

M2191.001400 Decision Analysis in Public Health

Fall 2019

Day and Time: Tuesday (10:00am-12:50pm)

3-credit hours

Classroom: Room 109, Building 221

Office Hour: Tuesday 1:00-2:00pm (Room 427, Building 221)

Instructor

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Course description

Decision analysis is defined as a systematic approach to decision making under uncertainty. Decision analysis is a multidisciplinary science that draws upon statistics, mathematics, economics, psychology, and engineering. It has been applied to a wide range of fields, including business, public health, medicine, environment, social policy, engineering, and meteorology. In the field of public health and medicine, decision analysis is being increasingly used as a framework for economic evaluation of healthcare interventions. This intermediate level course is designed to introduce key concepts and methods of decision analysis as applied to public health and medicine. Topics to be covered include (but are not limited to) decision analysis basics, decision structuring, decision modeling, parameter estimation, Monte Carlo simulation, model validation/calibration, and uncertainty analysis. Real-world application examples and recent trends in the field will be introduced as well.

Learning objectives

By the end of the course, students will be able to do the following:

- Understand the concepts and principles of decision analysis
- Describe the role of decision analysis in public health and medicine
- Understand the steps to construct a decision-analytic model
- Articulate different ways for handling uncertainty in a decision analysis

Prerequisites

- **902.544B Economic Evaluation in Health Care** (mandatory)
- Introductory (preferably intermediate) epidemiology and biostatistics (recommended)

Course format

- The first half of each session will be spent on lecture and class discussion, and the second half on tutorials/exercises, or critical appraisal of relevant articles.
- Students should bring their own laptop for most sessions so that they can work through instructor-assisted exercises using pre-installed EXCEL or a decision analysis software (TreeAge).
- TreeAge Student Course Licenses (which run for 6 months and limit models to 125 nodes or fewer) will be purchased through support by the SNU Graduate School of Public Health and be provided to each of the enrolled students.

Course materials

There is no required textbook for this course, but the recommended and optional textbooks are shown below. The required readings for reading assignments and supplementary readings for each topic are listed under the Detailed Course Schedule pages (pp.5-12) of this document.

Recommended texts:

- Hunink M, Weinstein MC, Wittenberg E, et al. Decision Making in Health and Medicine: Integrating Evidence and Values. Cambridge, UK: Cambridge University Press, 2nd edition, 2014.
- Drummond MF, Sculpher MJ, Claxton K, Stoddart GL, Torrance GW. Methods for the economic evaluation of health care programmes. Oxford, UK: Oxford University Press, Fourth edition, 2015.
- Andrew Briggs, Mark Sculpher and Karl Claxton, eds. Decision modelling for health economic evaluation. Oxford, Oxford University Press, 2006.

Optional texts:

- Edwards W, Miles Jr RF, Von Winterfeldt D, eds. Advances in decision analysis: From foundations to applications. Cambridge University Press; 2007.
- Clemen RT, Reilly T. Making Hard Decisions with Decision Tools Suite, 3rd Edition. Cengage Learning, 2013.

Course requirements

Attendance

- Students are expected to attend all classes. In case of unavoidable absence, students should let the instructor know ahead of time.

Reading assignments

- All students are expected to read all reading materials before attending class.
- The first 5-10 minutes will be spent on reviewing the students' understanding of the reading materials.

Class participation (in-class exercises & class discussion)

- All students are expected to participate in the in-class exercises and class discussion.

Critical appraisal of relevant articles

- For most sessions, one pre-selected student will critically appraise a published article (marked with * in the reading assignments) and lead the class discussion.

- Each student will be assigned 2-3 articles in total, depending on the class size.
- The pre-designated student should submit a 2-page critical assessment of the assigned articles along with 2-5 discussion questions by 5pm the day before each class.
- Students may want to create several slides (not more than 10) for their presentations.
- For more detailed guidance, refer to the accompanying document “**Guide to Critical Appraisal**” (to be posted on eTL). Further guidance will be provided by the instructor throughout the course.

Problem sets

- Four problem sets will be distributed according to the pre-specified schedule.
- Students may use any resources for completion of homework, but problem solving should be individual work. **Group work or consultation with colleagues is NOT allowed.** Any violation of this policy will lead to no grade points assigned to the student.
- Students are expected to submit their written (typed) answers on eTL before the class on each due date. Late submissions will not be accepted.

Final project

- Each student will develop her/his own proposal for a decision analysis of any public health program/intervention in any setting.
- A preliminary proposal topic is due one day before the class for Session10. Each student will present its own topic (10 minutes each) during the class for Session10.
- A final paper is due by the beginning of the class in the last week of the semester. Each student will present (30 minutes each) their final proposal during the last class.
- For more detailed guidance, refer to the accompanying document “**Guide to Final Project**” (to be posted on eTL). Further guidance will be provided by the instructor throughout the course.

Course policies

- **Auditing is NOT permitted for this course.**
- Any violation of academic integrity (e.g., group work on take-home problem sets) will result in a penalty grade.

Student assessment

- A total of 100 points are possible in this course. Grading will be based on the following performance:
 - Class participation (exercises/class discussion): 10
 - Critical appraisal: 20
 - Problem sets: 40
 - Final project: 30 (instructor evaluation: 20, peer evaluation: 10)
- Final letter grades will be assigned according to the following scale:
 - A = 88-100
 - B = 78-87
 - C = 68-77
 - D = 60-67
 - F = below 60

At-a-Glance Course Calendar

Week (Date)	Topic	Tutorial/ Exercise	Critical appraisal	Problem set	Final project
Session 1 (9/3/19)	Introduction to decision analysis		--		
Session 2 (9/10/19)	Workshop I: Using TreeAge	Tutorials for using TreeAge	--		
Session 3 (9/17/19)	Decision analysis basics	Exercises using Excel		PS1 out	
Session 4 (9/24/19)	Decision trees	Exercises using TreeAge	1 article	PS1 due	
Session 5 (10/1/19)	Workshop II: Decision analysis	Exercises using TreeAge	--		
Session 6 (10/8/19)	Markov models	Exercises using TreeAge	1 article		
Session 7 (10/15/19)*	Parameter estimation	Exercises using Excel	1 article	PS2 out	
Session 8 (10/22/19)	Monte Carlo simulation	Exercises using TreeAge	1 article	PS2 due	
Session 9 (10/29/19)	Uncertainty analysis	Exercises using Excel/TreeAge	1 article	PS3 out (due 11/5)	
Session 10 (11/12/19)**	Presentation of topic proposals				Topic proposal due
Session 11 (11/19/19)	Probabilistic sensitivity analysis (PSA)	Exercises using Excel/TreeAge	1 article		
Session 12 (11/26/19)	Value of information (VOI) analysis	Exercises using Excel/TreeAge	1 article	PS4 out	
Session 13 (12/3/19)	Model calibration and validation	Exercises using Excel/TreeAge	1 article	PS4 due	
Session 14 (12/10/19)	Advanced topics in decision modeling		2 articles		
Session 15 (12/17/19)	Presentation of final projects Class wrap-up				Final proposal due

* There will be a class on 10/15/19 though it is SNU Foundation day.

** Note that there is no class on 11/5/19 due to the instructor's business trip scheduled. Also the class time needs to be changed to afternoon hours of 11/12/19 due to the instructor's time conflict with another course.

Detailed Course Schedule

Session 1	Introduction to decision analysis	9/3/19
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Topics:

- Course overview/administration
- Introduction to decision analysis
- Role of decision analysis in health and medicine
- Decision modeling overview

Reading assignments:

Edwards W, Miles Jr RF, von Winterfeldt D. Chapter 1. Introduction. In: Edwards W, Miles Jr RF, Von Winterfeldt D, eds. *Advances in decision analysis: From foundations to applications*. Cambridge University Press; 2007.

Hunink M, Weinstein MC, Wittenberg E, et al. Chapter 1. Elements of Decision Making in Health Care. In: *Decision Making in Health and Medicine: Integrating Evidence and Values*. Cambridge University Press; 2014.

Supplementary readings (optional):

Clemen RT, Reilly T. Chapter 1. Introduction to Decision Analysis (pp.1-12). In: *Making Hard Decisions with Decision Tools®*. 3rd Edition ed. Mason, OH: South-Western, Cengage Learning; 2013.

Briggs A, Claxton K, Sculpher M. Chapter 1. Introduction. In: *Decision Modelling for Health Economic Evaluation*. New York: Oxford University Press; 2006.

Session 2	Workshop I: Using TreeAge	9/10/19
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Topics:

- Workshop on practicing use of the TreeAge software

Session 3	Decision analysis basics	9/17/19
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Topics:

- Probabilities – quantifying uncertainty: probability theory, Bayes' theorem, probability revision, interpreting diagnostic information, chance trees
- Payoffs
- Expected values

Reading assignments:

Hunink M, Weinstein MC, Wittenberg E, et al. Chapter 2. Managing Uncertainty. In: Decision Making in Health and Medicine: Integrating Evidence and Values. Cambridge University Press; 2014.

Hunink M, Weinstein MC, Wittenberg E, et al. Chapter 5. Interpreting Diagnostic Information. In: Decision Making in Health and Medicine: Integrating Evidence and Values. Cambridge University Press; 2014.

*Sox HC, Jr. Probability theory in the use of diagnostic tests. An introduction to critical study of the literature. *Ann Intern Med* 1986;104:60-6.

Problem set #1 handed out

Session 4	Decision trees	9/24/19
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Topics:

- Structuring decisions
- Analyzing decision trees
- Sensitivity analysis

Reading assignments:

Detsky AS, Naglie G, Krahm MD, Redelmeier DA, Naimark D. Primer on medical decision analysis: Part 2--Building a tree. *Med Decis Making* 1997;17(2):126-35.

*Arlandis-Guzman S, Errando-Smet C, Trocio J, Arumi D, Rejas J. Cost-effectiveness analysis of antimuscarinics in the treatment of patients with overactive bladder in Spain: a decision-tree model. *BMC Urol* 2011;11:9.

Problem set #1 due

Session 5	Workshop II: Decision analysis	10/1/19
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Topics:

- Workshop on practicing the steps of decision analysis and a simple cost-effectiveness analysis, using TreeAge and a hypothetical example

Session 6	Markov models	10/8/19
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Topics:

- Introduction to Markov models
- Building a Markov model
- Methods of evaluation

Reading assignments:

Sonnenberg F, Beck R. Markov Models in Medical Decision Making: A Practical Guide. *Med Decis Making* 1993;13:322-338.

Siebert U, Alagoz O, Bayoumi AM, Jahn B, Owens DK, Cohen DJ, et al. State-transition modeling: a report of the ISPOR-SMDM Modeling Good Research Practices Task Force-3. *Med Decis Making* 2012;32:690-700.

*Myers ER, McCrory DC, Nanda K, Bastian L, Matchar DB. Mathematical model for the natural history of human papillomavirus infection and cervical carcinogenesis. *Am J Epidemiol* 2000;151(12):1158-71.

Supplementary readings (optional):

Beck JR, Pauker SG. The Markov Process in Medical Prognosis. *Med Decis Making* 1983;3:419-58.

Naimark D, Krahn MD, Naglie G, Redelmeier DA, Detsky AS. Primer on medical decision analysis: Part 5—Working with Markov processes. *Med Decis Making* 1997;17:152-9.

Briggs A, Sculpher M. An introduction to Markov modelling for economic evaluation. *Pharmacoeconomics* 1998;13(4):397-409.

Problem set #2 handed out

Session 7	Parameter estimation	10/15/19
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Topics:

- Types of model parameters
- Rates versus probabilities
- Finding and summarizing evidence

Reading assignments:

Hunink M, Weinstein MC, Wittenberg E, et al. Chapter 8. Finding and summarizing the evidence. In: *Decision Making in Health and Medicine: Integrating Evidence and Values*. Cambridge University Press; 2014.

Miller DK, Homan SM. Determining transition probabilities: confusion and suggestions. *Med Decis Making* 1994;14(1):52-8.

Naglie G, Krahn MD, Naimark D, Redelmeier DA, Detsky AS. Primer on medical decision analysis: Part 3—Estimating probabilities and utilities. *Med Decis Making* 1997;17:136-41.

*Mathews WC, Agmas W, Cachay ER, Cosman BC, Jackson C. Natural history of anal dysplasia in an HIV-infected clinical care cohort: estimates using multi-state Markov modeling. *PLoS One* 2014;9(8):e104116.

Problem set #2 due

Session 8	Monte Carlo simulation	10/22/19
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Topics:

- Heterogeneity and uncertainty in decision models
- 1st order vs 2nd order uncertainty
- Assigning distributions to parameters
- 1st order vs 2nd order Monte Carlo simulation
- Practical issues in the application of Monte Carlo methods

Reading assignments:

Briggs A, Claxton K, Sculpher M. Chapter 4. Making decision models probabilistic. In: Decision Modelling for Health Economic Evaluation. New York: Oxford University Press, 2006.

Halpern EF, Weinstein MC, Hunink MGM, Gazelle GS. Representing Both First- and Second-order Uncertainties by Monte Carlo Simulation for Groups of Patients. *Med Decis Making* 2000;20:314-22.

*Paltiel AD, Scharfstein JA, Seage 3rd GR et al. A Monte Carlo simulation of advanced HIV disease: application to prevention of CMV infection. *Med Decis Making* 1998;18(2):S93–S105.

Session 9	Uncertainty analysis	10/29/19
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Topics:

- Overview of uncertainty analysis
- Sources of uncertainty
- Handling uncertainty in cost-effectiveness analysis: types of uncertainty analysis
- Deterministic sensitivity analysis in cost-effectiveness analysis
- Reporting deterministic sensitivity analysis results

Reading assignments:

Briggs AH. Handling uncertainty in cost-effectiveness models. *Pharmacoeconomics* 2000;17(5):479-500.

Briggs AH, Weinstein MC, Fenwick EA, Karnon J, Sculpher MJ, Paltiel AD, et al. Model parameter estimation and uncertainty analysis: a report of the ISPOR-SMDM Modeling Good Research Practices Task Force Working Group-6. *Med Decis Making* 2012;32:722-32.

*Kim SY, Goldie SJ, Salomon JA. Exploring model uncertainty in economic evaluation of health interventions: the example of rotavirus vaccination in Vietnam. *Med Decis Making* 2010;30(5):E1-E28.

Problem set #3 handed out
Problem set #3 due (11/4/19)

Session 10	Presentation of topic proposals	11/12/19
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Topics:

- Student presentation of research topic proposals
- Peer-review and discussion

Proposal topic due

Session 11	Probabilistic sensitivity analysis (PSA)	11/19/19
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Topics:

- Cost-effectiveness plane
- Net benefit framework
- Probabilistic sensitivity analysis
- Cost-effectiveness acceptability curves (CEACs)

Reading assignments:

Briggs A, Claxton K, Sculpher M. Chapter 5. Analysing and presenting simulation output from probabilistic models. In: *Decision Modelling for Health Economic Evaluation*. New York: Oxford University Press, 2006.

Fenwick E, Claxton K, Sculpher M. Representing uncertainty: the role of cost-effectiveness acceptability curves. *Health Economics* 2001;10:779-87.

*Briggs AH, Goeree R, Blackhouse G, O'Brien BJ. Probabilistic analysis of cost-effectiveness models: choosing between treatment strategies for gastro-esophageal reflux disease. *Med Decis Making* 2002;22:290-308.

Supplementary reading (optional):

Doubilet P, Begg CB, Weinstein MC, Braun P, McNeil BJ. Probabilistic sensitivity analysis using Monte Carlo simulation. *Med Decis Making* 1986;6:85-92.

Claxton K, Sculpher M, McCabe C et al. Probabilistic sensitivity analysis for NICE technology assessment: not an optional extra. *Health Economics* 2005;14:339-347.

Session 12	Value of information (VOI) analysis	11/26/19
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Topics:

- Role of VOI analysis in health care research priority setting
- Expected Value of Perfect Information (EVPI)
- Expected Value of Partial Perfect Information (EVPPI)

Reading assignments:

Briggs A, Claxton K, Sculpher M. Chapter 6. Decision making, uncertainty and the value of information. In: *Decision Modelling for Health Economic Evaluation*. New York: Oxford University Press, 2006.

Claxton K. The irrelevance of inference: a decision-making approach to the stochastic evaluation of health care technologies. *Journal of health economics* 1999;18(3):341-64.

Ginnelly L, Claxton K, Sculpher MJ, Golder S. Using value of information analysis to inform publicly funded research priorities. *Applied health economics and health policy* 2005;4(1):37-46.

*Woods B, Veenstra D, Hawkins N. Prioritizing pharmacogenetic research: a value of information analysis of CYP2D6 testing to guide breast cancer treatment. *Value Health* 2011;14(8):989-1001.

Supplementary readings (optional):

Steuten L, van de Wetering G, Groothuis-Oudshoorn K, Retel V. A systematic and critical review of the evolving methods and applications of value of information in academia and practice. *PharmacoEconomics* 2013;31(1): 25-48.

Problem set #4 handed out

Session 13	Model calibration and validation	12/3/19
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Topics:

- Overview of model evaluation
- Model calibration
- Model validation

Reading assignments:

Hunink M, Weinstein MC, Wittenberg E, et al. Chapter 11. Estimation, calibration, and validation. In: *Decision Making in Health and Medicine: Integrating Evidence and Values*. Cambridge University Press; 2014.

McCabe MC, Dixon S. Testing the validity of cost-effectiveness models. *Pharmacoeconomics* 2000;17:501-13.

Karnon J, Vanni T. Calibrating models in economic evaluation: a comparison of alternative measures of goodness of fit, parameter search strategies and convergence criteria. *Pharmacoeconomics* 2011;29(1):51-62.

*Kim JJ, Kuntz KM, Stout NK, Mahmud S, Villa LL, Franco EL, Goldie SJ. Multiparameter calibration of a natural history model of cervical cancer. *Am J Epidemiol* 2007;166(2):137-50.

Supplementary readings (optional):

Stout NK, Knudsen AB, Kong CY, McMahon PM, Gazelle GS. Calibration methods used in cancer simulation models and suggested reporting guidelines. *Pharmacoeconomics* 2009;27:533-545.

Eddy DM, Hollingworth W, Caro JJ, Tsevat J, McDonald KM, Wong JB, et al. Model transparency and validation: a report of the ISPOR-SMDM Modeling Good Research Practices Task Force-7. *Medical Decision Making* 2012;32:733-43.

Problem set #4 due

Session 14	Advanced topics in decision modeling	12/10/19
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Topics:

- Advanced types of simulation models
- Selection of model types
- Applications of decision-analytic models

Reading assignments:

Weinstein MC. Recent developments in decision-analytic modelling for economic evaluation. *Pharmacoeconomics* 2006; 24(11):1043-53.

Kim SY, Goldie SJ. Cost-effectiveness analyses of vaccination programmes: a focused review of modelling approaches. *Pharmacoeconomics* 2008;26(3):191-215.

Brennan A, Chick SE, Davies R. A taxonomy of model structures for economic evaluation of health technologies. *Health economics* 2006;15(12):1295-310.

*Karnon J. Alternative decision modelling techniques for the evaluation of

health care technologies: Markov processes versus discrete event simulation.
Health Econ 2003;12(10):837-48.

Supplementary readings (optional):

AHRQ. Research Report – Draft (September 15, 2014). Decision and Simulation Modeling: Review of Existing Guidance, Future Research Needs, and Validity Assessment. <http://effectivehealthcare.ahrq.gov/index.cfm/search-for-guides-reviews-and-reports/?productid=1965&pageaction=displayproduct>

Muller G, Grébaut P, Gouteux JP. An agent-based model of sleeping sickness: simulation trials of a forest focus in southern Cameroon. *C R Biol* 2004;327(1):1-11.

Session 15	Presentation of final projects/Class summary	12/17/19
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Topics:

- Student presentation of final projects
- Class wrap-up

Final proposal due