

Quantitative Finance
Course Number: 22:839:510
Course Title: Numerical Analysis

COURSE DESCRIPTION

The course covers common areas of Numerical analysis: interpolation, extrapolation, regression, solving differential equations and partial differential equations, as well as generating random variables and stochastic processes, variance reduction techniques, and Monte Carlo simulation.

COURSE MATERIALS

- **Textbooks**

1. *K. Atkinson, An Introduction to Numerical Analysis, Wiley (any edition).*
2. *P. Brandimarte, Numerical Methods in Finance and Economics: A MATLAB-Based Introduction, Second Edition*
3. *A. Hirtsa, Computational Methods in Finance, Chapman & Hall, CRC, 2012.*

Additional reading material may be introduced during the course.

Students are expected to take notes and use them while studying.

Check the course website on Canvas and your official Rutgers email account regularly.

- **Software:** MATLAB and /or Python will be used to illustrate all concepts and numerical algorithms. A sizeable part of your coursework will consist in writing MATLAB or Python programs.
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COURSE TOPICS

Modeling random variables and stochastic processes

Analysis of the simulation efficiency

Approximation of functions by polynomials and piecewise polynomials and regression

Numerical solutions of initial value problems for ordinary differential equations

Finite difference and finite element methods for two-point boundary value problems
Simulating stochastic differential equations
Estimating greeks

PREREQUISITES

Good knowledge of Linear Algebra and Differential/Integral Calculus, some background in Probability and Statistics. Knowledge of Numerical Methods, Differential Equations and some programming skills would be very helpful.

ACADEMIC INTEGRITY

I do NOT tolerate cheating. Students are responsible for understanding the RU Academic Integrity Policy (<http://academicintegrity.rutgers.edu/>)

I will strongly enforce this Policy and pursue *all* violations. On all examinations and assignments, students must sign the RU Honor Pledge, which states, “On my honor, I have neither received nor given any unauthorized assistance on this examination or assignment.” I will screen all written assignments through *SafeAssign* or *Turnitin*, plagiarism detection services that compare the work against a large database of past work. Don’t let cheating destroy your hard-earned opportunity to learn. See business.rutgers.edu/ai for more details.

ATTENDANCE POLICY

The University is committed to a culture of academic engagement between students and faculty. Part of this commitment involves taking responsibility for attending your classes, workshops and exams, and informing your instructors when you cannot attend.

If you are absent from a class or exam for any reason, please **email the instructor**.

All students are expected to bring a positive attitude to the classroom, and to respect the learning environment. This means, at a minimum, that no student will disrupt the learning environment, even in small ways, which includes sending or receiving text messages, or surfing the internet, or tweeting, or talking to other students about anything unrelated to the subject matter at hand. So, **PLEASE NO CELL PHONES, COMPUTERS or OTHER ELECTRONIC DEVICES IN CLASS** unless you are asked to use them.

PARTICIPATION

You are expected to actively participate in the course. This participation can consist of in-class discussions or visits to office hours.

The most active participants (those who ask relevant questions and provide good answers) **will get a bonus at the end of the course.**

TIME COMMITMENT

This is a challenging course.

Mastering the material of this course requires time. Successful students in the past reported that they consistently spent at least 7 hours per week to review the material and solve problems, and more than that before major exams.

... There have been many studies of elite performers - concert violinists, chess grand masters, professional ice skaters, mathematicians, and so forth - and the biggest difference researchers find between them and lesser performers is the amount of deliberate practice they've accumulated. Indeed, the most important talent may be the talent for practice itself.

Gawande A., "The Learning Curve", The New Yorker, January 28, 2002, p.52-61.

If you are just looking to fill a slot in your schedule or looking for a "light elective", you should not be taking this course.

I want you to do well in this class. Your approach should be learning concepts thoroughly and practicing with a variety of problems. You are warmly invited to ask questions in class and in office hours. Feel free to let me know if you have any problems with the class and express your concerns during the semester. Your feedback is always welcome!

CAUTION: The information in this syllabus is subject to change, as announced in class or via email/Canvas. No major changes are anticipated, but you are expected to attend class and check email regularly.

GRADING POLICY AND EXAMS

There are following graded items in this course:

- Homework;
- Midterm project;
- Final Exam.

The final grade will be a weighted average of these items using the weighted scheme indicated below.

- **Homework problems** will be graded "on completion". They have to be solved regularly and uploaded by the deadline on Canvas. Any student can be asked to explain their solutions at any time during the semester. No late homework will be accepted for any reason, but the lowest grade will be dropped at the end of the semester.

You can discuss assignments problems with your classmates, however you **MUST** write the code yourself, In case when the instructor suspects that the code was copied, you may be asked to explain in detail what your program does and how it operates. You should also be able to write a code for the same problem from scratch. In case when the cheating is confirmed, the student will receive a score of 0 for the whole portion of homework grade for the semester, not just for one set.

- The **Midterm Project** is to be done in groups and is due on (). Sample topics will be provided. Students are welcome to pick their own topic if its realization uses the methods discussed in class.
- The **Final Exam** (cumulative) will be held on (). Tentatively it will be in person. The format of the exam is closed-book, closed-notes. Please bring only pencils, pens, erasers, and your Rutgers ID card with you to the exam. All course materials will be relevant to the exam. There will be no make-up final exam, You will receive a score of zero if you miss the exam.

You need to score at least 40% on the Final Exam to pass the course.

- Grading distribution:

Homework	...	15%
Midterm Project	...	35%
Final Exam	...	50%

- There are no opportunities for extra credit except the ones provided in class and the exam.
- Grade allocation:

Weighted average of graded items	Corresponding grade
[92, +∞)	A
[90, 92)	A-
[84, 90)	B+
[76, 84)	B
[70, 76)	B-
[64, 70)	C+
[56, 64)	C
[50, 56)	C-
[40, 50)	D
[0, 40)	F

- All (partial) scores received throughout the course will be added to the *Gradebook* on the Canvas course website.
- Your partial scores/final grades are not subject to negotiation. If you feel I have made an error, submit your written argument to me within one week of receiving your grade/score. Clarify the precise error I made and provide all supporting documentation. If I have made an error, I will gladly correct it. But I will adjust grades only if I have made an error.

COURSE SCHEDULE

The course follows the Rutgers Academic Calendar, which can be found here: <https://scheduling.rutgers.edu/scheduling/academic-calendar>.

SUPPORT SERVICES

If you need accommodation for a *disability*, obtain a Letter of Accommodation from the Office of Disability Services. The Office of Disability Services at Rutgers, The State University of New Jersey, provides student-centered and student-inclusive programming in compliance with the Americans with Disabilities Act of 1990, the Americans with Disabilities Act Amendments of 2008, Section 504 of the Rehabilitation Act of 1973, Section 508 of the Rehabilitation Act of 1998, and the New Jersey Law Against Discrimination. More information can be found at ods.rutgers.edu.

[Rutgers University-New Brunswick ODS phone (848)445-6800 or email dsoffice@echo.rutgers.edu]

[Rutgers University-Newark ODS phone (973)353-5375 or email ods@newark.rutgers.edu]

If you are *pregnant*, the Office of Title IX and ADA Compliance is available to assist with any concerns or potential accommodations related to pregnancy.

[Rutgers University-New Brunswick Title IX Coordinator phone (848)932-8200 or email jackie.moran@rutgers.edu]

[Rutgers University-Newark Office of Title IX and ADA Compliance phone (973)353-1906 or email TitleIX@newark.rutgers.edu]

If you seek *religious accommodations*, the Office of the Dean of Students is available to verify absences for religious observance, as needed.

[Rutgers University-New Brunswick Dean of Students phone (848)932-2300 or email deanofstudents@echo.rutgers.edu]

[Rutgers University-Newark Dean of Students phone (973)353-5063 or email DeanofStudents@newark.rutgers.edu]

If you have experienced any form of *gender or sex-based discrimination or harassment*, including sexual assault, sexual harassment, relationship violence, or stalking, the Office for Violence Prevention and Victim Assistance provides help and support. More information can be found at <http://vpva.rutgers.edu/>.

[Rutgers University-New Brunswick incident report link: <http://studentconduct.rutgers.edu/concern/>. You may contact the Office for Violence Prevention and Victim Assistance at (848)932-1181]

[Rutgers University-Newark incident report link: https://cm.maxient.com/reportingform.php?RutgersUniv&layout_id=7 . You may also contact the Office of Title IX and ADA Compliance at (973)353-1906 or email at TitleIX@newark.rutgers.edu. If you wish to speak with a staff member who is confidential and does **not** have a reporting responsibility, you may contact the Office for Violence Prevention and Victim Assistance at (973)353-1918 or email run.vpva@rutgers.edu]

If students who have experienced a temporary condition or injury that is adversely affecting their ability to fully participate, you should submit a request via <https://temporaryconditions.rutgers.edu> .

If you are a military *veteran* or are on active military duty, you can obtain support through the Office of Veteran and Military Programs and Services. <http://veterans.rutgers.edu/>

If you are in need of *mental health* services, please use our readily available services.

[Rutgers University-Newark Counseling Center: <http://counseling.newark.rutgers.edu/>]

[Rutgers Counseling and Psychological Services–New Brunswick: <http://rhscaps.rutgers.edu/>]

If you are in need of *physical health* services, please use our readily available services.

[Rutgers Health Services – Newark: <http://health.newark.rutgers.edu/>]

[Rutgers Health Services – New Brunswick: <http://health.rutgers.edu/>]

If you are in need of *legal* services, please use our readily available services: <http://rusls.rutgers.edu/>

Students experiencing difficulty in courses due to *English as a second language (ESL)* should contact the Program in American Language Studies for supports.

[Rutgers–Newark: PALS@newark.rutgers.edu]

[Rutgers–New Brunswick: eslpals@english.rutgers.edu]

If you are in need of additional *academic assistance*, please use our readily available services.

[Rutgers University-Newark Learning Center: <http://www.ncas.rutgers.edu/rlc>]

[Rutgers University-Newark Writing Center: <http://www.ncas.rutgers.edu/writingcenter>]

[Rutgers University-New Brunswick Learning Center: <https://rlc.rutgers.edu/>]

[Optional items that many faculty include:

- Students must sign, date, and return a statement declaring that they understand the RU Academic Integrity Policy.

- Students must sign, date, and return a statement declaring that they understand this syllabus.]