

# **Financial Time Series Analysis**

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## ***Course Description:***

The importance of quantitative methods in finance has increased substantially in recent years because we are living in a data-rich environment. This course provides essential knowledge of financial time series and introduces statistical tools for analyzing financial data. Indeed, this course illustrates how the econometric models work by analyzing real-world financial data through R, a free package for advanced statistical computing. A salary level is positively associated with the quality of labor productivity, where the labor productivity is a positive function of special knowledge in modern economy. This course provides the special knowledge of financial time series analysis, which shall be a valuable asset for students who are seeking high-paid jobs in finance.

This course introduces many theorems without formal proofs and directly applies them to analyzing financial data. While I love the mathematical proof of the theorem, I skip most of the proofs at this time simply because it is too complicated for undergraduate students (in fact, even for graduate students) to prove those theorems. Occasionally, I witnessed that some students complained this approach and argued that their understanding might be better if they could see what is inside the black box by proving the theorems. For those students, I would like to advise them to go to the PhD program of statistics and learn the theory of time series analysis for many years. At the same time, those complaints are unreasonable, since this course is offered for undergraduate students who are just interested in practical applications of time series analysis.

This course is appropriate for students who are already familiar with various topics in investments, such as asset pricing, derivatives and so on. If you do not have sufficient knowledge on these topics, I am afraid that you will be very troubled with understanding how this course's materials are related to the practical topics in investments, and as a result cannot entertain the true beauty of the quantitative methods in financial time series. One simple solution to fix it would be to take this course after taking investments or related courses.

## ***Prerequisites:***

This course aims to cover a wide range of practical topics in financial time series in a single semester. Given the limited time and the amount of topics, I cannot repeat basic statistics in class. Instead, I operate this course under the assumption that students have already taken mathematical (not applied) statistics, econometrics, advanced calculus (including integration) or equivalent statistical/mathematical courses. Students should "sufficiently" understand the mathematical/statistical properties of probabilistic distributions, sampling distributions, asymptotic distributions, hypothesis testing, least squared estimation, and so on. If you do not satisfy these prerequisites, you are strongly advised to drop this course or seek to acquire my permission. Please do not overestimate your intellectual abilities by wishing that you could make up the insufficient knowledge of mathematics and statistics and at the same time understand the new topics of financial time series. In many cases, the overconfidence tends to result in miserable outcomes. Over the past years, I saw that numerous students who were not

ready in terms of the competency of statistics and mathematics were troubled in class and most likely to be ended with F at the end of the semester. As an instructor of this course, I do want to minimize the probability that such a miserable event occurs. So, I recommend you to take this course only if you are fully ready. In summary, this course is designed to offer a special knowledge which can be entertained by prepared students only, not a general knowledge which is defined as the knowledge everybody can learn regardless of academic preparation.

### ***Required Material:***

The required textbook is *An Introduction to Analysis of Financial Data with R*, by Ruey Tsay, one of the leading experts on financial time series analysis. Both hardcover and e-book are available in Amazon.com. I will use lecture notes which will be posted on the course website regularly. Students are asked to bring the notes to class. Keep in mind that the notes are not a substitute for the textbook and you are responsible to read the corresponding chapters in the textbooks. Noticeably, you need to read a document titled “R basics” if it is your first time to use R.

### ***Course Operation:***

There will be problem sets, all of which require R implementation. Each homework is intended to check if you correctly understand in-class topics and thereby broaden your understanding of them. It is not mandatory to submit your work. If you turn it to me, however, my TA will grade it and give you some feedback.

This course requires students spend a “significant” amount of time to study, since it is pretty challenging to analyze financial time series by nature. Some students often misunderstand that they could learn something in this class without making such an effort. Unfortunately to those students, I would like to say that the special knowledge, which will be a plus factor for future income, can be obtained with hard working. If you are not determined to study hard, you hardly learn the special knowledge and thus taking this course is likely to waste your time.

### ***Exams:***

There are one midterm exam and one final exam. The final exam will be comprehensive, with a greater focus on topics covered after the midterm. A periodic review of class material is strongly recommended. If you miss the exams without extraordinary circumstances (explained later), I will not allow the make-up exams and you will get zero for the missing exams.

### ***Special Arrangements:***

If you have a documented disability and anticipate the need for accommodations in this course, please make arrangements to meet with me as soon as possible. Documented evidence that you were seriously ill at the scheduled time of an exam or had an unexpected family emergency is the only valid excuses for missing a midterm or final exam. In order to be excused from an exam, you must contact me prior to the exam and be ready to provide me with documentation after the exam. In these rare cases, all of the weight from the missed midterm (final) will be moved to the final (midterm).

### ***Grading:***

Midterm Exam	40%
Final Exam	40%
Attendance	20%

If you believe that I made a mistake when grading your exam, you are entitled to request a re-grade. To receive a re-grade, you must submit to me both the original document and a separate written explanation of why you believe you deserve more points. In addition, you must do so within seven days of receiving the graded exam. If the re-grade request is made after seven days or without an accompanying written explanation, no re-grade will be given. Please note that all re-grade decisions are final.

***Attendance:***

Attendance is mandatory for this course per the University. If your attendance rate is less than 1/3, you will be automatically failed regardless of the course records of exams.

***Academic Integrity:***

Personal integrity and professional conduct are important aspects of business, and also one's personal life. The University has a Student Conduct Code, which should serve as guidelines to behavior regarding this class. In order to ensure fairness on behalf of the majority of honest students, anyone who is guilty of academic dishonesty will receive an F for the course. There are no exceptions to this policy under any circumstances. Remember that it is hard to get a good job after failing a course, so please do not cheat.

***Important Notices:***

Two things are important. First, no cell phone, no laptop, and no tablet pc in class! If you intentionally violate this rule and your intentions are repetitive, you will no longer be able to take this course. Second, I am a native Korean speaker, not a native English speaker. It means that while I am doing my best, some students may feel uncomfortable of my speaking skills. It is very sorry for the students but I have no choice but to say that the Hanyang University requires most of professors to teach one class in English per year and I should follow this mandatory policy according to my contract. Please remember that I am a professor of Finance, not a professor of English. I think it reasonable that you expect me to teach an advanced knowledge of finance, which cannot be taught by the English professor, but I think it unreasonable that you even expect me to deliver the knowledge with good English, as if it were taught by the English professor. So, I cautiously and seriously advise the students who are concerned with my speaking skills not to take this course but to find other courses operated by professors whose speaking skills are better than mine.

***Course Policies are designed to Ensure Fairness:***

By remaining enrolled in the course, you agree to abide by the policies detailed above. If you anticipate that you cannot abide by these policies (e.g., because you know that you have a conflict with an exam because of vacation travel or travel in connection with an interview), please either change your schedule or arrange to take this course in another time.

***Course Outline:***

If we fall behind schedule, the range of topics covered by the midterm and final will be adjusted appropriately.

- Week 1: Orientation
- Week 2: No class
- Week 3: Financial data and their properties
- Weeks 4-7: Linear models for financial time series
- Week 8: Midterm exam
- Weeks 9-10: Asset volatility and volatility models

- Week 11: High frequency financial data
- Weeks 12-14: Value at risk
- Week 15: TBA
- Week 16: Final exam