MA547 Fall 2014

Design and Analysis of Observational and Sampling Studies

COURSE OUTLINE **8/28/14**

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Office: SH 002A; Office Hours: Thu 2:00-4:00; other times by appointment

Class SH 203: Thu 5:30-8:20

Theme: This is a two-part course exploring randomization.

Goal: To develop skills in the fundamental issues of design and analysis of sample surveys and observational studies.

Textbooks:

Sharon Lohr (2010), **Sampling: Design and Analysis Inference**, 2^{nd} Edition, Brooks/Cole, Cengage Learning, Boston. **The course covers Chapters 1-7.**

Paul Rosenbaum (2002), **Observational Studies**, 2^{nd} Edition, Springer- Verlag, New York. **The course covers Chapters 1-5.**

Some materials will be skipped and some will be replaced by different ones.

Basic statistics knowledge and skills at the level of MA511, MA2611/MA2612 or equivalent are required to follow MA547. Of course, some knowledge of probability and mathematical statistics will be an advantage.

The topics covered are:

1. **Introduction** [2 weeks]
   (a) Experiments, sample surveys, observational studies;
   (b) Randomization, overt and covert biases, confounding effects, sampling weights.

2. **Sample Surveys** [6 weeks]

   (a) Sampling and nonsampling errors, questionnaire design, simple random sampling, ratio and regression estimators, means, proportions and totals;

   (b) Stratified sampling, optimal allocation; Cluster sampling (one-stage, two-stage);

   (c) Unequal probability sampling, Horvitz-Thompson estimator, design effects, survey weights, variance estimation (linearization, random group, bootstrap, jackknife).

3. **Observational Studies** [6 weeks]

   (a) Models of no treatment effect and no interference, strong ignorability, stratification and matching, propensity score, distribution of treatment assignments;

   (b) Retrospective and prospective studies; case-control study, matched pairs, odds ratio;

   (c) Sensitivity models and analyses: Fisher's exact test, McNemar's test, Wilcoxon signed rank test, Wilcoxon rank sum test, Lehman-Hodges test, extended hypergeometric distribution.

In MA547, you will be evaluated in three ways. Note that 60% of the work is based on two tests, strictly requiring your individual performance.

1. **Homework Assignments**
   There will be one assignment (about 3-5 problems) every two-three weeks. Some problems will be taken from the text books. For some of the problems you will be required to use a computer software (e.g., SAS, R) to solve them. Answers to the problems will be handed out after you have turned in your own. Key points will be discussed. Unless otherwise stated, each homework question is worth five points. Please note that at most two students will be allowed to turn in a single homework report. You are also allowed to discuss the solutions with your class mates.

2. **In-Class Tests**
   There will be three in-class tests. The first two tests will be based on all materials covered so far with emphasis on the most recent ones, and each will last seventy (70) minutes. The third test is comprehensive, and it will last one hundred twenty (120) minutes.

3. **Mini-Project**
   A few students will form a small team to work on the mini-project which will be assigned a few weeks before the end of the semester. This project must draw materials from the course content and numerical work using a computer is essential. The project team can propose the project its team members want to work on. The proposal must clearly show where the course contents will be used. Writing of the

project's report will be emphasized. The team must be clear about its objectives and how they are met. A clear summary of the results must be presented.

4. **Notebook**
   You are required to provide neat and clearly written lecture notes. You will be graded for demonstrating that you clearly understand the course materials. You are not required to discuss new materials, but there will be added incentives if you have new ways of presenting the same course materials already presented in each class. On top of the activities involving homework assignments and tests, this pedagogical activity will help you to master the course materials. Please note that you must turn in your individual notebook at the end of the course, and you are allowed to discuss how to present the course materials with your class mates.

The homework assignments and the tests assess different aspects of the course. For example, in the tests you can use a pocket calculator but not a computer; in the homework assignments, but not in the tests, there could be lengthy algebraic derivations. The mini-project is strictly applied in which you are required to use a computer for numerical work.

Different course activities are weighted as follows.

Homework Assignments	18	
Test 1	15	Thursday, October 2, 2014
Test 2	20	Thursday, November 6, 2014
Mini-Project	15	Thursday, December 11, 2014
Notebook	5	Thursday, December 18, 2014
Test 3	27	Thursday, December 18, 2014
	100	

Please note that you must participate satisfactorily in both aspects to pass the course (i.e., you must secure at least 50% in each test and all homework assignments combined).

Final Grade – A, B, C, D, F
F: 0-50; D: 50-59; C: 60-69; B: 70-84; A: 85-100
To earn a final grade of A, you must do so in all aspects of the course.

Disability

If you need course adaptations or accommodations because of a disability, or if you have medical information to share with me, please make an appointment with me as soon as possible; see my office hours on the first page of this document. If you have not already done so, students with disabilities, who believe that they may need accommodations in this class, are encouraged to contact the Disability Service Office (DSO) as soon as possible to ensure that such accommodations are implemented in a timely fashion. The DSO is located in the Student Development and Counseling Center, the phone number is 508-831-4908 and e-mail is DSO@WPI.EDU.

Academic Dishonesty

The web site, http://www.wpi.edu/Pubs/Policies/Honesty, states "Any act that interferes with the process of evaluation by misrepresentation of the relation between the work being evaluated (or the resulting evaluation) and the student's actual state of knowledge is an act of academic dishonesty." See the web site for the procedures associated with academic dishonesty.