I. Course Description
This course will focus on the core areas underlying decision analysis and medical decision making: the use of probabilities in medicine, choice and interpretation of diagnostic tests, decision tree construction and analysis, quantifying patient preferences, and cost-effectiveness analysis. Students will learn methodologies for dealing with complex decisions both on an individual patient level and at a policy level, and will have hands-on experience in applying these to a problem of their choice.

II. Prerequisites
None.

III. Learning Objectives
After completion of the course, students should be able to do the following:

Probabilities in medicine:
• explain how the concept of probability is used to make medical decisions
• demonstrate the use of personal experience to make a subjective probability estimate
• describe the concepts and potential biases of three types of heuristics: representativeness, availability, and anchoring and adjustment
• differentiate the 2 methods of objective probability assessment: population prevalence and clinical prediction rules

Diagnostic tests:
• explain how the performance of diagnostic tests is studied
• construct and explain the meaning of the 2 x 2 table
• define and differentiate the meaning of sensitivity, specificity, and likelihood ratios
• calculate these measures from raw data
• calculate post-test probability (predictive value)
• demonstrate how pretest probability, sensitivity, and specificity affect posttest probability
• define and explain the ramifications of the differences between a study population and
  the clinically relevant population
• list the biases that can enter into studies of test characteristics, and explain the expected
  impact that each would have
• create and interpret receiver operating characteristics curves

**Basic decision analysis:**
• define and explain the use of expected value decision making
• define and demonstrate the use of the terminology and notation of decision tree analysis
• construct decision trees for a complex clinical problem
• calculate the expected value of alternative management strategies
• demonstrate the use of the basic approach to handling uncertainty in decision analyses: 1-
  way sensitivity analysis

**Advanced decision analysis:**
• list and differentiate the different ways of handling uncertainty in decision analyses,
  including 2-way and 3-way sensitivity analyses, and Monte Carlo analysis
• demonstrate the use of Markov modeling

**Decision analysis software:**
• use a decision analysis program (DATA) to perform basic and advanced decision analysis

**Assessing patient preference:**
• explain the meaning of a utility
• perform a standard reference gamble to measure utility
• define the meaning of quality-adjusted life expectancy
• perform a time trade-off to measure quality-adjusted life expectancy
• identify sources of potential error in utility assessment

**Cost-effectiveness analysis:**
• define cost-effectiveness analysis, marginal cost-effectiveness, direct and indirect costs,
  discount rate, and cost-benefit analysis
• explain how cost-effectiveness analyses can be used to decide among treatment
  alternatives or to decide where to spend limited resources
• structure a cost-effectiveness analysis as a decision tree
• explain ways of handling uncertainty in cost-effectiveness analyses

**Threshold model of decision making:**
• define the concepts of treatment thresholds
• identify factors which determine the treatment threshold
• explain the threshold model for test selection

**IV. Teaching Format**
Teaching sessions are highly interactive seminars with printed materials for the students,
which make each session function as a workshop.
Software instruction occurs with students actively using the software on their own computers in real time, while the instructor demonstrates use of the program using a computer projector. These occur over 3 sessions, with homework projects assigned in between to consolidate facility with the program.

**NOTE:** Students must bring a laptop computer capable of running Windows to the 4 software instruction sessions.

V. Class assignments, projects, quizzes, tests
There be no quizzes or tests in this class, but student evaluation will be based in part on participation, which requires preparation as outlined in the syllabus and on Blackboard. The largest proportion of evaluation is based on a final project, described in the next section. Weekly homework projects are intended for self-evaluation, but will also be discussed in class as appropriate.

VI. Student Evaluation
Students are evaluated based on:
1. Class attendance and participation (33%). The course is structured so that much of the learning occurs in the interactive discussions that occur within each class session. Evaluation will be based on preparation for the classes, engagement with the discussions, and evidence of understanding of the concepts based on participation.
2. Satisfactory completion of a final decision analysis project (67%). The problem is generated by the student, and may be either a decision analysis or cost-effectiveness analysis. It may be focused on an individual patient decision or a policy decision. Each student works closely with the course director and faculty mentors in developing the problem and the tree, and prepares both an oral presentation for the rest of the class and a written summary of the problem, tree, results, and conclusions.

VII. Readings
There is no required textbook. Readings for some of the sessions will be provided by the instructor. Optional readings will be given from “Decision Making in Health and Medicine: Integrating Evidence and Values” by Myriam Hunink et al. (Cambridge University Press).

**Blackboard**
The syllabus, selected readings, problem sets, and answer sets will be posted on the course’s Blackboard site, available at https://courses.northwestern.edu/webapps/login if you are registered for the course.

VIII. Course Evaluation
The MPH Program administers web-based course evaluations to students for each course near the end of the quarter. **Your completion of both the unit (course) and faculty evaluation components is required; failure to complete either of the evaluations will result in an incomplete grade until the evaluations are submitted.** You will be sent the web link and instructions via email later in the quarter. You will have about two weeks to complete the evaluations before grades are submitted.
IX. Academic Integrity

Every Northwestern faculty member and student belongs to a community of scholars where academic integrity is a fundamental commitment. The Program in Public Health abides by the standards of academic conduct, procedures, and sanctions as set forth by The Graduate School at Northwestern University. Students and faculty are responsible for knowledge of the information provided by The Graduate School on their Web page at http://www.tgs.northwestern.edu/academics/academic-services/integrity/index.html

Academic misconduct includes, but is not limited to

1. Receiving or giving unauthorized aid on examinations or homework
2. Plagiarism
3. Fabrication
4. Falsification or manipulation of academic records
5. Aiding or abetting any of the above

The PPH follows The Graduate School’s procedure for evaluating alleged academic misconduct, as outlined on the TGS website. http://www.tgs.northwestern.edu/academics/academic-services/integrity/dishonesty/index.html

Faculty reserve the right to use the “Safe Assignment: Plagiarism Detection Tool” that is part of the Course Management System to evaluate student assignments. Information about this tool can be found at http://www.it.northwestern.edu/education/course-management/support/assessments/safeassignment.html
## Decision Analysis and Models of Decision Making
### Public Health 431
### Winter, 2014
### Course Schedule
### Wednesdays, 6:00 – 9:00 PM

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic(s)</th>
<th>Preparation</th>
<th>Optional readings *</th>
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</thead>
<tbody>
<tr>
<td>Jan. 8</td>
<td>Orientation, Decision trees, Basic decision analysis</td>
<td></td>
<td>Ch 2, pp 33-40, 53-54</td>
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<td>Ch 3, pp 61-70, 79-83</td>
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<td>Ch 5, pp 149-152</td>
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<td>Jan. 15</td>
<td>Measuring patient preferences and outcomes</td>
<td>Problem set</td>
<td>Ch 4</td>
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<td>Jan. 23</td>
<td>Cost-effectiveness analysis</td>
<td>Problem set</td>
<td>Ch 9</td>
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<td>Jan. 29</td>
<td>Advanced concepts in decision analysis 1 – Markov models</td>
<td>Problem set</td>
<td>Ch 10</td>
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<td>Read article</td>
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<td>• Mammography CEA</td>
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<td>Preliminary choice of project question</td>
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<td>Feb. 5</td>
<td>DATA 1 (decision analysis software): basics of decision tree construction (Bring laptop) Diagnostic test use-1 (calculating post-test probabilities, basic threshold model, ROC curves)</td>
<td>Read articles:</td>
<td>Ch 5, 128-149</td>
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<td>• Tsevat (example of DA article using Markov model)</td>
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<td>• Smith (example of CEA article using Markov model)</td>
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<td>• Mammography CEA</td>
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<td>Construct the Markov tree behind the mammography CEA. Work on project</td>
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<td>Problem set</td>
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<td>Final choice of project question</td>
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<td>Feb. 12</td>
<td>DATA 2 – Markov models, cost-effectiveness analysis (Bring laptop) Incorporating imperfect information into decision trees Handling multiple chance nodes in decision trees</td>
<td>Problem set</td>
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<td>Read article:</td>
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<td>• Ferritin (example of use of ROC’s) Create Module 7 tree structure in DATA Work on project</td>
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<td>Problem set</td>
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<td>Recreate mammography Markov model</td>
<td>Ch 11, pp 344, 349-353</td>
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<td>Feb. 19</td>
<td>DATA 3 – Monte Carlo, use of tables (Bring laptop)</td>
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<td>Feb. 26</td>
<td>Diagnostic test use-2 (Advanced threshold model) Use of decision analysis for diagnostic test thresholds</td>
<td>Problem set Work on project</td>
<td>Ch 6, 157-170</td>
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<td>(Bring laptop)</td>
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<td>Mar. 5</td>
<td>Examination of complex trees (Bring laptop) Extended dominance</td>
<td>Reread articles: • Mammography CEA • Smith CEA Work on project</td>
<td>Ch 9, pp 282-285</td>
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<tr>
<td>Mar. 12</td>
<td>Project presentations-1 Advanced concepts in decision analysis-3: Probabilistic sensitivity analysis in CEA</td>
<td>Read article: • Pletcher (example of use of probabilistic SA) Work on project</td>
<td>Ch 11, pp 353-356</td>
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<tr>
<td>Mar. 19</td>
<td>Project presentations-2 Advanced concepts in decision analysis-3: Net health benefits in CEA</td>
<td>Read articles: • Spronk (example of use of net health benefits Complete project</td>
<td>Ch 11, pp 356-358</td>
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* From “Decision Making in Health and Medicine: Integrating Evidence and Values” by Myriam Hunink et al. (Cambridge University Press).
Project Instructions

Purpose of the project

The project is intended to (1) allow the course director and mentors to evaluate your understanding of the concepts and techniques of the course, and (2) give you an opportunity to gain experience with them. While there is the potential for the projects to develop into a publishable paper, that is not the goal within the course. At most, they should be considered as pilots, although in some cases they might come close to a “finished product”.

Requirements

1. Construct a decision analysis or cost-effectiveness on any question (medical or other) that is of interest.
2. This will entail:
   a. Framing the problem
   b. Creating a decision tree
   c. Finding relevant data, or making up reasonable approximations
   d. Analyzing the tree for its results (expected value, or cost-effectiveness ratios)
   e. Performing at least one sensitivity analysis on a variable
   f. Writing a short report, to include:
      1. Background
      2. Methods (especially assumptions; a table of assumptions is often helpful)
      3. Printout of the decision tree
      4. Results
      5. Printout of sensitivity analysis/analyses
      6. Conclusions, including potential next steps
      7. References, if any

Presentation

Presentation and discussion should be around 20 minutes. You can use PowerPoint or other formats that you find most effective. It should include:

1. Oral presentation, including background, assumptions, decision tree, results, sensitivity analysis/analyses, and conclusions
2. Handouts of trees and sensitivity analyses for each of the students to follow

Timeframe

You should pick at least a tentative project by January 23. You should plan on meeting with the course director or faculty mentor at least 3-4 times in the course of working on the project. This will be to discuss framing the analysis, the decision tree structure, and the analysis itself. You may want to schedule more meetings.