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

Course Overview

The sections shown on this interface are based on the templates UG OBTL+ or PG OBTL+
If you are revising/duplicating an existing course and do not see the pre-filled contents you expect in the subsequent sections e.g. Course Aims, Intended Learning Outcomes etc. please refer to Data Transformation Status for more information.

Expected Implementation in Academic Year	AY2024-2025
Semester/Trimester/Others (specify approx. Start/End date)	Semester 1
Course Author * Faculty proposing/revising the course	Liu Wen Paul
Course Author Email	wenliu@ntu.edu.sg
Course Title	Engineering Statistics
Course Code	CH2010
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	MH1810
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

The objective of this course is to introduce the concept of statistics and probability in engineering. It helps students to obtain correct interpretation from data collected and construct models for performance prediction.

Course's Intended Learning Outcomes (ILOs)

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

ILO 1	Apply concepts of probability and probability distributions.
ILO 2	Identify the different type of statistical distributions (e.g., normal, and log-normal) and describe the typical phenomena of these distributions.
ILO 3	apply the concepts of point and interval estimation.
ILO 4	Apply the concepts of hypothesis testing.
ILO 5	Apply least squares method to estimate the parameters in a regression model.
ILO 6	Use standard software (e.g., Excel) to facilitate statistical analysis.

Course Content

Key topics taught: 1. Probability and probability distributions 2. Sampling distributions 3. Point estimation 4. Confidence intervals 5. Hypothesis testing 6. Regression

Reading and References (if applicable)

1. Raymond Myers and Ronald Walpole, Probability & Statistics for Engineers & Scientists, 9th Edition, Prentice Hall, 2012. 2. K.F. Riley, M.P. Hobson and S.J. Bence, Mathematical Methods for Physics and Engineering, 3rd Edition, Cambridge University Press, 2008.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Introduction to Statistics and Data Analysis	1, 4		In-person	Lecture, tutorials and self-learning (videos on NTULearn). Lecture is recorded and published on NTULearn.
2	Probability	1		In-person	Lecture, tutorials and self-learning (videos on NTULearn). Lecture is recorded and published on NTULearn.
3	Random Variables and Probability Distributions	1, 2		In-person	Lecture, tutorials and self-learning (videos on NTULearn). Lecture is recorded and published on NTULearn.
4	Mathematical expectation	2		In-person	Lecture, tutorials and self-learning (videos on NTULearn). Lecture is recorded and published on NTULearn.

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
5	Discrete and Probability Distributions	2		In-person	Lecture, tutorials and self-learning (videos on NTULearn). Lecture is recorded and published on NTULearn.
6	Continuous probability distributions	1, 2		In-person	Lecture, tutorials and self-learning (videos on NTULearn). Lecture is recorded and published on NTULearn.
7	CA1	3		In-person	In person quiz
8	Sampling distributions	1, 2		In-person	Lecture, tutorials and self-learning (videos on NTULearn). Lecture is recorded and published on NTULearn.
9	One and two-sample estimation problems	3		In-person	Lecture, tutorials and self-learning (videos on NTULearn). Lecture is recorded and published on NTULearn.

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
10	Hypothesis testing	4		In-person	Lecture, tutorials and self-learning (videos on NTULearn). Lecture is recorded and published on NTULearn.
11	Simple linear regression	5		In-person	Lecture, tutorials and self-learning (videos on NTULearn). Lecture is recorded and published on NTULearn.
12	Error analysis and curve fitting	1, 2, 3, 4, 5, 6		In-person	Lecture, tutorials and self-learning (videos on NTULearn). Lecture is recorded and published on NTULearn.
13	Bayesian analysis	1, 2, 3, 4, 5, 6		In-person	Lecture, tutorials and self-learning (videos on NTULearn). Lecture is recorded and published on NTULearn.

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lecture	Course materials covering all topics
Tutorial	12 classroom discussion sessions on tutorial questions and related topics

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Team/Individual	Rubrics	Level of Understanding
1	Summative Assessment (EXAM): Final exam()	1, 2, 3, 4, 5, 6	a, b, c, d	60	Individual	Analytic	Multistructural
2	Continuous Assessment (CA): Test/Quiz()	1, 2	a, b, c, d	20	Individual	Analytic	Relational
3	Continuous Assessment (CA): Project()	1, 2, 6	a, b, c, d, e, j, i	20	Individual	Holistic	Multistructural

Description of Assessment Components (if applicable)

The project typically involves the measurement, data processing and statistically analysis of real-life data to make statistically sound conclusions and interpretations about specific questions. Skills and knowledge in using computer programmes and software to perform data processing and statistical analysis will be assessed. The students will also demonstrate the ability to perform detailed error analysis.

Formative Feedback

During tutorials, the instructor will communicate expected learning outcomes in detail.

After each CA, the instructor will go through the problems during tutorials. Common mistakes and misunderstanding in concepts will also be addressed.

Specific feedback to project work will be returned to students in writing. General feedback to project work will be published online.

NTU Graduate Attributes/Competency Mapping

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

Attributes/Competency	Level
Adaptability	Intermediate
Communication	Intermediate
Curiosity	Intermediate
Digital Fluency	Basic
Problem Solving	Intermediate

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 responsible for meeting all course requirements, observing all deadlines, examination times, and other course procedures.

You are responsible for following the university regulations for final examination as indicated here:

http://www.ntu.edu.sg/Students/Undergraduate/AcademicServices/Examination/Pages/Instructionstoexamcand.aspx

You are responsible for being on time for all lectures and tutorials. Sufficient efforts should be put into solving or attempting the tutorial problems prior to attending the respective tutorial classes. You might be award an "F" for a component or expelled from the university if you are caught cheating. You are responsible for seeking academic help in a timely fashion.

Policy (Absenteeism)

You will be awarded ZERO mark for being absence from quizzes unless it is due to the following reasons:

Illness (valid medical certificate is required, not from Chinese doctor)

Passing away of immediate family member (parents, siblings or grandparents)

Participate in an activity representing NTU (support letter from participating organization)

There will be no makeup given for missed quizzes. Final grade will be determined based on the participated quiz and final examination.

Policy (Others, if applicable)

Last Updated Date: 03-07-2024 08:38:17

Last Updated By: Paul Liu (Asst Prof)

Rubrics for Project (CH2010 Engineering Statistics)

	Data analysis	Statistical analysis	Data presentation	Discussion	Language
Excellent 80% - 100%	Data analysis is correctly accurately performed based on the instruction give. The analysis results are presented in a clear yet efficient manner. Key steps are shown and concisely explained.	Appropriate statistical analysis are chosen and correctly performed. The choice of statistical analysis is explained and justified, without copying large portion of the lecture notes or textbook. Appropriate nuances (e.g. assumptions, approximations and justifications) are clearly explained. The questions given in the tasks are directly answered. The answers are based on the analysis results without over-interpretation.	Data are presented in the most appropriate formats. Tabulated data is only presented when absolutely necessary. All graphs are plotted clearly and in ways that allow the message to get across easily. The plots are properly labelled. The figure captions are informative and unambiguous. The student strategically select data from multiple measurements to be plotted on the same graph without affecting clarity. All figures are properly introduced and discussed thoroughly in the text.	The report is written clearly and concisely, without missing essential details. The discussion are entirely supported by data and properly cited literature. There is a clear distinction between facts and personal interpretation. The results of the analysis can be explained using knowledge covered in the course without over-interpretation or exaggeration.	There is no noticeable grammatical mistake (including comma splice!). All technical terms and measurements are expressed professionally. The descriptions are accurate and concise. There is no identifiable hyperbole, typo or spelling error.
Satisfactory 60% - 79%	Data analysis is performed correctly. The explanation of the analysis procedure may not be clearly explained, or simply copies the instruction. Attempts were made to interpret analysis results and make pre-mature conclusions without supporting evidence (e.g. further analysis).	Statistical analysis could be correctly performed. The analysis is largely accurate. However, the choice of the analysis may not be fully justified or explained. There is evidence of some misunderstanding of the concept covered in the course. The implication of the results may not be fully discussed, or over-interpreted.	Data are effectively represented in both graphic and tabular form. The graphs are plotted and labelled clearly with some minor issues (e.g. missing axis label). Some labelling and caption may not be fully informative or may be ambiguous. The numbers may be presented in too many or too few significant figures. Figures may be plotted in ways that are difficult to make comparisons between different datasets. Some figures may be difficult to interpret without reading the text.	Key results are discussed in the reports, while some nuances are missing. There is some over-interpretation of the analysis results, although the conclusions are mostly accurate. There are attempts to support statements and postulations with references, but citations are incomplete, inappropriate or with the wrong format.	There are some easily spotted grammatical mistakes. The report is written in a mixture of colloquial and written English. The report contains some redundant, repetitive or meaningless sentences
Unsatisfactory 40 - 59%	Data analysis is inaccurately performed. The procedure is insufficiently explained.	The type of statistically analysis is poorly chosen. The justification of the choice of analysis shows a general lack of understanding of the course material. The analysis is incorrectly done, sometimes with obvious mistakes in the calculation. The analysis results are wrongly interpreted.	Data are largely presented in tabular forms. The graphically presented data are poorly labelled and arranged. The captions are very general and not informative. Figures and tables are not properly introduced and discussed in the text. The data are presented with unsensible number of significant figures.	The results presented are poorly discussed. There is an obvious misuse of concepts to explain the analysis results. The student makes many unsupported claims. There is generally a lack of logic in the discussion.	Grammatical mistakes can be seen throughout the report. The report is written in largely colloquial language. A large portion of the report is filled with sentences that do not carry significant meaning.
No attempt <40%	Little or no attempt is shown.	Little or no attempt is shown.	Little or no attempt is shown.	Little or no attempt is shown.	Little or no attempt is shown.

Mapping of Course ILOs to EAB Graduate Attributes

Course Code & Title	CH2010 Engineering Statistics
Course Type	Core

Overview										
(a)	●	(b)	●	(c)	◐	(d)	●	(e)	●	(f)	◐
(g)	○	(h)	◐	(i)	◐	(j)	○	(k)	○		

Legend:

●	Fully consistent (contributes to more than 75% of Student Learning Outcome)
◐	Partially consistent (contributes to about 50% of Student Learning Outcome)
○	Weakly consistent (contributes to about 25% of Student Learning Outcome)
Blank	Not related to Student Learning Outcome

Course ILOs		**EAB Graduate Attributes**
1)	Apply concepts of probability and probability distributions.	a, b, d, e
2)	Identify the different type of statistical distributions (e.g., normal, and log-normal) and describe the typical phenomena of these distributions.	a, e, i
3)	Apply the concepts of point and interval estimation.	a, b, d, e
4)	Apply the concepts of hypothesis testing.	a, b, c, d, e, f
5)	Apply least squares method to estimate the parameters in a regression model.	a, b, c, d, e, f
6)	Use standard software (e.g., Excel) to facilitate statistical analysis.	b, c, d, e

EAB Graduate Attributes

a) **Engineering Knowledge**: Apply the knowledge of mathematics, natural science, computing and engineering fundamentals, and an engineering specialisation as specified in WK1 to WK4 respectively to the solution of complex engineering problems.

b) **Problem Analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences with holistic considerations for sustainable development. (WK1 to WK4)

c) **Design / Development of Solutions**: Design creative solutions for complex engineering problems and design systems, components or processes that meet identified needs with appropriate consideration for public health and safety, whole-life cost, net zero carbon as well as resource, cultural, societal, and environmental considerations as required. (WK5)

d) **Investigation**: Conduct investigations of complex problems using research-based knowledge (WK8) and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e) **Modern Tool Usage**: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering problems, with an understanding of the limitations. (WK2 and WK6)

f) **The Engineer and the World**: When solving complex engineering problems, analyse and evaluate sustainable development impacts to: society, the economy, sustainability, health and safety, legal frameworks and the environment (WK1, WK5, and WK7).

g) **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice and adhere to relevant national and international laws. Demonstrate an understanding of the need for diversity and inclusion (WK9).

h) **Individual and Collaborative Team Work**: Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multidisciplinary, face-to-face, remote and distributed settings (WK9).

i) **Communication**: Communicate effectively and inclusively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions, taking into account cultural, language, and learning differences.

j) **Project Management and Finance**: Demonstrate knowledge and understanding of engineering management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

k) **Life-long Learning**: Recognise the need for, and have the preparation and ability to (i) engage in independent and life-long learning, and (ii) adapt to new and emerging technologies, and (iii) think critically, in the broadest context of technological change (WK8).

No	Knowledge Profile
WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences
WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
WK5	Knowledge including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts that supports engineering design and operations in a practice area
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline such as the professional responsibility of an engineer to public safety and sustainable development.
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues
WK9	Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc with mutual understanding and respect, and of inclusive attitudes

Reference: EAB Accreditation Manual