SHANGHAI JIAO TONG UNIVERSITY

Shanghai Jiao Tong University

MA967 Statistics of Stochastic Processes

Instructor Information:	TBD		
Term:	December 16, 2019 - January 7, 2020	**Credits:**	4 units
Class Hours：	Monday through Friday, 160 mins per teaching day		
Discussion Sessions:	2 hours each week, conducted by teaching assistant(s)		
Total Contact Hours:	64 contact hours (1 contact hour = 45 mins, 2880 mins in total)		
Required Texts (with ISBN):	Unit information, summary lecture notes, assignments, exercises, marks, all handouts and all announcements are made available during class. Mathematical Statistics and Stochastic Processes, Denis Bosq, Wiley.		
Prerequisite:	Students need to finish one of the three courses below: Mathematics of Uncertainty Mathematical Statistics Probability and statistical inference for economics and business		

Course Overview

This unit will introduce statistical methods for such processes. Topics: Review of fundamental statistics: their distributions, properties and limitations; Stochastic Processes: Markov, ARMA, Stationary and Diffusion Processes; Likelihood models, Graphical models, Bayesian models; Decision theory, Likelihood ratio tests, Bayesian model comparison; Sufficient statistics, Maximum Likelihood Estimation, Bayesian Estimation; Exponential families; Convergence of random variables and measures; Properties of estimators: bias, consistency, efficiency; Laws of Large Numbers and Ergodic Theorems, Central Limit Theorems; Statistics for Stationary Processes; Statistics for ARMA Processes; Statistics for Diffusion Processes

Many practical experiments involve repeated measurements made over a period of time, where the individuals or systems being observed are evolving during the study period. Examples of this kind of data arise in signal processing, financial modelling and mathematical biology. For experiments of this kind, standard statistical methods that assume data points are independent and identically distributed (iid) are of limited value, due to dependencies among measurements.

Learning Outcomes

On completion of this subject students should be able to

1. Construct likelihood models for stochastic processes using graphical models;
2. Explain the central role of likelihood models in statistics;
3. Develop and apply likelihood ratio tests for model comparison and selection;
4. Apply Bayesian alternatives for model comparison and estimation;
5. Assess whether an estimator has desirable properties;
6. Use the principle of maximum likelihood to estimate parameters of a model;
7. Describe the asymptotic behaviour of time averages for stationary processes;
8. Perform model selection and estimation tasks for stationary, ARMA and diffusion processes.

Grading Policy

Assignment	30%
Homework	4%
Participation	6%
Final exam	60%

Grading Scale

Number grade	Letter grade	GPA
90-100	A	4.0
85-89	A-	3.7
80-84	B+	3.3
75-79	B	3.0
70-74	B-	2.7
67-69	C+	2.3
65-66	C	2.0
62-64	C-	1.7
60-61	D	1.0
≤59	F (Failure)	0

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Class Schedule

Date	Lecture	Readings
Day 1	IStatistics Revision	Chapter 1 Teaching Materials
Day 2	Measure Theory Modes of Convergence & Decision Theory & Estimation	Chapter 2 & Chapter 5 Teaching Materials
Day 3	Measure Theory Modes of Convergence & Decision Theory & Estimation	Chapter 2 & Chapter 5 Teaching Materials
Day 4	Linear Models	Teaching Materials
Day 5	Properties of Estimators &Stochastic Processes	Chapter9 Teaching Materials
Day 6	Properties of Estimators &Stochastic Processes	Chapter9 Teaching Materials
Day 7	Weakly Stationary Processes	Chapter 10 Teaching Materials
Day 8	Poisson processes	Chapter 11 Teaching Materials
Day 9	Square-integrable processes	Chapter 12 Teaching Materials
Day 10	Diffusion Processes	Chapter 13 Teaching Materials
Day 11	ARMA Processes	Chapter 14 Teaching Materials
Day 12	Prediction	Chapter 15 Teaching Materials
Day 13	Linear Models	Teaching Materials
Day 14	Revision	
Day 15	**Final exam**	