



Carnegie Mellon University
Master of
Software Engineering

17-611: STATISTICS FOR DECISION MAKING

T, Th., 1:25-2:45PM, In-person expectation, A1, Fall 2021, 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

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 rationale 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.

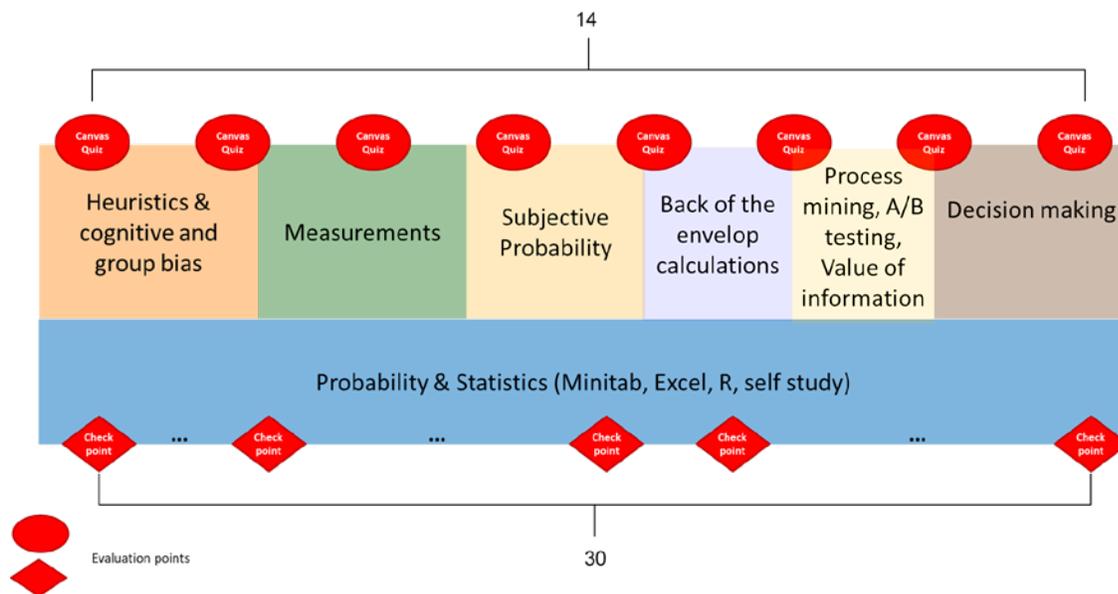


Figure 1 Course architecture

- Low stakes, incremental, self regulated  Many small evaluations
- Allows for less than perfect  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"
- Tolerates a few mishaps. There are no excuses accepted, except for major cause
- Penalizes consistent failure to perform  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"

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, are due Tuesdays 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 questions 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 comprehend 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 lectures
 - Grading, 1 point for taking the quiz, 0.5/1 point for correct answer
- **Late-work policy:** All work is expected to be handed in at the indicated due date and time. For fairness to the whole class, no late submissions will be accepted. In the first week of classes, you will receive a course schedule for the course; please use them to plan ahead.
- **Participation policy.** Class participation will be graded by in-class engagement, including asking relevant questions based on a critical review of required readings, lectures, and comments made by your peers. The lack of attendance, and the use of mobile devices — including phones, tablets, and laptops — for purposes other than participating in class, will count against your participation grade.

This semester involves regular use of technology. Research has shown that divided attention is detrimental to learning; I encourage you to close any windows not directly related to what we are doing while you are in class. Please turn off your phone notifications and limit other likely sources of technology disruption, so that you can fully engage with the material, each other, and me. This will create a better learning environment for everyone. A laptop will be required for our in-person classes. If you do not have access to one, please email me mirandae@andrew.cmu.edu as soon as possible so we can find a solution

Attendance. In order to attend class in person, I expect that you will abide by all behaviors indicated in [A Tartan's Responsibility](#), including any timely updates based on the current conditions.

Facial coverings. If you do not wear a facial covering to class, I will ask you to put one on (and if you don't have one with you, I will direct you to a distribution location on campus). If you do not comply, please remember that you will be subject to student conduct proceedings, up to and including removal from CMU. Accordingly, I will be obliged to take other measures for the safety of the whole class.

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 note 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). Please note that you are not allowed to share these recordings. This is to protect your FERPA rights and those of your fellow students.

Transferring to Fully Remote During the Semester. If the class needs to go fully remote, you will receive an email from me and an announcement will be published on our course website on Canvas.

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 | Tuesday, August 31, 2021 | Introduction, bias testing, decision quality, policies explanation | | - |
| 2 | Thursday, September 2, 2021 | Dual process theory of thought: System 1 and System 2, Common cognitive bias: Framing, representativeness, availability, confirmation, anchoring and overconfidence; bounded rationality. Counterproductive group behaviors | | Thinking, Fast and Slow Daniel Kahneman Talks at Google (Links to an external site.)  Groupthink. Watch at least the six first minutes and take note of events that could lead to bad decision outcomes. We will discuss those in class (Links to an external site.) |
| 3 | Tuesday, September 7, 2021 | Introduction to measurement. Definitions, representational condition, validity, scales, reliability, resolution | Module 4, 5 & 6 | Ford, Measurement Theory for Software Engineers download |
| 4 | Thursday, September 9, 2021 | What should we measure? The Goal Question Metrics approach | | Briand, Practical Guidelines for Measurement-Based Process Improvement download |

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|----|------------------------------------|---|--------------------|---|
| 5 | Tuesday, September 14, 2021 | Measuring people's opinion. Survey design | Module 7, 8 & 9 | Johnson, Chapter 7, How to construct a questionnaire, (Links to an external site.) |
| 6 | Thursday, September 16, 2021 | Metrics frameworks, motivational measurement | | Kaner, Software Engineering Metrics: What Do They Measure and How Do We Know? download |
| 7 | Tuesday, September 21, 2021 | Subjective probability, overconfidence, calibration (1) | Module 10 & 11 | Valerdi, The Human Element of Decision Making in Systems Engineers: A Focus on Optimism download |
| 8 | Thursday, September 23, 2021 | Subjective probability, overconfidence, calibration (2) | | McCahan, Introduction to Estimation download |
| 9 | Tuesday, September 28, 2021 | Back of the envelope calculations | Module 12 & 13 | Book, Estimating probable system cost download Ferreira, A Primer on Process Mining, 2nd, https://www.springer.com/us/book/9783030418182 (Links to an external site.) Aijaz, Understanding Experimentation Platforms download |
| 10 | Thursday, September 30, 2021 | Process mining, A/B Testing, Value of Information, Monte Carlo simulations (1) | | Dieter, Decision Making and Concept Selection download |
| 11 | Tuesday, October 5, 2021 | Process mining, A/B Testing, Value of Information, Monte Carlo simulations (2) | Module 14 & 15 | Grey, Modeling and Simulation |
| 12 | Thursday, October 7, 2021 | Decision making. The decision making process, utility theory, decision matrices, consequences: immediate, lifecycle | | |
| 13 | Tuesday, October 12, 2021 | | Module 16 & 17 | |

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.

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.

If you experience or observe unfair or hostile treatment on the basis of identity you might contact:

- **Center for Student Diversity and Inclusion:** csdi@andrew.cmu.edu, (412) 268-2150
- **Report-It online anonymous reporting platform:** reportit.net username: *tartans*
password: *plaid*

All reports will be documented and deliberated to determine if there should be any following actions. Regardless of incident type, the university will use all shared experiences to transform our campus climate to be more equitable and just.