University of Southampton
Division of Social Statistics

Professional Development in Official Statistics
MSc/Diploma/Cert in Official Statistics

Survey Sampling

2015/2016

STAT 6093 - Survey Sampling

Location: University of Southampton, Building 39 (S3RI), Seminar Room.

Lecturers:

Professor Li-Chun Zhang,
Dept. of Social Statistics and Demography (B58/4005)
University of Southampton
Southampton SO17 1BJ,
Email: L.Zhang@soton.ac.uk

Lecturer Angela Luna-Hernandez
Dept. of Social Statistics and Demography (B58/4007)
University of Southampton
Southampton SO17 1BJ,
Email: A.Luna-Hernandez@soton.ac.uk

Aim: Provide an overview of basic sampling and estimation methods.

Learning Outcomes: By the end of this course, the students should be familiarised with the basic methods in common use for sampling from finite populations, including the most common sampling designs, and how to estimate finite population parameters and how to assess the estimation errors.

Assessment: Based on a written 2-hour examination. Students can use copies of the course slides booklet during the examination.

Teaching structure: Formal teaching on 5 days in one week with integrated revision sessions aimed at solving exercises. Written solutions of the exercises and some of the previous exams will be provided.

Course Content

1. **Introduction**
2. **Simple Random Sampling**
3. **Sampling with Unequal Probabilities**
4. **Systematic Sampling**
5. **Stratified Sampling**
6. **Single-stage Cluster Sampling**
7. **Multi-stage Cluster Sampling**

Time Table

Monday 12 October 2015

10:00 – 11:30	Introduction to survey sampling
11:30 – 12:00	Coffee break
12:00 – 13:00	Simple random sampling
13:00 – 14:00	Lunch
14:00 – 15:30	Simple random sampling (cont.)
15:30 – 16:00	Coffee break
16:00 – 17:30	Private study, exercises

Tuesday 13 October 2015

09:30 – 11:00	Unequal probability sampling
11:00 – 11:30	Coffee break
11:30 – 13:00	Private study, exercises
13:00 – 14:00	Lunch
14:00 – 15:30	Systematic sampling
15:30 – 16:00	Coffee break
16:00 – 17:30	Private study, exercises

Wednesday 14 October 2015

09:30 – 11:00	Stratified sampling
11:00 – 11:30	Coffee break
11:30 – 13:00	Stratified sampling (cont.)
13:30 – 14:00	Lunch
14:00 – 15:30	Private study, exercises
15:30 – 16:00	Coffee break
16:00 – 17:00	Private study, exercises

Thursday 15 October 2015

09:30 – 11:00	Single-stage cluster sampling
11:00 – 11:30	Coffee break
11:30 – 13:00	Multi-stage cluster sampling
13:00 – 14:00	Lunch
14:00 – 15:30	Multi-stage cluster sampling (cont.)
15:30 – 16:00	Coffee break
16:00 – 17:30	Private study, exercises

Friday 16 October 2015

09:30 – 11:00	Revision and additional exercises
11:00 – 11:30	Coffee break
11:30 – 12:45	Private study, additional exercises
12:45 – 14:15	Lunch
14:15 – 16:00	Questions and possibly answers, exercise solution

Preliminary and Supplementary Reading:

Preliminary and supplementary reading from one or more of the following books is highly recommended.

Barnett, V. (1991). *Sample Surveys*, *Principles and Methods*. London: Edward Arnold. (Chapter 1 in particular, Chapter 2 if possible).

Cochran, W. G. (1977). *Sampling Techniques*; 3rd edition. New York: Wiley. (Chapters 1 and 2 if possible).

Levy, P.S. and Lemeshow, S. (1999). *Sampling of Populations*: *Method and Applications*; 3rd edition. New York: Wiley. (Chapters 1 and 2 in particular, Chapter 3 if possible).

Lohr, S.L. (1999). *Sampling Design and Analysis*. Pacific Grove: Duxbury Press (Chapter 1 in particular, Chapter 2 if possible).

Calculator:

It is compulsory to bring a university-approved calculator, one of the kinds that are permitted during in the exam, to the course to assist in numerical exercises.

Re-sit Arrangements:

No mark below 25% is allowed for any module in the programme. Students receiving below the minimum mark will have to re-sit the module according to school policy.

Academic Integrity:

The University places the highest importance on the maintenance of academic integrity in the conduct of its affairs, and has produced a guide to issues of academic integrity for students. This can be found in the University Calendar available online at: http://www.calendar.soton.ac.uk/sectionIV/part8a.html, and this is reproduced in your student handbook and can be downloaded at:
http://www.southampton.ac.uk/socsci/socstats/moffstat/index.html
Please familiarise yourself with what is expected of you in this regard by reading through this information. Your attention is drawn particularly to Appendix 1 of the Academic Integrity Statement, which outlines those things that you must avoid, including cheating and plagiarism.

Troubleshooting:

Please get in touch with Dr Paul Smith, should any difficulties arise with this module.

For self preparation:

Please make sure that you can answer the following questions, as these involve some basic technical knowledge and skills that are necessary in order to complete the course. Please revisit the Moffstat introductory material if necessary.

Question A: Let Y be a categorical random variable.

1) Provide expressions for the expectation and variance of Y, respectively.
2) Provided a sample of independent and identically distributed (IID) observations of Y, denoted by y_1, y_2, …, y_n, write down an unbiased estimator of the expectation of Y, and an unbiased estimator of the variance of Y.

Question B: Let X and Y be two categorical random variables.

1) Provide an expression for the covariance of X and Y, denoted by Cov(X,Y).
2) Provided an IID sample of pairwise observations of (X, Y), denoted by (x_1, y_1), (x_2, y_2), …, (x_n, y_n), write down an unbiased estimator of Cov(X,Y).

Question C: How many distinct subsets of size 3 are there of the set {1, 2, 3, 4, 5}? How many distinct subsets of size k are there of a set of n elements, where n>k?

Question D: Let $a_i = m - i$, where i is an integer and m is a constant.

1) Let m = 10. What is $\sum_{i=1}^{10} a_i$, i.e. the sum of a_1 to a_{10}? What is $\sum_{i=1}^{19} a_i$?
2) Now let m be an arbitrary number. What is $\sum_{i=1}^{10} a_i$? What is $\sum_{i=1}^{19} a_i$?

Question E: Let $a_i = i$, where i = 1, 2, 3, …, n.

1) Let n = 3. What is $(\sum_{i=1}^{n} a_i)^2$?
2) Let n be an arbitrary integer, where n>1. Provide an expression of $(\sum_{i=1}^{n} a_i)^2$.

   Provide an expression of $(\sum_{i=1}^{n} k a_i)^2$, where k is an arbitrary constant.