Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

Expected Implementation in Academic Year	AY2025-2026
Semester/Trimester/Others (specify approx. Start/End date)	Semester 2
Course Author * Faculty proposing/revising the course	Bernhard Schmidt
Course Author Email	bernhard@ntu.edu.sg
Course Title	Statistics I
Course Code	MH2510
Academic Units	3
Contact Hours	63
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	MH2500
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

You will be introduced to practically relevant statistical methods for students of all branches of science. The focus of the course explicitly is practical data analysis skills and not the theory of statistical inference.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Import and analyze real world data sets in R
ILO 2	Purposefully visualize data sets with various tools from exploratory data analysis
ILO 3	Apply concepts from statistical inference to real world scenarios
ILO 4	Apply methods of estimation to real world data sets
ILO 5	Apply hypotheses tests to real world data sets
ILO 6	Apply one-way ANOVA to analyze differences of means
ILO 7	Perform basic linear regression

Course Content

- Introduction to data and R
- Exploratory data analysis
- Fundamental concepts of statistical inference
- Probability distributions essential for statistics
- Methods of estimation
- Hypotheses testing
- Analysis of variance
- Linear regression

Reading and References (if applicable)

Michael J. Crawley: Statistics, An Introduction using R, Second Edition, Wiley 2015, ISBN 978-1-118-94109-6

NOTE: The above reading comprises the foundational readings for the course and more up-to-date relevant readings will be provided when they are available.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Introduction to data and R: numerical, categorical, discrete, continuous data, retrieving data from online data repositories, importing data into R and extracting information from them	1	Lecture notes	In-person	
2	Exploratory data analysis: bar plots, pie charts, contingency tables, scatterplots, correlation coefficient, coefficient of determination, histograms, density plots, Wooclap test.	2	Lecture notes and lab instructions	In-person	
3	Exploratory data analysis: mean, moving average, sample variance, percentiles, quartiles, median, mode, outliers, boxplots, Wooclap test.	2	Lecture notes and lab instructions	In-person	

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
4	Fundamental concepts of statistical inference: random samples, statistics based on random samples, sampling distributions, parametric and nonparametric models, point estimation, confidence intervals, hypotheses tests, simulation and bootstrap, Wooclap test.	3	Lecture notes and lab instructions	In-person	
5	Probability distributions essential for statistics: percentiles of distributions, normal distribution and CLT, t distribution, chi-square distribution, F distribution, Quiz 1.	3	Lecture notes and lab instructions	In-person	

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
6	Methods of estimation: estimating mean and variance (small sample and large sample confidence intervals), estimating proportions, Wooclap test.	4	Lecture notes and lab instructions	In-person	
7	Methods of estimation: empirical CDF, bootstrap estimators for variance, bootstrap confidence intervals, Wooclap test.	4	Lecture notes and lab instructions	In-person	
8	Hypotheses testing: test concerning means (one-sample and two-sample t- and z-tests), tests concerning variance, Wooclap test.	5	Lecture notes and lab instructions	In-person	
9	Hypotheses testing: sign test, U test, chi-square test for goodness of fit, Wooclap test.	5	Lecture notes and lab instructions	In-person	
10	Bootstrap Tests, Quiz 2.	5	Lecture notes and lab instructions	In-person	

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
11	Analysis of variance: one-way ANOVA, Wooclap test.	6	Lecture notes and lab instructions	In-person	
12	Regression: simple linear regression model, method of least squares, Wooclap test.	7	Lecture notes and lab instructions	In-person	
13	Revision, Wooclap test.	1-7	Lecture notes and lab instructions	In-person	

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lecture	You will be introduced to relevant concepts and methods and computer demonstrations will be performed to apply statistical ideas to real world data. This prepares you for conducting your own statistical studies in the lab sessions.
Lab Sessions	You apply the knowledge you have gained in the lectures to conduct statistical studies based on real world data. This reinforced the material covered in the lecture and provides room for experimentation and your creativity.

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Description of Assessment Component	Team/Individual	Rubrics	Level of Understanding
1	Continuous Assessment (CA): Test/Quiz(Quiz 1)	1-3		20		Individual	Analytic	Not Applicable
2	Continuous Assessment (CA): Test/Quiz(Quiz 2)	1-5		20		Individual	Analytic	Not Applicable
3	Summative Assessment (EXAM): Final exam(Final exam)	1-7		40		Individual	Analytic	Not Applicable
4	Continuous Assessment (CA): Class Participation(Wooclap test during lectures)	1-7		20		Individual	Analytic	Not Applicable

Description of Assessment Components (if applicable)

Quiz 1,2: You will be tested on applying R to analyse data sets according to the methods covered in the lecture.
Final exam: You will be tested on all topics covered in the course.
Wooclap tests: At the start of some lectures, topics from previous lectures will be tested.

Formative Feedback

Quiz papers will be returned to you with marking indicating how you performed for each question. Typical mistakes and strategies to improve understanding and performance will be discussed in lectures and lab sessions.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Care for Society	Intermediate
Collaboration	Intermediate
Communication	Intermediate
Information Literacy	Advanced

Course Policy

Policy (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. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

You are expected to complete all assigned readings, activities, assignments, attend all classes punctually and complete all scheduled assignments by due dates. You are expected to take responsibility to follow up with assignments and course related announcements. You are expected to participate in all project critiques, class discussions and activities.

Policy (Absenteeism)

In-class activities make up a significant portion of your course grade (20% of the final grade is based on in-class tests). Absence from class without a valid reason will affect your participation 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. There will be no make-up opportunities for in-class activities.

Policy (Others, if applicable)

Diversity and inclusion policy

Integrating a diverse set of experiences is important for a more comprehensive understanding of science.

It is our goal to create an inclusive and collaborative learning environment that supports a diversity of perspectives and learning experiences, and that honours your identities; including ethnicity, gender, socioeconomic status, sexual orientation, religion or ability.

To help accomplish this:
• If you are neuroatypical or neurodiverse, have dyslexia or ADHD (for example), or have a social anxiety disorder or social phobia;
• If you feel like your performance in the class is being impacted by your experiences outside of class;
• If something was said in class (by anyone, including the instructor) that made you feel uncomfortable;

Please speak to your teaching team, our school pastoral officer or a peer or senior (either in-person or via email)

about how we can help facilitate your learning experience.

As a participant in course discussions, you should also strive to honour the diversity of your classmates. You can do this by: using preferred pronouns and names; being respectful of others opinions and actively making sure all voices are being heard; and refraining from the use of derogatory or demeaning speech or actions.

All members of the class are expected to adhere to the NTU anti-harassment policy. if you witness something that goes against this or have any other concerns, please speak to your instructors or a faculty member.

Appendix 1: Assessment Rubrics

Rubric for Mid-semester Quiz 1: Short Answer Questions (20%)			
Standards	Fail standard	Pass standard	High standard
Methods of approach	Using methods that are irrelevant or do not apply to the given problem. Invoking theorems whose conditions are not satisfied.	Using relevant methods that help solve the problem. Invoking theorems whose conditions are satisfied.	Finding methods and utilizing theorems that are both relevant and effective
Validity of reasoning	Reasoning is logically invalid.	Reasoning is logically valid.	Reasoning is logically valid and effective.
Clarity of argument	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.

Rubric for Mid-semester Quiz 2: Short Answer Questions (20%)			
Standards	Fail standard	Pass standard	High standard
Methods of approach	Using methods that are irrelevant or do not apply to the given problem. Invoking theorems whose conditions are not satisfied.	Using relevant methods that help solve the problem. Invoking theorems whose conditions are satisfied.	Finding methods and utilizing theorems that are both relevant and effective
Validity of reasoning	Reasoning is logically invalid.	Reasoning is logically valid.	Reasoning is logically valid and effective.
Clarity of argument	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.

Rubric for Wooclap tests: Short Answer Questions (20%)			
Standards	Fail standard	Pass standard	High standard
Methods of approach	Using methods that are irrelevant or do not apply to the given problem. Invoking theorems whose conditions are not satisfied.	Using relevant methods that help solve the problem. Invoking theorems whose conditions are satisfied.	Finding methods and utilizing theorems that are both relevant and effective
Validity of reasoning	Reasoning is logically invalid.	Reasoning is logically valid.	Reasoning is logically valid and effective.
Clarity of argument	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.

Rubric for Final Exam Short Answer Questions (40%)			
Standards	Fail standard	Pass standard	High standard
Methods of approach	Using methods that are irrelevant or do not apply to the given problem. Invoking theorems whose conditions are not satisfied.	Using relevant methods that help solve the problem. Invoking theorems whose conditions are satisfied.	Finding methods and utilizing theorems that are both relevant and effective
Validity of reasoning	Reasoning is logically invalid.	Reasoning is logically valid.	Reasoning is logically valid and effective.
Clarity of argument	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.