Math 563 – Mathematical Statistics

Course Description from Bulletin: Theory of sampling distributions; principles of data reduction; interval and point estimation, sufficient statistics, order statistics, hypothesis testing, correlation and linear regression; introduction to linear models. (3-0-3)

Enrollment: Elective for AM and other majors,

Textbook(s): G. Cassella and R. L. Berger, Statistical Inference, Duxbury (2001) ISBN 0534243126.

Other required material: R software, other statistical software such as JMP

Prerequisites: MATH 475 Probability or MATH 474 Probability and Statistics

Objectives:
1. Students will learn the concept of statistical inference and the difference between population characteristics and sample estimates.
2. Students will learn the probabilistic basis for statistical inference and the qualities of a good estimator.
3. Students will learn how to correctly perform hypothesis tests and construct confidence intervals.
4. Students will learn the appropriateness of asymptotic considerations.
5. Students will learn to use statistical software to perform basic computations for statistical inference and sampling.

Lecture schedule: Three 50 minutes (or two 75 minutes) lectures per week.

Course Outline:	Hours
1. Introduction a. What is statistical inference and why do we need it?	3
2. Properties of a random sample a. Sampling from Normal distribution b. Order statistics c. Convergence concepts	5
3. Principles of data reduction a. The sufficiency principle b. The likelihood principle	6
4. Point estimation a. Methods of finding estimators: moment, MLE, Bayes b. Methods of evaluating estimators: MSE, bias, sufficiency,	6

Rao-Blackwell theorem, loss function optimality	
5. Hypothesis testing	8
a. Methods of finding tests: likelihood ratio test, Bayesian test	
b. Methods of evaluating tests: error probabilities, power function, p-values, Neyman-Pearson Lemma	
6. Interval estimation	6
a. Pivoting method	
b. Size and coverage probability	
7. Asymptotic evaluation	6
a. Point estimation: consistency, efficiency, comparisons	
b. Asymptotic distribution of LRTs / confidence intervals	
8. Introduction to linear models (time permitting)	3
a. Simple linear regression: least squares	
b. One-way ANOVA.	

Assessment:
Homework 10-30%
Project 0-20%
Quizzes/Tests 20-50%
Final Exam 30-50%

Syllabus prepared by: Lulu Kang, and Sonja Petrović (modification of original 563 syllabus prepared by Andre Adler, Fred Hickernell, and Lulu Kang)
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Revised by Despina Stasi, Sonja Petrović, and Lulu Kang , Oct. 25, 2019.