1 Probability Theory

- 1.1 Set Theory
- 1.2 Basics of Probability Theory
 - 1.2.1 Axiomatic Foundations
 - 1.2.2 The Calculus of Probabilities
 - 1.2.3 Counting
 - 1.2.4 Enumerating Outcomes
- 1.3 Conditional Probability and Independence
- 1.4 Random Variables
- 1.5 Distribution Functions
- 1.6 Density and Mass Functions.
- 1.7 Exercises
- 1.8 Miscellanea

2 Transformations and Expectations

- 2.1 Distributions of Functions of a Random Variable
- 2.2 Expected Values
- 2.3 Moments and Moment Generating Functions
- 2.4 Differentiating Under an Integral Sign
- 2.5 Exercises
- 2.6 Miscellanea

3 Common Families of Distributions

- 3.1 Introduction
- 3.2 Discrete Distributions
- 3.3 Continuous Distributions
- 3.4 Exponential Families
- 3.5 Location and Scale Families
- 3.6 Inequalities and Identities
 - 3.6.1 Probability Inequalities
 - 3.6.2 Identities
- 3.7 Exercises
- 3.8 Miscellanea

4 Multiple Random Variables

- 4.1 Joint and Marginal Distributions
- 4.2 Conditional Distributions and Independence
- 4.3 Bivariate Transformations
- 4.4 Hierarchical Models and Mixture Distributions
- 4.5 Covariance and Correlation
- 4.6 Multivariate Distributions
- 4.7 Inequalities
 - 4.7.1 Numerical Inequalities
 - 4.7.2 Functional Inequalities
- 4.8 Exercises
- 4.9 Miscellanea

5 Properties of a Random Sample

- 5.1 Basic Concepts of Random Samples
- 5.2 Sums of Random Variables from a Random Sample
- 5.3 Sampling from the Normal Distribution
 - 5.3.1 Properties of the Sample Mean and Variance
 - 5.3.2 The Derived Distributions: Student's t and Snedecor's F
- 5.4 Order Statistics
- 5.5 Convergence Concepts
 - 5.5.1 Convergence in Probability
 - 5.5.2 Almost Sure Convergence
 - 5.5.3 Convergence in Distribution
 - 5.5.4 The Delta Method
- 5.6 Generating a Random Sample
 - 5.6.1 Direct Methods
 - 5.6.2 Indirect Methods
 - 5.6.3 The Accept/Reject Algorithm
- 5.7 Exercises
- 5.8 Miscellanea

6 Principles of Data Reduction

- 6.1 Introduction
- 6.2 The Sufficiency Principle
 - 6.2.1 Sufficient Statistics
 - 6.2.2 Minimal Sufficient Statistics
 - 6.2.3 Ancillary Statistics
 - 6.2.4 Sufficient, Ancillary, and Complete Statistics
- 6.3 The Likelihood Principle
 - 6.3.1 The Likelihood Function
 - 6.3.2 The Formal Likelihood Principle
- 6.4 The Equivariance Principle
- 6.5 Exercises
- 6.6 Miscellanea

7 Point Estimation

- 7.1 Introduction
- 7.2 Methods of Finding Estimators
 - 7.2.1 Method of Moments
 - 7.2.2 Maximum Likelihood Estimators
 - 7.2.3 Bayes Estimators
 - 7.2.4 The EM Algorithm
- 7.3 Methods of Evaluating Estimators
 - 7.3.1 Mean Squared Error
 - 7.3.2 Best Unbiased Estimators
 - 7.3.3 Sufficiency and Unbiasedness
 - 7.3.4 Loss Function Optimality
- 7.4 Exercises
- 7.5 Miscellanea

8 Hypothesis Testing

- 8.1 Introduction
- 8.2 Methods of Finding Tests
 - 8.2.1 Likelihood Ratio Tests
 - 8.2.2 Bayesian Tests
 - 8.2.3 Union-Intersection and Intersection-Union Tests
- 8.3 Methods of Evaluating Tests
 - 8.3.1 Error Probabilities and the Power Function
 - 8.3.2 Most Powerful Tests
 - 8.3.3 Sizes of Union-Intersection and Intersection-Union Test
 - 8.3.4 p-Values
 - 8.3.5 Loss Function Optimality
- 8.4 Exercises
- 8.5 Miscellanea

9 Interval Estimation

- 9.1 Introduction
- 9.2 Methods of Finding Interval Estimators
 - 9.2.1 Inverting a Test Statistic
 - 9.2.2 Pivotal Quantities
 - 9.2.3 Pivoting the CDF
 - 9.2.4 Bayesian Intervals
- 9.3 Methods of Evaluating Interval Estimators
 - 9.3.1 Size and Coverage Probability
 - 9.3.2 Test-Related Optimality
 - 9.3.3 Bayesian Optimality
 - 9.3.4 Loss Function Optimality
- 9.4 Exercises
- 9.5 Miscellanea

10 Asymptotic Evaluations

- 10.1 Point Estimation
 - 10.1.1 Consistency
 - 10.1.2 Efficiency
 - 10.1.3 Calculations and Comparisons
 - 10.1.4 Bootstrap Standard Errors
- 10.2 Robustness
 - 10.2.1 The Mean and the Median
 - 10.2.2 M-Estimators
- 10.3 Hypothesis Testing
 - 10.3.1 Asymptotic Distribution of LRTs
 - 10.3.2 Other Large-Sample Tests
- 10.4 Interval Estimation
 - 10.4.1 Approximate Maximum Likelihood Intervals
 - 10.4.2 Other Large-Sample Intervals
- 10.5 Exercises
- 10.6 Miscellanea