

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: 6801 and 6540 or 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)
- concurrence_Economics.pdf: From Economics
(Concurrence. Owner: Craigmile, Peter F)
- concurrence_John Glenn School of Public Affairs.txt: From John Glenn School of Public Affairs
(Concurrence. Owner: Craigmile, Peter F)
- Statistics 8450 concurrence_Microbiology.pdf: From Microbiology
(Concurrence. Owner: Craigmile, Peter F)
- concurrence_Mathematics.pdf: From Mathematics
(Concurrence. Owner: Craigmile, Peter F)

Comments

- It should be 3 x 55 minutes per week, or equivalent. Corrected the syllabus.

Also added "per week"

All concurrences requested are attached. *(by Craigmile, Peter F on 06/27/2014 03:56 PM)*

- See 6-2 e-mail to P. Craigmile. *(by Vankeerbergen, Bernadette Chantal on 06/02/2014 11:53 AM)*
- This course has 2 contact hours per week. Why 3 credit hours? *(by Hadad, Christopher Martin on 04/08/2014 11:41 AM)*

COURSE REQUEST
8450 - Status: PENDING

Last Updated: Hadad,Christopher Martin
06/27/2014

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
Revision Requested	Vankeerbergen,Bernadette Chantal	06/02/2014 11:54 AM	ASCCAO Approval
Submitted	Craigmile,Peter F	06/27/2014 03:56 PM	Submitted for Approval
Approved	Craigmile,Peter F	06/27/2014 03:57 PM	Unit Approval
Approved	Hadad,Christopher Martin	06/27/2014 04:47 PM	College Approval
Pending Approval	Vankeerbergen,Bernadette Chantal Nolen,Dawn Jenkins,Mary Ellen Bigler Hogle,Danielle Nicole Hanlin,Deborah Kay	06/27/2014 04:47 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 minutes classes per week, 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 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. 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 University's Code of Student Conduct, the Student Handbook, and in the syllabi for their courses may constitute "Academic Misconduct". The Ohio State University's 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 University's Committee on Academic Misconduct. If COAM determines that the student has violated the University's 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

From: "Blau, David" <blau.12@osu.edu>
Subject: RE: Concurrence for Statistics 8450/PUBH-Bio 8450
Date: June 9, 2014 at 8:47:36 AM EDT
To: "Craigmile, Peter" <pfc@stat.osu.edu>
Cc: "Kubatko, Laura" <lkubatko@stat.osu.edu>, "Miyazaki, Hajime" <miyazaki.1@osu.edu>

Dear Peter,

The Department of Economics is pleased to concur with your new course.

Regards,

David

David Blau
Chair, Department of Economics
445 Arps Hall
1945 N. High St.
Ohio State University
Columbus OH 43210-1172
blau.12@osu.edu
Phone: 614-292-2009
Fax: 614-292-3906
<https://economics.osu.edu/people/blau>

-----Original Message-----

From: Craigmile, Peter
Sent: Monday, June 02, 2014 12:12 PM
To: Blau, David
Cc: Kubatko, Laura
Subject: Concurrence for Statistics 8450/PUBH-Bio 8450

Dear Prof. David Blau

I am writing to ask for your concurrence for the proposed cross listed course entitled:

Stochastic Epidemic Models.

We are proposing to teach this course joint between Statistics (Prof. Laura Kubatko) and The Division of Biostatistics in Public Health (Prof. Greg Rempala). This course provides an introduction to methods of analyzing large population epidemic data from the viewpoint of stochastic processes theory, and provides the statistical theory and methods for analyzing this type of data.

I have attached a syllabus and the course approval form for your reference.

Thank you for your time.

Regards,
Peter Craigmile

Peter Craigmile, Ph.D.,
Chair of the curriculum committee, Department of Statistics.
Associate Professor, Department of Statistics, The Ohio State University.

From: "Brown, Trevor" <brown.2296@osu.edu>
Subject: RE: Concurrence for Statistics 8450/PUBH-Bio 8450
Date: June 3, 2014 at 1:40:58 PM EDT
To: "Craigmile, Peter" <pf@stat.osu.edu>
Cc: "Kubatko, Laura" <lkubatko@stat.osu.edu>

Hi Peter,

Thanks for the opportunity to review this syllabus. We are happy offer our concurrence.

Sincerely,

Trevor

Trevor Brown
Director
John Glenn School of Public Affairs
350C Page Hall | 1810 College Road, Columbus, OH 43210
glenn.osu.edu

Recently published: Complex Contracting -- Government Purchasing in the Wake of the US Coast Guard's Deepwater Program (Cambridge University Press). Pick up a copy from Cambridge or Amazon.

From: Craigmile, Peter
Sent: Monday, June 02, 2014 12:11 PM
To: Brown, Trevor
Cc: Kubatko, Laura
Subject: Concurrence for Statistics 8450/PUBH-Bio 8450

Dear Prof. Trevor Brown,

I am writing to ask for your concurrence for the proposed cross listed course entitled:

Stochastic Epidemic Models.

We are proposing to teach this course joint between Statistics (Prof. Laura Kubatko) and The Division of Biostatistics in Public Health (Prof. Greg Rempala). This course provides an introduction to methods of analyzing large population epidemic data from the viewpoint of stochastic processes theory, and provides the statistical theory and methods for analyzing this type of data.

I have attached a syllabus and the course approval form for your reference.

Thank you for your time.

Regards,
Peter Craigmile

Peter Craigmile, Ph.D.,
Chair of the curriculum committee, Department of Statistics.
Associate Professor, Department of Statistics, The Ohio State University.



June 11, 2014

To Whom It May Concern,

I am writing this letter of concurrence to support the development of Statistics 8450/PUBH-Bio 8450, *Stochastic Epidemic Models*. This course will be taught jointly between Statistics (Prof. Laura Kubatko) and The Division of Biostatistics in Public Health (Prof. Greg Rempala). This course provides an introduction to methods of analyzing large population epidemic data from the viewpoint of stochastic processes theory, and provides the statistical theory and methods for analyzing this type of data. This course will address learning objectives distinct from those offered to students via courses taught within the Microbiology graduate program.

Sincerely,

Michael Ibba, Ph.D.
Professor and Chair
Department of Microbiology

From: Carlson, Timothy carlson@math.ohio-state.edu
Subject: Math concurrence for Statistics 8450/PUBH-Bio 8450
Date: June 27, 2014 at 3:10 PM
To: Craigmile, Peter pfc@stat.osu.edu
Cc: Casian, Luis casian@math.ohio-state.edu, Husen, William husen@math.ohio-state.edu

Dear Professor Craigmile,

The Department of Mathematics is happy support the proposal for Statistics 8450/PUBH-Bio 8450.

Sincerely,

Tim Carlson
Vice Chair for Undergraduate Studies
Department of Mathematics