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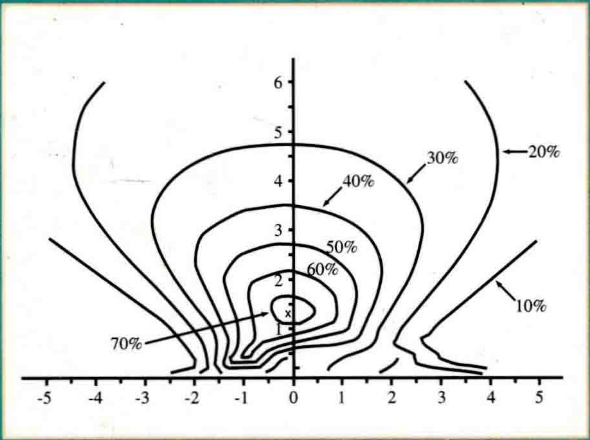

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To My Family,
Miyuki, Toshifumi and Yasuyuki

Preface

As the personal computer progresses day by day, computer-intensive procedures have been developed in the field of statistics and econometrics. The computational procedures in statistics and econometrics include both Monte Carlo methods and nonparametric methods (or distribution-free methods). In the first half of this book, the Monte Carlo methods are discussed. That is, some representative random number generation methods and their applications are shown. The second half of this book is related to computer-intensive statistical techniques other than Monte Carlo methods and simulations, where the nonparametric methods are introduced.

Chapter 1 is an introduction to statistics and econometrics, which corresponds to my lecture notes in mathematical statistics course (about 15 lectures, each 90 minutes long) for first-year graduate students. Based on Chapter 1, the Monte Carlo and nonparametric methods are discussed in Chapters 2 – 8.

In the Monte Carlo methods, we discuss how to generate various random draws. Almost all the random draws are based on the uniform random draws. Therefore, it is one of the most important tasks to investigate uniform random number generation. Transforming the variable from the uniform random variable, various random draws are generated in Chapter 2, e.g., Bernoulli random draws, binomial random draws, normal random draws, χ^2 random draws, t random draws, F random draws, exponential random draws, gamma random draws, beta random draws, Cauchy random draws, logistic random draws and others.

Importance resampling, rejection sampling and the Metropolis-Hastings algorithm are the methods to generate random draws from any distribution, which are useful tools for random number generation even when it is not easy to generate the random draws. Three sampling methods are discussed in Chapter 3. Thus, in the Monte Carlo methods, random number generation is very important. Once we have the random draws, simply the arithmetic average of the random draws indicates the estimate of mean. The arithmetic average is approximately distributed with a normal random variable by the central limit theorem. Therefore, the statistical inference also becomes quite easy, using the random draws.

As some applications in the Monte Carlo methods, Baysian inference (Chapter 4), bias correction of the ordinary least squares (OLS) estimator in the autoregressive models (Chapter 5) and nonlinear non-Gaussian state space modeling (Chapter 6) are shown.

In the nonparametric methods, nonparametric statistical tests are discussed in Chapters 7 and 8. Nonparametric tests of difference between two sample means include score tests (e.g., Wilcoxon rank sum test, normal score test, logistic score test, Cauchy score test and so on) and Fisher's randomization test (or Fisher's permutation test). The nonparametric tests of difference between two sample means are discussed in Chapter 7. One of the features of nonparametric tests is that we do not have to impose any assumption on the underlying distribution. From no restriction on the distribution, it could be expected that nonparametric tests would be less powerful than the conventional parametric tests such as the t test. However, it is shown that the Wilcoxon rank sum test is as powerful as the t test under the location-shift alternatives and moreover that the Wilcoxon test is sometimes much more powerful than the t test. Especially, the remarkable fact about the Wilcoxon test is that it is about 95 per cent as powerful as the t test for normal data. It is known that Pitman's asymptotic relative efficiency of the normal score test relative to the t test is greater than one under the location-shift alternatives. This implies that the power of the normal score test is always larger than that of the t test. It is known that the normal score test is less powerful than the Wilcoxon test if the tails of the underlying distributions are diffuse. Since in general the nonparametric tests require a large computational burden, however, there are few studies on small sample properties although asymptotic properties from various aspects were studied in the past.

In addition to testing difference between two sample means, in Chapter 8 we also consider testing independence between two samples, which corresponds to testing correlation coefficient and regression coefficient. Small sample properties are discussed in the nonparametric statistical tests part of the book.

Thus, some selected representative computer-intensive methods are treated in this book, where the source codes are shown by Fortran 77 and sometimes C languages for the purpose of practical understanding. For this book, I used seven personal computers, i.e.,

- Athlon 1.4 GHz CPU, Windows 2000 Operating System
- Pentium III 1.4 GHz Dual CPU, and Windows 2000 Operating System
- Pentium III 1.0 GHz Dual CPU, and Windows 2000 Operating System
- Athlon 2000+ Dual CPU, and Windows 2000 Operating System
- Athlon 2000+ Dual CPU, and Linux (Slackware 8.0) Operating System (see `http://www.slackware.com` for Slackware)
- Pentium III 1.4 GHz Dual CPU, and Linux (Plamo Linux 2.2.5, which is equivalent to Slackware+Japanese) Operating System (see `http://www.linet.jp/Plamo` or `http://plamo-linux.jp` for Plamo Linux, which is a Japanese site)
- Pentium III 1.0 GHz Dual CPU, and Linux (Plamo Linux 2.2.5) Operating System

For almost two years, my personal computers have been running all the time to prepare this book. Under the Windows 2000 Operating System, the following Fortran and C compilers are used for computation.

- Open WATCOM C/C++ and Fortran 1.0 (`http://www.openwatcom.org`)
- Cygwin (`http://www.cygwin.com`)
- DJGPP (`http://www.delorie.com/djgpp`)

In addition to the free compilers shown above, in Section 7.5, Tables 7.4 and 7.5, the IMSL library (`http://www.vni.com/products/imsl`) with Microsoft Fortran PowerStation Version 4.00 is used to obtain the percent points of the normal, t and F distributions.

I am indebted to many people for assistance with this book. All cannot be mentioned in this short space, but I would like to acknowledge the Acquisitions Editor Taisuke Soda (Marcel Dekker, Inc.), who suggested that I write a book on statistical computing. I presented some chapters at the Econometrics workshop, Graduate School of Economics, Kobe University. I would like to thank the participants at the workshop for valuable comments. Furthermore, as mentioned above, Chapter 1 is based on my lecture notes in mathematical statistics course. Graduate students found some errors in the lecture notes. I am grateful to them for that. This research was partially supported by Japan Society for the Promotion of Science, Grants-in-Aid for Scientific Research (C)(2) #14530033 and Grants-in-Aid for the 21st Century COE Program #15COE500.

I used LaTeX to write this book. I did all of the typing, programming and so on. Therefore, all mistakes are mine. In programming, I use Fortran 77 in the first half of the book (Chapters 2 – 6) and C in the last half (Chapters 7 and 8). The *pointer*, which is often used in C language, is not familiar to Fortran users. Therefore, in Chapters 7 and 8, I did not use the pointer. Instead, I declared the external variables in the source codes, which are similar to the `common` sentence in Fortran 77. Finally, all the source codes used in this book are available in the CD-ROM attached with this book (therefore, readers do not have to type the source codes from the beginning).

Hisashi Tanizaki

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