

COURSE OUTLINE: BA2203 Statistical Modelling

Academic Year	AY2022-23	Semester	1
Course Coordinator	Tan Ken Seng		
Course Code	BA2203		
Course Title	STATISTICAL MODELLING		
Pre-requisites	AB1202		
No of AUs	4		
Contact Hours	4 x 13 = 52 hours		
Proposal Date	13 June 2022		

A) Course Aims

This course provides an in-depth background knowledge in probability and statistics. It covers the necessary concepts and techniques in probability and statistics as well as the development of underlying theory. This course draws on applications from a variety of areas where risk analysis has become important including finance, insurance, actuarial science, corporate risk management and personal financial planning.

B) Intended Learning Outcomes (ILO)/Objectives

By the end of this course, you should be able to:

1. Use univariate distributions to calculate probabilities, quantiles and moments
2. Use joint distributions to calculate probabilities, quantiles and moments
3. Calculate conditional expectations and conditional probabilities
4. Explain the concepts of random sampling, statistical inference and sampling distribution
5. Analyse exploratory data and summary statistics with appropriate tools
6. Apply methods of estimation to point estimation
7. Construct confidence intervals for unknown parameters
8. Conduct hypothesis test and goodness-of-fit test
9. Use regression model to analyze data
10. Use R for problem solving and data analysis.

C) Course Content

- Exploratory Data Analysis
- Probability Distributions & Probability Densities (Univariate & Multivariate)
- Mathematical Expectation
- Generating Functions
- Compound Distribution
- Functions of Random Variables
- Sampling Distributions
- Statistical Inference: Point & Interval Estimations
- Hypothesis Testing & Goodness of Fit
- Regression & Correlation Analysis
- Analysis of Variance

D) Assessment (includes both continuous and summative assessment)

Component	ILO Tested	NBS Learning Goal (Refer to Appendix 1 for list)	Weightage	Team/Individual	Assessment Rubrics (attach rubrics in appendix)
1. Final Examination	ILO1-9	Acquisition of knowledge & Problem Solving	70%**	Individual	N.A
2. Midterm	ILO1-5	Acquisition of knowledge & Problem Solving	10%	Individual	Problem Solving
3. Class participation	ILO1-10	Oral Communication & Critical Thinking	10%	Individual	Class Participation
4. Class presentation	ILO1-10	Oral Communication & Critical Thinking	10%***	Individual	Class Presentation Rubric
Total			100%		

** The 70% weightage for final is required by the accreditation agreement with the IFOA

***The presentation should provide highlights related to an academic study, government report, or media coverage about a topic of common interests, broadly construed. Suggested presentation components to be included: 1) Brief background introduction 2) What is the sample and/or analysis done? 3) Summary of findings or conclusion from the statistics. You are encouraged to include critiques and/or some reflections if you find any. Note that the main assessment point of this assignment is on the presentation itself. Thus, you are advised to focus on the plot, design, and style, rather than statistical technicalities. See Appendix C for the assessment criteria.

E) Formative feedback

Feedback is central to this course. In addition to receiving feedback on your midterm, we will also rely on the “interactive classroom response system” via Kahoot to provide instant feedback to you and to evaluate your in-class participation.

F) Learning and Teaching approach

Approach	How does this approach support you in achieving the learning outcomes?
Seminars	Key concepts introduced in this module will be explained in detail in the seminars supported with examples and exercises. The seminars provide opportunities for open discussion on the conceptual questions, which allow you to think critically and share your ideas with the class. The seminars involve the interaction between the instructor and the entire class, making sure that the targeted learning outcomes could be successfully achieved.
In-Class activities	Interactions are encouraged in class to enhance critical thinking and class engagement. We will use the “interactive classroom response system” to provide instant feedback to your understanding and learning of the course material, thereby ensuring the learning goals/objectives are attained.

G) Reading and References

Basic Text

M&M: Miller, I. and M. Miller, John E. Freund's Mathematical Statistics with Applications, 8-Edition, 2014.

Other Resources

ActEd Study Materials: Subject CS1, The Actuarial Education Company.

H) Course Policies and Student Responsibilities**(1) General**

You are expected to complete all assigned pre-class readings and activities, attend all seminar classes punctually and take all scheduled assignments and tests by due dates. You are expected to take responsibility to follow up with course notes, assignments and course related announcements for seminar sessions they have missed. You are expected to participate in all seminar discussions and activities.

(2) Absenteeism

Absence from class 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.

If you miss a lecture, you must inform the course instructor via email prior to the start of the class.

I) 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.

J) Course Instructors

Instructor	Office Location	Phone	Email	Consultation Hours
Tan Ken Seng	S3-01B-38	6790 5725	kenseng.tan@ntu.edu.sg	By appointment

K) Planned Weekly Schedule

Week	Topic	ILO	Readings/ Activities
1	Review Exploratory Data Analysis & Probability Random Variables & Distributions	ILO1, ILO5	Basic Text Chapters 1, 2
2	Joint Distributions	ILO2	Chapter 3
3	Mathematical Expectation, Generating Functions, Compound Distribution	ILO3	Chapter 4
4 & 5	Some Discrete Probability Distributions Some Continuous Probability Densities	ILO1-3, ILO10	Chapters 5, 6
6	Functions of Random Variables	ILO1-3	Chapter 7
7	Sampling Distributions & the Central Limit Theorem	ILO4	Chapter 8
8	Recess		
9	Statistical Inference: Point & Interval Estimations	ILO6-7, ILO10	Chapters 10, 11
10	Hypothesis Testing & Goodness of Fit	ILO8, ILO10	Chapters 12, 13
11 & 12	Regression & Correlation Analysis Analysis of Variance	ILO9-10	Chapters 14, 15
13	Presentation		

ANNEX A:**Quantitative Literacy Skills Rubric – Mapped to Problem Solving and Decision Making Learning Goal**

Learning Objective: Quantitative Literacy (QL) – also known as Numeracy or Quantitative Reasoning (QR) – is a "habit of mind," competency, and comfort in working with numerical data. Individuals with strong QL skills possess the ability to reason and solve quantitative problems from a wide array of authentic contexts and everyday life situations. They understand and can create sophisticated arguments supported by quantitative evidence and they can clearly communicate those arguments in a variety of formats (using words, tables, graphs, mathematical equations, etc., as appropriate).

Traits		Performance	
<u>Interpretation</u>	Ability to explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words).	Not Yet Attempts to explain information presented in mathematical forms, but draws incorrect conclusions about what the information means.	Substantially Developed Provides accurate explanations of information presented in mathematical forms. Makes appropriate inferences based on that information.
		Evaluation: Not Yet 1 2 3 4 5 6 7 8 9 10 Substantially Developed	
<u>Representation</u>	Ability to convert relevant information into various mathematical forms (e.g., equations, graphs, diagrams, tables, words).	Not Yet Completes conversion of information but resulting mathematical portrayal is inappropriate or inaccurate.	Substantially Developed Skillfully converts relevant information into an insightful mathematical portrayal in a way that contributes to a further or deeper understanding.
		Evaluation: Not Yet 1 2 3 4 5 6 7 8 9 10 Substantially Developed	
<u>Calculation</u>	Ability to perform calculations.	Not Yet Calculations are attempted but are both unsuccessful and are not comprehensive.	Substantially Developed Calculations attempted are essentially all successful and sufficiently comprehensive to solve the problem. Calculations are also presented elegantly (clearly, concisely, etc.).
		Evaluation: Not Yet 1 2 3 4 5 6 7 8 9 10 Substantially Developed	
<u>Application/ Analysis</u>	Ability to make judgments and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis.	Not Yet Uses the quantitative analysis of data as the basis for tentative, basic judgments, although is uncertain about drawing conclusions from this work.	Substantially Developed Uses the quantitative analysis of data as the basis for deep and thoughtful judgments, drawing insightful, carefully qualified conclusions from this work.
		Evaluation: Not Yet 1 2 3 4 5 6 7 8 9 10 Substantially Developed	
<u>Presentation</u>	Expressing quantitative evidence in support of the argument or purpose of the work (in terms of what evidence is used and how it is formatted, presented, and contextualized).	Not Yet Presents an argument for which quantitative evidence is pertinent, but does not provide adequate explicit numerical support.	Substantially Developed Uses quantitative information in connection with the argument or purpose of the work, presents it in an effective format, and explicates it with consistently high quality.
		Evaluation: Not Yet 1 2 3 4 5 6 7 8 9 10 Substantially Developed	

Reference:: http://www.aacu.org/resources/assessment/quant_reasoning.cfm

Communication Rubric (Oral)

Learning Objective: The ability to communicate well with others verbally so that it clearly expresses the intended message and is understandable and useful to the receiving party.

Traits		Performance	
Communication Outcome	<ul style="list-style-type: none"> Has a clear message for audience Maximizes likelihood of audience accepting the message 	Not Yet Central message is not explicitly stated in the presentation. Main points are not clearly identified, audience unsure of the direction of the message.	Substantially Developed Central message is precisely stated; main points are clearly identified.
		Evaluation: Not Yet <u>1</u> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u> <u>8</u> <u>9</u> <u>10</u> Substantially Developed	
Situational Factors	<ul style="list-style-type: none"> Addresses audience needs Builds rapport with audience 	Not Yet Topic is irrelevant to audience needs and interest. No attempt made to connect topic to audience.	Substantially Developed Connection of topic to audience needs and interest is stated with sophistication. Identifies and expresses a deep understanding of the target audience.
		Evaluation: Not Yet <u>1</u> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u> <u>8</u> <u>9</u> <u>10</u> Substantially Developed	
Design Factors	Content <ul style="list-style-type: none"> Presents relevant information Supports main points with strong evidence 	Not Yet Content is erroneous or irrelevant; references and supporting materials are absent. Lacks of depth in content and little insights are exhibited. Presentation falls outside set time parameters.	Substantially Developed Content is accurate, thorough, and directly on point; strong support and references are provided. Exhibits depth and insight in content. Effective use of time and stays within time parameters.
	Evaluation: Not Yet <u>1</u> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u> <u>8</u> <u>9</u> <u>10</u> Substantially Developed		
	Structure <ul style="list-style-type: none"> Organises content coherently Signals transitions between points 	Not Yet Organizational pattern (specific introduction and conclusion, sequenced materials within the body, and transitions) is not observable.	Substantially Developed Organizational pattern is clearly and consistently observable and makes the content of the presentation cohesive.
	Evaluation: Not Yet <u>1</u> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u> <u>8</u> <u>9</u> <u>10</u> Substantially Developed		
	Verbal <ul style="list-style-type: none"> Speaks at appropriate speed and volume Uses correct grammar and pronunciation 	Not Yet Grammar, pronunciation and word choice are deficient. Vocal delivery is too soft or too fast to understand; gap-fillers interfere with expression.	Substantially Developed Free of errors in grammar and pronunciation; good choices of word enhance clarity of expression. Vocal delivery is varied and dynamic. Speech rate, volume, and tone facilitate audience comprehension. Minimal gap fillers.
	Evaluation: Not Yet <u>1</u> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u> <u>8</u> <u>9</u> <u>10</u> Substantially Developed		
	Non-Verbal <ul style="list-style-type: none"> Establishes eye contact Uses gestures and movement to convey energy and confidence 	Not Yet Eye contact, posture, gestures, movement and facial expressions are inappropriate and significantly distracting.	Substantially Developed Eye contact, posture, gestures, movement and facial expressions make the presentation compelling, and speaker appears polished and confident.
	Evaluation: Not Yet <u>1</u> <u>2</u> <u>3</u> <u>4</u> <u>5</u> <u>6</u> <u>7</u> <u>8</u> <u>9</u> <u>10</u> Substantially Developed		

Critical Thinking Rubric

Learning Objective: The ability to defineⁱ, examineⁱⁱ, evaluateⁱⁱⁱ, analyze^{iv} and synthesize^v various arguments and knowledge to form independent judgment.

Adapted from: Core Curriculum Learning Goals by Santa Clara University <http://scu.edu/provost/ugst/core2009/corecurriculumoverview.cfm>

Traits	Performance	
Identifies and summarizes the issue at hand.	Not Yet Does not identify and summarize the issue, is confused or represents the issue inaccurately.	Substantially Developed Identifies the main issue and its implicit aspects, addresses their relationships to each other and recognizes nuances of the issue.
	Evaluation: Not Yet <u>1</u> 2 3 4 5 6 7 8 9 10 Substantially Developed	
Identifies and considers other theoretical perspectives that are important to the analysis of the issue	Not Yet Deals only with a single perspective and fails to discuss other possible perspectives, especially those salient to the issue. Fails to identify or hastily dismisses strong, relevant counter-arguments.	Substantially Developed Addresses perspectives noted previously, and additional diverse perspectives drawn from outside information. Identifies the salient arguments (reasons and claims) pro and con.
	Evaluation: Not Yet <u>1</u> 2 3 4 5 6 7 8 9 10 Substantially Developed	
Identifies and assesses the quality of supporting data/evidence and provides additional data/evidence related to the issue.	Not Yet Merely repeats information provided, taking it as truth, or denies evidence without adequate justification. Confuses associations and correlations with cause and effect.	Substantially Developed <u>Examines the evidence and source of evidence; questions its accuracy, precision, relevance, and completeness. Observes cause and effect and addresses existing or potential consequences.</u>
	Evaluation: Not Yet <u>1</u> 2 3 4 5 6 7 8 9 10 Substantially Developed	
Identifies and considers key assumptions and the influence of the context on the issue.	Not Yet Does not surface the assumptions of the author and does not examine the contexts, e.g., cultural, and political.	Substantially Developed Identifies and questions the validity of the assumptions and analyzes the issue with a clear sense of scope and context.
	Evaluation: Not Yet <u>1</u> 2 3 4 5 6 7 8 9 10 Substantially Developed	
Identifies and assesses conclusions, implications and consequences	Not Yet Fails to identify conclusions, implications, and consequences of the issue or the key relationships among the various elements such as context, evidence or assumptions. Regardless of the evidence or reasons, maintains or defends views based on self-interest or preconceptions.	Substantially Developed Identifies and discusses conclusions, implications, and consequences, considering context, assumptions, data, and evidence. Objectively reflects upon own assertions. Draws warranted, judicious, non-fallacious conclusions.
	Evaluation: Not Yet <u>1</u> 2 3 4 5 6 7 8 9 10 Substantially Developed	

ANNEX B: LIST OF NBS LEARNING GOALS

LEARNING GOAL	LEARNING OBJECTIVE	CHECK
TASK SKILLS		
Acquisition of Knowledge	Students should be able to demonstrate understanding of the various concepts and methods introduced in the module.	<input checked="" type="checkbox"/>
Ethical Reasoning	The ability to recognize and understand ethical issues, and apply sound ethical reasoning.	<input type="checkbox"/>
Critical Thinking & Creative Thinking	The ability to define, examine, evaluate, analyze and synthesize various arguments and knowledge to form independent judgment.	<input checked="" type="checkbox"/>
	The ability to provide insight in an innovative way characterized by high degree of adaptiveness.	<input type="checkbox"/>
Problem Solving & Decision Making	The ability to identify problem, generate a plan to solve problem, implement and evaluate the plan and make sound business decision.	<input checked="" type="checkbox"/>
Planning & Execution	The ability to set clear priorities and plans of action for the task and define task objectives to fulfill goals within a planned schedule for execution.	<input type="checkbox"/>
PEOPLE SKILLS		
Oral Communication & Written Communication	The ability to communicate well with others verbally so that it clearly expresses the intended message and is understandable and useful to the receiving party.	<input checked="" type="checkbox"/>
	The ability to communicate well with others in writing so that it clearly expresses the intended message and is understandable and useful to the receiving party.	<input type="checkbox"/>
Negotiation	The ability to systematically plan and prepare for negotiation and apply negotiation skills in personal and professional practice.	<input type="checkbox"/>
Cultural Intelligence	The ability to function effectively in situations characterized by cultural diversity.	<input type="checkbox"/>
Teamwork & Interpersonal Skills	The ability to work effectively with others in a group setting.	<input type="checkbox"/>
Motivation & Development of Self & Others	The ability to develop a better understanding of one's strengths and weaknesses, and learn to view others and mistakes positively as sources of personal and professional development.	<input type="checkbox"/>

ANNEX C: CLASS PRESENTATION ASSESSMENT CRITERIA

Category	Scoring Criteria			Total Points	Score
	Fail standard (<40 %)	Pass standard (40%-70%)	High standard (70%-100%)		
Content (30%)	Content is attention-getting and provoke thinking.			20	
	Presentation contains accurate information.			10	
	Material included is relevant to the overall message/purpose.			10	
	Appropriate amount of material is prepared			10	
Presentation (70%)	Provide references to source of information whenever required			10	
	Speaker maintains good eye contact with the audience			10	
	Visual aids are well prepared, informative, and effective			10	
	Length of presentation is within the assigned time limits.			10	
	Speakers handle queries raised by the audience appropriately			10	
Score	Total Points			100	

ANNEX D: CLASS PARTICIPATION RUBRIC

Traits	Performance		
	1	2	3
Engagement	Hardly focuses in class (e.g. using mobile phone, unnecessary chatting)	Occasionally engages in distracting activities (e.g. using mobile phone, unnecessary chatting) in class.	Engages fully in class
Contribution frequency	Does not speak up/contribute in class	Occasionally speaks up/contributes in class	Speaks up/contributes in all classes
Contribution quality	No contributions/Contributions lack substance	Contributions demonstrate knowledge of subject matter	Contributions are constructive and insightful

ⁱ Define the subject matter at hand.

ⁱⁱ Discuss the subject matter from various theoretical perspectives.

ⁱⁱⁱ Assess the truth, relevance and strength of evidence used to support arguments.

^{iv} Bring to light hidden assumptions of arguments and examine the influence of the context on the subject matter and discuss the contingencies that constrain the validity of arguments.

^v Integrate, synthesize, or reconcile the various arguments presented and draw conclusions on the subject matter.