

STA 3120 Fundamentals of sample survey and experimental design (45 Contact Hours)

1. Pre-requisites

- (i) STA 3111: Information Processing in Python
- (ii) STA 3112: Fundamentals of R programming
- (iii) STA 3113: Statistical methods I

2. Course purpose

The purpose of this course is to introduce to the students the different techniques and methods in survey sampling, and design and analysis of experiments.

3. Learning outcomes

By the end of this course the student should be able to:

- (i) Understand and use standard survey terminology
- (ii) Recognize common features of sampling designs together with their advantages and disadvantages.
- (iii) Design a survey incorporating important features of the population and objectives of the study.
- (iv) Estimate sample size for different sampling designs to estimate population level point estimates and test null hypotheses.
- (v) Compute summary statistics and fit regression models to data from complex surveys using R.
- (vi) Plan, design and conduct experiments efficiently and effectively, and analyze the resulting data to obtain objective conclusions.

4. Tentative course outline

Period	Content	Mode	Hours
Week 1	Introduction to sampling techniques and terminologies Simple random sampling 1	Theory	3
Week 2	Simple random sampling 2	Theory and R practical	3
Week 3	Stratified random sampling	Theory and R practical	3
Week 4	Systematic and one and two stage cluster sampling	Theory and R practical	3
Week 5	Complex surveys and weighting Sampling and non-sampling errors.	Theory and R practical	3
Week 6	Cat 1/ Project 1	Theory and R practical	1
Week 7	Introduction to Missing data analysis The problem of missing data. Concepts of MCAR, MAR and MNAR	Theory and R practical	3
Week 8	Ad-hoc solutions to missing data.	Theory and R practical	3
Week 9	Introduction to multiple imputation	Theory and R practical	3
Week 10	Cat 2/ Project 2	Theory and R practical	1
Week 11	Introduction to design of experiments. Principles of experimental design: replication, randomization, and blocking. Designing and planning an experiment.	Theory	3

Week 12	Designs: completely randomized designs, blocking designs.	Theory and R practical	3
Week 13	Analysis of variance under different designs.	Theory and R practical	3
Week 14	Revision	Theory and R practical	1
Week 15	Exam	Theory and R practical	3

5. Teaching methodology

Lectures, tutorials, lab session, self-reading, discussions, and student presentations.

6. Instructional material and equipment

Black or White Boards, Chalk or White Board Markers, Dusters, Computer and Projector

(f) Course Assessment

- (i) End of Semester Examination (70%)
- (ii) Continuous Assessment Tests (20%)
- (iii) Assignments (10%)

(g) Course Textbooks

- (i) Poduri Rao (2000) Sampling Methodologies with Applications (Chapman & Hall/CRC Texts in Statistical Science) 1st Edition
- (ii) Ravindra Singh and Naurang Singh Mangat (2000) Elements of Survey Sampling
- (iii) Yan Lu and Sharon L. Lohr (2022) R Companion for Sampling Design and Analysis, Third Edition
- (iv) Lumley, T., 2011. Complex surveys: a guide to analysis using R. John Wiley & Sons.
- (v) Stef Van Buuren Flexible Imputation of Missing Data
- (vi) Montgomery, D.C., 2017. Design and analysis of experiments. John Wiley & Sons.

(h) Course journals

- (i) The journal Survey Methodology; ISSN 1492-0921; Statistics Canada
<http://www.statcan.gc.ca/pub/12-001-x/12-001-x2014002-eng.htm>
- (ii) Statistical Modelling; ISSN: 1471-082X; <http://journals.sagepub.com/home/smj>
- (iii) The Journal of Survey Statistics and Methodology, ISSN 2325-0984; Oxford
- (iv) <https://academic.oup.com/jssam>

(i) Reference text books

- (i) Mukhopadhyay, P., 2008. Theory and methods of survey sampling. Prentice Hall India.
- (ii) Kirk, R.E., 1982. Experimental design. John Wiley & Sons, Inc.
- (iii) Stock, J.H. and Watson, M.W., 2007. Introduction to econometrics.
- (iv) Heeringa, S.G., West, B.T. and Berglund, P.A., 2010. Applied survey data analysis. CRC Press.
- (v) Enders, C.K., 2010. Applied missing data analysis. Guilford Press.

(j) Reference Journals

- (i) Journal of Applied Econometrics; Online ISSN: 1099-1255; Wiley online.
[http://onlinelibrary.wiley.com/journal/10.1002/\(ISSN\)1099-1255](http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1099-1255)
- (ii) Journal of Educational and Behavioral Statistics; Sage.
<https://us.sagepub.com/en-us/nam/journal-of-educational-and-behavioral-statistics/journal201853>