COURSE OUTLINE: AB1202 Statistics & Analysis

Academic Year	2022-2023	**Semester**	Sem 2
Course Coordinator	Dr Michael Li (zfli@ntu.edu.sg)		
Course Code	AB1202		
Course Title	Statistics & Analysis		
Pre-requisites	N/A		
No of AUs	3 AUs		
Contact Hours	*3 hours per week (1hr online E-lecture; 2hr in-person seminar)*		

A) Course Aims

This course introduces the concepts and methods of statistical inferences: the process of inferring unknowns based on collected data. Students of this course will also learn basic programming skills to conduct statistical analyses in the R environment.

This course consists of three main modules. Module 1 introduces elements of probability theory. Module 2 covers the method of statistical inferences. Module 3 introduces two applications of statistical inferences, linear regression and simulation analysis.

B) Intended Learning Outcomes (ILO)

By the end of this course, you (as a student) should be able to:

1. Relate the theory of statistical inferences to business applications
2. Run simulation and regression analyses
3. Use R to conduct statistical analysis and interpret the results

C) Course Content

Module 1: Elements of probability

- Understand probability
- Conditional probability and statistical independence
- Random variables and probability distributions
- Expectations

Module 2: Statistical inferences

- Sampling and sampling distribution
- Confidence interval (CI)
- Null hypothesis statistical testing

Module 3: Simulation and Regression analysis

- Regression analysis and variable coding

- Conduct simulation analysis in the R environment

D) Assessment (includes both continuous and summative assessment)

Component	ILO tested	NBS Learning goals (Apx. 1)	Weight	Team /Individual	Assessment Rubrics
1. Individual participation	ILO1	C	10%	Individual	Appendix 1
2. Computer Quizzes	ILO2, ILO3	AK, PSDM	50%	Individual	
3. E-learning and online tests	ILO2, ILO3	AK, PSDM	20%	Individual	Appendix 1
4. Group project & presentation	ILO1	C	20%	Team	Appendix 2
Total			100%		

Explanations and course policies

1. Participation
Students are rated based on the *frequency* and *quality* of their interactions with their peers and instructor. "Quality" refers to opinions that are correct, thorough, and opens up a productive path of inquiry (i.e., Wow!). To meaningfully participate in class discussion, come to your class prepared.

2. Quizzes
Students of this course will complete two (2) **CLOSED-BOOK computer-based quizzes**.

	Date	Coverage	Weight
Quiz 1	22 Feb 2023 (Wed), Venue: NBS ITL Labs 6:30pm - 9:30pm	Weeks 1 to 5	20%
Quiz 2	15 Apr 2023 (Sat), Venue: NBS ITL Labs 10:00am - 1:00pm	Weeks 6 to 12	30%

The quiz questions are set primarily based on the lecture videos, online self-assessment exercises, and tutorial questions.

3. E-learning component

The e-learning materials are on the NTU Learn. **The materials for each teaching week will be viewable starting on Sunday two weeks prior.**

The weekly e-learning materials include (1) lecturing videos by Dr Chen Chien-Ming, AB1202 Course Coordinator in Semester 1, (2) self-assessment exercises (after each lecture video).

Evaluation

To receive the full 20% of this component, students must (1) complete all weekly exercises before their due dates, (2) obtain full marks for all weekly exercises.

As students may add/drop during Weeks 1-2, please note that only the assignments ***from Week-3 E-learning (Week 3 inclusive)***[1] **onward will be marked in this component.**

- *Late submissions*

Students should complete e-learning activities of the week latest by **11:00pm on the Sunday** of the seminar, that is, 11:00 pm of the Sunday **before** the class of the week.

The completion status is recognized by the timestamps at which *you complete **all sets of exercises***. Please be reminded that multiple sets of exercises are on the same web page, typically one after each video. You must complete **all of them**. Incomplete submissions will be considered late as well.

Penalty for 1 late assignment = 2%
Penalty for 2 late assignments = 5%
Penalty for 3 late assignments = 9%
Penalty for 4 late assignments = 14%
Penalty for 5 or more late assignments = 20% (i.e., zero mark for this component)

Note: The late assignments is counted by week, e.g., the penalty for missing one or five questions for a particular week is the same.

Penalties will not be waived after W3 (W3 inclusive) for any excuses -- including computer/internet problems, sudden illness, family emergency, "I forgot" etc. To avoid penalties, please plan ahead and refrain from last-minute submissions.

NOTE: International students or students travelling overseas (regardless of your travel arrangement) are subject to the same grading rule described above.

- *Assignment grading*

As noted, late submissions will receive a penalty and will not be marked. Submissions made before the deadline will be marked based on the last attempt.

Specifically, students are allowed unlimited attempts at the questions before the deadline. **The mark will be decided only based on the last attempt, not your best attempt.** Note that detailed feedback and hints for the questions will be shown after you submit the 1st attempt, which implies that **you can obtain full marks by redoing the test with the right answers by digesting the feedback**.

Finally, you can review your submission status, past E-learning questions and answers under *My Gradebook* on the LEC website.

[1] As W1-W2 allows add-drop, late submission penalty will be waived.

5. Group project (20%)
Each project group should consist of a maximum of five students (exceptions must be granted by the instructor) from the same class.
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The deliverables include (1) a group presentation video not longer than 8 minutes (15%) (2) an one-pager self-reflection + self-peer reviews (5%).

Please see Appendix 2 for further detail.

We will keep track of all assignments (current & past). Please follow the guideline of Academic Integrity when preparing this assignment to avoid disciplinary actions due to plagiarism.

Please note that we expect all students in a group to have the highest standard of work ethic and contribute earnestly and equally to the deliverables. As in any teamwork, students should also strive to resolve individual differences among group members and work collaboratively. As such, students from a project group in principle should receive the same marks (with necessary adjustments made according to individual presentation performance. The instructor will reserve the right to intervene and moderate the mark shall major anomalies come to his/her attention.

E) Formative Feedback

Students will receive formative feedback after completing the online exercises that follow the online lecture. Additional feedback may be provided by the instructor during the class.

F) Learning and Teaching Approach

The course follows the blended learning design, whereby students pick up the main concepts thru online learning materials before the seminar of the week. Students can assimilate the content at their own pace and are advised to repeat the online videos and exercises shall they wish to. To maximize the learning outcome, students should properly review the e-learning materials and complete the accompanying exercises before each seminar.

The seminar allows students to clear their queries interactively with their peers and the instructor.

G) Readings and References

This course does not require a textbook. Below is a list of the recommended reference books. Students are encouraged to work through the relevant exercises therein. You can find them from the course reserve and online library.

Key theory books:

DeGroot MH, Schervish MJ (2012). Probability and statistics, 4th ed. Addison Wesley. ISBN-13: 978-0-321-50046-5.

Law, A. M., Kelton, W. D., & Kelton, W. D. (2000). Simulation modeling and analysis. New York: McGraw-Hill.

Wooldridge JM (2009). Introductory econometrics: a modern approach, 4th ed. South-Western Cengage Learning. ISBN: 978-0-324-58162-1. NTU Business Library. Call Number: HB139.W913i 2009. [e-book available from NTU Library]

Exercise books:

Jaggia S, Kelly K (2019). Business Statistics – Communicating with Numbers, 3rd ed. McGraw-Hill International. ISBN 13: 978-1-260-28837-7.

Keller G (2014). Statistics for Management and Economics, 8th ed. Cengage. ISBN 13: 978-0-324-56949-0. NTU Business Library Call Number: HD30.215.K29 2008.

Weiers RM (2008). Introduction to Business Statistics, 6th ed. South Western Cengage Learning. ISBN 13: 978-0-324-38143-6. NTU Business Library Call Number: HF1017.W418 2008.

H) Course Policies and Student Responsibilities

(1) General

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

(2) Absenteeism

Absence from class without a valid reason may affect your learning and 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. Students are also obliged to inform their course instructor of their absence at the earliest convenience. Tardy notifications may not be accepted.

I) Academic Integrity

Good academic work depends on honesty and ethical behavior. 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

Instructors	Contact email	Tutorial Groups
Michael Li (Course Coordinator)	zfli@ntu.edu.sg	17, 18
Gan Chui Goh, Joan	jcggan@ntu.edu.sg	13, 14
Michele Nguyen	michele.nguyen@ntu.edu.sg	2, 7 10
Tan Chor Hoong	ch.tan@ntu.edu.sg	1, 3, 4
Josephine Zhou	josephine.zhou@ntu.edu.sg	15, 16
Wu Yuan	aywu@ntu.edu.sg	5, 6, 8, 9, 11, 12

K) Planned Weekly Schedule

Note that the first session will commence in Teaching Week 1 of the academic calendar

Week #	Topic	Suggested readings*	Notable R learning points*	Note	Outcomes Covered
I. Elements of Probability					
1	Probability basics	[Weiers]: 5.2,5.3 [Keller]: 6.1,6.2 [Jaggia]: 4.1 [DeGroot]1.3,1.4,1.6	Basic arithmetic operations		ILO-1
2	Counting methods, Conditional probability	[Weiers] 5.4,5.5,5.7 [Jaggia] 4.2 [DeGroot]1.7,1.8,2.1,2.2	Combinatorial calculations		ILO-1
3	Random variables (RV) and distribution function	[Weiers] 6,7 [Keller] 7,8 [Jaggia] 5,6 [DeGroot] 3.1,3.2	Four basic commands related to RV's		ILO-1
4	Expectations	[Jaggia] 5.2,5.3 [DeGroot] 7.1			ILO-1
5	Bivariate distributions and correlation	[Keller] 7.2 [DeGroot] 3.4,3.6,4.6	Load data files R		ILO-1

II. Sampling & Statistical Inference					
6	Sampling distributions	[Weiers] 3 [Keller] 4.1,4.2,4.3 [Jaggia] 3	Box plots, descriptive statistics		ILO-1, ILO-3
7	Central Limit Theory	[Weiers] 8.3 [Keller] 9.1	For-loop in R. Random samples	**Quiz 1 (W1—W5)**	ILO-1, ILO-3
RECESS WEEK					
8	Confidence intervals	[Weiers] 9.4,9.5 [Keller] 10 [Jaggia] 8.1,8.2			ILO-1, ILO-3
9	Hypothesis testing	[Weiers] 10 [Keller] 11.1,11.2,12.1 [Jaggia] 9.1,9.2,9.3			ILO-1, ILO-3
III. Regression & Simulation Analysis					
10	Regression analysis I	[Wooldridge] 2,3,6.2,7	Regression analysis in R		ILO-2, ILO-3
11	Regression analysis II	[Wooldridge] 2,3,6.2,7	Regression analysis in R		ILO-2, ILO-3
12	Simulation analysis	Class notes	For-loop		ILO-2, ILO-3
13				**Quiz 2. (W6--W12)**	

* The suggested readings do not fully match the course content. For detailed course coverage, please refer to the PowerPoint slides

Software Requirement

Students of this course will learn how to conduct data analysis, computations, and graphic generations in R. Thus, students are advised to read thru the course document that introduces R (covering installation and basic functionalities) asap and get some hand—especially for those of you who are new to it or have limited software experiences.

Appendix 1: Course Learning Objectives & Assessment Criteria

- **Course Learning Goals**

NBS LEARNING GOAL	LEARNING OBJECTIVE
Acquisition of Knowledge (AK)	Acquire basic knowledge of statistical theories and understand the connection among them
Problem Solving & Decision Making (PSDM)	The ability to generate a plan to solve statistical problems, implement and evaluate the plan and make sound business recommendations
Oral & Written Communication (C)	The ability to communicate clearly with others verbally. The communicator expresses the intended message in an understandable way.

- **Individual Participation (10%)**

Criteria	Standards		
	Fail standard (<40% marks)	**Pass standard (40%-70% marks)**	**High standard (70%-full marks)**
Contribution Quality	Asks questions that reflect little preparation or lack of attention to remarks of peers and/or the instructor	Asks questions that reflect appropriate preparation or lack of attention to remarks of peers and/or the instructor	Asks questions that advance the level and depth of conversation/discussion
Contribution Frequency	Seldom speaks up	Occasionally speaks up	Frequently speaks up

- **E-learning & Online Tests (20%)**

Criteria	Standards		
	Fail standard (<40% marks)	**Pass standard (40%-70% marks)**	**High standard (70%-full marks)**
Problem Solving	Lack the ability to solve basic questions that require little to no synthesis of topics from the learning materials	Possess the ability to solve intermediate questions that require some synthesis of topics from the learning materials	Possess the ability to solve questions that require a broad synthesis of topics from the learning materials
Pre-Class Online Learning	Unable to complete online learning frequently and the answers are mostly incorrect	Unable to complete online learning sometimes and some answers are incorrect	Always complete online learning on time and the answers are all correct

Appendix 2: Group Project (20%)

A. Group Presentation Video (15%)

To select a presentation topic, please visit ***https://www.mindsumo.com/*** and select a project posted on the website. Both "solved" and "unsolved" projects can be considered.

Note that the mindsumo project is to provide a business context for the problem. Your presentation needs not follow the all details described in the listing (e.g., the product type, the country, etc.) Nor are you required to address all problems in the project listing.

The presentation should include these components: (1) Introduce the problem and your recommendation, (2) Statistical analysis of the problem, and (3) Discuss the implications for the problem/recommendation (i.e., what do the results from (2) inform you about (1)?)

The focus of this presentation is **not** on statistical methods but on how the statistical methods you know can be interfaced with your business solutions. Finally, as in any presentation, make the presentation stimulating/intriguing.

Q: Do I need to collect data?
A: Not required. You can use illustrative numbers/data. But certainly, you can collect data if you think that can enhance your project.

Q: Do I need to focus more on statistics or the solution?
A: Statistical "theory" should not be the focus. Rather, explain how statistics can be the "enabler" of your solution. E.g., how can statistics enhance or measure the effectiveness of your solution (or provide decision support)?

Submission:
A submission link will be created on the AB1202 LEC website under "*Group Presentation*." Please use the provided word template (Group assignment template.docx) to prepare your submission (i.e., only submissions of the word file are required, not the video file).

Name your assignment as "*AB1202AY22S2-T_X-Grp_Y*." Replace "X" with your seminar group number and Y with a group identifier (if available).

Designate one group member to submit this assignment. Do not make duplicate submissions.

The assignment must be submitted to both the LEC website **and** to your course instructor (e.g., by email or NTULearn. Consult your instructor). **The submission will be considered complete only when you do both. Otherwise, the late submission penalty may apply.**

This assignment is due by noon of the Friday of Week 14. Late submissions will be penalized: -15% for 0-3 hrs, -50% for 3-24 hrs, and -100% for more than 24 hrs.

The presentation must be original work and comply with NTU Academic Integrity.

- **Assessment Rubrics for Group Presentation**

Category	Scoring Criteria			Total Points	Score
	Fail standard (<40 %)	Pass standard (40%-70%)	High standard (70%-100%)		
Content & organization (group) (50%)	Propose an innovative and thought-provoking solution			20	
	The proposed statistical analysis is logically coherent with the proposed solution			20	
	The overall transition from the start to the end of the video is smooth and appealing			10	
Presentation (individual) (50%)	Make your core arguments clearly and confidently/appropriately			20	
	Your presentation is relevant to or builds towards the central message of the entire video			20	
	Your presentation is attention-getting			10	
			Total	100	

B. One-page Reflection + Self/Peer Evaluation (5%)

- **One-page reflection**

Format: Use a cover page to indicate your name and seminar group. For the write-up, use an A4 paper, 11-pt font size, & 1.5 line spacing, with a one-inch margin on each side.

Explain succinctly the following two points (1) "Project" journey (from ideation to video production): What did you do and what did you learn? (2) Reflection: Looking back, what would you do differently for the project?

You are not required to devote equal space to these two points. Do not include the title of this assignment or the above two points in the main text.

- **Self-peer reflection (online)**

Complete the attached evaluation form for yourself and your teammates (1 form/person). Append the forms to the Reflection.

- **Submissions**

Submissions of this assignment are individual (i.e., each student should submit his/her reflection+review to the seminar instructor) and separated from the above video assignment.

Please consult your instructor regarding how he/she would like you to submit this assignment (e.g., via email or thru NTULearn).

- **Marking**

The peer-review forms will not be marked. However, failing to complete the peer-self reviews will adversely affect your marks.

The reflection will be marked based on the content/depth (80%) and writing (20%).

- **Self & Peer Evaluation Form (online at NTULearn)**

Please evaluate _____'s contributions to the group assignment.

	Strong Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strong Agree (5)	Score
1. Comes to group meetings on time	☐	☐	☐	☐	☐	
2. Is prepared for meetings and contributes ideas to meetings	☐	☐	☐	☐	☐	
3. Have a good sense of teamwork and is pleasant to work with	☐	☐	☐	☐	☐	
4. Able to meets deadlines	☐	☐	☐	☐	☐	
5. Produces professional and high-quality deliverable	☐	☐	☐	☐	☐	
					Total	
Any other thoughts or comments about yourself and your peers						