MATHEMATICS 376

MATHEMATICAL STATISTICS

I. Introduction

A. Catalog Description

This course provides an introduction to statistical concepts for students with a background in probability theory. Building on this background in probability, the course develops statistical theory based on likelihood functions and other standard topics in estimation and testing. Through the analysis of real data, the application of basic statistical concepts is introduced and some familiarity with statistical software is developed. At the conclusion of the course the student should be familiar with the "why, when, and how" of statistical analysis and with basic statistical theory. Satisfies the proof-based requirement in major contracts. *Prerequisite: MATH 375 or equivalent.* Offered Spring semester.

B. Objectives

The primary objective of the course is to provide students with knowledge of the mathematical theory of statistics. Nearly equal is the emphasis on applications of the derived statistical techniques. At the conclusion of the course the student should be familiar with the "why, when, and how" of statistical analysis and with basic statistical theory.

C. Prerequisites

Mathematics 375 or equivalent.

II. Required Topics

A. Point and Interval Estimation

1. Sampling distributions
2. Maximum likelihood estimation
3. Method of moments
4. Unbiased and asymptotically unbiased estimation
5. Minimum variance
6. Mean square error and other loss functions
7. Simple and MS consistency
8. The δ method

B. Testing Hypotheses

1. General concepts of the Neyman-Pearson Theory
2. UMP tests for certain composite hypotheses
3. Likelihood ratio tests
4. Wald tests and likelihood ratio tests
5. P-values

II. Required Topics (cont.)

C. The Linear Model

1. Introduction
2. Least Squares Estimates and Normal Equations
3. Estimation of s^2
4. Hypothesis Tests about Model parameters
5. Derivation of the F statistics

II Optional topics

A.

A Bayesian Inference

B. Non-parametric methods

C. $\chi 2$ procedures

D. Computer Intensive Methods

III. Bibliography

Roussas, G. Mathematical Statistics, Academic Press

Hoel, P., S. Port., & C. Stone, Statistical Theory, Houghton-Mifflin

Larson, H. Introduction to the Theory of Statistics,
John Wiley & Sons

Larsen, R. & M. Marx An Introduction to Mathematical Statistics
& its Application, Prentice Hall

Hogg, R. & C. Craig. Introduction to Mathematical Statistics,
Prentice Hall

De Groot, M.& Schervish, M. Probability & Statistics, Addison-Wesley

Hogg, R. & Tanis, E. Probability and Statistical Inference, Prentice Hall

Rice, J. Mathematical Statistics and Data Analysis, Duxbury

IV. Assessment

Student learning is assessed through the use of homework problems, in-class examinations, take-home examinations with detailed written solutions, computer simulation exercises, and the analysis of case studies involving real data.