Syllabus
HPM 785: Advanced Decision Modeling

Spring 2019
Credit Hours: 3
Class Location: 2302 McGavran-Greenberg Hall
Meeting Time: Thursdays 5:00 – 8:00 PM

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Course Overview

Course Description

This course is designed to add to the skills introduced in HPM 772 and/or HPM 770 by broadening your set of tools. In HPM 772 (and its pre-requisite for DSOR minors, HPM 770) you learned to develop economic models for cost-effectiveness and cost-utility analyses using data from the literature and other sources, and began the process of testing the sensitivity of model outcomes to parameters and assumptions made. In this course you will explore more sophisticated sensitivity analysis techniques. Specifically, you will learn how to select and correctly parameterize distributions to explore uncertainty in different parameters, explore the net-benefit framework for interpretation, and use incremental cost-effectiveness ratio (ICER) planes, cost-effectiveness acceptability curves (CEACs), and confidence intervals for presentation and interpretation. You will be introduced to additional sensitivity analysis methods from Engineering. You will also learn advanced methods to calibrate decision support models and build confidence in them. We will conclude with a discussion of advanced model analysis and interpretation, including design of (simulation) experiments, advanced approaches to uncertainty analysis, and interpretation of large quantities of simulation output (e.g., principle component analysis, classification, clustering).

Along the way, I will encourage you to broaden your thinking about the kinds of questions and problems for which decision support models are useful. For those of you who took HPM 770, we will revisit some decision support modeling derived from operations engineering – for example, forecasting and queueing models. As well, we will discuss key terms like "systems", "systems science", and "complexity," exploring how what you've already learned is a wonderful building block to addressing even more complex public health problems. Throughout, and in common with both HPM 770 and 772, we will practice formulating problem statements and conceptualizing decision problems. And, we will gain exposure to several modeling approaches (and supportive software) to address these problems, including TreeAge and AnyLogic. For each of these types of models and for the analytical techniques presented, we will discuss best practices. Instruction in this course will be multi-modal, employing lectures, guided instruction on "see one, do one" (SODO) exercises, and in-class exercises to reinforce course materials.

Prerequisites

HPM 772 or permission of instructor. High-level proficiency/expertise with Microsoft Excel required.

Instructor(s)

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Course Website	https://sakai.unc.edu/welcome/. Use your ONYEN and password.
Class Days, Times, Location	Thursdays, 5:00 – 8:00 PM, 2302 McGavran-Greenberg
Office Hours	TBD
Course Texts	Briggs A, Claxton K, Schulpher M. Decision Modelling for Health Economic Evaluation. Oxford: Oxford University Press, 2006. (Hereafter known as Briggs). Muennig P and Mark Bounthavong. Cost-Effectiveness Analysis in Health: A Practical Approach. (3rd edition) San Francisco: Jossey-Bass, 2016. (Hereafter known as Muennig.) https://ebookcentral-proquest-com.libproxy.lib.unc.edu/lib/unc/reader.action?docID=4388576&query= Neumann, Peter J., Gillian D. Sanders, Louise B. Russell, Joanna E. Siegel, and Theodore G. Ganiats, eds. Cost-Effectiveness in Health and Medicine. Second edition. Oxford University Press, 2016. (Hereafter known as Neumann.) http://www.oxfordscholarship.com.libproxy.lib.unc.edu/view/10.1093/acprof:oso/9780190492939.001.0001/acprof-9780190492939 (Optional) Glick HA, Doshi JA, Sonnad SS, Polsky D. Economic Evaluation in Clinical Trials. Oxford: Oxford University Press, 2007. (Hereafter known as Glick). Additional readings are available on the Sakai site
Other Resources	Five software programs will be used in this course—Crystal Ball (Oracle Corporation), TreeAge® Pro-Suite (TreeAge Software, Corp), and AnyLogic. Crystal Ball is available through UNC virtual lab. All other software can be obtained in evaluation/trial mode for the purposes of class. If you wish to work more extensively in any software, see me to find out how to acquire a student copy (there may be cost). For example, a limited (but very appropriately sized) version of TreeAge® Pro Suite is available (http://www.treeage.com/shop/) for purchase for $45. NB: In the drop down boxes on the website, select “Academic Use” and “Purchase Student Course License ($45.00)”. Please purchase your software with sufficient time to install and to familiarize yourself with basic commands.
Course Format	The course format will include weekly lectures that are supplemented with see-one-do-one (SODO) activities and in-class exercises. You will need to make certain that you have prepared thoroughly for the activities, have all necessary materials, and come prepared with thoughtful questions (questions of clarification on difficult points are considered thoughtful). Attendance is important; therefore please make certain that you notify the instructor if you will miss a session.

Course Policies and Resources

Recognizing, Valuing and Encouraging Inclusion and Diversity in the Classroom

We share the School`s commitment to diversity. We are committed to ensuring that the School is a diverse, inclusive, civil and welcoming community. Diversity and inclusion are central to our mission — to improve public health, promote individual well-being and eliminate health inequities across North Carolina and around the world. Diversity and inclusion are assets that contribute to our strength, excellence and individual and institutional success. We welcome, value and learn from individual differences and perspectives. These include but are not limited to: cultural and racial/ethnic background; country of origin; gender; age; socioeconomic status; physical and learning abilities; physical appearance; religion; political perspective; sexual identity and veteran status. Diversity, inclusiveness and civility are core values we hold, as well as characteristics of the School that we intend to strengthen.

We are committed to expanding diversity and inclusiveness across the School—among faculty, staff, students, on advisory groups, and in our curricula, leadership, policies and practices. We measure diversity and inclusion not only in numbers, but also by the extent to which students, alumni, faculty and staff members perceive the School's environment as welcoming, valuing all individuals and supporting their development."
In this class, we practice these commitments in the following ways:

- Develop classroom participation approaches that acknowledge the diversity of ways of contributing in the classroom and foster participation and engagement of *all* students.
- Structure assessment approaches that acknowledge different methods for acquiring knowledge and demonstrating proficiency.
- Encourage and solicit feedback from students to continually improve inclusive practices.

As a student in the class, you are also expected to understand and uphold the following UNC policies:

- Diversity and Inclusion at the Gillings School of Global Public Health: http://sph.unc.edu/resource-pages/diversity/
- UNC Non-Discrimination Policies: http://policy.sites.unc.edu/files/2013/04/nondiscrim.pdf
- Prohibited Discrimination, Harassment, and Related Misconduct at UNC: https://deanofstudents.unc.edu/incident-reporting/prohibited-harassmentsexual-misconduct

Accessibility

UNC-CH supports all reasonable accommodations, including resources and services, for students with disabilities, chronic medical conditions, a temporary disability, or a pregnancy complication resulting in difficulties with accessing learning opportunities. All accommodations are coordinated through the UNC Office of Accessibility Resources & Services (ARS), https://ars.unc.edu/; phone 919-962-8300; email ars@unc.edu. Students must document/register their need for accommodations with ARS before accommodations can be implemented.

UNC Honor Code

As a student at UNC-Chapel Hill, you are bound by the university's Honor Code, through which UNC maintains standards of academic excellence and community values. It is your responsibility to learn about and abide by the code. All written assignments or presentations (including team projects) should be completed in a manner that demonstrates academic integrity and excellence. Work should be completed in your own words, but your ideas should be supported with well-cited evidence and theory. To ensure effective functioning of the Honor System at UNC, students are expected to:

a. Conduct all academic work within the letter and spirit of the Honor Code, which prohibits the giving or receiving of unauthorized aid in all academic processes.
b. Learn the recognized techniques of proper attribution of sources used in written work; and to identify allowable resource materials or aids to be used during completion of any graded work.
c. **Sign a pledge on all graded academic work certifying that no unauthorized assistance has been received or given in the completion of the work.**
d. Report any instance in which reasonable grounds exist to believe that a fellow student has violated the Honor Code.

Instructors are required to report suspected violations of the Honor Code, including inappropriate collaborative work or problematic use of secondary materials, to the Honor Court. Honor Court sanctions can include receiving a zero for the assignment, failing the course and/or suspension from the university. If you have any questions about your rights and responsibilities, please consult the Office of Student Conduct at https://studentconduct.unc.edu/, or consult these other resources:

- Honor system module.
- UNC library's plagiarism tutorial.
- UNC Writing Center handout on plagiarism.

Instructor Expectations

Email

The instructor will typically respond to email within 48 hours or less if sent Monday through Friday. The instructor may respond to weekend emails, but it is not required of them. If you receive an out of office reply when emailing, it may

take longer to receive a reply. The instructor will provide advance notice, if possible, when they will be out of the office.

Feedback	All graded assignments will receive written feedback that coincides with the assessment rubric. Feedback is meant to be constructive and help the student continue to build upon their skills. The types of feedback you may receive are descriptive feedback, evaluative feedback, and motivational feedback. Feedback is a tool that you as a learner can use to understand the areas that you are succeeding in and what you can do to improve in other areas.
Grading	Assignments and projects will be graded no more than two weeks after the due date. Assignments that build on the next assignment will be graded within one week of the final due date. Early submissions will not be graded before the final due date.
Syllabus Changes	The instructor reserves to right to make changes to the syllabus, including project due dates and test dates. These changes will be announced as early as possible.
Telephone Messages	The instructor will respond to telephone messages as early as possible. However, it is advisable that an email message should be sent in addition to or instead of a telephone message – to be safe.

Student Expectations

Appropriate Use of Course Resources:	The materials used in this class, including, but not limited to, syllabus and assignments are copyright protected works. Any unauthorized copying of the class materials is a violation of federal law and may result in disciplinary actions being taken against the student. Additionally, the sharing of class materials without the specific, express approval of the instructor may be a violation of the University's Student Honor Code and an act of academic dishonesty, which could result in further disciplinary action. This includes, among other things, uploading class materials to websites for the purpose of sharing those materials with other current or future students.
Assignments	Submit assignments through Sakai using FORUMS. Emailing assignments is not acceptable unless prior arrangements have been made. If you are having issues submitting assignments, try a different web browser first. If switching browsers does not work, email or call the instructor for guidance.
Peer feedback	Students will use Sakai FORUM to submit and peer review their classmate's assignments throughout the course. The instructor will also provide feedback via the FORUMS and when requested by either student or instructor, verbally in office hours.
Attendance/ Participation	Your attendance and active participation are an integral part of your learning experience in this course. If you are unavoidably absent, please notify the course instructor.
Communication	You are expected to follow common courtesy in all communication to include email, discussion boards, and face-to-face. All electronic communications sent

should follow proper English grammar rules to include complete sentences. This is a professional course, and you are expected to communicate as a professional.

Contributions

You are expected to offer individual contributions in class and on individual assignments. You may discuss your ideas with classmates (and I encourage this), but submissions must represent your own work.

Email

All email correspondence between student/instructor and peer/peer will be conducted in a professional manner following email etiquette.

- View the following link for more information on email etiquette: http://metropolitanorganizing.com/etiquette-professional-organizing-services/essential-email-etiquette-tips/

Late Work

All assignments are due at time/dates specified in this syllabus and corresponding schedule on Sakai. Late assignments will not be accepted except in the case of unforeseen and distressing events (serious illness, a death in the family). Please notify the instructor immediately should one of these events arise.

Readings

Readings for a particular class should be completed before the class session and before completing associated activities

Technical support

The UNC Information Technology Services (ITS) department provides technical support 24-hours per day, seven days per week. If you need computer help, please contact the ITS Help Desk by phone at +1-919-962-HELP (919-962-4357), or by email at help@unc.edu, or by visiting their website at http://help.unc.edu, or by UNC Live Chat at http://its.unc.edu/itrc/chat.

Competencies, Learning Objectives, and Assessment

Map

Competencies taught in this course, learning objectives mapped to these competencies, and assignments that assess attainment of these competencies.

Competencies	Learning Objectives	Assessment Assignment (including peer review of each assignment)
Master's Program: AT, ST, IS PhD Core: 2, 6, 7, 9	Conduct probabilistic sensitivity analysis, including the identification and appropriate parameterization of parameter distributions, correct use and interpretation of the net-benefit framework using ICER planes, CEACs, and confidence intervals.	
Master's Program: AT, ST, IS PhD Core: 2, 6, 7, 9	Develop proficiency in the use of Crystal Ball software and to have fundamental expertise in the use of TreeAge® Pro-Suite software for the conduct of probabilistic sensitivity analysis and development of sophisticated decision models, respectively	
Master's Program: AT, ST, IS PhD Core: 2, 6, 7, 9	Identify and understand when other types of advanced decision models (i.e., discrete event simulation, agent-based modeling, and system dynamics) are more appropriate than standard decision analysis techniques, and to be able to design, conduct analysis, and interpret results from these approaches	
Master's Program: CS PhD Core: 10	Critique economic evaluation and decision modeling studies in the peer reviewed literature	

Master's Program Competencies:

AT: Analytical Thinking
ST: Systems Thinking
IS: Information Seeking
CS: Communication Skills

PhD Core Competencies:

2: Develop expertise in a substantive area (a minor)
6: Select appropriate research designs and methodologies (quantitative and qualitative) for health services/health policy research
7: Understand and appropriately apply analytical strategies used in health services/health policy research
9: Interpret and explain the results of research
10: Critically evaluate articles from scholarly journals and research presentations

Course Assignments and Assessments

This course will include graded assignments, including peer model critiques, and a final modeling project. Peer model critique will provide you with the opportunity to give and receive detailed feedback regarding various aspects of your modeling process. The culminating assignment for the semester is a modeling project in which you will be allowed to continue work from an existing model from HPM 770 or 772
Each student will be expected lead a course discussion or SODO activity. Active participation is expected in this course and will be incorporated in your grade. A list of assignments and the associated points/percentages are provided below.

Assignments	Points/Percentages
Peer Model Critique (4 total; 5 pts each)	20
In class activities/assignments (5 total; 5 pts each)	25
Modeling project (4 monthly reports; 2.5 pts each, final presentation/write-up/model 40 pts)	50
Class participation	5
TOTAL	100

Grading Scale

Final course grades will be determined using the following UNC Graduate School grading scale. The relative weight of each course component is shown in the table above.

H	Greater than or equal to 90	High Pass: Clearly excellent graduate work
P	76 to 89	Pass: Entirely satisfactory graduate work
L	65 to 75	Low Pass: Inadequate graduate work
F	Below 65	Fail

Assignment Descriptions

Active Participation in class discussion and see-one-do-one (SODO) activities:
In order to be successful learning experiences, your active participation is required in the SODO discussions and the in-class exercises/activities. You will need to make certain that you have prepared thoroughly for the activities, have all necessary materials, and come prepared with thoughtful questions (questions of clarification on difficult points are considered thoughtful). Attendance is important; therefore please make certain that you notify the instructor if you will miss a session.

Peer model critique:

One skill we will practice in this class is really stepping into a colleague's model, making sense of it, and giving thoughtful feedback. Not only will this help you learn to debug your own models, it will also help you appreciate why it's worth spending a little extra time thinking about the "art" of modeling. I will ask you to do this 4 times during the semester for different students, twice in the start of the semester and twice toward the end. All feedback is due within one week after the assignment is submitted.

In class activities/assignments:

Throughout the semester we will do activities in class to practice the lesson. There will be multiple activities and a subset will be due for a grade. I will let you know which assignments will be graded. The

purpose of these activities is to encourage class participation and develop a more thorough understand of the material being presented. They will also help you think more like a modeler.

Modeling Project:
In lieu of a final exam, you will be asked to present a final modeling project in a poster session. Each student will be asked to develop a model over the course of the semester, which may continue their work from HPM 770 or 772, or develop a new model using any techniques learned in class. Students are required to submit reports monthly, throughout the semester.

Model Project Components	Description	Due Date	Peer Evaluation Due
Model Update 1	Describe the focal problem statement, motivate and inform it using a conceptual framework, and outline modeling approach at a high-level and introduce your objectives	February 7	February 14
Model Update 2	Update prior content, and add a formal modeling plan	March 7	March 21
Model Update 3	Update prior content, and add an operationalized simulation model and sensitivity analysis description and results	April 4	April 11
Model Update 4	Update prior content, and add a final poster presentation, explaining how calibration was, testing, uncertainty analysis, and interpretation of results	April 18	April 25
Formal Presentation Session	Prepare presentation to present modeling work	April 25	
Final Product	Completed modeling project to include any revisions made upon receiving feedback from presentation.	April 30	

Course-at-a-Glance

The instructor reserves to right to make changes to the syllabus, including project due dates and test dates. These changes will be announced as early as possible.

Session/ Date	Topic and Competency
Session #1 Jan 10	Topic: Introductions and overview/discussion of why and how we model Competency: AT, ST, 7
Session #2 Jan 17	Topic: Infectious disease modeling Competencies: AT, ST, 6, 7, 9
Session #3	Topic: Introduction to Agent-based modeling and AnyLogic

Jan 24	Competencies: AT, ST, 6, 7, 9
Session #4 Jan 31	Topic: More with AnyLogic Competencies: AT, ST, IS, CS, 6, 7, 9
Session #5 Feb 7	Topic: Discrete event simulation Competencies: AT, ST, IS, CS, 6, 7, 9
Session #6 Feb 14	Topic: Decision trees and evaluating the use of imperfect information Competencies: AT, ST, IS, CS, 6, 7, 9
Session #7 Feb 21	Topic Advanced sensitivity/uncertainty analysis Competencies: AT, ST, IS, CS, 6, 7, 9
Session #8 Feb 28	Topic: Advanced sensitivity analysis – methods from engineering Competencies: AT, ST, IS, CS, 6, 7, 9
Session #9 Mar 7	Topic: Advanced presentation of sensitivity and uncertainty analysis – ICER planes, CEACs, and the Net Benefit framework Competencies: AT, ST, IS, 6, 7, 9
Mar 14	SPRING BREAK (NO CLASS)
Session #10 Mar 21	Topic: Model calibration Competencies: AT, ST, IS, 6, 7, 9
Session #11 Mar 28	Topic: Building confidence in models Competencies: AT, ST, IS, 6, 7, 9
Session #12 Apr 4	Topic: Uncertainty analysis, value of information, and design of simulation experiments Competencies: AT, ST, IS, 6, 7, 9
Session #13 Apr 11	Topic: Practicing the model analysis process Competencies: AT, ST, IS, 6, 7, 9
Session #14 Apr 18	Topic: Advanced interpretation of results Competencies: AT, ST, IS, 6, 7, 9,
Session #15 Apr 25	Topic: Final presentation day Competencies: CS, IS, 10

Course Schedule

The instructor reserves to right to make changes to the syllabus, including project due dates and test dates. These changes will be announced as early as possible.

January 10, 2019 5:00-8:00pm

Session 1	
Topic	**Introductions and overview/discussion of why and how we model**
Competency Addressed	7: Understand and appropriately apply analytical strategies used in health services/health policy research
Learning Objective(s)	(20 min) Introductions (15 min) Introduction to course (45 min) Why do we model? (10 min) Break (45 min) Overview of types of models (30 min) Model Reflection
Required Readings	None
Assignments/Deadlines	None

January 17, 2019 5:00-8:00pm

Session 2	
Topic	**Infectious disease modeling**
Competencies Addressed	AT: Analytical Thinking; ST: Systems Thinking; 6: Select appropriate research designs and methodologies (quantitative and qualitative) for health services/health policy research; 7: Understand and appropriately apply analytical strategies used in health services/health policy research; 9: Interpret and explain the results of research
Learning Objective(s)	(80 min) Introduction to infectious disease modeling (SIR models) (10 min) Break (60 min) Translating SIR model into Excel (30 min) Discussion of equation modeling versus simulation modeling (Excel model)

Required Readings	1. Thompson KM, Tebbens RJ. "Current polio global eradication and control policy options: perspectives from modeling and prerequisites for oral poliovirus vaccine cessation." Expert Rev Vaccines. 2012 Apr;11(4):449-59. https://doi.org/10.1586/erv.11.195. Review. 2. Please read "Epidemic theory (effective and basic reproduction numbers, epidemic thresholds) and techniques for infectious disease data (construction and use of epidemic curves, generation numbers, exceptional reporting and identification of significant clusters)," available here.
Assignments/Deadlines	None

January 24, 2019 5:00-8:00pm

Session 3	
Topic	**Introduction to Agent-based modeling and AnyLogic**
Competencies Addressed	AT: Analytical Thinking; ST: Systems Thinking; 6: Select appropriate research designs and methodologies (quantitative and qualitative) for health services/health policy research; 7: Understand and appropriately apply analytical strategies used in health services/health policy research; 9: Interpret and explain the results of research
Learning Objective(s)	(60 min) Intro to Agent-Based Modeling (ABM) (40 min) Discussion of AMB in Public Health paper and converting excel model (from session 2) into an ABM (10 min) Break (60 min) AnyLogic Basics (10 min) Exploring infectious disease models in AnyLogic
Required Readings	Tracy M, Cerda M, Keyes K. "Agent-Based Modeling in Public Health: Current Applications and Future Directions." Annual Rev. Public Health 2018. 39:77-94. https://doi.org/10.1146/annurev-publhealth040617-014317
Assignments/Deadlines	None

January 31, 2019 5:00-8:00pm

Session 4	
Topic	**More AnyLogic**

Competencies Addressed	AT: Analytical Thinking; ST: Systems Thinking; 6: Select appropriate research designs and methodologies (quantitative and qualitative) for health services/health policy research; 7: Understand and appropriately apply analytical strategies used in health services/health policy research; 9: Interpret and explain the results of research
Learning Objective(s)	(90 min) More practice with AnyLogic models (10 min) Break (30 min) Discussion of insights from NetLogo models (50 min) Introduction to discrete event simulation
Required Readings	None
Assignments/Deadlines	- AnyLogic Acitivty

February 7, 2019 5:00-8:00pm

Session 5	
Topic	**Discrete event simulation**
Competency Addressed	AT: Analytical Thinking; ST: Systems Thinking; 6: Select appropriate research designs and methodologies (quantitative and qualitative) for health services/health policy research; 7: Understand and appropriately apply analytical strategies used in health services/health policy research; 9: Interpret and explain the results of research
Learning Objective(s)	(80 min) DES simulation by hand and DES activity (10 min) Break (45 min) Continue DES Activity (45 min) DES in AnyLogic
Required Readings	None
Assignments/Deadlines	- Discrete Event Simulation by hand Activity - Model Update 1 Due

February 14, 2019 5:00-8:00pm

Session 6	
Topic	**Decision trees and evaluating the use of imperfect information**
Competencies Addressed	AT: Analytical Thinking; ST: Systems Thinking; 6: Select appropriate research designs and methodologies (quantitative and qualitative) for health services/health policy research; 7: Understand and appropriately apply

	analytical strategies used in health services/health policy research; 9: Interpret and explain the results of research
Learning Objective(s)	(70 min) Review of decision trees and introduction to TreeAge (10 min) Explanation of activity (10 min) Break (90 min) TreeAge Activity and discussion
Required Readings	TreeAge User manual, available in pdf on sakai and downloadable here: https://s3.amazonaws.com/us-tp11/treeagepro/16.1.0/20160107/TP-Manual-2016R1.pdf Please read chapters 1-4 prior to class.
Assignments/Deadlines	- Understanding TreeAge Acitivity - Peer Evaluation for Model Update 1 Due

February 21, 2019 5:00-8:00pm

Session 7	
Topic	**Advanced sensitivity/uncertainty analysis**
Competencies Addressed	AT: Analytical Thinking; ST: Systems Thinking; 6: Select appropriate research designs and methodologies (quantitative and qualitative) for health services/health policy research; 7: Understand and appropriately apply analytical strategies used in health services/health policy research; 9: Interpret and explain the results of research
Learning Objective(s)	(60 min) Survival analysis methods (20 min) Probabilistic sensitivity analysis (10 min) Break (30 min) Probabilistic sensitivity analysis (60) Survival analysis in probabilistic sensitivity analysis activity
Required Readings	Review material from HPM770 and/or 772 on probabilistic sensitivity analysis, Crystal Ball, and the characterization of uncertainty in parameters using univariate, bivariate, or multivariate sensitivity analyses (see additional readings as well as old course notes). Survival analysis: 1. Clark TG, Bradburn MJ, Love SB, Altman DG. Survival Analysis Part I: Basic concepts and first analysis. *British Journal of Cancer* 2003;89:232-8.

	2. Bradburn MJ, Clark TG, Love SB, Altman DG. Survival Analysis Part II: Multivariate data analysis—An introduction to concepts and methods. *British Journal of Cancer* 2003;89:431-6. 3. Bradburn MJ, Clark TG, Love SB, Altman DG. Survival Analysis Part III: Multivariate data analysis—Choosing a model and assessing its adequacy. *British Journal of Cancer* 2003;89:605-11. 4. Clark TG, Bradburn MJ, Love SB, Altman DG. Survival Analysis Part IV: Further concepts and methods in survival analysis. *British Journal of Cancer* 2003;89:781-6. 5. Latimer NR. Survival analysis for economic evaluations alongside clinical trials—Extrapolation with patient-level data: Inconsistencies, limitations, and a practical guide. *Medical Decision Making* 2013;33:743-54.
Assignments/Deadlines	- Survival Analysis in Probabilistic Sensitivity Analysis Activity

February 28, 2019 5:00-8:00pm

Session 8	
Topic	**Advanced sensitivity analysis – methods from engineering**
Competencies Addressed	AT: Analytical Thinking; ST: Systems Thinking; 6: Select appropriate research designs and methodologies (quantitative and qualitative) for health services/health policy research; 7: Understand and appropriately apply analytical strategies used in health services/health policy research; 9: Interpret and explain the results of research
Learning Objective(s)	(25 min) Discuss purpose and approaches to sensitivity analysis (75 min) Meet and practice Dirichlet (10 min) Break (30 min) Dirichlet Discussion (40 min) Stroke modeling example – SA approach
Required Readings	1. Pannell DJ. Sensitivity analysis: Strategies, methods, concepts, examples. http://dpannell.fnas.uwa.edu.au/dpap971f.htm 2. Iooss B, Lemaitre P (2014). A review on global sensitivity analysis methods. In: Uncertainty Management in Simulation-Optimization of Complex Systems. 2014; 59:101-122. https://hal.archives-ouvertes.fr/hal-00975701/document 3. Wu J, Dhingra R, Gambhir M. Remais JV. Sensitivity analysis of infectious disease models; methods, advances and their application. Journal of the Royal Society Interface. 2013;10: 20121018. http://rsif.royalsocietypublishing.org/content/10/86/20121018
Assignments/Deadlines	- Dirichlet Activity