Term Information

Effective Term	Spring 2015

General Information

Course Bulletin Listing/Subject Area	Statistics
Fiscal Unit/Academic Org	Statistics - D0694
College/Academic Group	Arts and Sciences
Level/Career	Graduate
Course Number/Catalog	8450
Course Title	Stochastic Epidemic Models
Transcript Abbreviation	Stoch Epi Models
Course Description	Introduction to methods of analyzing large population epidemic data from the viewpoint of stochastic processes theory. Topics will cover the SIR (susceptible-infective-removed) epidemic models both under the homogenous and restricted contact structures. Lectures will introduce the necessary background in probability and statistics along with real-life applications (e.g. HIV, H1N1 and SARS).
Semester Credit Hours/Units	Fixed: 3

Offering Information

Length Of Course	14 Week, 7 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Lecture
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus

Prerequisites and Exclusions

Prerequisites/Corequisites	Prereq: STAT 6801 and (STAT 6540 or STAT 7540), or permission of instructor
Exclusions	Not open to students with credit for PUBH-BIO 8450

Cross-Listings

Cross-Listings	Cross-listed in PUBH-BIO

Subject/CIP Code

Subject/CIP Code	27.0501
Subsidy Level	Doctoral Course
Intended Rank	Masters, Doctoral

Requirement/Elective Designation

The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes

- Proficiently apply the deterministic and stochastic susceptible-infective-removed (SIR) epidemic model
- Explain important aspects of the theory of density dependent counting processes and their asymptotic behavior
- Explain and apply the likelihood-based methods of inference for completely observed SIR-type epidemics
- Explain and apply the Monte Carlo Markov chain (MCMC) methods for partially observed SIR-type epidemics
- Interpret the results of a statistical analysis

Content Topic List

- Introduction to Stochastic Epidemic Models
- SIR (Susceptible/Infected/Removed) model
- The threshold limit theorem
- Density dependent jump Markov processes
- Epidemics and graphs
- MLE for completely observed epidemics
- Estimation in partially observed epidemics
- MCMC Methods
- Vaccination (if time permits)

Attachments

- PH8450 Syllabus CPH approved.pdf: Syllabus

  (Syllabus. Owner: Craigmile,Peter F)

Comments

- It should be 3 x 55 minutes per week, or equivalent. Corrected the syllabus. *(by Craigmile,Peter F on 04/08/2014 02:18 PM)*
- This course has 2 contact hours per week. Why 3 credit hours? *(by Hadad,Christopher Martin on 04/08/2014 11:41 AM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Craigmile,Peter F	03/31/2014 12:17 PM	Submitted for Approval
Approved	Craigmile,Peter F	04/07/2014 03:50 PM	Unit Approval
Revision Requested	Hadad,Christopher Martin	04/08/2014 11:41 AM	College Approval
Submitted	Craigmile,Peter F	04/08/2014 02:17 PM	Submitted for Approval
Approved	Craigmile,Peter F	04/08/2014 02:18 PM	Unit Approval
Approved	Hadad,Christopher Martin	04/08/2014 02:22 PM	College Approval
Pending Approval	Vankeerbergen,Bernadette Chantal Nolen,Dawn Jenkins,Mary Ellen Bigler Hogle,Danielle Nicole Hanlin,Deborah Kay	04/08/2014 02:22 PM	ASCCAO Approval

PUBH-BIO 8450

Stochastic Epidemic Models
Spring 2015 (every other year thereafter)

Instructor:	Grzegorz A. Rempala, Ph.D. D.Sc. Email: grempala@cph.osu.edu Office: 226 Cunz Hall
Office Hours:	M/W 12pm–1pm, or by appointment
Lectures:	Three 55 minute classes, or equivalent
Course Webpage:	Carmen: `http://carmen.osu.edu` Login with OSU internet username (name.#) and password, then go to PUBH-BIO 8450.
Course Notes:	When available, posted on the course website prior to each lecture
Textbook:	*Stochastic Epidemic Models and Their Statistical Analysis* by Anderson, H. & Britton, T. Published by Springer (2000)
Required Software:	R (`http://www.r-project.org/`) R is available free online.
Prerequisites:	STAT 6801 and (STAT 6540 or STAT 7540), or permission of instructor
Course Description:	This course will introduce the basic methods for analyzing large population epidemic data from the viewpoint of the stochastic processes theory. The course will cover the basic SIR (susceptible-infective-removed) epidemic models both under the homogenous and restricted contact structures. The lectures will introduce the necessary background in probability and statistics along with the examples of models application to real data (e.g., HIV, H1N1 and SARS).
Homework:	There will be 8 homework assignments. Late homework will **NOT** be accepted without a reasonable and advance notice. Students are permitted (indeed encouraged) to work together on homework, but submitted assignments must be written independently.
Exam:	There will be two in-class midterm exams. The exams will be closed book and closed notes, but students are allowed to bring TWO letter-size sheets of notes (both sides) to the exams.
Project:	The project in this course will account for a significant portion (20%) of the grade and will showcase students understanding of methods in advanced epidemic analysis. Each student will be required to write a short project report and be prepared to give a 20-minute in-class presentation towards the end of the term.

Grading: Final class grade will be determined as follows:

20%	Homework
60%	Two Midterm Exams
20%	Final project

Grading Scale: 90-100 A, 78-89 B, 66-77 C, 50-65 D, below 50 E. ("+" for exceeding mid-range, no "-")

Learning Objectives

Upon successful completion of the course, students will have the knowledge, comprehension and/or skills to be able to use and apply commonly used statistical methods for analyzing univariate and multivariate epidemic data. Particularly, the students will be able to

- proficiently apply the deterministic and stochastic SIR epidemic model,
- explain important aspects of the theory of density dependent counting processes and their asymptotic behavior,
- explain and apply the likelihood-based methods of inference for completely observed SIR-type epidemics,
- explain and apply the MCMC methods for partially observed SIR-type epidemics,
- interpret the results of a statistical analysis.

Competencies

- *Core MPH Competencies*
  1. Apply descriptive and graphical techniques commonly used to summarize epidemic data.
  2. Describe basic concepts of probability and stochastic processes applied to dynamical systems.
  3. Apply common statistical methods for inference and describe the assumptions required.
  4. Describe alternatives to standard statistical methods when assumptions are not met.
  5. Apply descriptive and inferential methodologies according to the type of longitudinal data available for answering a particular research question.
  6. Interpret results of statistical analyses of epidemic data.
- *Core MPH in Biostatistics Competencies*
  1. Conduct statistical procedures and data analysis methods appropriate for analyzing data obtained from epidemic-related research studies.
  2. Apply appropriate statistical techniques for analyzing public data with specific characteristics, including missing data.
  3. Have hands-on experience with one major statistical data analysis package (R).
- *Core MS Competencies*
  1. Read the scientific literature in the students field and critique the methods and results.
  2. Conduct a brief literature review to evaluate the state of the science regarding a specific topic in the students area of interest.
- *Core PHD Competencies*
  1. Conduct a thorough literature review to summarize and evaluate the state of the science regarding a new topic in the students general area.
  2. Outline a study to address one of those questions using the appropriate research design.
  3. Prepare and deliver lectures or other appropriate class sessions in the students area of expertise.

4. Demonstrate advanced knowledge in at least one area of subspecialty within the discipline of specialization.

Office for Disability Services Any student who feels s/he may need an accommodation based on the impact of a disability should contact me privately to discuss your specific needs. Please contact the Office for Disability Services at 614-292-3307 in room 150 Pomerene Hall to coordinate reasonable accommodations for students with documented disabilities.

Student Support Students experiencing personal problems or situational crises during the semester are encouraged to contact OSU Counseling and Consultation Services (292-5766; `http://www.ccs.ohio-state.edu`) for assistance, support and advocacy. This service is free to students and is confidential.

Academic Integrity The Ohio State University, the College of Public Health, and the Committee on Academic Misconduct (COAM) expect that all students have read and understood the University's *Code of Student Conduct* and the College's *Student Handbook*, and that all students will complete all academic and scholarly assignments with fairness and honesty.

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University, the College of Public Health, and the Committee on Academic Misconduct (COAM) expect that all students have read and understood the Universitys Code of Student Conduct and the Colleges Student Handbook, and that all students will complete all academic and scholarly assignments with fairness and honesty. The Code of Student Conduct and other information on academic integrity and academic misconduct can be found at the COAM web pages (`http://oaa.osu.edu/coam/home.html`). Students must recognize that failure to follow the rules and guidelines established in the Universitys Code of Student Conduct, the Student Handbook, and in the syllabi for their courses may constitute "Academic Misconduct". The Ohio State Universitys Code of Student Conduct (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the University, or subvert the educational process". Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Please note that the use of material from the Internet without appropriate acknowledgement and complete citation is plagiarism just as it would be if the source were printed material. Further examples are found in the Student Handbook. Ignorance of the Code of Student Conduct and the Student Handbook is never considered an excuse for academic misconduct. If I suspect a student of academic misconduct in a course, I am obligated by University Rules to report these suspicions to the Universitys Committee on Academic Misconduct. If COAM determines that the student has violated the Universitys Code of Student Conduct (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in the course and suspension or dismissal from the University. If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Tentative Schedule: *The course schedule given below is approximate, and may change subject to the progress of the class.*

1. Intro (Text Chap 1; 1 week)
   - Stochastic vs deterministic models
   - Reed Frost model
   - Large communities
2. SIR Model (Text Chap 2; 2 weeks)
   - The Sellke construction

- The Markovian case
- Coupling methods with applications
- Branching approximation for early epidemics

3. The threshold limit theorem (Text Chap 4; 2 weeks)
   - The imbedded process
   - Preliminary convergence results
   - Final epidemic size
   - Duration of Markovian SIR epidemic
4. Density dependent jump Markov processes (Text Chap 5; 3 weeks)
   - Introductory examples
   - The general model
   - The Law of Large Numbers
   - The Central Limit Theorem
   - Applications to epidemic models
5. Epidemics and graphs (Text Chap 7; 2 weeks)
   - Random graph model
   - Constant infection period
   - Epidemics and social networks
6. MLE for completely observed epidemics (Text Chap 9; 1 week)
   - Martingale methods
   - CLT for MLE in SIR model
7. Estimation in partially observed epidemics (Text Chap 10; 1 week)
   - Estimating equations and EM algorithm
8. MCMC Methods (Text Chap 11; 2 weeks)
   - Description of the technique
   - Important examples
   - Implementation in R
   - Bayesian inference
9. Vaccination (Text Chap 12; 1 week)
   - Estimating vaccination policies based on one epidemic
   - Estimating vaccination efficacy