MA552 Fall 2009

Distribution-Free and Robust Statistical Methods

COURSE OUTLINE **September 9, 2009**

Instructor: Balgobin Nandram; V: 831-5539, F: 831-5824, E: balnan@wpi.edu

Office: SH 103; Office Hours: Wed 4:00-5:00; other times by appointment

Class SH202: Wed 5:30-7:10; Break 7:10-7:20; 7:20-8:10

Theme: Statistics without distributional assumptions
Goal: To understand the applications, methods and theories of nonparametric statistics
Prerequisite: While MA541, Probability and Mathematical Statistics II, is recommended, you need much less to benefit fully from this course.

TEXT BOOK

James, J. Higgins (2004), **Introduction to Modern Nonparametric Methods**, Duxbury Press, California. **The course covers Chapters 1-5, 8, 10.** Some of my own materials will be handed out.

COURSE MATERIALS

1. **Preliminaries and Introduction** [2 weeks]
   (a) Cumulative distribution function (b) Central limit theorem, Binomial distribution (c) Ranks and order statistics, permutations

2. **One samples and two samples** [3 weeks]
   (a) Median; Binomial test; power (b) Permutation tests; Wilcoxon rank-sum test; Hodges-Lehmann estimator; Mann-Whitney test (c) Comparisons with parametric tests; kolmogorov-Smirnoff test; asymptotics

3. **K samples** [2 weeks]
   (a) Permutation tests (b) Kruskal-Wallis Tests (c) Multiple comparisons

4. **Blocked designs, trends and association** [3 weeks]
   (a) Signed-rank tests, Freedman's test (b) Correlation and slope (c) Contingency tables, Fisher's exact test, Mantel-Haenszel test, McNemar's test

5. **Bootstraps, Smoothing and Model-fitting** [4 weeks]
   (a) Bootstrap intervals (percentile and bias-corrected); k samples; multiple regression (b) Parzen-Rosenblatt kernel; Loess Method (c) M-estimation; Nadaraya-Watson estimator; Rank-based regression

COURSE ACTIVITIES

1. **Homework Assignment**
   There will be one assignment (about 5 problems) every two weeks. Most problems will be taken from the text book. The problems will involve algebra, arithmetic, and using the computer (SAS, R and other software). Answers to the problems will be handed out after you have turned in your own. Key points will be discussed; you will be asked to discuss the solution of an important homework problem on the chalk board. The activity of solving the problems is a vehicle to learn the course materials. You are required to spend about ten hours per week on this activity. You are strongly encouraged to discuss the solutions of the home work problems with your class mates, but you must write up distinct solutions.

2. **In-Class Tests**
   There will be three in-class tests; each will be given at the end of 4-6 weeks' work. They will be based on all materials covered so far with emphasis on the most recent ones. The first test will last up to one hour, the second test will last up to one and a half hours, and the third test (final) will last up to two and a half hours. If it is required, in extreme circumstances there will be a 15 minutes' oral test in my office based on your performance on each test. This will be used to improve your understanding of the material and your test scores. No oral will be given after the final exam.

Homework assignments	25	
Test I	15	Wednesday, October 7, 2009
Test II	25	Wednesday, November 4, 2009
Test III	35	Wednesday, December 16, 2009
	100	

You must participate satisfactorily in all aspects of the course.

FINAL GRADE

A, B, C, D, F
F: 0-50; D: 50-59; C: 60-69; B: 70-84; A: 85-100