

**ISE 505: Modeling for Health Policy and Medical
Decision Making**
3 Units

Location:
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Course Description

This graduate level survey course introduces students to modeling techniques used to inform decisions in public health, disease control, and hospital operations.

Learning Objectives

The goal of this course is to provide graduate level students with an overview of modeling frameworks and techniques in healthcare decision making. We will draw from concepts in industrial engineering, epidemiology, and statistics to provide insight into multi-disciplinary problems with real world implications. To this end, we will be critically reviewing papers to see how modeling techniques have been used to address health policy problems, and we will discuss the strengths and weaknesses of various analyses. The course will equip students to pursue research projects using operations research methods and modeling in their own areas of specialization.

Prerequisites

None.

Recommended Preparation

Basic preparation in probability. Advanced undergraduates should obtain instructor permission.

Course Notes

Lecture slides will be posted on Blackboard following the lecture. Homework assignments will be posted one week in advance of the due date.

Technological Proficiency and Hardware/Software

Students should have access to a computer with software capable of basic calculations and simulating probability distributions (Matlab, R, Stata, Excel, etc.). An optional basic introduction to Matlab will be provided to facilitate projects and homework.

Course Schedule

Session	Topic	Due at the beginning of class:
1	Introduction	
2	Overview of Model Frameworks and Decision Trees	
<u>Cost-Effectiveness and Compartmental Models</u>		
3	Cost-effectiveness Analysis	Reading 1
4	Cost-effectiveness Analysis: QALYs and Costs	
5	Markov Processes and Compartmental Models	Project Milestone 1
<u>Model Inputs</u>		
6	Acquiring model parameters	
7	Interpreting regressions for models	
<u>Compartmental Models: Research Examples</u>		
8	Compartmental Models: Research Examples	Reading 2
9	Compartmental Models of Infectious Disease	HW 1
<u>Microsimulation Models</u>		
10	Microsimulation and Agent Based Models	Reading 3
11	Microsimulation: Research Examples	
<u>Calibration, Validation, and Sensitivity Analysis</u>		
12	Calibration and Validation	Project Milestone 2
13	Sensitivity Analysis	
<u>Optimization Models</u>		
14	Optimization for Healthcare Applications	HW 2
15	Optimization: Research Examples	
<u>Network Models</u>		
16	Network Models	
17	Networks in Infectious Disease Research Examples	Reading 4
<u>Bayesian Calibration</u>		
18	Bayesian Methods in Modeling I	Project Milestone 3
19	Bayesian Methods in Modeling II	
<u>Capacity Planning, MDPs, and Queuing Models</u>		
20	Capacity Planning: Research Examples	HW 3
21	Queuing	
22	Queuing: Research Examples	Reading 5
23	Markov Decision Processes in Healthcare	
24	Markov Decision Processes: Research Examples	Reading 6
<u>Value of Information Analysis</u>		
25	Value of Information Analysis	
26	EVSI, EVPI	Reading 7

<u>Student Presentations and Paper</u>	
27	Student Presentations
28	Student Presentations, Wrap Up, and Review
29	Final paper due

Textbooks and Supplementary Materials

There are no required textbooks. Some good reference books are:

1. Margaret L. Brandeau, Francois Sainfort, William P. Pierskalla (Editors). Operations Research and Health Care: A Handbook of Methods and Applications (International Series in Operations Research & Management Science). Springer; 2004.
2. Brian T. Denton (Editor). Handbook of Healthcare Operations Management: Methods and Applications (International Series in Operations Research & Management Science). Springer; 2013.
3. Yasar A. Ozcan. Quantitative Methods in Health Care Management: Techniques and Applications. Jossey-Bass, 2 edition, 2009.
4. Michael Drummond and Alistair McGuire. Economic Evaluation in Health Care. New York: Oxford University Press, 2001.
5. Frederick Hiller, Gerald Lieberman. Introduction to Operations Research (9th edition). McGraw-Hill Science/Engineering/Math; 2009

Description and Assessment of Assignments

Readings:

- Reading 1: CEAs
Weinstein MC, O'Brien B, Hornberger J, Jackson J, Johannesson M, McCabe C, Luce BR. Principles of good practice for decision analytic modeling in health-care evaluation. *Value in Health* 2003;6:9-17.
- Reading 2: Compartmental Models
Hutton DW, Tan D, So SK, Brandeau, ML. Cost effectiveness of hepatitis B screening and vaccination among adult Asian and pacific islanders in the United States, *Annals of Internal Medicine*, 2007, Vol. 147, pp. 460-469.
- Reading 3: Simulation
Suen SC, Bendavid E, Goldhaber-Fiebert JD. Disease control implications of India's changing multi-drug resistant tuberculosis epidemic. *PLoS One*. 2014 Mar; 9(3):e89822.
- Reading 4: Network Models
Enns EA, Brandeau ML. Inferring model parameters in network-based disease simulation. *Health Care Manag Sci* (2011) 14: 174. doi:10.1007/s10729-011-9150-2
- Reading 5: Queuing
de Bruin AM, van Rossum AC, Visser MC, Koole GM, Modeling the emergency cardiac in-patient flow: an application of queuing theory, *Health Care Manag Sci*. 2007 Jun;10(2):125-37
- Reading 6: MDP
Shechter SM, Bailey MD, Schaefer AJ, Roberts MS. The optimal time to initiate HIV therapy under ordered health states. *Operations Research* 2008; 56:20-33.

- Reading 7: VOI
Ades, AE, Lu G, Claxton K. Expected value of sample information calculations in medical decision modeling. *Med Decis Making*; 24(2), 207-27.

Project Milestones and Final Paper:

Milestone 1: Identify your project team members (up to 3 students on a team), your research question, and motivate the research problem. Why is this an important topic? Will it help inform health policy decision makers?

Milestone 2: Describe the structure of your model. Why did you choose this model structure? What advantages and disadvantages are there? Identify data sources for parameterizing your model, and describe how you will build and calibrate the model. The level of detail should be similar to the Methods section of a research article. Responses should be between 2-3 pages double spaced.

Milestone 3: Describe your preliminary results. If these results are correct, what implications do they have for health policy? What additional analyses need to be completed? Describe how you will perform sensitivity analyses. Responses should be between 2-3 pages double spaced.

Final Paper: The final paper should have the following sections, and be limited to 10 pages double spaced, not including tables, figures, and references:

- Introduction/Motivation: What is your research question and why should we care?
- Methods: What did you do to answer the question and why is this reasonable?
- Results: What did you find? How sensitive are they to model assumptions?
- Discussion: What do your results mean? What limitations are there to this study?
- Future Work: If you had more time, what additional resources would you use and how would you use them?

Grading Breakdown

Late assignments will receive no credit.

- Attendance and class participation 10%
- Homework 20%
- Term project milestones 15%
- Term project paper 40%
- Term project presentation 15%

Assignment Submission Policy

Please submit all assignments via Blackboard.

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, “Behavior Violating University Standards” <https://policy.usc.edu/scampus-part-b/>. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

Support Systems:

Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. <https://engemannshc.usc.edu/counseling/>

National Suicide Prevention Lifeline - 1-800-273-8255

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. <http://www.suicidepreventionlifeline.org>

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. <https://engemannshc.usc.edu/rsvp/>

Sexual Assault Resource Center

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: <http://sarc.usc.edu/>

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086

Works with faculty, staff, visitors, applicants, and students around issues of protected class. <https://equity.usc.edu/>

Bias Assessment Response and Support

Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. <https://studentaffairs.usc.edu/bias-assessment-response-support/>

The Office of Disability Services and Programs

Provides certification for students with disabilities and helps arrange relevant accommodations. <http://dsp.usc.edu>

Student Support and Advocacy – (213) 821-4710

Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. <https://studentaffairs.usc.edu/ssa/>

Diversity at USC

Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. <https://diversity.usc.edu/>

USC Emergency Information

Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible, <http://emergency.usc.edu>

USC Department of Public Safety – 213-740-4321 (UPC) and 323-442-1000 (HSC) for 24-hour emergency assistance or to report a crime.

Provides overall safety to USC community. <http://dps.usc.edu>