上海交通大學
SHANGHAI JIAO TONG UNIVERSITY

Shanghai Jiao Tong University

MA413 Time Series & Random Processes in Linear Systems (Online)

Instructor Information	Wanchunzi Yu Home Institution: Bridgewater State University Email: wyu@bridgew.edu		
Term	December 17, 2020 - January 8, 2021	**Credits**	4 units
Course Delivery	The course will be delivered in the format of online. Other than recorded lecture videos, the instructor will arrange 3 hours' real-time interaction with students per week (via zoom meeting). The workload students are expected to complete to properly pass this course is about 12-16 hours per week. Exams are proctored under zoom-meeting camera.		
Required Texts (with ISBN)	Time Series Analysis Univariate and Multivariate Methods, 2nd Edition, by William W.S. Wei ISBN-13: 978-0321322166 ISBN-10: 0321322169		
Prerequisite	Financial Mathematics related courses are needed before enrolling in this lesson		

Course Overview

Time Series & Random Process in Linear System is a course designed for students of Financial Mathematics. This is a course of Time Series Theory for the students specializing in the field of Finance and Banking. The course will cover both various of time series models and the application with financial time series data. Interpretation and conclusion of the analysis results of real-life examples are also importation.

Course Goals

Upon successful completion of this course, students will be conversant with

- main concepts of Time Series theory and methods of analysis
- analysis and modeling of stochastic processes of ARMA models
- seasonal ARIMA models
- autoregressive models
- co-integration and error correction models
- Spectrum analysis
- forecasting using transfer function models
- working with real-life economic time series data using the statistical software

Grading Policy

Attendance	20%
Assignment 1	15%
Assignment 2	15%
Midterm Exam	25%
Final Group Project	25%

Grading Scale is as follows

Number grade	Letter grade	GPA
90-100	A	4
85-89	A-	3.7
80-84	B+	3.3
75-79	B	3
70-74	B-	2.7
67-69	C+	2.3
65-66	C	2
62-64	C-	1.7
60-61	D	1
≤59	F (Failure)	0

Class Schedule

Date	Lecture	Arrangement	Readings
Day 1	1.1 Introduction 1.2 Examples and Scope of This Book 2.1 Stochastic Processes 2.2 The Autocovariance and Autocorrelation Functions 2.3 The Partial Autocorrelation Function 2.4 White Noise Processes	1.5 hours Zoom meeting 0.75 hours pre-recorded video	1, 2
Day 2	2.5 Estimation of the Mean, Autocovariances, and Autocorrelations 2.6 Moving Average and Autoregressive Representations of Time Series Processes 2.7 Linear Difference Equations	2.25 hours pre-recorded video	2
Day 3	3.1 Autoregressive Processes 3.2 Moving Average Processes 3.3 The Dual Relationship Between AR(p) and MA (q) Processes	2.25 hours pre-recorded video	3
Day 4	3.4 Autoregressive Moving Average ARMA (p, q) Processes 4.1 Nonstationary in the Mean 4.2 Autoregressive Integrated Moving Average (ARIMA) Models	1.5 hours Zoom meeting 0.75 hours pre-recorded video	3, 4
Day 5	4.3 Nonstationary in the Variance and the Autocovariance 5.1 Introduction 5.2 Minimum Mean Square Error Forecasts 5.3 Computation of Forecasts	2.25 hours pre-recorded video	4, 5
Day 6	5.4 The ARIMA Forecast as a Weighted Average of Previous Observations 5.5 Updating Forecasts 5.6 Eventual Forecast Functions	2.25 hours pre-recorded video	5
Day 7	6.1 Steps for Model Identification 6.2 Empirical Examples 6.3 The Inverse Autocorrelation Function (IACF)	1.5 hours Zoom meeting 0.75 hours pre-recorded video	6
Day 8	7.1 The Method of Moments 7.2 Maximum Likelihood Method 7.3 Nonlinear Estimation	2.25 hours pre-recorded video	7
Day 9	7.4 Ordinary Least Squares (OLS) Estimation in Time Series Analysis 7.5 Diagnostic Checking	1.5 hours Zoom meeting 0.75 hours pre-recorded video	7

Day 10	8.1 General Concepts 8.2 Traditional Methods 8.3 Seasonal ARIMA Models & Exam 1 Review	2.25 hours pre-recorded video	8
Day 11	**Exam 1**	2.25 hour online exam proctored under zoom-meeting camera	
Day 12	11.1 General Concepts 11.2 Orthogonal Functions 11.3 Fourier Representation of Finite Sequences 11.4 Fourier Representation of Periodic Sequences	1.5 hours Zoom meeting 0.75 hours pre-recorded video	11
Day 13	11. 5 Fourier Representation of Nonperiodic Sequences 11.6 Fourier Representation of Continuous-Time Functions 11.7 The Fast Fourier Transform	2.25 hours pre-recorded video	11
Day 14	12.1 The Spectrum 12.2 The Spectrum of Some Common Processes 12.3 The Spectrum of Linear Filters 12.4 Aliasing	1.5 hours Zoom meeting 0.75 hours pre-recorded video	12
Day 15	13.1 Periodogram Analysis 13.2 The Sample Spectrum 13.3 The Smoothed Spectrum 13.4 ARMA Spectral Estimation	2.25 hours pre-recorded video	13
Day 16	14.1 Single-Input Transfer Function Models 14.2 The Cross-Correlation Function and Transfer Function Models 14.3 Construction of Transfer Function Models	2.25 hours pre-recorded video	14
Day 17	14.4 Forecasting Using Transfer Function Models 14.5 Bivariate Frequency-Domain Analysis 14.6 The Cross-Spectrum and Transfer Function Models 14.7 Multiple-Input Transfer Function Models	1.5 hours Zoom meeting 0.75 hours pre-recorded video	14
Day 18	**Final Project Presentation**	2.25 hours online group project presentation via zoom-meeting camera.	