

## **COURSE CONTENT FOR MH4511**

|                           |   |                 |   |
|---------------------------|---|-----------------|---|
| <b>Academic Year</b>      | AY 1819   | <b>Semester</b> | 1 |
| <b>Course Coordinator</b> | Yeo Kwee Poo  |                 |   |
| <b>Course Code</b>        | MH4511  |                 |   |
| <b>Course Title</b>       | Sampling and Survey   |                 |   |
| <b>Pre-requisites</b>     | MH2500 Probability & Introduction to Statistics and MH3500 Statistics |                 |   |
| <b>No of AUs</b>          | 4 AU  |                 |   |
| <b>Contact Hours</b>      | 3 hours lecture and 1 hour tutorial per week                          |                 |   |
| <b>Proposal Date</b>      | 24-Apr-2018   |                 |   |

### **Course Aims**

Surveys and samples is part of our daily life. By understanding the basic characteristics of various sampling designs, you will be able to appreciate information reported in the medias. This course gives an introduction to the statistical aspects of taking and analysing a sample. You will learn to determine the appropriate design in various situations, use the correct method for analysis and interpret the results. This course is essential for working Statisticians.

### **Intended Learning Outcomes (ILO)**

By the end of the course, students should be able to:

1. Recognise and describe various sampling designs discussed throughout the course.
2. Compute the estimates for population mean, proportion and total under each of the sampling schemes.
3. Construct confidence intervals for the population parameters.
4. Apply ratio and regression estimations to improve the accuracy of estimates.
5. Determine the sample size required and its allocation under given conditions.
6. Explain the importance of nonresponse and apply techniques to reduce nonresponse rate.

### **Course Content**

#### Probability Sampling

- Types of Probability Samples
- Simple Random Sampling
- Estimation of Population Mean, Proportion and Total
- Sample Size Estimation
- Systematic Sampling

#### Stratified Sampling

- Theory of Stratified Sampling
- Sampling Weights
- Estimation of Population Mean, Proportion and Total
- Allocating Observations to Strata
- Sample Size Estimation
- Defining Strata
- Post-stratification

#### Ratio and Regression Estimations

- Ratio Estimation
- Regression Estimation
- Selecting the Sample Size
- Relative Efficiency of Estimators

#### Cluster Sampling

- One-Stage and Two-Stage Cluster Samplings
- Estimation of Population Mean, Proportion and Total
- Selecting the Sample Size

- Cluster Sampling with Probability Proportional to Size

#### Sampling with Unequal Probabilities

- One-Stage Sampling with Replacement
- Two-Stage Sampling with Replacement
- Unequal-Probability Sampling without Replacement

#### Nonresponse

- Effects of Ignoring Nonresponse
- Call backs and Two-Phase Sampling
- Weighting Methods for Nonresponse
- Imputation

#### Assessment (includes both continuous and summative assessment)

| Component                       | Course ILO Tested | Related Programme LO or Graduate Attributes | Weighting | Team/Individual | Assessment rubrics |
|---------------------------------|-------------------|---|-----------|-----------------|--------------------|
| 1. Final Examination            | 1 – 6             | A1, A2, A3, B2, B4, C1                      | 60%       | Individual      | Appendix 1         |
| 2. Mid-Term Test                | 2 – 5             | A1, A2, A3, B2, B4, C1                      | 20%       | Individual      | Appendix 1         |
| 3. Weekly/Bi-weekly Assignments | 1 – 5             | A1, A2, A3, A4, B1, B2, B4, C1              | 20%       | Individual      | Appendix 1         |
| Total                           |                   |   | 100%      |                 |                    |

Graduates of MAS programmes should be able to:

|                           |   |
|---------------------------|---|
| <b>Competence</b>         |   |
| A1: {Understanding}       | <i>independently process and interpret mathematical theories and methodologies, and apply them to solve problems</i>                            |
| A2: {Rigour}              | <i>formulate mathematical statements precisely using rigorous mathematical language</i>   |
| A3: {Intuition}           | <i>discover patterns by abstraction from examples</i>   |
| A4: {Modern Tool Usage}   | <i>use computer technology to solve problems, and to communicate mathematical ideas</i>   |
| <b>Creativity</b>         |   |
| B1: {Critical Thinking}   | <i>critically assess the applicability of mathematical tools in the workplace</i>   |
| B2: {Analysis}            | <i>critically analyse data from a multitude of sources</i>  |
| B3: {Interdisciplinarity} | <i>build on the connection between subfields of mathematics to tackle new problems</i>  |
| B4: {Creativity}          | <i>develop new applications of existing techniques</i>  |
| <b>Communication</b>      |   |
| C1: {Communication}       | <i>present mathematics ideas logically and coherently at the appropriate level for the intended audience</i>                                    |
| C2: {Teamwork}            | <i>work in teams on complicated projects that require applications of mathematics, and communicate the results verbally and in written form</i> |
| <b>Civic-Mindedness</b>   |   |
| D: {Professionalism}      | <i>develop and communicate mathematical ideas and concepts relevant in everyday life for the benefits of society</i>                            |
| <b>Character</b>          |   |

|             |  |
|-------------|--|
| E: {Ethics} | <i>act in socially responsible and ethical ways in line with the societal expectations of a mathematics professional, particularly in relation to analysis of data, computer security, numerical computations and algorithms</i> |
|-------------|--|

**Formative feedback**

Component 2: Feedback on common mistakes and the level of difficulty of the problems will be given to you.

Component 3: You will receive individual written and/or verbal feedback about your assignments, as the lecturer will return each assignment individually.

**Learning and Teaching approach**

| Approach   | How does this approach support students in achieving the learning outcomes?   |
|------------|---|
| Lecture    | Help you understand the motivation and definitions of the concepts and notions, approaches to solving problems in pursuant to learning outcomes |
| Assignment | Develop writing and presentation skills, strengthen the understanding of the concepts and notions, and apply the techniques in problem solving  |
| Tutorial   | Develop problem solving skills, reinforce the understanding of the concepts and notions   |

**Reading and References**

- 1 Sampling: Design and Analysis. Lohr, 2nd Ed, Brooks/Cole (978-0495105275)
- 2 Elementary Survey Sampling. Scheaffer, et al., 7th Ed, Brooks/Cole (978-0840053619)

**Course Policies and Student Responsibilities**

(1) General

You are expected to complete all assignments and take the midterm test. You are expected to take responsibility to follow up with course notes, assignments and course related announcements if they are absent.

(2) Absenteeism

Absence from test and examination without a valid reason will affect your overall course grade. Valid reasons include falling sick supported by a medical certificate and participation in NTU's approved activities supported by an excuse letter from the relevant bodies.

(3) Absence Due to Medical or Other Reasons

If you are sick and not able to attend the midterm, you have to submit the original Medical Certificate (or another relevant document) to the administration to obtain official leave. In this case, the missed assessment component will not be counted towards the final grade. There are no make-up midterm.

**Academic Integrity**

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the [academic integrity website](#) for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Use of materials outside the course is strongly discouraged. If you use outside source, you must reference it in your solution.

You must write up your solutions by yourself and understand anything that you hand in.

### Course Instructors

| Instructor   | Office Location | Phone     | Email              |
|--------------|-----------------|-----------|--------------------|
| Yeo Kwee Poo | SPMS-MAS-04-16  | 6513-7456 | kweepoo@ntu.edu.sg |

### Planned Weekly Schedule

| Week    | Topic                                       | Course ILO | Readings/ Activities                  |
|---------|---|------------|---------------------------------------|
| 1       | Introduction and review of basic Statistics | 1          | Lecture notes                         |
| 2 – 4   | Probability sampling                        | 2, 3, 5    | Lecture notes / Tutorial / Assignment |
| 5 – 6   | Stratified sampling                         | 2, 3, 5    | Lecture notes / Tutorial / Assignment |
| 6 – 8   | Ratio and regression estimations            | 2, 3, 4, 5 | Lecture notes / Tutorial / Assignment |
| 9 – 10  | Cluster sampling                            | 2, 3, 5    | Lecture notes / Tutorial / Assignment |
| 11 – 12 | Sampling with unequal probability           | 2, 3, 5    | Lecture notes / Tutorial / Assignment |
| 13      | Nonresponse                                 | 6          | Lecture notes                         |

### Appendix 1: Assessment Criteria for Assignments, Tests and Final Exams

The assessments are meant to ascertain your ability to:

1. Recognise and describe various sampling designs discussed throughout the course.
2. Compute the estimates for population mean, proportion and total under each of the sampling schemes.
3. Construct confidence intervals for the population parameters.
4. Apply ratio and regression estimations to improve the accuracy of estimates.
5. Determine the sample size required and its allocation under given conditions.
6. Explain the importance of nonresponse and apply techniques to reduce nonresponse rate.

| Criteria                            | Standards   |   |   |
|-------------------------------------|---|---|---|
|                                     | Fail standard   | Pass standard   | High standard   |
| Methods of approach (LO 1, 4, 5, 6) | <ul style="list-style-type: none"> <li>Using methods that are irrelevant or do not</li> </ul> | <ul style="list-style-type: none"> <li>Using relevant methods that help solve the problem.</li> </ul> | Finding methods and utilizing theorems that are both relevant and effective |

|                                   |  |   |  |
|-----------------------------------|--|---|--|
|                                   | <p>apply to the given problem.</p> <ul style="list-style-type: none"> <li>• Invoking theorems whose conditions are not satisfied.</li> </ul> | <ul style="list-style-type: none"> <li>• Invoking theorems whose conditions are satisfied.</li> </ul> |  |
| Validity of reasoning (LO 2 to 6) | Reasoning is logically invalid.  | Reasoning is logically valid.   | Reasoning is logically valid and effective.                |
| Clarity of argument (LO 2 to 6)   | Reasoning is poorly explained or not explained at all.   | Reasoning is clear but may contain some gaps.   | Reasoning is clear, precise with no or insignificant gaps. |