

# Course Syllabus 2024



## FE 545 - Design, Patterns and Derivatives Pricing

*School of Business*

Spring 2024

Instructor: Steve Y. Yang

Canvas Course Address:

Course Schedule: Tuesday 6:30 PM -9:00PM

Contact Info: [syang14@stevens.edu](mailto:syang14@stevens.edu) (<mailto:syang14@stevens.edu>)

Office: Babbio 602

Virtual Office Hours: Wednesday 10:00 – 11:00 AM

Classroom: Burchard 714

Prerequisite(s): None

Corequisite(s): None

Cross-listed with: None

## COURSE DESCRIPTION

This course covers the design patterns and implementation of financial models using object oriented programming in C++. It discusses advanced applications on quantitative finance with special emphasis on derivatives pricing and their calculations using commonly known formulas such as the

Black-Scholes and lattice models. The course uses available simulation techniques such as Monte Carlo simulation and its implementations in financial engineering problems.

## STUDENT LEARNING OUTCOMES

After successful completion of this course, students will be able to...

- Understand common object-oriented (OO) design patterns used in relation to financial models
- Implement common object-oriented design patterns used in relation to financial models
- Understand and implement derivatives pricing model in OO paradigm utilizing design patterns with focus on clarity, simplicity, elegance and extensibility.
- Be proficient with basic C++ and OO programming

## COURSE FORMAT AND STRUCTURE

This course is on-campus. To access the course, please visit [stevens.edu/canvas](https://stevens.edu/canvas) (<http://stevens.edu/canvas>). For more information about course access or support, contact the Technology Resource and Assistance Center (TRAC) by calling 201-216-5500.

## Course Logistics

- When assignments are due, they are due by 11:59 pm EST on the due date listed in the course schedule.
- Deadlines are an unavoidable part of being a professional, and this course is no exception. Course requirements must be completed and posted or submitted on or before the specified due date and delivery time deadline. Due dates and delivery time deadlines are in Eastern Time (as used in Hoboken, NJ). Please note that students living in distant time zones or overseas must comply with this course time and due date deadline policy. Avoid any inclination to procrastinate. Due dates have been established for each assignment to encourage you to stay on schedule
- Assignments received 1-6 days late will have 20% of the total points deducted; assignments received more than one week late will receive 0 points. [this should align with what your late policy states]
- An assignment file should be appended by your username, such as "assignment1\_kim53.pdf". This makes it easier for me to manage assignment files you download to my computer.
- All assignments require programming, your code need to be submitted as a zip file. You need to ensure the code should compile with the indicated c++ compiler and be able to run on the the platform you use.

## Instructor's Online Hours

I will be available via email and respond as soon as I am available (generally within 24-48). For the online discussions, I will check in at least three times per week. Keep in mind that it is not possible for me to respond to every single posting every week (nor is it pedagogically appropriate), but I will be sure to respond to various postings and students each week and attempt to assure equality in terms of responses to students. Furthermore, there is a specific discussion forum that you can use to ensure that you have my attention – to ask questions or to call my attention to a particular discussion you are engaged in that you would like me to take a look at. If you feel you are being neglected in any way, please contact me. When emailing me, please place in the subject line the course number/section and the topic of the email (i.e., FE545 – Assignment 2 Question). This will help me tremendously in locating your emails quicker when I scan the hundreds of emails that seem to make it into my box each day.

## Virtual Office Hours

Virtual Office Hours are a synchronous session (through Zoom or Blackboard Collaborate) to discuss questions related to weekly readings and/or assignments. Office hours will be held Wednesday from 10:00 – 11:00 am EST. To connect to the weekly session, go to <https://stevens.zoom.us/my/dr.syang>.

## Online Etiquette Guidelines

Your instructor and fellow students wish to foster a safe online learning environment. No matter how different or controversial they may be perceived, all opinions and experiences must be respected in the tolerant spirit of academic discourse. You are encouraged to comment, question, or critique an idea, but you cannot attack an individual. Our differences, some of which are outlined in the University's inclusion statement below, will add richness to this learning experience. Please consider that sarcasm and humor can be misconstrued in online interactions and generate unintended disruptions. Working as a community of learners, we can build a polite and respectful course ambiance. Please read the Netiquette rules for this course:

- Do not dominate any discussion. Allow other students to join in the discussion.
- Do not use offensive language. Present ideas appropriately.
- Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- Avoid using vernacular and/or slang language as it could lead to misinterpretation.
- Keep an "open-mind" and be willing to express even your minority opinion.
- Think and edit before you push the "Send" button.
- Do not hesitate to ask for feedback.

# TENTATIVE COURSE SCHEDULE

| Lecture | Topic   |
|---------|---|
| 1       | Introduction and A Simple Option Pricing Model    |
| 2       | Encapsulation, Inheritance, and virtual functions |
| 3       | Bridging with a Virtual Constructor               |
| 4       | Strategies, Decoration, and Statistics            |
| 5       | A Random Numbers Class                            |
| 6       | An Exotics Engine and the Template Pattern        |
| 7       | Trees   |
| 8       | More on Tree for Option Pricing                   |
| 9       | Solvers, Templates, and Implied Volatilities      |
| 10      | The Factory and The Design Patterns Revisited     |
| 11      | Standard Library and Exceptions                   |
| 12      | Templatizing Factory and Decoupling               |
| 13      | Final Exam  |

## COURSE MATERIALS

### Textbook:

Mark S. Joshi, *C++ Design Patterns and Derivatives Pricing*, 2nd edition. Cambridge University Press, 2008 (**required**).

### Supp. Text:

Mark S. Joshi, *The Concepts and Practice of Mathematical Finance*, 2<sup>nd</sup> edition, Cambridge University Press, 2008.

R. Lafore, *Object-Oriented Programming in C++*, 4th edition. Sams, 2002.

Gamma, R. Helm, R Johnson, J. Vlissides, *Design Patterns: Elements of Reusable Object-Oriented Software*, 2<sup>nd</sup> Edition, Addison-Wesley, 2000.

### Materials:

1. **Lecture slides:** available online through Canvas course shell.
2. **A working C++ IDE. Recommendations:**
  - **Windows: Microsoft Visual Studio:** <https://www.visualstudio.com/free-developer-offers/>
  - **macOS: Xcode**
  - **Linux: Eclipse with gcc**

## COURSE REQUIREMENTS

**Attendance** Students are expected to attend lectures.

**Participation** Students are expected to participate in class work.

**Homework** Students are required to hand-in homework on time. Failure to do so will carry a penalty of 10% to the homework grade.

**Exam** Students are required to complete a final individual exam.

## TECHNOLOGY REQUIREMENTS

### Baseline technical skills necessary for online courses

- Basic computer and web-browsing skills
- Navigating Canvas

### Technology skills necessary for this specific course

- Live web conferencing using Zoom
- Recording a slide presentation with audio narration
- Recording, editing, and uploading video via Kaltura

### Required Equipment

- Computer: current Mac (OS X) or PC (Windows 7+) with high-speed internet connection
- Webcam: built-in or external webcam, fully installed

- Microphone: built-in laptop or tablet mic or external microphone

## Required Software

- - Windows: Microsoft Visual Studio: <https://www.visualstudio.com/free-developer-offers/>
  - macOS: Xcode
  - Linux: Eclipse with gcc

## GRADING PROCEDURES

To pursue the course objectives effectively, students will engage in the following activities:

- Read assigned material prior to class sessions
- Complete all assignments
- Participate in class discussions
- Prepare and submit a Final Project/Exam paper

Grades will be based on:

|                          |     |
|--------------------------|-----|
| Homework (5 assignments) | 45% |
| Class Breakout Exercise  | 5%  |
| Quizzes (4)              | 20% |
| Final Exam               | 30% |

## Late Policy

**All assignments should be the work of an individual student are due on the date shown in the course schedule.** Submit to Canvas any late assignments. Late homework will be penalized 5% per late week. Grading will be based upon your understanding and analysis of the issues presented in class and readings.

## Academic Integrity

# Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at <http://web.stevens.edu/honor/> (<http://web.stevens.edu/honor/>)

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

***"I pledge my honor that I have abided by the Stevens Honor System."***

## Reporting Honor System Violations

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at [www.stevens.edu/honor](http://www.stevens.edu/honor) (<http://www.stevens.edu/honor>).

## 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](http://www.stevens.edu/provost/graduate-academics) (<http://www.stevens.edu/provost/graduate-academics>).

## Special Provisions for Undergraduate Students in 500-level Courses

The general provisions of the Stevens Honor System do not apply fully to graduate courses, 500 level or otherwise. Any student who wishes to report an undergraduate for a violation in a 500-level

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course shall submit the report to the Honor Board following the protocol for undergraduate courses, and an investigation will be conducted following the same process for an appeal on false accusation described in Section 8.04 of the Bylaws of the Honor System. Any student who wishes to report a graduate student may submit the report to the Dean of Graduate Academics or to the Honor Board, who will refer the report to the Dean. The Honor Board Chairman will give the Dean of Graduate Academics weekly updates on the progress of any casework relating to 500-level courses. For more information about the scope, penalties, and procedures pertaining to undergraduate students in 500-level courses, see Section 9 of the Bylaws of the Honor System document, located on the Honor Board website.

# EXAM CONDITIONS

The following procedures apply to quizzes and exams for this course. As the instructor, I reserve the right to modify any conditions set forth below by printing revised Exam Conditions on the quiz or exam.

1.
1. Students may use the following materials during quizzes and/or exams. Any materials that are not mentioned in the list below are not permitted.

| Material   | Permitted? |    |
|--|------------|----|
|  | Yes        | No |
| Handwritten Notes<br>Conditions: i.e. size of note sheet |            | x  |
| Typed Notes<br>Conditions: i.e. size of note sheet       |            | x  |
| Textbooks<br>Conditions: i.e. specific books             |            | x  |
| Readings<br>Conditions: i.e. specific documents          |            | x  |
| Other (specify)  |            | x  |



2. Students are/are not allowed to work with or talk to other students during quizzes and/or exams.
3. Specific Parameters: [if you permit students to communicate with each other during exams, be sure to explain exactly what is permitted.]

## 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> (<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](mailto:pgehman@stevens.edu) (<mailto: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). Appointments can be made by phone (201-216-5177).

## 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](mailto:care@stevens.edu) (<mailto:care@stevens.edu>). A member of the CARE Team will respond to your concern as soon as possible.