CHAPTER 1

INTRODUCTION

As noted in the preface, the purpose of this book is to provide information on topics not covered in the fourth edition of *Loss Models: From Data to Decisions* [59]. In general, the emphasis here is less on data and decisions and more on what is in between, namely the vast array of models available for actuarial work. In this introduction we give a brief overview of the models covered. The material can be broken up into six sets of topics.

Univariate models for loss amounts

Three chapters are devoted to classes of univariate models. The first is the class of Coxian distributions (Chapter 2). These distributions have the desirable property that their Laplace transform (or, equivalently, their moment generating function) is a ratio of polynomials. Thus, when used as a claim size distribution, convenient explicit expressions for the associated aggregate or compound distribution may sometimes be derived. The second is the class of mixed Erlang distributions (Chapter 3). These distributions are notable because they can approximate any positive continuous distribution to an arbitrary degree of accuracy. Moreover, the mixed Erlang class contains a large number of distributions, including some whose mixed Erlang structure is not obvious. Also, calculations of most quantities of interest in an insurance loss context are computationally straightforward. The third chapter (Chapter 4) covers the two classes of extreme value distributions. This material is largely reproduced from the third edition [58] with some additional material on tail calculations.

As the name implies, these models are especially useful for management of risks that may produce large losses.

Calculation of aggregate losses

The basic methods for these calculations are covered in the fourth edition. This book contains two enhancements. Some of the univariate models introduced in the early chapters allow for exact calculation of aggregate loss probabilities. The formulas are developed in Chapter 5 along with asymptotic formulas for the right tail. Computational methods left out of the fourth edition are provided in Chapter 6. These include inversion methods, calculating with approximate distributions, and calculating from the individual risk model (which was in the second edition, but not the third). A new item is a presentation of the recursive formula when the frequency distribution is a member of the (a, b, m) class of distributions.

Loss model applications of discrete counting models

The next three chapters focus on various issues that are of interest in the loss modeling context. The first chapter (Chapter 7) introduces counting processes and, as in the third edition, deals with nonhomogeneous birth processes and mixed Poisson processes, which are useful for modeling the development of claim counts over time. Chapter 8 is new and considers properties of discrete counting distributions that are of interest in connection with loss model concepts such as deductibles and limits, recursions for compound distributions, evaluation of stop-loss moments, and computation of the risk measures VaR and TVaR in a discrete setting. The third chapter (Chapter 9) deals with models where the claim amounts depend on the time of incurral of the claim. Examples include inflation and claim payment delays.

Multivariate models

Chapter 10 covers the analysis of multivariate models based on copula functions. The material is taken from the third edition. Methods for simulation that were in a later chapter of the third edition were moved to this chapter.

Continuous-time ruin models

The material in Chapter 11 is taken directly from the third edition. It contains the classic analysis of the infinite-time ruin problem.

Interpolation and smoothing

While this material was covered in the third edition, two changes have been made for Chapter 12. First, some of the earlier material has been eliminated or streamlined. The goal is to efficiently arrive at the smoothing spline, the method most suitable for actuarial problems. More emphasis is placed on the most common application, the smoothing of data from experience studies. A traditional actuarial method, Whittaker–Henderson, has been added along with discussion of its similarity to smoothing splines.