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	Hemant Tyagi
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Course Title	Statistics
Course Code	MH3500
Academic Units	4
Contact Hours	51
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

This course aims to develop your understanding of the statistical concepts of parameter estimation and hypothesis testing that are fundamental for real life applications of statistics as well as for numerous further courses in the curriculum of the statistics track.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Apply basic probability concepts such as PMF, PDF, CDF, expected values, variance, and moments in a statistical context and perform the involved computations of series and integrals.
ILO 2	Use standard probability distributions to model statistical scenarios and to derive useful conclusions from computations based on these distributions.
ILO 3	Explain the relevance of the Central Limit Theorem for statistics.
ILO 4	Construct parameter estimators using the maximum likelihood method and the method of moments.
ILO 5	Rigorously assess the quality of parameter estimators.
ILO 6	Analyse the asymptotic properties of parameter estimators.
ILO 7	Construct exact and approximate confidence intervals.
ILO 8	Explain the purpose and philosophy of hypothesis testing, as well as the meaning of p-values.
ILO 9	Given a dataset, create and apply a useful hypothesis test based on these data.
ILO 10	Compute the size and power of a hypothesis test.
ILO 11	Construct most powerful tests using the Neyman-Pearson Lemma.

Course Content

Review of probability
Random samples, sample mean and sample variance, distributions derived from the normal distribution, Central Limit Theorem and its significance for statistics
Introduction to parameter estimation, quality criteria for parameter estimators
Constructing good estimators: method of moments and maximum likelihood method
Asymptotic properties of estimators, Cramer-Rao bound and efficient estimators
Confidence intervals for estimators
Introduction to hypothesis testing and Fisher-type tests
Neyman-Pearson tests and Neyman-Pearson Lemma

Reading and References (if applicable)

John A. Rice: Mathematical Statistics and Data Analysis, Third Edition, ISBN-13: 978-8131519547 ISBN-10: 8131519546

Introduction to Mathematical Statistics. Hogg McKean & Craig. Eighth Edition, Pearson

Statistical Inference. Casella G. and Berger R.L. Second Edition, Thomson Press

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Review of probability	1	Study lecture notes	In-person	
2	Review of probability	1	Study lecture notes	In-person	
3	Random samples, sample mean and sample variance, distributions derived from the normal distribution, Central Limit Theorem and its significance for statistics	2,3	Study lecture notes	In-person	
4	Introduction to parameter estimation, quality criteria for parameter estimators	5	Study lecture notes	In-person	
5	Constructing good estimators: method of moments and maximum likelihood method	4	Study lecture notes	In-person	
6	Constructing good estimators: method of moments and maximum likelihood method	4	Study lecture notes	In-person	

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
7	Constructing good estimators: method of moments and maximum likelihood method	4	Study lecture notes	In-person	Midterm Quiz
8	Asymptotic properties of estimators, Cramer-Rao bound and efficient estimators	6	Study lecture notes	In-person	
9	Asymptotic properties of estimators, Cramer-Rao bound and efficient estimators	6	Study lecture notes	In-person	
10	Confidence intervals for estimators	7	Study lecture notes	In-person	
11	Introduction to hypothesis testing and Fisher-type tests	8	Study lecture notes	In-person	
12	Neyman-Pearson tests and Neyman-Pearson Lemma	9, 10, 11	Study lecture notes	In-person	
13	Neyman-Pearson tests and Neyman-Pearson Lemma	9, 10, 11	Study lecture notes	In-person	

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lectures (39 hours)	The lectures cover the basic theory of parametric statistics using the following approach: - Illustration of concepts and theorems by numerous examples - Exercises embedded in lectures that you are encouraged to solve independently before seeing the solution in the lectures
Tutorials (12 hours)	Two types of tutorial problems will be given: 1) Problems that test comprehension of basic definitions and theorems. 2) More advanced problems that either require quite strong computational and reasoning skills or creativity in coming up with mathematical proofs.

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): Assignment(Assignment)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11		15	These will be exercises on topics taught in the lectures	Individual	Analytic	Not Applicable
2	Continuous Assessment (CA): Test/Quiz(Midterm exam)	1, 2, 3, 4, 5		20	This will be a 2 hour written exam, held halfway through the course	Individual	Analytic	Not Applicable
3	Summative Assessment (EXAM): Final exam()	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11		60	This will be a 2 hour written exam, held upon the completion of the course	Individual	Analytic	Not Applicable
4	Continuous Assessment (CA): Class Participation()			5	Complete 8 out of 12 Wooclap in-class activities to receive full marks		Analytic	Not Applicable

Description of Assessment Components (if applicable)

Formative Feedback

Midterm exam: Feedback on common mistakes and the level of difficulty of the problems is given.

Assignment: You will receive individual feedback on your performance in the assignments during the tutorial sessions.

NTU Graduate Attributes/Competency Mapping

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

Attributes/Competency	Level
Creative Thinking	Intermediate
Curiosity	Advanced
Decision Making	Advanced
Learning Agility	Intermediate
Problem Solving	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)

Described under: Academic Integrity, Absenteeism, Others.

Policy (Absenteeism)

Absence Due to Medical or Other Reasons:

If you are sick and not able to submit an assignment or take 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 assignments or make-up midterm.

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 Tutorials: Assignment (15%)
Point-based marking (not rubrics based)

Rubric for Class Participation: Wooclap (5%)
Point-based marking (not rubrics based)
Complete 8 out of 12 Wooclap in-class activities to receive full marks

Rubric for Mid-semester Quiz: Short Answer Questions (20%)
Point-based marking (not rubrics based)

Rubric for Examination: Short Answer Questions (60%)
Point-based marking (not rubrics based)