Ross, Sheldon M.

Introduction to probability models. 7th ed. (English) Zbl 0977.60001

San Diego: Harcourt/Academic Press. xvi, 693 p. (2000).

This is the seventh edition of the book, for a review of the sixth edition (1997) see Zbl 0914.60005, for a review of the fifth edition (1993) see Zbl 0781.60001, for the fourth edition (1989) see Zbl 0676.60002.

It is not an unexpected surprise for the mathematicians community to see the seventh edition of this textbook which is very popular among those who teach probability theory as well as among those who want to apply probability theory to the study of phenomena in fields such as engineering, computer science, management science, physical and social sciences, and operations research. It is a well organized and clear written elementary introduction to probability theory and stochastic processes with lots of exercises, examples and applications. The seventh edition includes additional material in all chapters. New examples and exercises have been added. There are about 600 exercises (with 100 solutions). Among the more significant additions there are new derivations for the Poisson and non-homogeneous Poisson processes.

The author's description of the chapters will give some impression from the book. Chapters 1 and 2 deal with basic ideas of probability theory. In Chapter 1 an axiomatic framework is presented, while in Chapter 2 the important concept of a random variable is introduced. Chapter 3 is concerned with the subject matter of conditional probability and conditional expectation. "Conditioning" is one of the key tools of probability theory, and it is stressed throughout the book. When properly used, conditioning often enables us to easily solve problems that at first glance seem quite difficult. The final section of this chapter presents applications to (1) a computer list problem, (2) a random graph, and (3) the Polya urn model and its relation to the Bose-Einstein distribution. In Chapter 4 we come into contact with our first random, or stochastic, process, known as a Markov chain, which is widely applicable to the study of many real-world phenomena. Applications to genetics and production processes are presented. The concept of time reversibility is introduced and its usefulness illustrated. In the final section we consider a model for optimally making decisions known as a Markovian decision process.

In Chapter 5 we are concerned with a type of stochastic process known as a counting process. In particular, we study a kind of counting process known as a Poisson process. The intimate relationship between this process and the exponential distribution is discussed. Examples relating to analyzing greedy algorithms, minimizing highway encounters, collecting coupons, and tracking the AIDS virus, as well as material on compound Poisson processes are included in this chapter. Chapter 6 considers Markov chains in continuous time with an emphasis on birth and death models. Time reversibility is shown to be a useful concept, as it is in the study of discrete-time Markov chains. Chapter 7, the renewal theory chapter, is concerned with a type of counting process more general than the Poisson one. By making use of renewal reward processes, limiting results are obtained and applied to various fields.

Chapter 8 deals with queueing or waiting line theory. After some preliminaries dealing with basic cost identities and types of limiting probabilities, we consider exponential queueing models and show how such models can be analyzed. Included in the models we study is the important class known as a network of queues. We then study models in which some of the distributions are allowed to be arbitrary. Chapter 9 is concerned with reliability theory. This chapter will probably be of greatest interest to the engineer and operations researcher. Chapter 10 is concerned with Brownian motion and its applications. The theory of options pricing is discussed. Also, the arbitrage theorem is presented and its relationship to the duality theorem of linear program is indicated. We show how the arbitrage theorem leads to the Black-Scholes option pricing formula. Chapter 11 deals with simulation, a powerful tool for analyzing stochastic models that are analytically intractable. Methods for generating the values of arbitrarily distributed random variables are discussed, as are variance reduction methods for increasing the efficiency of the simulation.

Reviewer: M.P.Moklyachuk (Kyïv)

MSC:

60-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to probability theory

62-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to statistics