

**Applied Sampling**  
*SURV 625/SURVMETH 625*  
**Winter/Spring, 2019**

**CLASS MEETINGS**

9:00 - 11:30 AM, Wednesdays, January 9 - April 24, 2019  
Room 1208 Lefrak, University of Maryland, College Park, Maryland  
Room G300 ISR-Perry, University of Michigan, Ann Arbor, Michigan

**INSTRUCTORS**

**Brady T. West**

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**ASSISTANTS**

**Jodi Holbrook** (Video / Technical / Administrative Support)

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**OFFICE HOURS**

By appointment (in person, by telephone, or online / Skype / Google Hangout)

**COURSE CONTENT**

Applied Sampling is an applied statistical methods course concerned almost exclusively with the *design* of data collection. Little of the analysis of collected data will be discussed, but rather the course will concentrate on problems of applying sampling methods to human populations.

The course is presented at a moderately advanced statistical level. While mathematical aspects of sampling theory are not covered, statistical notation and some algebraic derivations will be presented. Thus, a thorough understanding of statistical notation and principles will be needed.

The course will cover the main techniques used in sampling practice: simple random sampling, stratification, systematic selection, cluster sampling, multistage sampling, and probability proportional to size sampling. These methods will be examined further in the context

of area sampling. The course will also cover sampling frames, cost models, sampling error estimation techniques, non-sampling errors, and compensating for missing data.

## **COURSE LECTURES**

This course combines pre-recorded video lectures (courtesy of **Dr. James Lepkowski**, a former instructor and developer of the course) and in-class discussions. The pre-recorded video lectures are available through the course Canvas web site, as are associated lecture slides. **The pre-recorded video lectures are to be viewed before scheduled class discussions sessions.** Live discussion sessions will include reviews of the pre-recorded lectures, answers to questions on the pre-recorded lectures, clarifying examples of sampling concepts, quizzes, homework preparation, review of marked homework, and discussion of the course project.

## **DISCUSSION SESSIONS**

Drs. West and Si will be present each Wednesday at one of two course sites: the Joint Program in Survey Methodology at the University of Maryland (Lefrak Hall) or the Institute for Social Research at the University of Michigan (Perry Building). An interactive audio-video system connects the sites where the instructors will be to the remote sites.

Students may also join discussion sessions via the BlueJeans system, a cloud-based online system used to connect classrooms. Students wishing to join discussions via BlueJeans from a location other than the classrooms will be given instructions on how to connect through a web browser.

Students thus have the option of attending class in-person at one of the classroom sites or attending via a desktop or laptop from elsewhere. If a student chooses to join class sessions via a desktop or laptop, they are required to have a separate camera (desktop or laptop built-in cameras typically have inadequate video quality) and a separate headset with microphone (desktop and laptop built-in microphones and speakers typically have inadequate audio for this kind of an application). Poor quality desktop or laptop equipment can create echoing, degrading the video or audio of all connected participants, including the regular classrooms.

Each weekly discussion session is scheduled from 9:00 AM until 11:30 AM. There will be a two- or three-item quiz covering content in the assigned pre-recorded video lectures at the beginning of almost every session. **Students attending remotely will be responsible for receiving the quiz via email and responding via email with their solutions within 10 minutes.** Drs. West and Si will then present examples clarifying the pre-recorded material and provide opportunities for students to ask questions about lectures. Drs. West and Si will also discuss homework exercises and the course project.

## **HOMEWORK AND COURSE PROJECT**

Nine homework assignments and a final project are planned. Each are to be turned in by the beginning of the class session when due (see syllabus below).

Homework assignments correspond with the course units and are designed to aid in skill development. Assignments will be graded check-plus (100 points), check (90), check-minus (80), and not submitted (0), and will ordinarily be marked and returned before the next class session. Students may request permission to submit homework late via email to the instructor, but the request must be no later than one hour before the homework is due. Permission is not guaranteed, although typically granted. If late submission is granted, there will be an agreed upon date and time when the late assignment must be submitted; such assignments will be

graded using the specified marking system. If homework is submitted late without prior permission, scores will be check-plus (70), check (60), and check-minus (50).

The project is a **team-based, semester-length exercise** leading to a 10-page technical memorandum describing the team's proposed approach to a survey sampling problem set by Drs. West and Si. The student projects will be assigned to teams of 3-5 students, depending on enrollment counts, and each team will submit a team project. The grading will consist of two parts: 1) a team score (80 points maximum) and a student project score (up to 20 points). Each student will evaluate the contributions of each of the other team members to the final team written project. The student's teammate's evaluation scores will be averaged to generate the individual student project score. Each student must complete an evaluation for the other students on the team; students not submitting evaluations receive zero for the individual component score.

Homework is submitted electronically via the online Canvas system's Assignment tool as an attachment. Homework solutions may be handwritten or typed, and submitted in a single .pdf format file with name and homework number at the top of the first page and page numbers at the bottom of each page. Files must be submitted using a standard naming convention. For homework, the naming convention is 'Surname First-Initial HW #.pdf' (for example, 'West B HW 1.pdf'). For the project, the convention is 'Team name project.pdf' (for example, 'Team A project.pdf'). Failure to follow these conventions may lead to deduction of points from the assignment score. The marked submitted homework along with a copy of the solutions will be returned via the Assignment tool.

Study groups are useful, and encouraged, for preparing answers to homework exercises. Group answers are not acceptable. That is, each student must submit individual homework solutions.

## EXAMINATIONS & FINAL GRADE

There will be a two-hour, in-class, cumulative, open book / **open** notes midterm examination on **Wednesday, February 27**. The two-hour, in-class, cumulative, open book / open notes final examination will be held on **Wednesday, May 1**. *(If this examination time conflicts with other regularly scheduled examination times for University of Michigan or University of Maryland students, students must inform Drs. West and/or Si as soon as possible.)*

Final grades will be a weighted composite of quizzes (10%), homework (25%), the class project (25%), and examination scores (40%), where each exam will receive equal weight (i.e., the midterm and final exam will each be worth 20% of the final grade).

## CLASS ATTENDANCE

**Students are required to attend all live class sessions.** A student who anticipates missing a class due to illness or other reason must notify Drs. West or Si via email at least 30 minutes before the session with the reason for missing the session. University of Maryland (including those at Census) students should examine University attendance policies at [http://www.faculty.umd.edu/teach/attend\\_student.html](http://www.faculty.umd.edu/teach/attend_student.html). University of Michigan students should review <https://lsa.umich.edu/advising/policies-procedures/class-attendance.html>.

Each student is permitted up to two excused absences for class without penalty. Absences after two excused will cause deduction of points from the course average score. Each student is also permitted to miss up to two quizzes. The quiz contribution to the grade will be based on the average of the eight best quiz scores; missed quizzes will have a score of zero.

## COURSE WEB SITE

All registered students have access to a course web site (Canvas) hosted at the University of Michigan. Guest accounts will be arranged for University of Maryland students. The Canvas web site contains lecture notes, homework problems and solutions, readings, course project materials, and a chat room. Materials will be posted on the web site and not distributed as paper copies.

## ACADEMIC INTEGRITY

The course follows ethical standards at the respective campuses. The University of Maryland Honor Code (<http://www.president.umd.edu/policies/iii100a.html>) is administered by the Student Honor Council. The Student Honor Council statement *I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination* ordinarily should be *handwritten* and signed on the front cover of all papers, projects, or other academic assignments submitted for evaluation in this course. The instructors waive this requirement for JPSM students, but not the other provisions of the Honor Code. The student name on a document is the student's pledge that this work is theirs and theirs alone. University of Michigan students are expected to follow academic integrity policies in the University of Michigan Standard Practice Guide (<http://www.rackham.umich.edu/policies/academic-policies/section11>). Violation of the Maryland Honor Code pledge or the University of Michigan policy is a serious matter and may lead to a failing mark on a submission or for the entire course.

## STUDENT COURSE EVALUATION

Both the University of Maryland (via TESTUDO) and the University of Michigan (via Canvas) have online student course evaluation systems. All students are strongly urged to use the respective university online course evaluation system at the end of the term. Since course evaluations will only be available to other students when at least 70% of registered students complete the evaluation, it is very important to future students that all enrolled students log on at the end of the semester to complete a course evaluation.

## TEXTBOOKS & 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 other texts to be useful supplemental reading, including *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). Selected assigned readings will also be available on the course web site:

- [1] Rust, K, and Rao, J.N.K. "Variance Estimation for Complex Surveys Using Replication Techniques," *Statistical Methods in Medical Research*, Vol. 5, 1996, pp. 283-310.
- [2] Kish, L. and Frankel, M. "Inference from complex samples," *Journal of the Royal Statistical Society, Series B*, **36** (1974): 1 - 37.
- [3] American Association for Public Opinion Research. *Standard Definitions: Final Disposition of Case Codes and Outcome Rates for Surveys*. AAPOR, 2016.
- [4] Kalton, G. and Kasprzyk, D. "The treatment of missing survey data," *Survey Methodology*,

12 (1986): 1 - 16.

## **COMPETENCY**

The student will learn (and will be tested on) the following competencies in this course:

1. Learn the meaning and application of expressions for sampling variance of means and proportions under a variety of finite population sampling techniques.
2. Understand the properties of (and how to apply) various sampling techniques, including simple random sampling, stratification and stratified random sampling, cluster sampling, systematic sampling, two-stage sampling, multistage sampling, probability proportionate to size sampling, and stratified multistage sampling.
3. Understand sampling variance estimation techniques for means and proportions for each of the sampling techniques in the course, including procedures for nonlinear statistics using the Taylor series expansion technique, as well as the balanced repeated replication and jackknife repeated replication techniques.
4. Learn how nonresponse can affect survey estimates, and what techniques can be used to reduce nonresponse and compensate for it through weighting and imputation.

## **SYLLABUS**

The syllabus below presents approximate dates of lecture topics. Students must complete assigned readings prior to each Wednesday discussion section. Each homework assignment is to be submitted via the Canvas web site Assignment tool by the start of the class session when due.

Week Date(s)	Time	Activity	Location	Subject (Reading)
1 Jan 9	9:00 AM	Lecture <sup>a</sup>	Classroom <sup>b</sup>	Unit 1: Preliminaries. ( <i>Live</i> ) 1. Course description (Syllabus, Canvas Syllabus tool). 2. Course perspectives (Kish 1.0-1.7).
1 Jan 9 to Jan 16	Anytime	Lecture	MediaSite/ At home	Unit 2: Elements. ( <i>Pre-recorded lectures</i> ) 3. Simple random sampling (Kish 2.1-2.6). 4. Three frame problems (Kish 2.7, 11.1-11.2).
2 Jan 16	8:50 AM	Homework	Canvas	HW 1 & Project released.
	9:00 AM	Discussion <sup>c</sup>	Classroom or BlueJeans	Student connection tests (BlueJeans). Quiz 1. Preview HW 1. Review lectures 1, 2, 3, & 4. Preview lectures 5 & 6.
2 Jan 16 to Jan 23	Anytime	Lecture	MediaSite/ At home	Unit 2: Elements ( <i>Pre-recorded lectures</i> ) 5. Frames: Clusters (Kish 11.3). Unit 3: Clusters ( <i>Pre-recorded lectures</i> ) 6. Cluster sampling (Kish 5.1-5.2).
3 Jan 23	8:50 AM	Homework	Canvas	<b>Submit HW 1 via Assignment tool.</b> Homework 2 released.
	9:00 AM	Discussion	Classroom or BlueJeans	Quiz 2. Preview HW 2. Review lectures 5 & 6. Preview lectures 7 & 8. Project introduction.
3 Jan 23 to Jan 30	Anytime	Lecture	MediaSite/ At home	Unit 3: Clusters ( <i>Pre-recorded lectures</i> ) 7. Two-stage sampling (Kish 5.3-5.4) 8. Subsample size (Kish 8.3)

Week Date(s)	Time	Activity	Location	Subject (Reading)
4 Jan 30	8:50 AM	Homework	Canvas	<b>Submit HW 2 via Assignment tool.</b> HW 3 released.
	9:00 AM	Discussion	Classroom or BlueJeans	Quiz 3. Review HW 1 solution & preview HW 3. Review lectures 7 & 8. Preview lectures 9 & 10. Project teams & target sample sizes.
4 Jan 30 to Feb 6	Anytime	Lecture	MediaSite/ At home	Unit 4: Stratification ( <i>Pre-recorded lectures</i> ) 9. Stratified random sampling (Kish 3.1-3.3) 10. Allocations (Kish 3.4-3.5)
5 Feb 6	8:50 AM	Homework	Canvas	<b>Submit HW 3 via Assignment tool.</b> HW 4 released.
	9:00 AM	Discussion	Classroom or BlueJeans	Quiz 4. Review HW 2 solution & preview HW 4. Lecture 9 & 10 questions. Preview lectures 11 & 12. Project: subsample size.
5 Feb 6 to Feb 13	Anytime	Lecture	MediaSite/ At home	Unit 4: Stratification ( <i>Pre-recorded lectures</i> ) 11. Stratification topics (Kish 3.6, 4.5A) Unit 5: Systematic selection ( <i>Pre-recorded lectures</i> ) 12. Systematic selection (Kish 4.1-4.3)
6 Feb 13	8:50 AM	Homework	Canvas	<b>Submit HW 4 via Assignment tool.</b> HW 5 released.
	9:00 AM	Discussion	Classroom or BlueJeans	Quiz 5. Review HW 3 solution & preview HW 5. Review lectures 11 & 12. Preview lectures 13 & 14. Project: achieved precision.
6 Feb 13 to Feb 20	Anytime	Lecture	MediaSite/ At home	Unit 6: Unequal sized clusters ( <i>Pre-recorded lectures</i> ) 13. Unequal sized cluster sampling (Kish 6.1-6.3) 14. Stratified unequal sized clusters (Kish 6.4)

Week Date(s)	Time	Activity	Location	Subject (Reading)
7 Feb 20	8:50 AM	Homework	Canvas	<b>Submit HW 5 via Assignment tool.</b> HW 6 released.
	9:00 AM	Discussion	Classroom or BlueJeans	Quiz 6. Review HW 4 & 5 solutions. Review lectures 13 & 14. Preview lectures 15, 16, & 17. Review. Project sampling rates.
7 Feb 20 to Feb 27	Anytime	Lecture	MediaSite/ At home	Unit 6: Unequal sized clusters ( <i>Pre-recorded lectures</i> ) 15. Complex designs (Kish 6.5)
8 Feb 27	9:00 AM	<b>Midterm Exam</b>	Classroom <sup>b</sup>	
<b>Feb 27 – Mar 6</b>		<b>Spring Break</b>		<b>No Class</b>
9 Mar 6 to Mar 13	Anytime	Lecture	MediaSite/ At home	Unit 6: Unequal sized clusters ( <i>Pre-recorded lectures</i> ) 16. PPS (Kish 7.1-7.3) 17. PPeS (Kish 7.4-7.5)
10 Mar 13	9:00 AM	Discussion <sup>c</sup>	Classroom or BlueJeans	Quiz 7. Review HW 5 solution & preview HW 6. Review lectures 15, 16 & 17. Preview lectures 18, 19, & 20. Project domains, PPeS.
10 Mar 13 to Mar 20	Anytime	Lecture	MediaSite/ At home	Unit 7: Area sampling ( <i>Pre-recorded lectures</i> ) 18. Two-stage (Kish 9.1-9.6, 9.8) 19. Three-stage (Kish 10.1) 20. Multistage (Kish 10.2-10.3)
11 Mar 20	8:50 AM	Homework	Canvas	<b>Submit HW 6 via Assignment tool.</b> HW 7 released.
	9:00 AM	Discussion	Classroom or BlueJeans	Quiz 8. Preview HW 7. Review lectures 18, 19, & 20. Preview lectures 21, 22, & 23. Project 2 <sup>nd</sup> stage selection & subclasses.
11 Mar 20 to Mar	Anytime	Lecture	MediaSite/	Unit 8: Variance estimation ( <i>Pre-recorded lectures</i> )



Week Date(s)	Time	Activity	Location	Subject (Reading)
27			At home	21. Forming computing units (Kish 8.6) 22. Taylor series expansion ([1] Rust & Rao) 23. Replicated sampling (Kish 4.4)
12 Mar 27	8:50 AM	Homework	Canvas	<b>Submit HW 7 via Assignment tool.</b> HW 8 released.  Quiz 9. Preview HW 8. Review lectures 21, 22, & 23. Preview lectures 24, 25, & 26. Project 2 <sup>nd</sup> stage selection & subclasses.  Unit 8: Variance estimation ( <i>Pre-recorded lectures</i> ) 24. Balanced repeated replication ([1] Rust & Rao) 25. Jackknife repeated replication ([2] Kish & Frankel) 26. Estimation & presentation (Kish 14.1, 14.2)
	9:00 AM	Discussion	Classroom or BlueJeans	
12 Mar 27 to Apr 3	Anytime	Lecture	MediaSite/ At home	
13 Apr 3	8:50 AM	Homework	Canvas	<b>Submit HW 8 via Assignment tool.</b> HW 9 released.  Quiz 10. Preview HW 9. Review lectures 24, 25, & 26. Preview lectures 27, 28, & 29. Project: describing estimation procedures.  Unit 9: Non-sampling error ( <i>Pre-recorded lectures</i> ) 27. Total survey error (Kish 13.1-13.3) 28. Response error 29. Nonresponse (Kish 13.4-13.6; [3] AAPOR)
	9:00 AM	Discussion	Classroom or BlueJeans	
13 Apr 3 to Apr 10	Anytime	Lecture	MediaSite/ At home	
14 Apr 10	8:50 AM	Homework	Canvas	<b>Submit HW 9 via Assignment tool.</b>  Quiz 11. Review HW 8 solution. Review lectures 27, 28, & 29. Preview lectures 30 & 31.
	9:00 AM	Discussion	Classroom or BlueJeans	

<b>Week Date(s)</b>	<b>Time</b>	<b>Activity</b>	<b>Location</b>	<b>Subject (Reading)</b>
14 Apr 10 to Apr 17	Anytime	Lecture	MediaSite/ At home	Unit 9: Non-sampling error ( <i>Pre-recorded lectures</i> ) 30. Weighting ([4] Kalton & Kasprzyk) 31. Imputation
15 Apr 17	9:00 AM	Discussion	Classroom or Bluejeans	Review HW 9 solution. Review lectures 30 & 31. Final exam questions.
16 Apr 24	8:50 AM	Homework	Canvas	<b>Submit Final Projects &amp; Team Evaluations via Assignment tool.</b>  <b>Optional course review.</b>
	9:00 AM	Discussion <sup>c</sup>	Classroom or BlueJeans	
17 May 1	9:00 AM	<b>Final Exam</b>	Classroom <sup>b</sup>	

<sup>a</sup> Recorded and available for viewing after 24-48 hours on MediaSite.

<sup>b</sup> 1208 Lefrak / G300 ISR-Perry.

<sup>c</sup> One of the Instructors will be at JPSM, 1208 Lefrak Hall, University of Maryland.