MA967 Statistics of Stochastic Processes (Online)

Instructor Information	Wanchunzi Yu Home Institution: Bridgewater State University Email: wyu@bridgew.edu		
Term	December 13, 2021 - January 7, 2022	**Credits**	4 units
Course Delivery	The class will be delivered in the format of online. Other than recorded lecture videos, the instructor will arrange 3 hours' real-time interactions with students per week (via discussion forum, zoom meeting, and WeChat). The workload students are expected to complete to properly pass this course is about 15 hours per week.		
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

Standard statistical methods always assume that the sampling data are independent and identically distributed. However, in practice, it is quite common that the observed data are correlated, for example in chemistry, economics, biology and so on. Stochastic Processes are ways of modelling this relationship. This course aims to familiarize students with such statistical processes.

The following topics will be covered in this course: Review of probability and mathematical statistics; convergence of random variables and measures; Decision theory: loss function, Bayesian statistics; Classical theory of estimation: bias, consistency, sufficiency, completeness, efficiency, maximum-likelihood estimation, Bayesian estimator, likelihood ratio test; Stochastic processes: Stationary processes, Markov processes, Poisson processes, Square-integrable processes, Diffusion processes, ARMA; Prediction.

Learning Outcomes

On completion of this subject students should be able to

1. Familiar with the maximum likelihood estimation, likelihood ratio test;
2. Clear the principle of Bayesian analysis and use it for parameter estimation and model selection;
3. Understand the basic concepts of common random processes;
4. Estimate the unknown parameter(s) and derive the corresponding properties of the estimator(s) for a given model;
5. Perform model selection (and verification) for stationary, ARMA and diffusion processes;
6. Construct statistical predictor for ARMA.

Course Structure

1. Asynchronous Hours: Sunday through Thursday, total 25 hours Pre-recorded videos will be posted on SJTU SCE online learning platform.
2. Synchronous Hours: Beijing Time: Tuesday: 7:30 – 9:00 pm, Thursday: 8:30 – 10 am.

Grading Policy

Three Assignments	30%
Quizzes/Attendance	20%
Midterm Exam	25%
Final exam	25%

Grading Scale is as follows

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

Class Schedule

Date	Lecture	Readings	Online Teaching Arrangement
Day 1	Review of Probability	Notes	Approximately 80 minutes pre-recorded video lectures
Day 2	Review of Mathematical Statistics	Notes	Approximately 80 minutes pre-recorded video lectures
Day 3	Chapter 1. Introduction to Mathematical Statistics	1	Approximately 30 minutes pre-recorded video lectures plus 90 minutes online interaction via Zoom
Day 4	Chapter 2. Principles of Decision Theory	2	Approximately 30 minutes pre-recorded video lectures plus 90 minutes online interaction via Zoom
Day 5	Chapter 3. Conditional Expectation	3	Approximately 80 minutes pre-recorded video lectures
Day 6	Chapter 4. Statistics and Sufficiency	4	Approximately 80 minutes pre-recorded video lectures
Day 7	Chapter 5. Point Estimation	5	Approximately 80 minutes pre-recorded video lectures
Day 8	Chapter 5. Point Estimation	5	Approximately 30 minutes pre-recorded video lectures plus 90 minutes online interaction via Zoom
Day 9	Chapter 6. Hypothesis Testing and Confidence Regions	6	Approximately 30 minutes pre-recorded video lectures plus 90 minutes online interaction via Zoom
Day 10	Chapter 6. Hypothesis Testing and Confidence Regions	6	Approximately 80 minutes pre-recorded video lectures
Day 11	Chapter 7. Asymptotic Statistics	7	Approximately 80 minutes pre-recorded video lectures
Day 12	Midterm Exam Review	1-7	Approximately 80 minutes pre-recorded video lectures

Day 13	**Midterm Exam**	1-7	Exam via Zoom
Day 14	Chapter 9. Introduction to Statistics for Stochastic Processes	9	Approximately 30 minutes pre-recorded video lectures plus 90 minutes online interaction via Zoom
Day 15	Chapter 10. Weakly Stationary Discrete – Time Processes.	10	Approximately 80 minutes pre-recorded video lectures
Day 16	Chapter 11. Poisson Processes – A Probabilistic and Statistical Study	11	Approximately 80 minutes pre-recorded video lectures
Day 17	Chapter 12. Square-Integrable Continuous – Time Processes	12	Approximately 80 minutes pre-recorded video lectures
Day 18	Chapter 14. ARMA Processes	14	Approximately 30 minutes pre-recorded video lectures plus 90 minutes online interaction via Zoom
Day 19	Final Exam Review	9-14	Approximately 30 minutes pre-recorded video lectures plus 90 minutes online interaction via Zoom
Day 20	**Final Exam**	9-14	Exam via Zoom