hard subject for most students. For this reason I have decided to drastically limit the number of topics and concentrate on a few concepts that I feel every student should thoroughly understand in a first probability and statistics course. I have also decided to introduce statistics as early as possible in the book in order to provide interesting and useful applications of probability.

I have tried to write this book so that the calculus difficulties of the students do not obscure the probability content. I have kept theory to a minimum and I have concentrated on interesting examples. Chapter 1 has the basic rules of probability and conditional probability with some interesting applications such as Bayes’ rule and the birthday problem. In Chap. 2 discrete and continuous random variables, expectation, and variance are introduced. Chapter 2 is mostly computational with few probability concepts and many applications of calculus. In Chaps. 3 and 4, we get to the heart of the subject: binomial distribution, normal approximation to the binomial, Poisson distribution, Law of Large Numbers, and Central Limit Theorem. I also cover the Poisson approximation to the binomial (in a nonstandard way) and the Poisson scatter theorem. In Chap. 5, we apply some of the concepts of the preceding chapters to introduce statistics. We cover confidence intervals and hypothesis testing for large samples, we also introduce Student tests to deal with small samples and a nonparametric test. Finally, we test independence and goodness of fit using chi-square tests. Chapter 6 is a short introduction to linear regression. Chapters 7 and 8 rely heavily on calculus of one and several variables to study sums of random variables (via moment generating functions), transformations
of random variables (using distribution functions), and transformations of random vectors. In Chap. 8, we prove a number of facts regarding expectation, variance, and covariance that are used throughout the book. We also prove facts about normal samples that are useful in statistics.

There are at least two ways to use this book for a one semester course. In both ways, one should first cover the first four chapters. Then one might choose to do some statistical applications and cover Chaps. 5 and 6 or one might choose to concentrate on probability and cover Chaps. 7 and 8.