Reviewed: September 26, 2008

Study Guide

for the Ph.D. Comprehensive Exam

Mathematical Statistics (22S:193-194, 253)

The following texts are suggested as references, with the first six serving as the primary sources:

CB: Casella and Berger, *Statistical Inference*

S: Serfling, *Approximation Theorems of Mathematical Statistics*

HC: Hogg and Craig, *Introduction to Mathematical Statistics*

RF: Ross, *A First Course in Probability*

RP: Ross, *Introduction to Probability Models*

V: Van der Vaart, *Asymptotic Statistics*

W: Wilks, *Mathematical Statistics*

D: DeGroot, *Probability and Statistics*

R: Rohatgi, *An Introduction to Probability and Mathematical Statistics*

BD: Bickel and Doksum, *Mathematical Statistics*

K: Karr, *Probability*

A: Ash, *Real Analysis and Probability*

Topics (number in parentheses indicates chapter):

1. Limit Theorems: CB(5), R(6), BD(appendices, 14, 15), RF(8), K, A, S(1), V(2)

    a. Convergence in probability, convergence in distribution, convergence a.s.
    b. Laws of large numbers
    c. Central limit theorems

2. Standard material on probability and distributions: CB(2, 3, 4), BD(1), HC(3, 4), D(3), R(1, 2, 3, 4, 5), RF(1-7), RP(1-3), S(1-3)

    a. Distribution theory for random samples, expectations, moments, etc.
    b. Distribution theory for transformations of random variables and random vectors
    c. Conditional distributions and independence
    d. Approximations, inequalities, identities

3. Statistical Models: CB(6), BD(2), HC(3, 7, 8), D(6, 7), R(8)

    a. Sufficiency, completeness
    b. Exponential families
    c. Bayesian models

4. Methods of Estimation: CB(6, 7), BD(3), HC(6, 7, 8), W(10), R(8), S(4), V(4, 5)

    a. Substitution principles (including method of moments)
    b. Least squares methods
    c. Maximum likelihood estimators
    d. Bayes estimators
    e. Invariant estimators

5. Comparison of Estimators: CB(6, 7), BD(4), HC(6, 7, 8), W(12), D(6, 7), R(8), S(4, 10), V(8)

    a. Criteria of estimation
    b. Uniformly minimum variance unbiased estimates
    c. The Information Inequality
    d. Large sample theory
    e. Mean square error

6. Confidence Interval and Testing: CB(8, 9), BD(5), HC(6, 9), D(8, 9), W(12, 13, 14), R(9, 10, 11), S(4)

    a. Precision, confidence intervals, and bounds
    b. Elements of hypothesis testing
    c. Unbiased and invariant tests, Bayes and union-intersection tests
    d. Power
    e. Sample size determination

7. Optimal Tests and Confidence Intervals: CB(8, 9), BD(6), HC(6, 9), W(12, 13), D(7, 8), R(9, 10, 11), S(4), V(8)

    a. Neyman-Pearson lemma
    b. UMP, UMPI and UMPU tests, locally most powerful tests
    c. Likelihood ratio and related procedures
    d. Large sample approximations in testing