Chapter 1

Introduction

The number of puppies in a litter, the life of a light bulb, and the time to arrival of the next bus at a stop are all examples of random variables encountered in everyday life. Random variables have come to play an important role in nearly every field of study: in physics, chemistry, and engineering, and especially in the biological, social, and management sciences. Random variables are measured and analyzed in terms of their statistical and probabilistic properties, an underlying feature of which is the distribution function. Although the number of potential distribution models is very large, in practice a relatively small number have come to prominence, either because they have desirable mathematical characteristics or because they relate particularly well to some slice of reality or both.

This book gives a concise statement of leading facts relating to 40 distributions and includes diagrams so that shapes and other general properties may readily be appreciated. A consistent system of nomenclature is used throughout. We have found ourselves in need of just such a summary on frequent occasions—as students, as teachers, and as practitioners. This book has been prepared and revised in an attempt to fill the need for rapid access to information that must otherwise be gleaned from scattered and individually costly sources.

In choosing the material, we have been guided by a utilitarian outlook. For example, some distributions that are special cases of more general families are given extended treatment where this is felt to be justified by applications. A general discussion of families or systems of distributions was considered beyond the scope of this book. In choosing the appropriate symbols and parameters for the description of each distribution, and especially where different but interrelated sets of symbols are in use in different fields, we have tried to strike a balance between the various usages, the need for a consistent system of nomenclature within the book, and typographic simplicity. We have given some methods of parameter estimation where we felt it was appropriate to do so. References listed in the Bibliography are not the primary sources but should be regarded as the first "port of call".

In addition to listing the properties of individual variates we have considered relationships between variates. This area is often obscure to the nonspecialist. We

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have also made use of the inverse distribution function, a function that is widely tabulated and used but rarely explicitly defined. We have particularly sought to avoid the confusion that can result from using a single symbol to mean here a function, there a quantile, and elsewhere a variate.

Building on the three previous editions, this fourth edition documents recent extensions to many of these probability distributions, facilitating their use in more varied applications. Details regarding the connection between joint, marginal, and conditional probabilities have been included, as well as new chapters (Chapters 5 and 6) covering the concepts of statistical modeling and parameter inference. In addition, a new chapter (Chapter 38) detailing many of the existing standard queuing theory results is included. We hope the new material will encourage readers to explore new ways to work with statistical distributions.