where \( F(x) \) is the distribution function of a positive random variable \( Y \), \( F^{*n}(x) \) is its \( n \)th convolution power, and \( \{p_n, n = 0, 1, \ldots \} \) is a probability function of a random variable \( N \) assuming nonnegative integer values. The \( G(x) \) is the distribution function of a random sum \( X = Y_1 + \cdots + Y_n \), where \( Y_1, \ldots, \) are independent copies of \( Y \), also independent of \( N \). Such compound distributions appear naturally in various theories as insurance mathematics, queueing theory, or reliability theory. These lecture notes were stimulated mainly by insurance problems, and thus \( X \) is said to be the aggregate claim amount. In collective risk theory, \( Y_1, \ldots, \) are claim sizes and \( N \) represents a total number observed claims within a specified period.

Although transforms or moments of \( X \) are accessible, an explicit form of \( G(x) \) is generally intractable. Two cases of \( \{p_n\} \) are of importance: geometric, when \( p_1 = (1 - \phi)\phi^n, \ n = 0, 1, \ldots \) and modified geometric, when \( p_n = (1 - p_1)(1 - \phi)^{n-1}, \ n = 1, 2, \ldots \). Another assumption appearing in the notes is of an asymptotic form that \( p_n \sim Cn^{-\alpha} \) for \( n \to \infty \). A substantial part of the notes is devoted to various bounds and asymptotics for \( G(x) = 1 - G(x) \) as \( x \to \infty \), depending on assumptions on \( F(x) \) and \( \{p_n\} \).

Of particular importance are exponential bounds or exponential asymptotics when the bound or asymptotics is an exponential function of the so called defective renewal equation \( m(x) = \phi \int_0^\infty m(x-y)dF(y), \ x \geq 0 \).

Various improvements for the preconstants can be obtained under different assumptions on \( F(x) \), that is, when \( F(x) \) belongs to one of reliability classes. The case when \( F(x) \) is heavytailed (e.g., subexponential) is discussed on the margin only.

Many formulas in applied probability modeling are solutions \( m(x) \) of the so called defective renewal equation \( m(x) = \phi \int_0^\infty m(x-y)dF(y), \ x \geq 0 \). Equations of this form arise repeatedly in various areas, including insurance risk theory, branching processes, and inventory theory. It turns out that \( m(x) \) can be expressed in terms of the geometric compound distribution, and hence bounds and asymptotics of \( m(x) \) can be derived. This technique has been applied in the notes to study the time to ruin, severity of ruin, etc., which are crucial for applications. Major theorems are quoted from literature. Despite its drawbacks, however, Lundberg approximations for compound distributions with insurance applications can serve as a companion to a course on risk theory, wherein one can find many examples illustrating ruin theory. It can be also recommended as a reference source with its many references from the risk theory area.

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Econometric Analysis of Count Data (3rd ed.)

Rainer Winkelmann. New York: Springer, 2000. ISBN 3-540-67340-7. xii + 282 pp. $83.00.

This hardcover monograph is dedicated to modeling and estimating the parameters of the distributions of event count random variables. In recent years this has been a research area of active growth, as evidenced by the fact that this book, originally published in 1994, is already into its third edition. Like most areas in the statistical sciences, this field has grown as researchers have developed methods to relax overly restrictive assumptions and explore more complex issues. Almost as a truism, least squares techniques as applied to count data are generally inefficient, because they ignore its discrete nature. Poisson models, although recognizing this problem, are severely limited in their scope. At the very least, these need to be extended to account for overdispersion or underdispersion, simultaneity, endogeneity, nonobservables, and other issues that intrinsically affect count data in very special ways. Much of this book is devoted to these extensions.

Winkelmann has published numerous articles on using count models in economics and other social science journals. Because these are both applied and theoretical, he is well suited to write a monograph in this area. This book provides a very useful survey for anyone doing serious research using count data.

The book is aimed at graduate students and researchers interested in modeling count data. Although it reflects an econometrician’s interests, it should be useful to a wide variety of applied statisticians, because the analytical tools are basically the same regardless of discipline. Although the level of analysis is not particularly high (i.e., no measure theory), it would be difficult for anyone without a mathematical statistics background at or above, say, the level of the text by Wackerly, Mendehall, and Scheaffer (2001) to follow some of the derivations, particularly in Chapter 2, which goes into some detail on deriving various distributions for count data. And although the author provides an introduction to maximum likelihood and generalized method-of-moments estimation, anyone not comfortable with these approaches will find some of the reading tough going.

The main competition for this book is the monograph by Cameron and Trivedi (1998). Although both books share the same focus, their main approaches are quite different. Winkelmann’s main (although not exclusive) estimation approach is maximum likelihood. As is well known, this leads to efficient estimates under correct model specification, but it is a potential source of inconsistent parameter estimates in misspecified models. The main estimation tool of Cameron and Trivedi, in contrast, is regression analysis and its extensions. Although not necessarily efficient, such an approach is often more robust to specification errors. The choice largely comes down to a matter of taste. Winkelmann is clearly aware of the shortcomings of maximum likelihood estimation, and devotes substantial space to misspecification testing. Moreover, some of the semiparametric extensions to the basic models examined by Winkelmann allow for a robust maximum likelihood approach.

This is a specialized book, with much of the content devoted to detailed discussion of the distributions associated with count data. I see this as a strength. Much of my own research has focused on nonstandard count and duration models with unobserved heterogeneity and partially observed and multivariate dependent variables. In cases like this, one is often at a loss as to how to even approach an estimation problem. A reference such as this, which systematically treats many of the nonstandard cases, can be very helpful. One of the benefits of a maximum likelihood approach is that it automatically provides for an estimation approach once one has derived a distribution for the observable random variables. Winkelmann also provides a useful explanation of the underlying connection between count and duration models.

This is a substantially enlarged version of the previous edition with modifications to each chapter. In particular, the sections on correlated count data (time series and multivariate models) and empirical applications have been extended. The latest edition includes studies from accident analysis, health economics, demography, and marketing, with considerable detail provided on how to model and estimate these.

As for the book’s shortcomings, I would have liked to see some of the other recent advances in econometrics—in particular, nonparametric specification testing and bootstrapping—applied to count data. Although Winkelmann devotes a great deal of space in Chapter 3 to misspecification testing, this is basically in a traditional framework, where the alternative model is fully specified. It would be nice to see some sort of robust testing as suggested by, say, Fan and Li (1996). A second popular tool not introduced in the book is the bootstrap. At the very least an explanation of how the bootstrap could be used to improve inferences with count models would have been nice. To his credit, Winkelmann provides a short discussion of analytically derived bias corrections for the standard Poisson model. However, few applied researchers will probably be interested in this and would prefer something more automatic, such as is provided by the bootstrap.

To summarize, for those who want a simple introduction to count models and/or are content to do some simple estimation, the limited coverage of count models provided in textbooks such as that by Greene (2000) will probably be sufficient. However, for those who are doing substantive research using count data, Economic Analysis of Count Data will prove quite useful.

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*Rainer Winkelmann*. Berlin: Springer-Verlag, 2000. ISBN 3-540-67340-7. xii + 282 pp. $83.00. This book provides an overview of regression models appropriate for dependent count variables. Models for the analysis of normal variables or non-negative variables (lognormal, exponential regression), and limited dependent variables already have a relatively long tradition in econometrics. In contrast, models for count data have received considerable attention only in the last few years. This book aims to fill this gap by trying to represent the state of the art in econometric count data methodology used in the econometrics literature. After an extensive theoretical discussion on the genesis of the Poisson distribution (including an introduction to the Poisson process and some of its relevant generalizations), alternatives including the negative binomial, binomial, and logarithmic distributions are reviewed. Additional modifications of the Poisson distribution, such as truncation, censoring and grouping, and generalizations relying on mixing or compounding, are then discussed and carefully explained in a “definition, proposition, proof” format. Analogies between probabilistic models for duration data and count data are also highlighted in this chapter.

In the subsequent chapters, Winkelmann focuses on loglinear regression models for counts. The basic Poisson loglinear model is used as the benchmark model, and topics like estimation, inference, and misspecification of the model are covered in Chapter 3 (“Basic Issues”). After reading a section about maximum likelihood estimation, I was somewhat surprised to see a statement about the advantages of using numerical derivatives because they “have the virtue of reducing the risk of programming errors” (p. 79). Such ideas certainly seem inappropriate when discussing a standard member of the class of generalized linear models (GLMs). Occasionally the reader gets the impression that the author would like to dissociate from GLMs, which he finds to be “mainly associated with the discipline of biometrics rather than that of econometrics” (p. 88). This might also be a reason why some of the book’s terminology sometimes conflicts with its original meaning. For example, quasi-maximum likelihood estimation is related to parameter estimates obtained by maximizing a misspecified log-likelihood (p. 84), which contradicts its meaning in the GLM context. Later on, the author reminds himself about “estimation of the model parameters by quasi-likelihood in the tradition of GLMs” (p. 200).

The heart of the book, Chapter 4, covers interesting extensions to the Poisson regression model. Various mixture models are introduced to analyze count data under unobserved heterogeneity. Truncated and censored, hurdle, and zero-inflated count data models are also considered to model particular deviations from the Poisson distribution. Chapter 5 covers correlated count data and discusses various multivariate distribution models that have been put to practical use in econometrics. These include models appropriate for panel count data and for time series of counts, the latter referring mainly to generalized estimating equation models and the INAR(1) process.

Bayesian econometrics and appropriate but computationally expensive estimation techniques are briefly introduced in a much too short Chapter 6. The concluding chapter discusses applications. It nicely summarizes many practical important aspects of econometrics and includes many references on real data problems there. The only dataset analyzed in this is from a study dating back to 1984 on labor mobility in Germany, concentrating on the frequency of job changes and the number of unemployment spells. All explanatory variables seem to be either categorical or ordinal. Unfortunately, log-linear models for the analysis of contingency tables and their merits are not covered. Nothing is said about prediction or diagnostics, even though the former is even termed an “important purpose of the econometric analysis” (p. 241).

Compared to the second edition, this third edition does not involve a major reorganization of the material. It is carefully typeset in $\LaTeX$, and typographical errors are rather rare. I would certainly recommend *Econometric Analysis of Count Data* to econometricians, because it represents an interesting and well written survey on count models used in this domain. It could also serve as a textbook for a graduate course, although it does not contain problems or exercises. However, most references are exclusively from the econometric literature; original references are replaced by some recent ones in econometrics (the author is a major contributor to this field). Another gap is the absence of references on computer software or programs that would allow the researcher to also use the more sophisticated models in practice.

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**Wavelet Methods for Time Series Analysis.**

Donald B. Percival and Andrew T. Walden. New York: Cambridge University Press, 2000. ISBN 0-521-64068-7. xv + 594 pp. $69.95. In this monograph, Percival and Walden provide a wealth of material (nearly 600 pages!) including not only a rigorous and thorough coverage of a variety of facets of wavelet theory, but also a nice treatment of various practical aspects that arise when wavelet methods are applied to the analysis of real data. As the title states, the book’s primary aim is to explore wavelet theory and practice as it pertains to analyzing data ordered in time (or in space, etc.). Its overall approach tends to follow more closely the “time series” way of thinking about ordered data (in that primary interest is in describing facets of the mechanism that produces the data) than the approach of the “smoothers” (who tend to think of recovering the “true” signal from a noisy version of it). With this outlook, the book offers a number of rich insights into applications of wavelet theory in such situations.

This book evolved from course notes developed from a graduate course taught at the University of Washington over a number of years. Partially as a result of this origin, one of the book’s strengths is its wealth of exercises. In addition to a great many end-of-chapter exercises, there are also quite a few exercises embedded in the text in their appropriate context. (To give an idea of the extent of these exercises, the solutions to the embedded exercises alone take up more than 50 pages in the Appendix!)

Because of the ambitious depth of coverage, a great deal of notation is required. The authors are meticulous about maintaining notational conventions throughout, and a multiple-page glossary of notation used is included in the Preface for ready reference. Although this is unavoidable with the sheer volume of notation used (i.e., script vs. boldface vs. italics vs. plain, tildes vs. bars, subscripts and superscripts, etc.) tends to require frequent reference to the glossary to sort out concepts while reading, especially when using the book as a reference. Those reading the book more or less sequentially as they study wavelet theory and methods can be expected to gradually become familiar with the notation as it is introduced and thus reference the glossary less often.

More detailed summaries of the book’s chapters follow:

**Chapter 1.** This chapter provides the initial introduction to wavelets, beginning with the continuous wavelet transform of real-valued functions and moving directly to the discrete wavelet transform of sequences of data.

**Chapters 2 and 3.** To meet the stated objective of producing a largely self-contained book, the authors included these chapters to provide background information necessary for later treatment of wavelet theory. Chapter 2 covers both Fourier theory (focusing primarily on Fourier transforms of sequences) and filter theory. Chapter 3 treats general orthonormal transforms of sequences (of which the discrete wavelet transform is an example), covering the discrete Fourier transform in some detail. These chapters each end with a summary section to which readers with some familiarity of these topics can refer to determine what they need to read more carefully.

**Chapter 4.** This chapter introduces the (usual) discrete wavelet transform (DWT) in a fair amount of detail. It begins with a qualitative description of the DWT (including a nice description of the scale of each wavelet level in terms of the original sampling rate of the data) and goes on to cover the DWT in terms of the filtering operations involved and how these operations are combined in the various decomposition and reconstruction algorithms used in wavelet analysis. From this, the treatment turns to a study of two wavelet