

Course Syllabus

STATISTICS 517: Stochastic Modelling (4 credits) Winter Quarter - 2008

Instructor: I. Longini

Meeting time and place: Tuesdays and Thursdays 1:30 P.M. - 3:20 P.M., Room A114, Physics & Astronomy Auditorium

Office hours: By appointment

Office location: Department of Biostatistics, Room F-653, Health Sciences Building (In the F – Wing
<http://www.washington.edu/admin/ada/MagMap.FH7.jpg>)

Objectives: The student will learn the stochastic theory of epidemics and infectious disease transmission. 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, birth and death processes as applied to epidemic theory. There will be an emphasis on learning methods of strong scientific importance as opposed to purely mathematical theory.

Course Website: <http://www.stat.washington.edu/courses/stat517/winter08/>

Lecture Notes:

Longini, I.M. and Hudgens, M.G. (2003). *Lecture Notes on Stochastic Processes in Biostatistics: Applications to Infectious Diseases* (On the web).

Required text:

Chiang, C.L. (1980). *An Introduction to Stochastic Processes and Their Applications*, Krieger, N.Y.

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.

Prerequisites: Statistics 516 or suitable course in stochastic processes that includes inference

Additional helpful background: Real Analysis, Differential Equations (including nonlinear theory), Survival analysis

Evaluation:	Homework	10%
	Midterm	30%
	Final	60%

Tentative Course Outline

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

§ Lecture number

* Material covered in Chiang and in Lecture Notes in many cases

** Material covered only in the Lecture Notes

*** Guest lecture