Updated: September 26, 2008

# Study Guide

for the Minor in Statistics

Mathematical Statistics (22S:153-154)

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This is a Three-Hour Examination.
You are allowed to

- consult either four single-sided or two double-sided 8.5" x 11" crib notes
- use your own non-graphing calculator

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Study the following topics.

1. Probability Spaces

    a. Sample Spaces and Events
    b. Axioms
    c. Properties

2. Conditional Probability and Independence

    a. Definition and Properties
    b. Bayes Theorem

3. Random Variables

    a. Definition
    b. Discrete, Continuous, and Mixed
    c. Cumulative Distribution Function
    d. Probability Density Function; Probability Mass Function

4. Moments and Quantiles of General Distributions

    a. mean, median, quantiles
    b. variance

5. Special Discrete Distributions

    a. Binomial
    b. Hypergeometric
    c. Poisson
    d. Geometric and Negative Binomial
    e. Moments of these

6. Special Continuous Distributions

    a. Normal
    b. Gamma (including exponential and chi-square)
    c. Weibull
    d. Uniform
    e. Lognormal
    f. Cauchy
    g. Student's t
    h. F
    i. Moments of these

7. Multivariate Distributions

    a. Definition
    b. Bivariate Normal
    c. Multinomial
    d. Joint and Marginal Distributions
    e. Conditional Distributions and Independence
    f. Covariance and Correlation
    g. Conditional Mean and Variance

8. Generating Functions

    a. Moment Generating Functions
    b. Obtaining Moments from Generating Functions
    c. Moment Generating Functions of Special Distributions
    d. Moment Generating Functions of Sums of Independent Random Variables

9. Functions of Random Variables

    a. Distributions Function Technique
    b. Change of Variable Technique
    c. Moment Generating Function Technique
    d. Expectations of Functions of Random Variables
    e. Linear Combinations of Random Variables
    f. Order Statistics (definition and distributions)

10. Convergence Concepts

    a. Convergence in Probability
    b. Convergence in Distribution
    c. Laws of Large Numbers
    d. Central Limit Theorem

11. Estimation

    a. Maximum Likelihood
    b. Method of Moments
    c. Bayes Estimation
    d. Fisher Information
    e. Interval Estimation (Confidence Intervals for Proportions, Means, Variance)
    f. Decision Theory and Bayesian Methods
    g. Methods of evaluating estimators (Mean Square Error, Consistency, Bias)

12. Hypotheses Tests

    a. Definition of Tests of Statistical Hypotheses
    b. Neyman-Pearson Lemma
    c. Power Functions
    d. Uniformly Most Powerful Tests
    e. Likelihood Ratio Tests
    f. Chi-Square Tests (including Contingency Tables)

13. Sufficient Statistics

    a. Definition
    b. Factorization Theorem
    c. Rao-Blackwell Theorem
    d. Completeness and Uniqueness
    e. Exponential Families
    f. Sufficiency and Independence