Literatur-Rundschau

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Albert W. Marshall and Ingram Olkin:
Life Distributions: Structure of Nonparametric, Semiparametric and Parametric Families. Springer Series in Statistics, 2007.

In the preface Marshall and Olkin say that for many years they have been interested in writing a book on multivariate distributions that are useful in reliability theory and survival analysis. Of course, such a book would need an introductory chapter on univariate models. The present work, a book of more than 700 pages, is the result of this effort of writing an introductory chapter. That is, the authors have soon realized that there is so much to say about the univariate case, well beyond a single chapter. They have definitely written an impressive book on that topic.
I have enjoyed a lot reading the book. Marshall and Olkin manage to describe the different models and distributions in a very lively way. Moreover, the book profits very much from their deep knowledge of mathematical theory and practical problems. The reader will find deeper insights into models, practical problems, properties and usefulness of methods described in the book. The book could also serve as a base reference on univariate life and survival distributions because one can start reading from almost any place.
Let us briefly describe the structure and the contents of the book. We start with the rough structure before going into details.
The book is divided into 7 parts that have different chapters. Each of these 7 parts is already very useful on its own:
1. Basics
2. Nonparametric Families
3. Semiparametric Families
4. Parametric Families
5. Models Involving Several Variables
6. More About Semiparametric Families
7. Complementary Topics

1. Basics. The first part gives the necessary notations and an introduction into the different notions and concepts. Distribution functions, density functions, hazard rates and residual life functions are introduced. First mixtures of distributions are considered, as well as first characterizations of survival functions. Further, several

orderings of random variables and their implications are introduced and stated. Especially, the chapter on mixtures is very important, also for problems that go beyond the scope of the book. For instance, mixture models offer an important approach in constructing multivariate models, they also allow for Bayesian inference.

2. Nonparametric Families. The concept of nonparametric families of life distributions is introduced in this part of the book. Since nonparametric families have mostly been studied in the context of reliability theory, Marshall and Olkin describe their development within reliability theory. The reader, e.g., learns about failure and functioning in coherent systems which then leads to reliability functions, hazard transforms and survival functions. These systems are then characterized by different notions such as "increasing hazard rate", "increasing hazard rate average", "new better than used" or "decreasing mean residual life". These terms are defined, characterized and preservation properties are derived. Section 5.G gives an overview of these notions and their interrelationships. In Section 4.D the reader learns that the bathtub hazard rate is not only important in life theory but also for safety considerations in nuclear power plants. Further, shock models are derived and inequalities for the moments of nonparametric distributions and their survival functions are discussed.

3. Semiparametric Families. In this part semiparametric families of distributions are introduced. Usually, parameters of distributions are thought of as being real or vector-valued. For semiparametric families, distributions enter with parameters which are themselves distribution functions. The authors discuss various useful examples of semiparametric families. These include: location parameters, scale parameters, power parameters, frailty and resilience parameters, tilt parameters, hazard power parameters, moment parameters, Laplace transform parameters, age parameters as well as convolution parameters. These families are characterized and properties are derived such as the study of the total time of test transform, order properties and order preservations.

4. Parametric Families. This is by far the biggest part of the book. In it all parametric probability distributions that are of interest for modelling survival times are considered in detail.

The first chapter is devoted to the exponential distribution. Various distributional properties of the exponential distribution are given as well as several characterizations.

In the next chapter extensions are considered among which are the gamma distribution, the Weibull distribution, exponential distributions with resilience parameter or

tilt parameter. The authors describes their properties as well as their usefulness for practical problems.
In Chapter 10 the Gompertz-Makeham distribution is presented including a short historical review. These distributions belong to the most popular parametric distributions in life insurance, though in other fields they only receive little attention. Besides its properties several extensions are discussed.
The next chapters are devoted to the Pareto and the F distributions and to their properties and generalizations. Then logarithmic distributions such as the lognormal distribution, the log extreme value or the log Cauchy distribution, the inverse Gaussian and the generalized inverse Gaussian distribution together with the Birnbaum-Saunders distribution are studied. The next chapters are devoted to distributions with finite support as well as to additional parametric families, like the chi-square distribution.

5. Models Involving Several Variables. This part consists of two chapters. The first chapter considers covariate models. That is, the distributions of the random variables, e.g. the lifetimes, depend on explanatory variables (covariates) that describe the corresponding distributions. The most commonly used covariate functions are either the linear or log linear. These concepts lead to the well-known regression and generalized linear models. The second chapter is devoted to an approach where it is assumed that the life length U depends on several underlying failure variables $X_1, \ldots, X_n$ (latent variables), given by $U = \min \{X_1, \ldots, X_n\}$. This allows in a natural way for multivariate distributions and copula functions.

6. More About Semiparametric Families. In Part 3 of the book semiparametric families of distributions are introduced based on a location or a scale parameter. In this chapter the authors analyze for which continuous and discrete distributions one obtains the same semiparametric family by introducing different parameters. In the next chapter they study stability criteria and classification of parameters for semiparametric families. Finally, the order properties of semiparametric families are studied.

7. Complementary Topics. The final part can also be viewed as an appendix. Here the basics of probability spaces, distribution functions, convergence concepts, convolutions and transforms are presented. Then renewal processes and extreme value distributions are introduced, as well as the basics from the theory of multivariate distributions are given.

The book is supported by an extensive list of references, as well as a very helpful author and subject index. We believe that the present book will become a standard reference on the topic life distributions. Both academics and practitioners will no doubt enjoy it. It can serve as a textbook for presenting distributions and their properties, but more likely it will be used as a kind of encyclopedia for life distributions.

Mario V. Wüthrich

Michel Denuit, Xavier Maréchal, Sandra Pitrebois and Jean-François Walhin:
Actuarial Modelling of Claim Counts. John Wiley & Sons, 2007.

The book provides a comprehensive text on risk classification, credibility and experience rating in general insurance. It combines various techniques such as Bayesian inference methods, credibility theory, maximum likelihood estimations in generalized linear models, and regression. I believe that this book will become a standard reference on experience rating for practitioners, researchers and students in actuarial science. I enjoyed reading the book as it clearly presents the relevant theory in a modern language and also gives several numerical illustrations based on Belgian motor third party liability data.

The text is divided into three parts:

Part I: Modelling Claim Counts. This part starts with the discussion of the classical claim counts distributions in risk theory, such as the Poisson distribution and the mixed Poisson distribution with various different random effect distributions. For these models, parameter estimation is discussed. As a next step, the authors introduce risk classification. Tariff segmentation is discussed using regression analysis and random effects models. In doing so, the authors discuss multiplicative tariff structures, parameter reduction techniques and model selection problems.

Part II: Basics of Experience Rating. In this part, the authors discuss how individual claims experience of policyholders is integrated in order to obtain an individual premium for each claims history. One therefore needs to combine information from the collective as well as from the individual policyholder. This is done using credibility models in a Bayesian inference framework. The authors then continue to describe a bonus-malus tariff structure which rewards or penalizes policyholders with a good or a bad claims history, respectively. Such bonus-malus scales can be seen as commercial versions of credibility formulas. They are usually based on a Markov chain framework. Markov chains for ratemaking are then studied in full detail, going from transition probabilities to stationary distributions for the study of the long-term behaviour which is the basis of the bonus-malus scales.

Part III: Advances in Experience Rating. This part of the book presents several selected topics that need a careful treatment in practical applications. We mention some of the issues. Though the bonus-malus scales in general only depend on claim

counts for ratemaking, one also needs to study the claim severities. For example, the policyholder may not report small claims to the insurance company due to the fact that bonus-malus scales only depend on claim counts; this is the so-called bonus hunger. Another example is that large claims need a special treatment because often they do not fit into the usual picture and their claims load needs to be distributed in another meaningful way among the policyholders. Moreover, optimal retention levels and efficiency of bonus-malus designs are discussed. In this part, advanced methods are used such as multidimensional credibility and multi-event bonus-malus scales modelling.
Another issue that needs to be studied is the speed of convergence to the stationary limit of the Markov chains. Often the bonus-malus scales are calculated based on these asymptotic values. However, it may take relatively long to reach these steady states and the relevant policies are typically only in force during a limited time period. Therefore transient behaviours and speed of convergence need to be studied carefully. Finally, the book closes with an actuarial analysis of the French bonus-malus system.

In conclusion, I believe this is an excellent text on experience rating that picks up the actuarial reader at almost any level. The authors have found an excellent balance between theory and practice.

Mario V. Wüthrich