FA-542: Time Series with Applications to Finance
Fall 2023

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Schedule: FA-542-A & FA-542-W0
Thursday (10:00am-12:30pm)
Hanlon Lab II (Babbio 111) and Zoom

Office Hours: Babbio 430: Tuesday & Thursday (5:30pm-6:30pm)
Zoom (By Appointment):
https://outlook.office365.com/owa/calendar/OfficeHours1@stevens0.onmicrosoft.com/bookings/

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.

Objective: 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
Textbooks:	Ruey S. Tsay, *Analysis of Financial Time Series*. 3rd Edition, Wiley.
Other References:	Peter Daalgard, *Introductory Statistics with R*. 3rd Printing Edition, Springer. (Supplementary text for R programming) Ruey S. Tsay, *An Introduction to Analysis of Financial Data with R*. Wiley. (An easier version of the main textbook)
Outcomes:	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.
Grading:	Class Participation 5% Assignments 40% Midterm Exam 20% Final Exam 35%
Assignments Policy:	To understand the course material and get a good grade, it is necessary invest a substantial amount of time working on the assignments. Assignments 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 assignments. 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. Both exams will be take-home with (at least) 24 hours provided to complete the exam. They will be open-book and open-notes; any resources other than course notes or the textbook must be properly cited. Both exams are individual tests; during the exams you may not talk to your classmates or anyone else about the material except the course instructor.

There will be no individual make up exams without prior approval. To be granted this approval, you must have a valid reason with written documentation.

Graduate Student Code of Academic Integrity:

All Stevens, graduate students promise to be fully truthful and avoid dishonesty, fraud, misrepresentation, and deceit of any type in relation to their academic work. A student's submission of work for academic credit indicates that the work is the student's own. All outside assistance must be acknowledged. Any student who violates this code or who knowingly assists another student in violating this code shall be subject to discipline.

All graduate students are bound to the Graduate Student Code of Academic Integrity by enrollment in graduate coursework at Stevens. It is the responsibility of each graduate student to understand and adhere to the Graduate Student Code of Academic Integrity. More information including types of violations, the process for handling perceived violations, and types of sanctions can be found at www.stevens.edu/provost/graduate-academics .

Learning Accommodations:

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

For more information about Disability Services and the process to receive accommodations, visit https://www.stevens.edu/office-disability-services . If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at pgehman@stevens.edu or by phone 201-216-3748.

Disability Services Confidentiality Policy
Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

Inclusivity:

Name and Pronoun Usage
As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the

ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement
Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

Mental Health Resources:

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression) and who can visit the office in person. CAPS is open from 9:00 am – 5:00 pm Mondays, Wednesdays, Thursdays and Fridays and from 9:00 am – 7:00 pm on Tuesdays during the Fall and Spring semesters; appointments are highly encouraged. For those students who cannot visit the Stevens campus for an in-person appointment, you can contact a local mental health care provider for an in-person appointment, or if you are enrolled in the Stevens Student Health Insurance, you may call Care Connect for 24/7 mental health support at 1-888-857-5462.

For further information please visit the CAPS webpage on Seeking Help Off-Campus.

Emergency Information:

In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. For students who do not reside near the campus and require emergency support, please contact your local emergency response providers at 911 or via your local police precinct. Other 24/7 national resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text “Home” to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is not urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.

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