FE-545
Design, Patterns and Derivatives Pricing

School of Business
Spring 2021

Live Webcast: **Friday 3:00 - 5:30 PM EST**
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Office Hours: Zoom by appointment
Course Web Address: Canvas

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.

LEARNING OBJECTIVES

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 techniques.

FORMAT AND STRUCTURE

This course is comprised of weekly **live webcast** and recorded lectures, homework, and a final project. Lectures will be available immediately after live webcast.

COURSE MATERIALS

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

Supp. Text: S. Lippman, J. Lajoie, B. Moo, *C++ Primer*, 5th edition. Addison-Wesley, 2012.

Design Patterns Explained Simply, e-book, https://sourcemaking.com/design-patterns-ebook.

Materials:

1. **Lecture slides:** available online through Canvas course shell.
2. **A working C++ IDE. Recommendations:**
   a. **Windows: Microsoft Visual Studio: https://www.visualstudio.com/free-developer-offers/**
   b. **macOS: Xcode**
   c. **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 to the homework grade.
Exam	Students are required to complete a final group exam.

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

GRADING POLICY

Final Exam	30%
Assignments	70%

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 one grade letter 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/

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.

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 by 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.

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 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 ROOM 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 Room Conditions on the quiz or exam.

1. Students may use the following devices during quizzes and exams. Any electronic devices that are not mentioned in the list below are <u>not</u> permitted.

Device	**Permitted?**	
	Yes	No
Laptops		X
Cell Phones		X
Tablets		X
Smart Watches		X
Google Glass		X
Other		X

2. Students may use the following materials during quizzes and exams. Any materials that are not mentioned in the list below are <u>not</u> permitted.

Material	**Permit-ted?**	
	Yes	No
Handwritten Notes *Conditions*:		X
Typed Notes *Conditions*:		X
Textbooks *Conditions*:		X
Readings *Conditions*:		X
Other aid materials		X

3. Students are not allowed to work with or talk to other students during quizzes and/or exams.

LEARNING ACCOMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. Student Counseling and Disability Services works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, and psychiatric disorders 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 SCDS staff. The SCDS staff will facilitate the provision of accommodations on a case-by-case basis. These academic accommodations are provided at no cost to the student.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the office of Student Counseling, Psychological & 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.

For more information about Disability Services and the process to receive accommodations, visit https://www.stevens.edu/sit/counseling/disability-services. If you have any questions please contact:

> Lauren Poleyeff, Psy.M., LCSW - Disability Services Coordinator and Staff Clinician in Student Counseling and Disability Services at Stevens Institute of Technology at lpoleyef@stevens.edu or by phone (201) 216-8728.

INCLUSIVITY STATEMENT

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in education and innovation. Our community represents a rich variety of backgrounds, experiences, demographics and perspectives and Stevens is committed to fostering a learning environment where every individual is respected and engaged. To facilitate a dynamic and inclusive educational experience, we ask all members of the community to:

- be open to the perspectives of others
- appreciate the uniqueness their colleagues
- take advantage of the opportunity to learn from each other
- exchange experiences, values and beliefs
- communicate in a respectful manner
- be aware of individuals who are marginalized and involve them
- keep confidential discussions private

SCHEDULE

Lectures Schedule

Lecture	Topic
1	Chpt. 1: A simple Monte Carlo model
2	Chpt. 2 & 3: Encapsulation, Inheritance, and virtual functions
3	Chpt. 4: Bridging with a virtual constructor
4	Chpt. 5: Strategies, decoration, and statistics
5	Chpt. 6: A random numbers class
6	Chpt. 7: An exotics engine and the template pattern
7	Chpt. 8: Trees
8	Chpt. 9: Solvers, templates, and implied volatilities
9	Chpt. 10 & 11: The factory & Design patterns revisited
10	Chpt. 12 & 13: The situation & Exceptions
11	Chpt. 14: Templatizing the factory
12	OMP & Intel Math Kernel Library (MKL) I
13	OMP & Intel Math Kernel Library (MKL) II
14	OMP & Intel Math Kernel Library (MKL) III

Homework and Exams Schedule

1. At least 5 Homework with a total of 70% of class grade
2. Final exam at the end of semester

Note: All homework is to be done individually.