STAT 3430: Sampling and Survey

2023 Summer Session	
Total Class Sessions: 25 **Class Sessions Per Week: 5** **Total Weeks: 5** **Class Session Length (Minutes): 145** **Credit Hours: 4**	**Instructor: Staff** **Classroom: TBA** **Office Hours: TBA** **Language: English**

Course Description:

This course will provide the students with foundations of the development of design and analysis of sampling and surveys. The course will examine the importance of proper sampling and surveys methodology and then how can they be applied in different aspects of business, science, and other areas. We will concentrate on the statistical aspects of taking and analyzing a sample and usage of these methods in surveys. The students will learn when the sample is valid or not, and how to design and analyze different forms of sample surveys.
The course includes plenty of practical exercises, and projects, including many numerical examples, advanced problems, and extended discussions of empirical implementation—all of which are intended to show students how sampling and surveys are used today.

Prerequisites:

An introductory level college courses in statistics and probability are strongly recommended due to the highly quantitative nature of the course. In addition, a college course in calculus, with the grade of "C" or better is required.

Textbooks:

"Sampling: Design and Analysis" Sharon L. Lohr, 2nd edition, (2010), Brooks/Cole Cengage Learning, Boston, MA.

The course will also use R programming language for statistical analyses. This program is available for free: www.r-project.org; there is a video on YouTube that helps in downloading and installing R: https://www.youtube.com/watch?v=7iuKrPS8fMM

Recommended: Lecture Notes provided by the instructor

Course Format and Requirements:

Class time will be used for a combination of lectures, class discussions, in-class, and homework assignments.

Attendance:

Attendance at lectures is vital to get a thorough understanding of the material. This course requires verbal participation in-class exercises, activities, and contributions to class discussions. Students must be present and actively involved to receive these points.

Course Assignments:

5 Quizzes

Weekly quizzes will usually consist of short answer questions and or short essay questions. No make-up quiz will be given.

Exams (One Midterm and One Final)

Exams may not be taken early, made-up, or turned in late. Students must comply with all Applicable instructions to receive credit. The exams will include discussion questions and case problems. During the exams, each student must work individually without consulting others.

Homework Lab Assignments There will be weekly set of a set of assignments to complete at home and submit weekly. The instructor will select and distribute during each class meeting a selection of mostly quantitative problems from each appropriate chapter. **The assignments will need to be completed and submitted back to the instructors at the end of class no. 6, 11, 16 21, and 25, (usually on Mondays, except the last one)**

Course Assessment:

Quizzes	-	20%
Midterm	-	25%
Homework Assignments	-	20%
Final Exam	-	35%

Grading Scale (percentage):

A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
98-100	93-97	90-92	88-89	83-87	80-82	78-79	73-77	70-72	68-69	63-67	60-62	<60

Academic Integrity:

Students are encouraged to study together, and to discuss lecture topics with one another, but all other work should be completed independently.

Students are expected to adhere to the standards of academic honesty and integrity that are described in the Chengdu University of Technology's Academic Conduct Code. Any work suspected of violating the standards of the Academic Conduct Code will be reported to the Dean's Office. Penalties for violating the Academic Conduct Code may include dismissal from the program. All students have an individual responsibility to know and understand the provisions of the Academic Conduct Code.

Special Needs or Assistance:

Please contact the Administrative Office immediately ifyou have a learning disability, a medical issue, or any other type of problem that prevents professors from seeing you have learned the course material. Our goal is to help you learn, not to penalize you for issues which mask your learning.

Tentative Course Schedule:

Please use this as an approximate class schedule; section coverage may change depending on theflow ofthe course.

Class 1:

Material: Chapter 1: Introduction.

Topics: Review of the syllabus, introduction to the scope of the course and the overview of the textbook, requirements, and the nature of assignments. An introduction to the general terms and topics in sampling, requirements for a good sample, selection bias, measurement error, questionnaire design, sampling, and non-sampling errors.

Problems to solve (homework):

Any two exercises from 1 to 20; then 21, 22, 23, and 28.

Class 2:

Material: Chapter 2. Simple Probability Samples and Appendixes A1 - A4.

Topics: Types of probability samples; framework for probability sampling; simple random sampling, sampling weights; confidence intervals.

Refresher of basic probability concepts used in sampling (see appendices A1 to A4, pgs. 549-562.

Problems to solve (homework):

Exercises 1 to 10.

Class 3:

Material: Chapter 2. Simple Probability Samples, continued.

Topics: Discussion of systematic sampling; randomization theory results for simple random sampling; prediction approach for simple random sampling; usage of simple random sampling.

Problems to solve (homework):

Any two exercises from 11- 19; any two from 20 to 29; any two from 30 to 37, (total 6).

Class 4:
Material: Chapter 3. Stratified Sampling.

Topics: To understand stratified sampling; theory of stratified sampling; sampling weights in stratified random sampling; allocating observation to strata.

Problems to solve (homework):
Exercises 1 to 8.

Class 5:
Material: Chapter 3. Stratified Sampling, continued.

Topics: We look at the definition of strata; model-based inference for stratified sampling; quota sampling.

Problems to solve (homework):
Any two exercises from 9 to 20; any two from 21 to 26; any two from 27 to 37, (total 6).

Class 6:
Submission of the 1st week homework assignments

QUIZ no. 1 (chapters 1-3)

Material: Chapter 4. Ratio and Regression Estimation.

Topics: Review and analysis of ratio estimation in a simple random sample; estimation in domains; regression estimation in simple random sampling.

Problems to solve (homework):
Exercises 1 to 3.

Class 7:
Material: Chapter 4. Ratio and Regression Estimation, continued.

Topics: We examine the concept of poststratification; ratio estimation with stratified samples; model-based theory for ratio and regression estimation.

Problems to solve (homework):

Any two exercises from 4 to 17; any two from 18 to 37; any two from 38 to 44, (total 6)

Class 8:
Material: Chapter 5. Cluster Sampling with Equal Probabilities.

Topics: Overview and analysis of notations for cluster sampling; one-stage cluster sampling; two-stage cluster sampling.

Problems to solve (homework):
Exercises 1 to 10.

Class 9:
Material: Chapter 5. Cluster Sampling with Equal Probabilities, continued.

Topics: We will learn how to design a cluster sample; what is systematic sampling; model-based inference in cluster sampling.

Problems to solve (homework):
Any two exercises from 11 to 21; any two from 22 to 32, any two from 33 to 38, (total 6).

Class 10:
QUIZ no. 2 (chapters 4 and 5)

Material: Chapter 6. Sampling with Unequal Probabilities.

Topics: Overview and analysis of sampling one primary sampling unit; one-stage sampling with replacement; two-stage sampling with replacement; introduction to unequal probability sampling without replacement.

Problems to solve (homework):
Exercises 1 to 8.

Class 11:
Submission of the 2nd weekly homework assignments

Material: Chapter 6. Sampling with Unequal Probabilities, continued.

Topics: Practice of unequal probability samples on numerous examples; overview of randomization theory results and proofs; introduction to models and unequal probability sampling.

Problems to solve (homework):
Any two exercises from 9 to 14; any two from 15 to 37; any two from 38 to 45, (total 6).

Class 12:
MIDTERM (material covered in classes 1-6)

Class 13:
Material: Chapter 7. Complex Surveys.

Topics: Overview of assembling design components; sampling weights; estimating a distribution function; plotting data from a complex survey.

Problems to solve (homework):
Exercises 1 to 6.

Class 14:
Material: Chapter 7. Complex Surveys, continued.

Topics: We look at complex surveys design effects; analysis for practical use the National Crime Victimization Survey (NCVS); overview of various sampling and design experiments.

Problems to solve (homework):
Any two exercises from 7 to 17; any two from 18 to 25; any two from 26 to 30, (total 6)

Class 15:
Material: Chapter 8. Nonresponse.

Topics: Analysis and consequences of the effects of ignoring nonresponse; how to design surveys to reduce/avoid non-sampling errors; callbacks and two-phase sampling; mechanisms for nonresponse.

Problems to solve (homework):
Exercises 1 to 4.

Class 16:
Submission of the 3rd weekly homework assignments

Material: Chapter 8. Nonresponse, continued

Topics: Analysis of weighting methods for nonresponse; introduction to the concept of imputation; use of parametric models for nonresponse; analysis of what is the acceptable response rate.

Problems to solve (homework):
Any two exercises from 5 to 15; any two from 16 to 20, any two from 21 to 26.

Class 17:
QUIZ no. 3 (chapters 6-8)

Material: Chapter 9. Variance Estimation in Complex Surveys.

Topic: Introduction to Linearization (Taylor series) methods; random group methods; resampling and replication methods; generalized variance functions; what are the confidence intervals.

Problems to solve (homework):
Exercises 1 to 4, then any two from 5 to 12; any two from 13 to 25; any two from 26 to 31, (total 10).

Class 18:
Material - Chapter 10. Categorical Data Analysis in Complex Surveys.

Topic: Overview of Chi-square tests with multinominal sampling; what are the possible effects of survey design on Chi-square tests; correction of x squared tests; use of loglinear models.

Problems to solve (homework):
Exercises 1 to 4, then any two from 5 to 12; any two from 13 to 19; any two from 20 to 23, (total 10).

Class 19:
Material - Chapter 11. Regression with Complex Survey Data.

Topics: We examine model-based regression in simple random samples; we introduce regression in complex surveys; how do we use regression to compare domain means; use of weights in regression.

Problems to solve (homework):
Exercises 1 to 3.

Class 20:
Material - Chapter 11. Regression with Complex Survey Data, continued.

Topics: Introduction of mixed models for cluster samples; concept of logistic regression; generalized regression estimation for population totals.

Problems to solve (homework):
Any two exercises from 4 to 16; any two from 17 to 30, any two from 31 to 34.

Class 21:
Submission of the 4th weekly homework assignments

QUIZ no. 4 (chapters 9-11)

Material - Chapter 12. Two-Phase Sampling.

Topics: This chapter analyzes the theory of two-phase sampling; how this work with stratification; ratio and regression estimation; jackknife variance estimation; how to design two-phase sampling.

Problems to solve (homework):
Exercises 1 and 2, then any two from 3 to 9; any two from 10 to 22, and 23 to 24, (total 8).

Class 22:
Material - Chapter 13. Estimating Population Size and Chapter 14. Rare Populations and Small Area Estimation.

Topics: Learning how to estimate and analyze population size methods, including capture recapture estimation; multiple recapture estimation; how do we sample rare populations; how do we estimate small areas.

Problems to solve (homework):
Chapter 13: Exercise 1, and any two from 2 to 10; any two from 11 to 17, and 18- 19, (total 7).
Chapter 14: Exercise 1, and any two from 2 to 7; any two from 8 to 10, (total 5).

Class 23:
Material: Chapter 15. Survey Quality.

Topics: We focus on how to minimize/avoid coverage error, nonresponse error, measurement error, and processing error; what are sensitive questions; how we determine total survey quality.

Problems to solve (homework):
Exercises 1 to 4, then any two from 5 to 14, (total 6).

Class 24:
QUIZ no. 5: (chapters 12-15)

Topics: Review of ahead of the Final Exam.

Class 25: - FINAL EXAM
Submission of the 5th weekly homework assignments