Part A Fundamen

Part A Fundamental Statistics and Its Applications

1 **Basic Statistical Concepts**
Hoang Pham, Piscataway, USA

2 **Statistical Reliability with Applications**
Paul Kvam, Atlanta, USA
Jye-Chyi Lu, Atlanta, USA

3 **Weibull Distributions and Their Applications**
Chin-Diew Lai, Palmerston North, New Zealand
D.N. Pra Murthy, Brisbane, Australia
Min Xie, Singapore, Singapore

4 **Characterizations of Probability Distributions**
H.N. Nagaraja, Columbus, USA

5 **Two-Dimensional Failure Modeling**
D.N. Pra Murthy, Brisbane, Australia
Jaiwook Baik, Seoul, South Korea
Richard J. Wilson, Brisbane, Australia
Michael Bulmer, Brisbane, Australia

6 **Prediction Intervals for Reliability Growth Models with Small Sample Sizes**
John Quigley, Glasgow, Scotland
Lesley Walls, Glasgow, Scotland

7 **Promotional Warranty Policies: Analysis and Perspectives**
Jun Bai, Wilmington, USA
Hoang Pham, Piscataway, USA

8 **Stationary Marked Point Processes**
Karl Sigman, New York, USA

9 **Modeling and Analyzing Yield, Burn-In and Reliability for Semiconductor Manufacturing: Overview**
Way Kuo, Knoxville, USA
Kyungmee O. Kim, Seoul, S. Korea
Taeho Kim, Sungnam, Kyonggi-do, S. Korea

Part A provides the concepts of fundamental statistics and its applications. The first group of five chapters exposes the readers, including researchers, practitioners and students, to the elements of probability, statistical distributions and inference and their properties. This comprehensive text can be considered as a foundation for engineering statistics. The first chapter provides basic statistics-related concepts, including a review of the most common distribution functions and their properties, parameter-estimation methods and stochastic processes, including the Markov process, the renewal process, the quasi-renewal process, and the nonhomogeneous Poisson process. Chapter 2 discusses the basic concepts of engineering statistics and statistical inference, including the properties of lifetime distributions, maximum-likelihood estimation, the likelihood ratio test, data modeling and analysis, and system reliability analysis, followed by variations of the Weibull and other related distributions, parameter estimations and hypothesis testing, and their applications in engineering. Chapter 4 describes the basic concept of characterizing functions based on random samples from common univariate discrete and continuous distributions such as the normal, exponential, Poisson, and multivariate distributions, including the Marshall–Olkin bivariate exponential and multivariate normal distributions. Chapter 5 discusses two-dimensional approaches to failure modeling, with applications in reliability and maintenance such as minimal repair and imperfect repair, and compares this through applications with the one-dimensional case.

The following four chapters cover the basic concepts in engineering statistics in specific topics such as reliability growth, warranty, marked point processes and burn-in. Chapter 6 presents the derivation of the prediction intervals for the time to detect the next fault for a small sample size by combining the Bayesian and frequentist approaches. It also provides examples to explain the predictions of the models, as well as their strengths and weaknesses. Chapter 7 gives an overview of various existing warranty models and policies and a summary of the issues in quantitative warranty modeling such as warranty cost factors, warranty policies, the warranty cost of multicomponent systems, the benefits of warranties, and optimal warranty policy analysis. Chapter 8 discusses the concept of a random market point process and its properties, including two-sided market point processes, counting processes, conditional intensity, the Palm distribution, renewal processes, stationary sequences, and time-homogeneous Poisson processes, while Chapt. 9 focuses on the yield, multilevel burn-in and reliability modeling aspects for applications in semiconductor manufacturing, considering various infant-mortality issues with the increased complexity of integrated circuits during manufacturing processes.