Methods of Survey Sampling
Summer 2024

CLASS MEETINGS:

9:00 AM-12:00 PM, Tuesday & Thursday, June 4 – July 25, 2024
Room 1070 ISR-Thompson

INSTRUCTORS

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OFFICE HOURS

By Zoom or in person, per appointment.

COURSE CONTENT

Methods of Survey Sampling is an applied statistics methods course but differs from most statistics courses, because it is concerned almost exclusively with the *design* of data collection. Methods for the analysis of collected data will not be discussed much in the course. The course will concentrate on problems of applying sampling methods to human populations, since sampling human populations poses a number of particular problems not found in sampling of other types of units. The principles of sample selection, though, can be applied to many other types of populations.

The course is presented at a moderately advanced statistical level. While we will not develop mathematical aspects of sampling theory, statistical notation and outlines of some algebraic proofs will be given. Therefore, a sound background in applied statistics is necessary. A thorough understanding of the notation and results will be required.

The aims of the course are to teach basic ideas of sampling from an applied perspective and to provide experience with realistic problems. The course will cover the main techniques used in sampling practice: simple random sampling, stratification, systematic selection, cluster sampling, multistage sampling, and probability proportionate to size sampling. These methods will be examined further in the context of two particular types of sample designs, area sampling and telephone sampling. The course will also cover sampling frames, cost models, sampling error estimation techniques, non-sampling errors, and compensating for missing data.

COURSE MATERIALS AND CLASS SESSIONS

All registered students have access to the course page in the Canvas website through registration at the University of Michigan. Instruction on how to access Canvas will be provided by email before the first day of class. The course page contains lecture notes, homework problems and related materials, homework solutions, readings, the course project and related materials, and the lecture recordings. Hard-copy of the materials posted on the course page in Canvas will not be distributed in class.

Class sessions are twice per week, starting at 9:00 AM each day, with one 10 minute break. Class sessions end at 12:00 PM. All class sessions will be recorded in Zoom and may be viewed later in the course page in Canvas. Students have access to a copy of all lecture notes and materials presented in class through the course page in Canvas website, although handwritten notes will be inserted in lecture frequently.

HOMEWORK

The homework assignments are to be turned in by the beginning of the class session when due. The regular problems will be graded on a five level system: check-plus (100), check (90), check-minus (80), late (60), not submitted (0). The 'late' score will be assigned for any assignment turned in after the assigned time and day, without prior permission of the instructors.

Homework will be submitted electronically via the course web site as an attachment to the Assignment tool. Students must submit solutions, handwritten or typed, in a single .pdf format file, with name and homework set number at the top of the first page, and page numbers at the bottom of each page. Files must be submitted in a standard name convention: 'Surname First Initial HW #.pdf'. For example, 'Nishimura R HW 1.pdf'. The submitted homework will be marked electronically and returned via the Assignment tool as an attachment, along with a copy of a homework solution.

Study groups are useful and encouraged. Group answers are not acceptable. Each student must submit individual homework exercise solutions.

Optional homework preview sessions will be held upon request on an ad hoc basis. The purpose of the preview sessions will be to answer questions about the homework assignments due at the beginning of the next class session.

The project is a multi-stage sampling exercise distributed early in the term and discussed throughout the course during class sessions. The instructors will assign 4-5 students each to project teams. Each team will submit one copy of the project in .pdf format with name 'Team # project.pdf' (for example, 'Team A project.pdf') via the Assignment tool.

All students in a team receive the same base score (maximum 80 points). Each student also completes an evaluation for the other students in the team. The remainder of each student's project grade (maximum 20 points) will be based on the evaluations by fellow students in the team. Students who do not turn in evaluations of other team members will receive zero for the individual component, regardless of team ratings.

EXAMINATIONS AND FINAL GRADE

There will be an in-class cumulative open book, open notes midterm examination on Thursday, June 27, 9:00 AM-12:00 PM. The cumulative, open book, open notes final examination will be held Thursday, July 25, 9:00 AM-12:00 PM.

Final grades will be a weighted composite of homework (approximately 30%), class project (approximately 30%), and examination scores (approximately 40%). The instructors may alter the relative weights, depending on overall class performance on each component of the final grade.

ACADEMIC INTEGRITY

The course will abide by ethical standards of the University of Michigan. Students are responsible for upholding the policy on academic integrity in the University of Michigan Standard Practice Guide; please see https://spg.umich.edu/policy/303.03.

TEXTBOOKS AND ASSIGNED READING

The principal text for the course will be *Survey Sampling* by Leslie Kish (John Wiley and Sons, Inc., New York, 1965). It is available at university bookstores or through online sales. Students may find that the following texts serve as useful supplemental reading to several lecture topics: *Introduction to Survey Sampling* by Graham Kalton (Sage Publications, Beverly Hills, 1983), *Sample Survey Methods and Theory*, Volume 1, by Morris Hansen, *et al*. (New York: John Wiley and Sons, Inc., 1953), and *Sampling Techniques*, 3rd

edition, by William G. Cochran (New York: John Wiley and Sons, Inc., 1977).

There are also assigned readings of several papers (see list below), available on the course page in Canvas.

[1] Rust, K. "Variance estimation for complex estimators in sample surveys," *Journal of Official Statistics*, 1(4) (1985): 381-397.

[2] Kish, L. and Frankel, M. "Inference from complex samples," *Journal of the Royal Statistical Society*, Series B, **36** (1974): 1 - 37.

[3] Waksberg, J. "Sampling methods for random digit dialing," *Journal of the American Statistical Association*, (1978), 73:40–46.

[4] Tucker, C., Lepkowski, J.M., Piekarski, L. "The current efficiency of list-assisted telephone sample designs," *Public Opinion Quarterly*, (2001), 66:321–338

[5] Kalton, G. and Kasprzyk, D. "The treatment of missing survey data," *Survey Methodology*, **12** (1986): 1 - 16.

[6] American Association for Public Opinion Research. "Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys." (2023), Available at https://aapor.org/wp-content/uploads/2024/03/Standards-Definitions-10th-edition.pdf

SYLLABUS

Date		Time	Topic	Readings[a]	HW
June	4	9:00-12:00	**Lecture:** Introduction; Section 1 (Course perspectives). Section 2 (Simple random sampling; Precision and relative precision). [SL]	Kish 1.0-1.7	
	6	9:00-12:00	**Lecture:** Section 2 (Simple random sampling; Precision and relative precision). Section 3 (Frame problems; Weights and weighted estimators). Homework preview. [RN]	Kish 2.1-2.7	
	11	9:00-12:00	**Lecture:** Section 4 (Cluster sampling; Design effect; Intra-cluster homogeneity; Two-stage cluster sampling). [SL]	Kish 5.1-5.4	1
	13	9:00-12:00	**Lecture:** Section 5 (Subsample size); Section 6 (Unequal sized cluster sampling); Section 7 (Stratified sampling). Project introduction. Homework review. [SL]	Kish 6.1-6.2, 3.1-3.3	
	18	9:00-12:00	**Lecture:** Section 7 (Sample allocation; Stratification topics). Project discussion. [RN]	Kish 3.4-3.6	2
	20	9:00-12:00	**Lecture:** Section 8 (Systematic sampling); Section 9 (Complex sampling - Stratified unequal sized clusters). Project discussion & Homework review. [SL]	Kish 4.1-2, 6.3-6.5	
	25	9:00-12:00	**Lecture:** Section 10 (Complex sampling – Stratified clusters and weights). Midterm Exam review, Homework review & Project discussion. [SL]	Kish 5.5, 11.7	3
	27	9:00-12:00	**Examination:** Open book, open notes in-class midterm.		
July	2	9:00-12:00	**Lecture**: Section 11 (Probability proportionate to size selection, PPS). Project discussion. [RN]	Kish 7.1-7.3	4
	9	9:00-12:00	**Lecture**: Section 11 (Probability proportionate to estimated size selection, PPeS. PPS problems). Project discussion & Homework review. [RN]	Kish 7.4-7.5	
	11	9:00-12:00	**Lecture:** Section 12 (Area sampling - two & three stage). Project discussion. [RN]	Kish 9.1-9.7	5
	16	9:00-12:00	**Lecture:** Section 13 (Variance estimation - collapsing & combining strata, Balanced repeated replication). Project discussion & Homework review. [RN]	Kish 4.3-4.4, **[1]**	
	18	9:00-12:00	**Lecture:** Section 13 (Jackknife repeated replication. Generalized variances & software). Section 14 (Telephone sampling). Project discussion. [RN]	Kish 14.1-14.3, **[2], [3], [4]**	6
	23	9:00-12:00	**Lecture:** Section 15 (Total survey error. Response error). Section 16 (Non-observation error & nonresponse adjustment. Missing data compensation). Section 17 (Software for Sampling). Final Exam review. [RN]	Kish 13.1-13.2, 13.3-13.6, **[5]**, **[6]**	Project
	25	9:00-12:00	**Examination:** Open book, open notes in-class cumulative final.		

[a] Readings are from the textbooks by Kish, or from specified papers.