

Topics Overview

MIT 18.655

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Introduction to Mathematical Statistics

- Data and Probability Models
- Parameters and “Statistics”
- Bayesian Models
- Statistical Inference as a Decision Problem
- Prediction
- Sufficient Statistics
- Exponential Families of Probability Models

Estimation Methods

- Least Squares
- Weighted Least Squares
- Method-of-Moments (MOM)
- Maximum Likelihood
- Bayes
- M Estimation
- Estimation Algorithms
 - Root-finding
 - Coordinate Ascent
 - Newton-Raphson
 - Expectation-Maximization (EM) Algorithm

Performance Measurement and Optimization

- Bayes Procedures
- Minimax Procedures
- Constrained Optimization
 - Unbiased Estimation (UMVU)
 - Linear Estimation (BLUE)
- Robustness Criteria

Hypothesis Testing and Confidence Regions

- Neyman-Pearson Lemma
- “Most Powerful” Tests
 - UMP Tests
 - Monotone Likelihood Ratio Models
- Confidence Bounds
- Confidence Intervals/Regions
- Likelihood Ratio Procedures

Asymptotics

- Consistency
- Asymptotic Normality
- MLEs in Exponential Families
- M-Estimators
- Efficiency
- Limiting Posterior Distribution

Multiparameter Statistical Inference

- Gaussian Linear Models
- Large Sample Tests
 - Likelihood Ratio Test
 - Wald's Test
 - Rao's Score Test
 - Pearson's Chi-squared Test (Discrete Models)
- Generalized Linear Models

Text Book: Mathematical Statistics: Basic Ideas and Selected Topics. Vol 1. Second Edition, Peter J. Bickel and Kjell A. Doksum

Useful References:

- Berger, J. (1993) Statistical Decision Theory and Bayesian Analysis, Second Edition, Springer.
- Cox, D.R. and Hinkley, D.V. (1974). Theoretical Statistics, Chapman Hall.
- Ferguson, T.J. (1967). Mathematical Statistics: A Decision Theoretic Approach, Academic Press.
- Lehmann, E.L. (1958). Testing Statistical Hypotheses, Wiley.
- Lehmann, E.L., and Romano, J.P. (2008). Testing Statistical Hypotheses, Third Edition, Springer.
- Lehmann, E.L. (1983). Theory of Point Estimation, Wiley.
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