STAT 440: SAMPLING THEORY

COURSE OUTLINE

FALL 2022 (Section 0101)

Instructor: Paul J. Smith, Statistics Program

Office hours: MWF 11:30-12:30
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Schedule: Fall 2022, MWF 10, PHYS 2213

Textbook: Lohr, S. L. (2022). *Sampling: Design and Analysis (3rd ed.).*   Boca Raton, FL: CRC Press.

Prerequisites: At least one semester of statistics, preferably STAT 401 or STAT 420.

Course Description:

Sampling refers to the statistical techniques used in political polls, marketing surveys, federal data gathering, environmental surveys and many other areas of social science and public health.

This course provides an introduction to methods of sampling and analyzing data from finite populations from both a theoretical and applied perspective. It is intended for Statistics and Mathematics students interested in applications and students in the Applied Statistics track of the Survey Methodology program, as well as students in disciplines such as business, life science or social science who need sampling in their research.

The mathematics used in the course is not deep, but it can be intricate. It is essential that you understand basic probability and statistical concepts such as point estimation, confidence limits, regression and the central limit theorem.

STAT 440 is part of the required material for the Written Examinations in Applied Statistics.

Computing:

We will use the computer package R throughout the course, both to analyze real data and to illustrate statistical principles using simulation. Students who are knowledgeable in SAS may use SAS in place of R. Computing guides for both R and SAS are available at no cost from the author's website (https://www.sharonlohr.com), along with all data sets used in the textbook. Some of these will be used for homework assignments.

Topics:

- *Basic concepts:* populations, probability samples, sample design, bias, sampling and nonsampling errors.
- *Simple probability sampling*: statistics, estimates, weights, choosing the sample size, confidence limits, use of R, systematic sampling.
- *Stratified sampling:* theory, defining strata, sample allocation, precision, advantages over simple random sampling.
- *Ratio and regression estimation:* advantages, bias and variance of ratio estimates, regression estimates, domains vs. strata, combining ratio estimates and stratified sampling.
- *Cluster sampling with equal probabilities:* estimation, two stage samples, design issues, systematic sampling as cluster sampling.
- *Sampling with unequal probabilities:* sampling with replacement, choosing selection probabilities, estimation, sampling without replacement, Horvitz-Thompson estimate, two stage samples.
- *Complex surveys:* assembling the design, weights, estimating distributions and quantiles, design effects, graphical methods.
- *Nonresponse:* effects on bias and precision, two phase sampling, adjusting weights, poststratification., imputation.
- *Advanced topics:* double sampling, variance estimation, categorical data analysis and regression in complex surveys (as time permits).

Examinations and Grading

- *Midterms:* Monday, Oct. 3 and Friday, Oct. 28 (tentative).
- *Final:* Tuesday, December 20, 8-10 a.m., PHYS 2213.
- *Homework:* Frequent problem sets will be assigned. These will be a mix of theoretical and applied problems involving analysis of real data sets on the computer. Assignments will be posted on ELMS.
- *Grading:* The midterms will each count for approximately 20% of the grade, the final will count for 30%, and the homework will count for 30%. Homework will not be accepted late.

References:

Cochran, W. J. (1977). *Sampling Techniques* (3rd. ed.). Hoboken, NJ: J. Wiley.

Lohr, S. L. (2022). *SAS Software Companion for* Sampling: Design and Analysis (3rd ed.). Boca Raton, FL: CRC Press.

Lohr, S. L. & Lu, Y, (2022). *R Companion for* Sampling: Design and Analysis (3rd ed.). Boca Raton, FL: CRC Press.

Sarndal, C.-E., Swensson, B., and Wretman, J. (1992). *Model Assisted Survey Sampling.* New York: Springer.

Thompson, S. K. *Sampling* (3rd ed.) . Hoboken, NJ: J. Wiley.

Course Evaluation

Your participation in the evaluation of courses through CourseEvalUM is a responsibility you hold as a student member of our academic community. Your feedback is confidential and important to the improvement of teaching and learning at the University as well as to the tenure and promotion process. CourseEvalUM will be open for you to complete your evaluations for fall semester courses between Tuesday, December 1 and Sunday, December 13. You can go directly to the website (www.courseevalum.umd.edu) to complete your evaluations starting December 1. By completing all of your evaluations each semester, you will have the privilege of accessing the summary reports for thousands of courses online at Testudo.

Honor Pledge

In 2002, the University adopted an honor pledge in which students are asked to write out and sign the pledge on major assignments and exams, as designated by the instructor. The Honor Pledge is designed to encourage instructors and students to reflect upon the University's core institutional value of academic integrity. Professors who invite students to sign the Honor Pledge signify that there is an ethical component to teaching and learning. Students who write by hand and sign the Pledge affirm a sense of pride in the integrity of their work. The Pledge states:

"I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/ examination."

For more information regarding the Code of Academic Integrity, the Honor Pledge, or the Student Honor Council please refer to www.shc.umd.edu (Links to an external site.) or contact the Office of Student Conduct.