

IE 522: STATISTICAL METHODS IN FINANCE

University of Illinois Urbana-Champaign

Fall 2026

Class Schedule

Days: Mondays and Wednesdays

Time: 9:00 AM – 10:40 AM

Venue: Transportation Building 103

Instructor

Abhishek Umrawal

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Office Hours: Mondays, 11:00 AM – 12:00 PM

Teaching Assistant

Hao Qin

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Office Hours: TBD

Course Platforms

- Canvas: Primary source for course materials, announcements, lecture notes, and assignments.
- Gradescope: Homework submission, grading, and regrade requests.
- Campuswire: Course-related questions and discussions.

Introduction

Welcome to IE 522: Statistical Methods in Finance, a graduate course in the Master of Science in Financial Engineering (MSFE) program jointly offered by the Grainger College of Engineering and the Gies College of Business at the University of Illinois Urbana-Champaign.

Financial engineering relies heavily on statistical methods to analyze market behavior, estimate risk, identify patterns in financial data, evaluate investment strategies, and make decisions under uncertainty. This course develops the statistical foundations necessary for modern quantitative finance.

The course emphasizes the connection between statistical methodology and financial applications. Students will learn how to analyze financial data, quantify uncertainty, construct predictive models, perform simulation studies, and evaluate statistical evidence. Throughout the semester, we will combine theoretical principles with computational implementation and applications drawn from finance.

Key Topics

The key topics covered in this course are:

- Descriptive statistics, exploratory data analysis, summary statistics, and statistical visualization.
- Statistical inference including point estimation, confidence intervals, hypothesis testing, maximum likelihood estimation, Monte Carlo simulation, bootstrap, and resampling methods.
- Regression analysis including simple linear regression, multiple linear regression, variable selection, prediction, and regression diagnostics.
- Financial time series analysis, stationarity, autocorrelation, and dependence modeling.
- Time series modeling and forecasting using MA, AR, ARMA, and ARIMA models.
- Financial data modeling and risk analysis including volatility modeling, normal mixture models, statistical learning, and forecasting.

Prerequisites

IE 300: Analysis of Data and MATH 461: Probability Theory.

Students are expected to have prior exposure to probability theory, statistics, calculus, and linear algebra.

Learning Outcomes

By the end of this course, students will be able to:

- Summarize, visualize, and interpret financial data using appropriate statistical techniques.
- Apply principles of statistical inference to estimate unknown quantities and quantify uncertainty.
- Construct and interpret confidence intervals and hypothesis tests.
- Implement Monte Carlo simulation methods for financial modeling and risk analysis.
- Estimate statistical models using maximum likelihood and related methods.
- Build and interpret regression models for financial applications.
- Evaluate model quality through diagnostic analysis and validation methods.
- Analyze financial time series using AR, MA, and ARIMA models.
- Generate forecasts and assess predictive performance.
- Implement statistical methods using R.
- Communicate statistical findings and their financial implications effectively.

Course Structure

The course combines lectures, computational demonstrations, homework assignments, examinations, and an applied project. Emphasis is placed on developing both statistical intuition and practical modeling skills through the analysis of real financial data.

Textbooks and References

The primary references for the course are:

- Casella, G., and Berger, R. *Statistical Inference*, 2nd Edition.
- Ruppert, D., and Matteson, D. *Statistics and Data Analysis for Financial Engineering*, 2nd Edition.
- Tsay, R. *Analysis of Financial Time Series*, 3rd Edition.

Some references may be available through the University Library: <https://www.library.illinois.edu/>.

Additional references include:

- James, G., Witten, D., Hastie, T., and Tibshirani, R. *An Introduction to Statistical Learning*. Available online at <https://www.statlearning.com/>.

Lecture notes and supplementary readings will be provided throughout the semester.

Software

Computational implementation is an important component of this course. We will primarily use R for statistical computing, financial data analysis, simulation, visualization, and forecasting. Students are expected to become comfortable working with financial data and implementing statistical methods in R. Assignments may require both programming and written interpretation of results. Students should ensure that all submitted code runs correctly and is adequately documented.

Grading

Grades will be based on class participation, homework assignments, examinations, and a course project.

- Class Participation: 5%
- Homework Assignments: 48% (13 assignments in total; the lowest homework grade will be dropped)
- Exams: 35% (Midterm Exam: 15% + Final Exam: 20%)
- Group Project: 12%
- Optional Reflections: Up to 3% extra credit (3 reflections in total; up to 1% each)

The final letter grades will be assigned as follows based on the course average:

$$[90, 100] = A, \quad [80, 90) = B, \quad [70, 80) = C, \quad [60, 70) = D, \quad [0, 60) = F.$$

Note that $[x, y)$ denotes the interval that includes x but not y .

Grades may be curved upward based on overall class performance. No grading adjustment will lower a student's course grade.

Homework

Homework assignments are designed to reinforce concepts from lecture and develop practical statistical modeling skills. Students may discuss general ideas with classmates; however, all submitted work must be completed independently. Homework must be submitted through Gradescope by the stated deadline. There will be thirteen homework assignments, and the lowest score will be dropped. Regrade requests are due within one week of return. Homework assignments will generally be released on Wednesdays and due the following Wednesday at 11:59 PM. A tentative schedule of homework assignments is:

Homework	Release Date	Due Date
HW1	Aug. 26	Sep. 2
HW2	Sep. 2	Sep. 9
HW3	Sep. 9	Sep. 16
HW4	Sep. 16	Sep. 23
HW5	Sep. 23	Sep. 30
HW6	Sep. 30	Oct. 7
HW7	Oct. 7	Oct. 14
HW8	Oct. 21	Oct. 28
HW9	Oct. 28	Nov. 4
HW10	Nov. 4	Nov. 11
HW11	Nov. 11	Nov. 18
HW12	Nov. 18	Dec. 2
HW13	Dec. 2	Dec. 9

All homework assignments must be submitted by the stated deadline. Students are allotted 5 late days for the semester. Late days may be used on homework assignments only and may be distributed across assignments in any manner. Once all late days have been exhausted, a penalty of 33% will be imposed for each day (or fraction thereof) that an assignment is late. Assignments submitted more than three days late will receive no credit. Late days cannot be used for anything but homework assignments. It is the responsibility of each student to keep track of how many late days have been used.

Exams

Exams are designed to assess both conceptual understanding and problem-solving ability. Students are expected to demonstrate mastery of statistical methods, analytical reasoning, and the application of course concepts to financial data and real-world scenarios. Midterm exam regrade requests are due within one week of return. Final exam grades are not subject to regrade.

- Midterm Exam: Wednesday, October 21, 2026 (in class)
- Final Exam (cumulative): According to the official University schedule.

Project

The course project provides students with an opportunity to apply statistical and computational methods to real-world financial data and problems. Students will work in teams of up to four members and develop a data-driven solution to a financial modeling, forecasting, or risk-analysis problem. Additional project requirements, milestones, and deliverables will be discussed during the semester. Project grades are not subject to regrade.

Project Due: Thursday, December 17, 2026

Optional Reflection Assignments

Three optional reflection assignments will be offered during the semester. Each reflection is worth up to 1% extra credit toward the final course grade, for a maximum of 3% total extra credit.

Reflections should be approximately one page in length and should discuss the student's learning experience in the course, the relevance of course material to financial engineering, and how the course is contributing to the student's academic and professional goals. The purpose of these reflections is to encourage students to reflect on their learning, growth, and professional development in the course and within the MSFE program.

Reflections will be evaluated primarily on thoughtfulness, clarity, engagement with course material, and the ability to connect course concepts to broader goals in financial engineering.

The tentative reflection schedule is:

- Reflection 1: Released Sep. 16, Due Sep. 23
- Reflection 2: Released Oct. 28, Due Nov. 4
- Reflection 3: Released Dec. 2, Due Dec. 17

The third reflection serves as a final reflection on the course and is due together with the course project.

Absence Policy

One of the great aspects of the college experience is that it is truly what you make of it. Attendance will not be enforced in this class. However, attending lectures is strongly encouraged. Students are responsible for all lecture material, announcements, examples, and discussions regardless of attendance.

Please communicate with the instructor and/or teaching assistant if illness or emergencies arise that may affect your participation in the course. Article 1, Part 5 of the Student Code outlines those circumstances in which a student may be eligible to obtain a letter from the Office of the Dean of Students for absences.

Academic Honesty

The usual academic integrity policies apply. Students are expected to behave in a professional and ethical manner, and all submitted work must represent their own understanding. At minimum, plagiarism, cheating, fabrication, or unauthorized collaboration may result in a zero on the relevant assignment or examination.

Please refer to Article 1, Part 4 – Academic Integrity Policy and Procedure of the Student Code of the University of Illinois Urbana-Champaign for relevant definitions and policies.

Generative AI Policy

Generative AI tools can provide useful assistance for learning and programming, but they do not replace understanding. You may use generative AI tools to assist your learning and problem-solving, but only under the following conditions:

- You must clearly document and explain how you used the tool.
- You must write all submitted explanations, analyses, reports, code, and answers yourself in your own words based on your understanding.

- Students remain fully responsible for verifying the correctness of any AI-generated content.
- Direct submission of AI-generated work as one's own is prohibited.

Treat AI assistance as any other external source: cite it, explain its role, and describe how it informed your work.

Accessibility and Disability Accommodations

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor as soon as possible and provide a Letter of Academic Accommodations from Disability Resources and Educational Services (DRES).

Please refer to the DRES website for details.

Community of Care

As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether regarding their well-being or yours, we encourage you to refer this behavior to the Connie Frank CARE Center (formerly the Student Assistance Center) in the Office of the Dean of Students. You may do so by calling (217) 333-0050 or by submitting an online referral. Based on your report, staff in the Student Assistance Center will reach out to offer support and assistance.

Disruptive Behavior

Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach.

A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem, and may be reported to the Office for Student Conflict Resolution for disciplinary action.

Emergency Response Recommendations

Emergency response recommendations and campus building floor plans can be found at <https://police.illinois.edu/em/run-hide-fight/>.

Students are encouraged to review this information during the first weeks of the semester.

Religious Observances

It is the policy of the University of Illinois Urbana-Champaign to reasonably accommodate its students' religious beliefs, observances, and practices that conflict with a student's class attendance or participation in a scheduled examination or work requirement, consistent with state and federal law. Students should make requests for accommodation in advance of the conflict to allow time for both consideration of the request and alternate procedures to be prepared. Requests should be directed to the instructor. The Office of the Dean of Students provides an optional resource on its website to assist students in making such requests.

Other Policies

The Grainger College of Engineering at Illinois is committed to the creation of an anti-racist, inclusive community that welcomes diversity along several dimensions. The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language.

If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to Campus Belonging Resources.