

Modeling

Part E

Part E Modeling and Simulation Methods

**37 Bootstrap, Markov Chain
and Estimating Function**

Feifang Hu, Charlottesville, USA

38 Random Effects

Yi Li, Boston, USA

39 Cluster Randomized Trials: Design and Analysis
Mirjam Moerbeek, Utrecht, Netherlands

**40 A Two-Way Semilinear Model for Normalization
and Analysis of Microarray Data**

Jian Huang, Iowa City, USA
Cun-Hui Zhang, Piscataway, USA

**41 Latent Variable Models for Longitudinal Data
with Flexible Measurement Schedule**

Haiqun Lin, New Haven, USA

42 Genetic Algorithms and Their Applications

Mitsuo Gen, Kitakyushu, Japan

43 Scan Statistics

Joseph Naus, Piscataway, USA

44 Condition-Based Failure Prediction

Shang-Kuo Yang, Taiping City, Taiwan, R.O.C.

**45 Statistical Maintenance Modeling
for Complex Systems**

Wenjian Li, Irving, USA
Hoang Pham, Piscataway, USA

46 Statistical Models on Maintenance

Toshio Nakagawa, Toyota, Japan

Part E contains ten chapters and focuses on statistical methods and modeling. Chapt. 37 provides an overview of several well-known bootstrap methods, including Efron's bootstrap and Studentized bootstrap interval for constructing confidence intervals and introduces some recently developed bootstrap methods such as the estimation-function bootstrap and the Markov-chain marginal bootstrap. Chapter 38 discusses generalized linear mixed models for correlated non-normal data and various methods for random-effect model parameters including the EM algorithms, penalized quasi-likelihood, the Markov-chain Newton–Raphson, the stochastic approximation, and the S–U algorithm. Chapter 39 focuses on the design and analysis of cluster randomized trials. This chapter also describes cost-efficiency models with covariates and the robustness of optimal designs, including both the number of clusters and cluster size. Chapter 40 discusses a semiparametric estimation method for an extension of the semiparametric regression model, called the two-way semilinear model, for normalization to estimate normalization curves and its applications to microarray data. Chapter 41 covers the development of latent-variable models for longitudinal data such as the generalized linear latent and mixed model, hierarchical latent-variable models, the linear mixed model for multivariate longitudinal responses as well as structural-equation models with latent variables for longitudinal data.

The next two chapters focus on genetic algorithms and scan statistics. Chapter 42 provides an overview of the concept of genetic algorithms, including

hybrid genetic algorithms, adaptive genetic algorithms and fuzzy-logic controllers, and their applications in scheduling problems, network design, reliability design-optimization problems, logistic network, and transportation-related problems. Chapter 43 describes the concepts of scan statistics and the various types used to localize large clusters in continuous time, space, and on a two-dimensional lattice. It also discusses recent double-scan statistics methods that allow practitioners to test for some unusual lagged clustering of different types of events and complex systems.

The final three chapters focus on various issues in maintenance modeling. Chapter 44 describes a condition-based failure-prediction method consisting of both a computer simulation and an experiment on a DC motor for preventive maintenance using the Kalman filter. The applications of the method and experimental set ups with related system parameters and experimental results are also discussed. Chapter 45 gives a brief introduction to maintenance modeling and discusses generalized multistate maintenance models for repairable systems as well as condition-based inspection strategies for degraded systems with multiple, competing failure processes such as degradation processes and random shocks, while Chapt. 46 presents a review of major maintenance models and policies in the maintenance literature that are commonly used in practice and discusses various recent maintenance models with consideration of repair policies and inspection with human errors.