88-380 Dynamic Decisions
Carnegie Mellon University
Department of Social and Decision Science
Spring 2021: February 1 – May 7

Professor: Cleotilde (Coty) Gonzalez, Ph.D.
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Lectures: Mon & Wed- 4:00PM-5:20PM – Synchronously and Remotely via Zoom:

https://cmu.zoom.us/j/95899178167?pwd=UXkzekYvTWJ2bmNDWGZYL1hENDRVQT09

Meeting ID: 958 9917 8167
Passcode: 528214

TA: Ngoc Nguyen
ngocnt@cmu.edu
Ask the TA! : Tuesdays: 4-5PM and Fridays: 5-6PM– Synchronously and Remotely via Zoom:

https://cmu.zoom.us/j/91807101536?pwd=TWZKODJIcWZrL2N0blplckF0NVM1UT09

Meeting ID: 918 0710 1536
Passcode: 609316

Help wanted: Set up an appointment with Coty or with Ngoc via E-mail.

Prereqs: Basic knowledge of Cognitive Psychology, Statistics, and Programming.

Relevance: DC Gen Ed: Computational Thinking; Complex Problem Solving; Interdisciplinary Perspectives.

Course Description:

Decisions we make every day may range from simple to highly complex. For example, during driving we make many effortless and routine decisions (judging the distance to the front car, the speed, the directions), while other decisions such as allocating limited time over multiple school projects in the presence of overwhelming distractions may be very complex. These and many of the decisions we make over-time are, however, very similar: they are made in the presence of environmental change and in the absence of explicit information regarding probabilities and potential outcomes from decisions made. Some decisions appear simple and others complex because they depend on the experiences decision makers hold and on how such experiences are acquired and used in context. The way humans make dynamic decisions depend on individualized experience, cognitive abilities, and their interaction with the particular conditions of the decision environment.

In this course, students will understand how decisions are made from experience, in different dynamic situations; how our cognitive processes (e.g., attention, memory, risk tendencies, and other factors), and how the characteristics of the environments (e.g., time constraints, workload, dynamic change) influence the way those decisions are made. Students will use simulations of dynamic systems (e.g., microworlds/decision games) to understand how humans learn and adapt to changing conditions of choice. Students will also learn to construct cause-effects causal loop and stock-and-flow diagrams to represent dynamic systems, and to construct actionable models of those systems using Vensim-PLE. Students will learn the process of analyzing complex dynamic decision making problems by working on a semester-long project involving an accident or a disaster (natural or man-made) case in a particular domain (e.g., aviation, management, social issues and others). Students will analyze the sources of error, construct causal-loop diagrams, stock and flow diagrams and represent their models

in Vensim-PLE to construct scenarios that help analyze the consequences of potential decisions in the case example. Students will learn to interpret simulation results to provide decision recommendations, in a final report.

Goals:

By the end of this semester students will be able to:

- Critically analyze complex, dynamic decision making situations to determine sources of human error and biases according to cognitive human factors such as: attention, memory, and experience.
- Utilize simulation-based representations of dynamic decision making problems to explore the sources of human error and possible interventions or solutions.
- Learn to construct model representations of dynamic systems, learn how to simulate a dynamic decision making process, and use modeling and simulation tools to determine the impact of various environmental conditions and propose solutions to potential decision problems.

Textbook and Resources:

Given the novelty and diversity of the topics discussed in this course, no textbook is published yet to fit the plan for this course. To help you in getting information from various sources, I will provide book chapters and research articles that support the different topics of the course. You will be able to access those materials electronically through Canvas.

During the course you will also need to use simulations (microworlds/decision games) developed at the Dynamic Decision Making Laboratory (DDMLab: www.cmu.edu/ddmlab); as well as a modeling product called Vensim-PLE, from Ventana Systems. The free download link for Vensim-PLE is here: http://vensim.com/free-download/. All the software to be used in this course is cost-free and you will be given additional instructions on how to get access, when needed.

Course Plan and Requirements:

The material is divided into four modules: Module I: Foundations of Dynamic Decisions; Module II: Learning and Decisions from Experience; Module III: Concepts of Dynamic Systems; Module IV: System Dynamics Modeling. The lecture sessions are designed to provide conceptual knowledge, but lectures will also provide opportunities for interactive learning, using Vensim-PLE in the classroom.

Each student individually, needs to accomplish: four homework assignments, one semester-long project, in-class quizzes regarding readings assigned for each lecture, and two exams. The descriptions and requirements of semester-long project will be posted on Canvas.

Please attend TA office hours for informal discussions and questions you may have. You may also make appointments for meeting with the TA or with me outside office hours, by sending an E-mail.

Homework and Semester-long Project.

All the requirements for each of the four **homework assignments** will be described in detail at least one week ahead of the due date during the semester.

The **semester-long project** consists of 3 reports of work in progress (milestones), one final presentation, and one final report. You should look closely at the description of the semester-long project available in Canvas.

All homework assignments, milestones, and final report are **due at 4:00PM of the due date identified in the schedule below**. We will use Canvas submission time to determine the lateness of your assignment. **No late submissions are allowed**: **all points will be forfeited for assignments handed in late.**

Exams

Two exams will include multiple-choice and True/False questions. Questions may need you to perform some analyses/calculations or critical thinking before an answer can be found. Some questions may require short written answers in addition to the selection of an option. **Exams will NOT be cumulative**. They will only cover materials not covered in the previous exam. The exams will be based on lecture materials and the content of articles assigned for reading. Exams will take place in the dates **identified in the schedule below.**

In-class Quizzes.

Students will get quizzes to cover research articles assigned for reading to the particular day as identified in the schedule below. Quizzes will include multiple-choice and True/False questions. You are responsible for reading all the material provided to you for the class and for coming prepared to each lecture. Each student is required to read the articles assigned for each lecture. Students are **NOT** allowed to use the research articles while answering this quiz!!

Quizzes will be directly related to the readings assigned for the lecture of the day. Students are required to take a daily quiz **at the beginning of each class: from 4:00-4:10PM**. No make-up quizzes are possible and there is no option to take the quiz at a different time. **Thus, you must be present online at 4:00PM in order to take the quiz**. An access code will be provided to take the quiz for each class. **This code cannot be shared to students that are not attending the class.** Not all lectures will include a reading assignment (and therefore, a quiz). Please see the schedule below.

Grading:

We will use a point grading system. Grading will be based on your cumulative point total for the components listed below:

- **Four homework assignments (48%)**, 12 points each;
- **Two exams (24%)**, 12 points each;
- **Quizzes (4%),** 20 total quizzes, 0.2 points each;
- **One semester-long project (24%),** 24 points total as follows:
  - **Milestone 1:** 2 points
  - **Milestone 2:** 3 points
  - **Milestone 3:** 4 points
  - **Presentation:** 5 points
  - **Final report:** 10 points
- **Attendance to all presentations for the semester-long project is mandatory. Points will be deducted from your own semester-long project grade for every presentation you miss.**

I will aim to post your grades in Canvas within one week of the due date. At the end of the semester, the sum of your points will be converted to a letter grade after rounding up the points as follows: 90-100 points (A), 80-89 points (B), 70-79 points (C), etc. The points will be rounded-up at the end of the semester, but no curves or adjustments are done to the accumulated points otherwise.

Academic Integrity:

Students are expected to respect the integrity of their work as well as that of their classmates. Please refer to the University Policy for further detail. Evidence of cheating or plagiarism will be referred to the Department Head and/or the College. Depending upon the individual violation, students could face penalties ranging from failing the assignment to failing the class. All violations will be reported through the University's Academic Disciplinary Action Procedures for Undergraduate Students, which is published in The WORD student handbook. To learn more about the disciplinary actions that can result from dishonesty, refer to the Office of Community Standards & Integrity**. Do not accept or use copies of previous exams, problem sets, or other assignments from this course that you receive from any source**. Use of previous course materials from any outside source (e.g., fraternity file or other students) will be considered a violation of academic integrity, and if you are found to have obtained or distributed such materials, you will be subject to disciplinary actions.

The instructor may provide lecture materials such as copies of lecture slides posted to the Canvas course site. These materials are the intellectual property of the instructor and are provided for use only by students registered for the course in the current semester. Do not share these materials with people outside the current class or post them to online repositories such as Course Hero. If you are found to have shared course materials inappropriately, you will be subject to disciplinary actions.

Special rules for remote class:

I know we all may feel burned out from spending much time in front of our computers and trying to keep attention during our zoom meetings. I will do my best to make this an effective remote learning experience for you. To accomplish this, please follow the next rules:

1) Please have your camera ON and pointing to your face at all times during the class. I will do the same. Feel free to use a virtual background if privacy is a concern for you.
2) Keep your mics muted during the lecture, but please feel free to unmute any time you have a question.
3) You may also use the "raise hand" feature if you prefer, but unmute and speak up if you are not given a turn, as it is difficult to monitor several different features some times.
4) Please do not use the chat to ask questions or exchange comments during the class. Those questions or comments might be relevant to others in the class, and it would be preferable to speak up and let all know your questions and hear the answers.
5) Be ready to share your screen when asked to do so. There will be times in which demonstrations of your work to the rest of the class will be needed.
6) Please note that all the lectures will be recorded.

Schedule:

Module I: Foundations of Dynamic Decisions				
Date	***Topic***	***Readings Due***	***Homework Due***	***Extra Read/ Examples***
1.Feb. 1	Discussion of course Goals, Syllabus, and Grading policies.			
2.Feb. 3	Overview of Dynamic Decision Making (DDM).	Gonzalez, Fakhari, & Busemeyer, 2017		
3.Feb. 8	Human Error, Hierarchical Task Analysis and Fault Trees	Annett, 2008		Three Mile Island case: McElvily & Le May, 2002
4.Feb. 10	Fault Tree Exercise-Zeebrugge Microworlds Examples: the Water Purification Plant (WPP) and Dynamic Stocks and Flows (DSF)	Gonzalez, Vanyukov, & Martin, 2005	Milestone 1	Zeebrugge Ferry Disaster. WPP: Gonzalez et al. 2003 DSF: Gonzalez & Dutt, 2011
5.Feb. 15	Learning with Microworlds	Gonzalez, 2004		
Module II: Learning and Decisions from Experience				
Date	***Topic***	***Readings Due***	***Homework Due***	***Extra Read/ Examples***
6.Feb. 17	Learning and Instance-Based Learning Theory (IBLT)	Gonzalez, 2013	Homework 1	
7.Feb. 22	Decisions from Experience (DfE) in binary choice	Hertwig & Erev 2009		
8.Feb. 24	IBL models of DfE and binary choice	Lejarraga, Dutt, & Gonzalez, 2012	Milestone 2	Model comparisons: Gonzalez & Dutt, 2011 (Psych Review)

9.Mar. 1	Practice on Binary Choice Tasks of DfE and an IBL model in Shiny R			Links for DfE tasks The IBL Shiny app
10.Mar. 3	DfE in 2-person games	Gonzalez, Ben-Asher, Martin, & Dutt, 2015	Homework 2	
11.Mar. 8	Dynamic Decisions from Individuals to Networks	Lejarraga, Lejarraga, Gonzalez, 2014		
12.Mar 10	Exam 1: Modules I, II			Exam proctored by TA
Module III: Concepts of Dynamic Systems				
Date	***Topic***	***Readings Due***	***Homework Due***	***Extra Read/ Examples***
13.Mar. 15	Building blocks of dynamic systems: Stocks, Flows and Feedback Loops	Meadows, 2008 (chapter 1)		Vensim-PLE installation
14.Mar. 17	Causal Loop Diagrams (CLDs), Stock and Flow Diagrams (SFDs), and fundamental patterns of behavior of dynamic systems	Kirkwood, 2013 (Chapters 1 and 2)		Drawing CLDs and SFDs in Vensim-PLE
15.Mar. 22	Stock and Flow Failure	Cronin, Gonzalez & Sterman, 2009		
16.Mar. 24	Impact of Stock and Flow Failure in Climate Change and Other Global Problems	Sterman, 2008	Homework 3	Dutt & Gonzalez, 2012
17.Mar. 29	The Beer Game: A practical management game of stocks and flows	Sterman, 1989		Beer Game simulation
Module IV: System Dynamics Modeling				
Date	***Topic***	***Readings Due***	***Homework Due***	***Extra Read/ Examples***
18.Mar. 31	Introduction to System Dynamics Modeling	Ford, 2010 (chapter 1)		Vensim-PLE
Apr. 5	BREAK DAY NO CLASSES			
19.Apr. 7	SD modeling exercises I	Ford, 2010 (chapter 2)	Milestone 3	Vensim-PLE
20.Apr. 12	SD modeling exercises II	Kirkwood, 2013 (chapter 8)		Vensim-PLE
21.Apr. 14	SD modeling exercises III	A disaster case study		Vensim-PLE
22.Apr. 19	SD modeling exercises IV	Ford, 2010 (chapter 8)	Homework 4	Vensim-PLE
23.Apr. 21	SD modeling exercises V	Dynamic model of Corona Virus		Vensim-PLE
24.Apr. 26	In-Class questions/exercises and review for Exam 2			Vensim-PLE
25.Apr. 28	Exam 2: Modules III and IV			Exam proctored by TA
26.May 3.	Final Presentations I			
27.May 5	Final Presentations II			
28.May 10.	FINAL project report due			