17-611: STATISTICS FOR DECISION MAKING

T, Th., 1:30PM-2:50PM, Remote, Recitation for overseas students, Th. 8:00-9:00AM. All times and dates are Easter Standard Time
A1, Fall 2020, 6 Units

Instructor	Email	Office Location & Hours
Prof. Eduardo Miranda	mirandae @ andrew.cmu.edu	Remote, by appointment

Course Description. From the selection a software package to the prioritization of requirements, decision making is central to the software engineering discipline. This course is designed to acquaint students with the limitations of unaided decision making and propose structured approaches to overcome them. The course combines a refresher on probability and statistics with an introduction to measurement and decision making theory, to enable students make better decisions. After completing this course, students will be able to describe the bias that affect the unaided decision making process and be capable of formulating a decision problem in terms of a matrix of alternatives, preferences and consequences, as well as defining, collecting and synthetizing the data required to make the decision.

Prior Knowledge. Undergrad course on probability and statistics.

Learning Objectives. After completing this course, you will be able to:

- Apply basic techniques for inferential statistics
- Design and apply selection process
- Define valid measurements

Learning Resources. Reading material is provided.

Probability and Statistics, self-study course, OLI, https://oli.cmu.edu/
Thinking, Fast and Slow, D. Kahneman, Talks at Google
Measurement Theory for Software Engineers, G. Ford, CMU/SEI-93-EM-9
Practical Guidelines for Measurement-Based Process Improvement, L. Briand et al, ISERN
How to construct a questionnaire in Educational Research: Quantitative, Qualitative, and Mixed Approaches, B. Johnson et al, 2020
A Primer on Process Mining, 2nd, D. Ferreira, 2020
Understanding Experimentations Platforms, A. Aijaz et al, 2018
Software Engineering Metrics: What Do They Measure and How Do We Know? C. Kaner et al, 2004

The Human Element of Decision Making in Systems Engineers: A Focus on Optimism, Valerdi et al, 2009
Estimating Probable System Cost, S. Book, 2001
Decision Making and Concept Selection in Engineering Design, G. Dieter et al, 2009
Modeling and Simulation in Practical Risk Assessment for Project Management, S. Grey, 1995
Performance and Decision Making in Group Dynamics 7th, D. Forsyth, 2019
Structured Decision Making, R. Wilson et al, 2011
Diversity and Creativity in Work Groups in Group Creativity Innovation Through Collaboration, F. Milliken et al, 2003

Use of Zoom in the Class. In our class, we will be using Zoom. The link is available on Canvas. Please make sure that your Internet connection and equipment are set up to use Zoom and able to share audio and video during class meetings. (See this page for Computing Resources for information on the technology you are likely to need.) Let me know if there is a gap in your technology set-up as soon as possible, and we can see about finding solutions.

Sharing video: In this course, being able to see one another helps to facilitate a better learning environment and promote more engaging discussions. Therefore, our default will be to expect student to have their cameras on during lectures and discussions. However, I also completely understand there may be reasons students would not want to have their camera son. If you have any concerns about sharing your video, please email me as soon as possible and we can discuss possible adjustments. Note: You may use a background image in your video if you wish; just check in advance that this works with your device(s) and internet bandwidth.

During our class meetings, please keep your mic muted unless you are sharing with the class or your breakout group.

If you have a question or want to answer a question, please use the chat or the "raise hand" feature (available when the participant list is pulled up).

Course and Grading Policies

The course features two parallel tracks. A self-study track which corresponds to the probability and statistical topics, delivered through the Open Learning Initiative (https://oli.cmu.edu/) platform, and a series of instructor led lectures for the measurement and decision making topics. The rational for the choice of architecture was, that the probability and statistics part is a refresher, so it was better to reserve the lecture time for those topics expected to be new for the students. See Figure 1. The grading philosophy is explained on Figure 2.
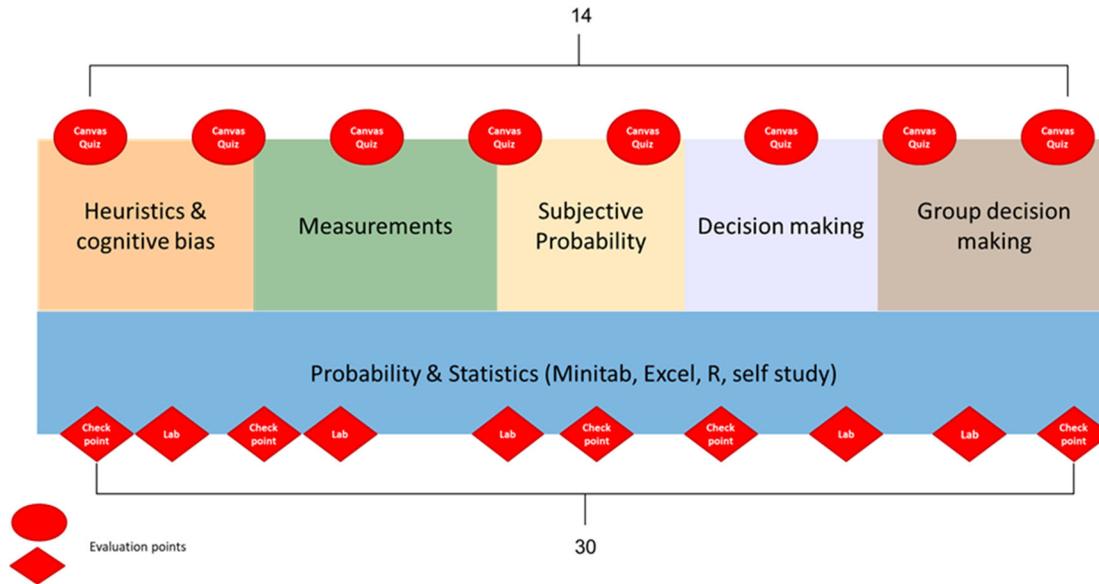
Figure 1 Course architecture

- Low stakes, incremental, self regulated ➡ Many small evaluations

- Allows for less than perfect
- Tolerates a few mishaps. There are no excuses accepted, except for major cause ➡ The total of the points adds to more than 100%, so you can get a few bad grades or miss an assignment, and still get an "A"

- <u>Penalizes consistent failure to perform</u> ➡ If you consistently miss deliveries, skip classes and get bad grades you will fail the course

Figure 2 Grading philosophy

Final grades in the course will be assigned according to the following scale:

- Maximum number of points = 118
- 110+ points, "A+"
- 100+ points, "A"
- 90+ points, "A-"
- 75+ points, "B+"
- 70+ points, "B"
- 65+ points, "B-"
- 55+, "C"
- "D"

Individual assignments will be graded as follows:

- In class CANVAS quizzes: 0-2 points each, 28 points maximum
- Self-study exercises, 0-3 points each, 90 points maximum
- The OLI platform grades the assignments on a 0-100% scale, the points for each assignment will be $= 3 \times OliPercentageGrade$, e.g. $OliPercentageGrade = 80\% \rightarrow PointsInAssignment = 2.4$

Grading policy for the self-study assignments

- Only checkpoints are graded. Labs are recommended but not required. Submitting the feedback forms about the course is at your discretion
- Not all assignments require the same amount of effort, some are longer than others. Plan ahead by looking at the syllabus in the OLI website
- The checkpoints are available now. They can be completed at any time before the due date
- All checkpoints, but the last one are due on Tuesdays at 1:00PM. The last one is due on Thursday, October 15th, at 1:00PM
- Every checkpoint, has up to two attempts, you can take one or both. The grade will correspond to what you scored in your last attempt
- Beware that the question in the second attempt are different from those in the first
- After submitting any attempt, you will get feedback explaining why your answer is right or wrong, but you will not be able to change your responses

Grading policy for Canvas assignments

- These quizzes serve a double purpose:
    - To track class attendance
    - To make sure the students look back at the material presented in class
- Quiz
    - Duration 10 minutes, at any point during the class
    - Typically, 2 multiple choice questions referring to what was presented in the slides in the previous lecture

- Grading, 1 point for taking the quiz, 0.5/1 point for correct answer

Recording of Class Sessions. All synchronous classes will be recorded via Zoom so that students in this course (and only students in the course) can watch or re-watch past class sessions. Please not that breakout rooms will not be recorded. I will make recordings available on Canvas as soon as possible after each class session (usually within 3 hours of the class meeting). Recordings will live in our Canvas website. Please note that you are not allowed to share these recordings. This is to protect your FERPA rights and those of your fellow students.

Course Schedule. The following schedule provides a general overview of topics and assignments and will be not updated during the course. For actual dates and changes, please refer to the online syllabus in Canvas.

No.	Date	Lecture topic	Assignment due (All labs and checkpoints for the corresponding modules)	Supporting material
1	T, Sep 1, 2020	Introduction, bias testing, decision quality, policies explanation		-
2	Th, Sep 3, 2020	Dual process theory of thought: System 1 and System 2, Common cognitive bias: Framing, representativeness, availability, confirmation, anchoring and overconfidence; bounded rationality		https://www.youtube.com/watch?time_continue=1101&v=CjVQJdIrDJ0&feature=emb_logo
3	T, Sep 8, 2020	Introduction to measurement. Definitions, representational condition, validity, scales, reliability, resolution	Module 4 & 5	Ford, Measurement Theory for Software Engineers
4	Th, Sep 10, 2020	GQM		Practical Guidelines for Measurement-Based Process Improvement
5	T, Sep 15, 2020	Survey design	Module 6 & 7	Johnson, Chapter 8, How to construct a questionnaire, https://www.sagepub.com/sites/default/files/upm-binaries/77685_Chapter_8.pdf
6	Th, Sep 17, 2020	Process mining, A/B Testing		Ferreira, A Primer on Process Mining, 2nd, https://www.springer.com/us/book/9783030418182 Aijaz, Understanding Experimentations Platforms
7	T, Sep	Metrics frameworks, motivational	Module 8 & 9	Kaner, Software

	22, 2020	measurement value of information		Engineering Metrics: What Do They Measure and How Do We Know?
8	Th, Sep 24, 2020	Subjective probability, overconfidence, calibration		Valerdi, The Human Element of Decision Making in Systems Engineers: A Focus on Optimism
9	T, Sep 29, 2020	Subjective probabilities, typical distributions, elicitation	Module 10 & 11	Book, Estimating probable system cost
10	Th, Oct 1, 2020	Decision making. The decision making process, utility theory, decision matrices, consequences: immediate, lifecycle		Dieter, Decision Making and Concept Selection
11	T, Oct 6, 2020	Decision making. Options thinking, tradeoff analysis, Monte Carlo simulations	Module 12, 13 & 14	Grey, Modeling and Simulation
12	Th, Oct 8, 2020	Group decision making. The value of diversity, social and In-group bias: conformity, groupthink, groupshift, shared information bias		Foresyth, Performance and Decision Making
13	T, Oct 13, 2020	Group decision making. Methods		Wilson, Structured Decision Making
14	Th, Oct 15, 2020	Optional lecture/buffer	Module 15, 16 & 17	Milliken, Diversity and Creativity in Work Groups

Accommodations for Students Disabilities. If you have a disability and have an accommodations letter form the Disability Resources office, I encourage you to discuss your accommodations and needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at access@andrew.cmu.edu.

Academic Integrity. Honesty and transparency are important to good scholarship. Plagiarism and cheating, however, are serious academic offenses with serious consequences. If you are discovered engaging in either behavior in this course, you will earn a failing grade on the assignment in question, and further disciplinary action may be taken.

For each major assessment, you will be asked to sign a statement affirming that you will not cheat, plagiarize, or receive unpermitted assistance on the work that you turn in. For a clear description of what counts as plagiarism, cheating, and/or the use of unauthorized sources, please see the University's Policy on Academic Integrity.

If you have any questions regarding plagiarism or cheating, please ask me as soon as possible to avoid any misunderstandings. For more information about Carnegie Mellon's standards with respect to academic integrity, you can also check out the Office of Community Standards & Integrity website.

Student Wellness. As a student, you may experience a range of challenges that can interfere with learning, such as strained relationships, increased anxiety, substance use, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may diminish your academic performance and/or reduce your ability to participate in daily activities. CMU services are available, and treatment does work. You can learn more about confidential mental health services available on campus at the [Counseling and Psychological Services](#) website. Support is always available (24/7) from Counseling and Psychological Services: 412-268-2922.

This semester is unlike any other. We are all under a lot of stress and uncertainty at this time. Attending Zoom classes all day can take its toll on our mental health. Make sure to move regularly, eat well, and reach out to your support system or me if you need to. We can all benefit from support in times of stress, and this is semester is no exception.

Respect for Diversity. It is my intent that students from all diverse backgrounds and perspective be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength, and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know if any of our class meetings conflict with your religious observations so that I can make alternate arrangements for you.