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FA542 Time Series with Applications to Finance

Course Catalog Description

Introduction

In this course the students will learn how to estimate financial data model and predict using time series models. The course will cover linear time series (ARIMA) models, conditional heteroskedastic models (ARCH type models), non-linear models (TAR, STAR, MSA), non-parametric models (kernel regression, local regression, neural networks), non-parametric methods of evaluating fit such as bootstrap, parametric bootstrap and cross-validation. The course will also introduce multivariate time series models such as VAR. Prerequisite: FE 541 or MA 331 or MA 541 or MA 612

Campus	Fall	Spring	Summer
On Campus		X	
Web Campus		X	

Instructors

Professor	Email	Office
Zachary Feinstein (https://web.stevens.edu/facultyprofile/?id=2357)	zfeinste@stevens.edu	Babbio 628

More Information

Course Description

This course is designed for Master and Ph.D. graduate students and advanced undergraduates. The purpose is to learn applied statistical methodologies pertaining to time series (i.e., a discrete series of observations related in time). The students are required to have taken a probability course such as FE 540 or MA 540 and an applied statistics course such as FE541 and have a solid working knowledge of probability and statistics. Simple regression, estimation, confidence intervals and testing from the applied perspective are crucial notions assumed known for this course. We will use R throughout the course so a running knowledge of it is good to have. FE515 is a one credit course teaching R programming that complements this class. The course is one of the core courses for the Financial Analytics (FA) program.
Learning Goals In this course, students will Generally:

- Gain some knowledge of financial time series
- Gain knowledge of some statistical tools useful for analyzing financial time series
- Gain experience in financial applications of various econometric methods
  Specifically:
- Learn how to test for normality, stationarity, and unit-root stationarity
- Learn linear time series models (AR/MA/ARMA/ARIMA) in theoretical and applied ways
- Learn how to test and model heteroscedastic effects using ARCH/GARCH type time series

Course Outcome

A student graduating this course will be expected to possess the following specific knowledge:

1. The ability to approach and analyze any discrete time signal from a time series perspective
2. The ability to differentiate between various time series models
3. The ability to forecast future observations of the time series.

Course Resources

Textbook

Primary Textbook: Ruey S. Tsay, Analysis of Financial Time Series. 3rd Edition, Wiley.

Additional References

Peter Daalgard, Introductory Statistics with R. 3rd Printing Edition, Springer. (Supplemntary text for R programming)

Ruey S. Tsay, An Introduction to Analysis of Financial Data with R. Wiley. (An easier version of the primary textbook)

Grading

Grading Policies

Assignments
To understand the course material and get a good grade, it is necessary (though not sufficient) to invest a substantial amount of time working on the assignments. Homeworks will be posted on Canvas (approximately) every other week. These assignments will be due on the specified due date at the specified time. No late assignments, without prior approval, will be accepted.
You are encouraged to discuss homeworks. However, all written homework must be written by you. Copying solutions from other students in the class, former students, tutors, or any other source is strictly forbidden. Copying the solution of one or more problems from another source than your own brain is considered academic dishonesty/misconduct and will be dealt with according to the Stevens honor board policy. Please review the “Collaborating or Working in Groups” document posted on Canvas which details what is considered fair collaborating and what is considered academic misconduct.
Your solutions must be those that you fully understand and can produce again (and solve similar problems) without help. The ideal model to follow is: first work independently, then to discuss issues with your classmates, and then to prepare the final write-up individually.
This is an applied course. Therefore, I expect any solution to a problem in this class will follow the steps below: 1. Outline the steps and identify the mathematical techniques learned that pertain to the respective problem. 2. If the problem needs a method, first identify and describe the methodology to be applied. 3. Apply the methodology to the problem or data under study. 4. Write a conclusion explaining if the application seems to support the method.

Exam policy
We will have one midterm and one final exam. The format will be decided at a later time. If an in-class exam, you will be allowed to bring a single 8.5” by 11” sheet of paper (both sides) containing any material you want on it. If you need a computer, the exam will be open-book and open-notes. The date for the midterm is provided in the tentative schedule below.
There will be no individual make up exams without prior approval. To be granted this approval, you must have a valid reasoning with written documentation that explains the reason for the missed exam.

Grade distribution

- 5% Attendance/Participation and In-Class Exercises
- 35% Homework Assignments
- 20% Midterm Exam
- 40% Final Exam

- This grading scheme is subject to change based on student outcomes.It may be curved more leniently. It will not be made more difficult.

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Lecture Outline

	Topic	Reading
Week 1	Review of probability and statistics	
Week 2	Characteristics of discrete time financial data	Chapter 1
Week 3	Correlations, dependence, autocorrelation	Chapter 2
Week 4	Linear time series analysis	Chapter 2
Week 5	Linear time series analysis continued	Chapter 2
Week 6	Volatility modeling via conditional heteroscedastic models	Chapter 3
Week 7	Volatility modeling via conditional heteroscedastic models continued	Chapter 3
Week 8	Midterm Exam	
Week 9	Spring Break – No Class	
Week 10	Nonlinear models and applications	Chapter 4
Week 11	Nonlinear models and applications continued	Chapter 4
Week 12	Multivariate time series models	Chapter 8
Week 13	Multivariate time series models continued	Chapter 8
Week 14	Neural networks for time series	TBD
Week 15	Final Exam	

Please note that this schedule is a tentative plan for the semester. As we move through the semester the schedule outlined here is subject to change.

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