College of Public Health & Health Professions
Course Syllabus
PHC 6937: Stochastic Modeling
Spring 2013
Tuesdays 10:40 am – 12:35 pm, Room 205 Little Hall
Thursdays 11:45 are – 12:35 am, Room 237 Little Hall
Course Website:

**Instructor Information**

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**Course Overview**

The student will learn both the theory and practice of stochastic processes and modeling. This will include the theory of random phenomena that is concerned with the flow of events in time and space, especially those exhibiting highly variable behavior that can be described by probability distributions. Specifically, the student will learn to deal with the branching process, random walks, martingales, Markov processes, Poisson process, counting processes, birth and death processes as applied to the health sciences biology. Many of the examples and illustrations of the methods will be in the area infectious diseases. There will be an emphasis on learning methods of strong scientific importance as opposed to purely mathematical theory.

**Prerequisites**

STA 6326, 6327, 7346, 7466 or suitable courses in probability and statistics.

**Additional helpful background**

STA 7347, 7467, also on some level, Real Analysis, Differential Equations (including nonlinear theory), Survival analysis

**Course Objectives and/or Goals**

Upon successful completion of the course, students should be able to:

- Formulate and analyze stochastic models for research on biological and physical processes
- Understand and apply important inferential methods based on stochastic processes
- Set up methods for estimation and hypothesis testing based on stochastic models
- Understand the underlying dynamics of physical processes such as epidemics, networks and genetics.

- Interpret stochastic analysis while remaining aware of assumptions and limitations.

**Course Materials**

Chiang, C.L. (1980). *An Introduction to Stochastic Processes and Their Applications*, Krieger, N.Y. Required text: ISBN: 0-88275-200-6.

Longini, I.M. and Hudgens, M.G. (2012). *Lecture Notes on Stochastic Processes in Biostatistics: Applications to Infectious Diseases* (On the web). Lecture Notes

**Reference texts:**

Guttorp, P. (1995). Stochastic Modeling in Scientific Applications, Chapman & Hall,.

Bailey, N.T.J. (1964). The Elements of Stochastic Processes with Applications to the Natural Sciences, Wiley, N.Y.

Karlin, S. and Taylor, H.M. (1975). A First Course in Stochastic Processes (2nd edn.), Academic Press, N.Y.

Ross, S.M. (1983). Stochastic Processes, Wiley, N.Y.

Basawa, I.V. and Prakasa Rao, B.L.S. (1980). Statistical Inference for Stochastic Processes, Academic Press, N.Y.

**Course Requirements/Evaluation/Grading**

Students are responsible for all course material, including reading required materials prior to each class. Failure to complete assignments will result in a failing grade.

The assessment will include class participation, assignments, and two exams. Class participation will include weekly attendance and participation in discussions.

Class participation: 10%
Assignments: 10%
Exam 1 (mid-semester): 30%
Exam 2 (final day of classes): 50%

The grading scale for this course consists of the standard scale, including minus grades, below. The conversion factors for grade point values that are assigned to each grade are also included (in parentheses):

93% - 100% = A (4.00)
90% - 92% = A- (3.67)
87% - 89% = B+ (3.33)
83% - 86% = B (3.00)
80% - 82% = B- (2.67)
77% - 79% = C+ (2.33)
73% - 76% = C (2.00)
70% - 72% = C- (1.67)
67% - 69% = D+ (1.33)
63% - 66% = D (1.00)
60% - 62% = D- (0.67)
Below 60% = E (0.00)

**Tentative Outline**

| # | Dates | Topic | Reference in Chiang* (Lecture Notes**) |
|---|---|---|---|
| 1 | Jan 8 | Introduction to the Stochastic Theory | Readings |
| 2 | 10, 15 | Branching Processes | 3.1-3.4, 4.1 |
| 3 | 17 | Epidemics as Branching Processes | (3.2-3.3) |
| 4 | 22 | Gambler's Ruin, Gambling Systems, Discrete-time Martingales | 4.3 (4.3) |
| 5 | 24, 29 | Discrete State Space and Time Markov Processes, Deterministic Dynamic Processes | 5.1-5.8 |
| 6 | 31 | Chain Binomial Models, Reed-Frost Model of Epidemics | (5.5-5.5, 5.8) |
| 7 | Feb 5 | Inference on Markov chains and chain binomial models | (5.3) |
| 8 | 7, 12 | Algebraic Treatment of Markov chains | 6.1-6.3, 14.3 (6.1-6.3) |
| 9 | 14, 19 | Continuous-time Markov Processes | 10.1-10.3 (6.4) |
| 10 | 21 | Stages of Disease Process, HIV progression | 11.7 (5.7, 6.7) |
| 11 | 26, 28 | Forward Kolmogorov Differential Equations | 14.1-14.2, 14.4-14.5 (6.3) |
| | March 5,7 | Spring Break – Go to beach or something | |
| 12 | 12 | Mid-term exam (Jan 8 – Feb 12 material) | In class, open book |
| | 14,19 | Embedded Process and Semi-Markov Process, Inference on Continuous-time Markov Processes | (6.5) |
| 13 | 21, 26 | Stochastic Models for Graphs | Readings *** |
| 14 | 28 | Inference for Stochastic Epidemic Models – Efficacy Studies | Readings*** |
| 15 | April 2 | Inference for Stochastic Epidemic Models – Real-time Estimation for Outbreaks | Readings*** |
| 16 | 4 | Hidden Markov Processes | (8) |
| 17 | 9, 11 | Counting Processes and Continuous-time Martingales | (7.1) |
| 18 | 16, 18 | Inference Using Continuous-time Martingales | (7.1-7.3) |
| 19 | 23 | Individual-level stochastic simulation models, agent based | Readings |

* Material covered in Chiang and in Lecture Notes in many cases, ** Material covered only in the Lecture Notes, *** Guest lecture

**Statement of University's Honesty Policy (cheating and use of copyrighted materials)**

***Academic Integrity –*** Students are expected to act in accordance with the University of Florida policy on academic integrity (see Student Conduct Code, the Graduate Student Handbook or this web site for more details:
**www.dso.ufl.edu/judicial/procedures/academicguide.php**).

Cheating, lying, misrepresentation, or plagiarism in any form is unacceptable and inexcusable behavior.

*We, the members of the University of Florida community,*
*pledge to hold ourselves and our peers to the*
*highest standards of honesty and integrity.*

**Policy Related to Class Attendance and Late or Missed Assignments:**

Attendance of all class sessions is required. Please see the instructor as early as possible regarding possible absences. All assignments need to be handed in on time. Grading will penalize late assignments. Missed assignments will receive a zero score. Personal issues with respect to class attendance or fulfillment of course requirements (assignments, final presentation, class discussion) will be handled on an individual basis.

**Accommodations for Students with Disabilities**

If you require classroom accommodation because of a disability, you must first register with the Dean of Students Office (http://oss.ufl.edu/). The Dean of Students Office will provide documentation to you, which you then give to the instructor when requesting accommodation. The College is committed to providing reasonable accommodations to assist students in their coursework. We all learn differently: however, if you have experienced problems in university classes with writing, in-class exams, understanding or concentrating in class; please talk to us or access a learning or education testing resource at the University or in another professional setting.

**Counseling and Student Health**

Students may occasionally have personal issues that arise in the course of pursuing higher education or that may interfere with their academic performance. If you find yourself facing problems affecting your coursework, you are encouraged to talk with an instructor and to seek confidential assistance at the University of Florida Counseling Center, 352-392-1575, or Student Mental Health Services, 352-392-1171. Visit their web sites for more information: http://www.counsel.ufl.edu/ or http://www.health.ufl.edu/shcc/smhs/index.htm#urgent

The Student Health Care Center at Shands is a satellite clinic of the main Student Health Care Center located on Fletcher Drive on campus. Student Health at Shands offers a variety of clinical

services, including primary care, women's health care, immunizations, mental health care, and pharmacy services. The clinic is located on the second floor of the Dental Tower in the Health Science Center. For more information, contact the clinic at 392-0627 or check out the web site at: www.health.ufl.edu/shcc

Crisis intervention is always available 24/7 from:
Alachua County Crisis Center: (352) 264-6789.

BUT – *Do not wait until you reach a crisis to come in and talk with us. We have helped many students through stressful situations impacting their academic performance. You are not alone so do not be afraid to ask for assistance.*

**Class Demeanor Expected by the Professor (late to class, cell phones) :**

Students are expected to show up for class prepared and on time. Cell phones are to be silenced during class unless there is an emergency, in which case please inform the instructor.