This course will provide an introduction to the use of decision sciences in health care. In addition to developing a conceptual understanding of medical decision making, the course will emphasize technical skills in decision analysis including the creation and evaluation of decision trees, the use of sensitivity analysis, and the incorporation of specific patient preferences for various interventions and health states. The advantages and disadvantages of formal mathematical models for the analysis of clinical conditions will be presented; examples from the current medical literature will be discussed. Homework assignments will be used to practice concepts learned in the course; at the end of the course, students will complete a take-home final exam.

Course Mechanics

This is a 1.0-credit course, with total of 8 sessions (2 hours per session).

Responsibilities and Attendance Policy

Students are expected to read the assigned readings, attend and participate in class, and complete the problem sets and the final exam.

Students are expected to sign in to each class (computer provided outside of classroom). If students encounter any problems, please contact the course instructor(s) and Allie Giel (giela@upmc.edu) immediately.

IMPORTANT: Assignments may be submitted in class or by email; they must be submitted on time to receive credit, even on days when students are absent.

Course Textbook

Assigned readings are based primarily on journal articles (listed in the syllabus). We also use the following text:


NOTE: This is the primary text used in CLRES 2120 / HPM 2220.

Course Grading Policy

Course grades are assigned on the basis of **homework assignments (50%)** and a **final exam (50%)**. The grading scale is as follows:

- A: 93 – 100
- B: 83 – 92
- C: 74 – 82
- D: 65 – 73
IMPORTANT: Students are expected to show their work (e.g., formulas, calculations, and derivations) on all assignments and the final exam; answers must be legible. When the steps or details of your answer are not provided (or are not clearly written), the point values will be awarded at the discretion of the instructor.

Students are encouraged to use Excel worksheets for help with calculations and tree structures.

Homework Assignments (50%)

There are 4 homework assignments, and all of them are posted on Blackboard. The first assignment is worth 5 points; other assignments are worth 15 points. Due dates are posted on Blackboard and also listed below.

Final Exam (50%)

 Students must complete a take-home final exam, which will be posted on Blackboard on the last day of class.

IMPORTANT: Each student is expected to complete the final exam independently. Students should not discuss the exam with others. All questions should be directed to the Course Director or the TA.
University Policies

Academic Integrity

Students in this course are expected to comply with the University of Pittsburgh’s Policy on Academic Integrity. Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include, but is not limited to, the confiscation of the examination of any individual suspected of violating University Policy. Furthermore, no student may bring any unauthorized materials to an exam, including dictionaries and programmable calculators.

For Clinical Decision Analysis, students are encouraged to learn together and to help one another understand the material and the assignments. However, students are NOT permitted to complete assignments together or to submit collective assignments; copying solutions to assignments is a violation of the Academic Integrity policy.

Students should and are expected to work on their final exam independently. Students may direct any questions about concepts, assignments, or the final exam to course director or teaching assistants. There should be no discussion or collaboration about the final exam with any other individuals.

Disabilities

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and Disability Resources and Services (DRS), 140 William Pitt Union, (412) 648-7890/(412) 383-7355 (TTY), as early as possible in the term. DRS will verify your disability and determine reasonable accommodations for this course.

Competencies

Because this course is cross-listed, core competencies are presented in two ways.

First, for students taking this as CLRES 2121, the core competencies in clinical research are listed in the syllabus for every session (see “Clinical Research Competencies”).

Second, for students taking this as HPM 2217, the learning competencies in health policy and management are assessed through the evaluation of assignments and exams. Specific competencies addressed for health policy are as follows:

Cross-Cutting Competencies:

1. Communication. The course will improve communication skills through
   a. explicit statement of assumptions made in addressing problems;
   b. accurate identification, description/definition, and labeling of model parameters (e.g., probabilities, utilities).

2. Analytical Thinking. The course will increase analytic skills through
   a. problem decomposition (breaking down problem into key parts);
   b. systematic problem-solving (requiring students to demonstrate the steps in derivations/calculations to support conclusions);
c. multiple examples and optional problems to practice skills; revisiting examples and expanding their complexity throughout the course.

**Health Policy and Management**

3. Systems Thinking/Problem Solving. The course will enhance systems thinking by
   a. working across multiple disciplines (e.g., medicine, social science) to reinforce concepts and translate terminology;
   b. developing decision trees from a variety of perspectives and understanding the impact of perspective on the structure and parameters included in the tree.

**Competency/Assessment map:**

<table>
<thead>
<tr>
<th>Competencies</th>
<th>Teaching Methods</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>Readings, Lectures, Participation, Exam Preparation/Study</td>
<td>Exams, problem sets</td>
</tr>
<tr>
<td>Analytical Thinking</td>
<td>as above</td>
<td>as above</td>
</tr>
<tr>
<td>Systems Thinking</td>
<td>as above</td>
<td>as above</td>
</tr>
</tbody>
</table>
Session 1  
Introduction and foundation of medical decision making

Concepts and Topics
1. Introduction to the need for decision analysis and conditions required for a problem to be appropriately addressed by a formal decision analysis
2. Prescriptive versus descriptive analysis of problems
3. Examples of clinical/social problems addressed by decision analysis
4. Basic elements of decision analysis (nodes, branches, probabilities, outcomes)

Learning Objectives
- Identify the seven main steps in solving a decision tree
- List the basic elements of a decision tree

Clinical Research Competencies

Problem Formulation: Propose significant and novel empirical, testable, hypothesis-driven research questions using, where appropriate, different disciplines and community engagement.

Required Reading (prior to session)

Session 2  
Psychology of decision making (biases and heuristics)

Concepts and Topics
1. Translating normative decision analysis to descriptive decision making, pitfalls and problems
2. Descriptive decision making (base rate neglect, heuristics, and limits of primate cognitive architecture)
3. Decision making under uncertainty and time pressure, overview of computational decision making models

Learning Objectives
- Define common decision-making heuristics and the potential pitfalls that result
- Identify responses/solutions to common decision-making heuristics

Clinical Research Competencies

Applied Analytic Techniques: Determine and apply a range of appropriate statistical techniques to answer research questions and explain the implications of missing data on conclusions drawn from statistical results.
Methodology: Design basic features of research protocols based on specific research questions, appropriately addressing bias.

Required Reading (prior to session)

Optional Reading

Session 3  
Mechanics of decision analysis and probability review

Concepts and Topics
1. Elements of a decision tree (nodes, branches, probabilities, outcomes)
2. Steps for solving a decision tree (averaging out/folding back)
3. Brief review: contingency tables and probability rules

Learning Objectives
- Solve a simple, “full-information” decision tree
- Use contingency tables and probability rules to solve for unknown probability values

Clinical Research Competencies
*Applied Analytic Techniques*: Determine and apply a range of appropriate statistical techniques to answer research questions and explain the implications of missing data on conclusions drawn from statistical results.
*Data Management and Biomedical Informatics*: Organize datasets (variable display and structure) appropriately for given statistical techniques.
*Written Communication*: Prepare written presentations of research at a variety of stages to a range of audiences, technical and non-technical, and respond to constructive criticism and questions.

Required Reading (prior to session)
  Also CHOOSE 1 of the following articles:
Session 4  Bayes’ Theorem and diagnostic testing

Concepts and Topics
1. Common structural errors and pitfalls in building decision trees
2. Using Bayes’ Theorem in decision trees
3. Special case: diagnostic testing and 2x2 contingency tables
4. Measures of test performance (sensitivity, specificity, PPV, NPV, likelihood ratios)

Learning Objectives
- Apply Bayes Rule to solve for unknown probability values
- Compute performance measures for diagnostic tests
- Recognize synonyms for familiar statistical terminology and concepts used in other disciplines

Clinical Research Competencies

Applied Analytic Techniques: Determine and apply a range of appropriate statistical techniques to answer research questions and explain the implications of missing data on conclusions drawn from statistical results.

Written Communication: Organize and report statistical results.

Multidisciplinary Teamwork: Describe the functions and roles of multiple disciplines with which (students) interact.

Required Reading (prior to session)

Session 5  Value of information and sensitivity analysis

Concepts and Topics
1. Receiver Operating Characteristic (ROC) curves
2. Uses of sensitivity analysis
   - Patient subgroups, examining outcomes in different risk sets
   - Testing the model’s robustness to errors in assumptions
   - Providing information on critical values and areas for further research
3. One-way sensitivity analysis, thresholds
4. Two- and three-way sensitivity analyses

Learning Objectives
- Read and interpret graphs from two- and three-way sensitivity analyses
- Describe the steps for constructing graphs (two-way sensitivity analysis)
Clinical Research Competencies

**Applied Analytic Techniques:** Determine and apply a range of appropriate statistical techniques to answer research questions and explain the implications of missing data on conclusions drawn from statistical results.

**Measurement:** Describe the characteristics of underlying data quality and their ability to answer clinical or translational research problems.

Required Reading (prior to session)


**Session 6**

**Outcomes and value nodes:** payoffs associated with a decision

Concepts and Topics

1. Incorporating single and multiple attributes (payoffs) into decision trees
2. Patient-centered outcomes: health status and quality of life
3. Overview of quality of life measures

Learning Objectives

- Solve simple decision trees using alternative payoff structures (e.g., changing the type of payoff, incorporating more than one payoff)

Clinical Research Competencies

**Applied Analytic Techniques:** Determine and apply a range of appropriate statistical techniques to answer research questions and explain the implications of missing data on conclusions drawn from statistical results.

**Measurement:** Identify basic reliability and validity issues of measuring instruments.

Required Reading (prior to session)


Also CHOOSE 1 of the following articles:


Optional Reading

Session 7 QALYs and utility estimation

Concepts and Topics
1. Computing quality-adjusted life-years (QALYs) (or, “What health status measures cannot do”)
2. Utility theory, preferences, and the value of intermediate states
3. Direct and indirect methods of assessment

Learning Objectives
- Calculate QALYs in applied problems
- Compute utility weights using both direct and indirect methods of assessment
- Identify the strengths and weaknesses of different methods of assessment, when applied to a specific context or clinical setting

Clinical Research Competencies

Applied Analytic Techniques: Determine and apply a range of appropriate statistical techniques to answer research questions and explain the implications of missing data on conclusions drawn from statistical results.

Measurement: Describe the characteristics of underlying data quality and their ability to answer clinical or translational research problems.

Required Reading (prior to session)

Optional Reading
Concepts and Topics
1. Limitations of static trees/nodes for modeling events that occur over time or repetitively
2. Life expectancy models and survival analysis

Learning Objectives
• Construct Markov Process models for basic decision problems with repeated events
• Convert (i.e., show the equivalence between) a basic decision analytical model from tree form to a Markov Process

Clinical Research Competencies

*Applied Analytic Techniques:* Determine and apply a range of appropriate statistical techniques to answer research questions and explain the implications of missing data on conclusions drawn from statistical results.

Required Reading (prior to session)

Optional Reading