Shanghai Jiao Tong University

MA413 Time Series & Random Processes in Linear Systems

Instructor Information:	Wanchunzi Yu Home Institution: Bridgewater State University Email: wyu@bridgew.edu Office Hours: Determined by Instructor		
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):	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 Exam	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	Chapter
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, 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 3.1 Autoregressive Processes	2, 3
Day 3	3.2 Moving Average Processes 3.3 The Dual Relationship Between AR(p) and MA (q) Processes 3.4 Autoregressive Moving Average ARMA (p, q) Processes	3
Day 4	4.1 Nonstationary in the Mean 4.2 Autoregressive Integrated Moving Average (ARIMA) Models 4.3 Nonstationary in the Variance and the Autocovariance	4
Day 5	5.1 Introduction 5.2 Minimum Mean Square Error Forecasts 5.3 Computation of Forecasts 5.4 The ARIMA Forecast as a Weighted Average of Previous Observations 5.5 Updating Forecasts 5.6 Eventual Forecast Functions	5
Day 6	6.1 Steps for Model Identification 6.2 Empirical Examples 6.3 The Inverse Autocorrelation Function (IACF)	6
Day 7	7.1 The Method of Moments 7.2 Maximum Likelihood Method 7.3 Nonlinear Estimation 7.4 Ordinary Least Squares (OLS) Estimation in Time Series Analysis 7.5 Diagnostic Checking	7

Day 8	8.1 General Concepts 8.2 Traditional Methods 8.3 Seasonal ARIMA Models	8
Day 9	11.1 General Concepts 11.2 Orthogonal Functions 11.3 Fourier Representation of Finite Sequences 11.4 Fourier Representation of Periodic Sequences 11. 5 Fourier Representation of Nonperiodic Sequences 11.6 Fourier Representation of Continuous-Time Functions 11.7 The Fast Fourier Transform	11
Day 10	12.1 The Spectrum 12.2 The Spectrum of Some Common Processes 12.3 The Spectrum of Linear Filters 12.4 Aliasing	12
Day 11	13.1 Periodogram Analysis 13.2 The Sample Spectrum 13.3 The Smoothed Spectrum 13.4 ARMA Spectral Estimation	13
Day 12	14.1 Single-Input Transfer Function Models 14.2 The Cross-Correlation Function and Transfer Function Models 14.3 Construction of Transfer Function Models	14
Day 13	14.4 Forecasting Using Transfer Function Models 14.5 Bivariate Freqency-Domain Analysis 14.6 The Cross-Spectrum and Transfer Function Models 14.7 Multiple-Input Transfer Function Models	14
Day 14	**Exam 1**	
Day 15	**Exam 2**	