FRE GY-6123, Section A
Financial Risk Management
Spring 2024

Course Prerequisite
Graduate standing.

Course Description and Objectives
This M.S. course in Finance and Risk Engineering covers the pantheon of five major classes of risk that are measured and monitored by most financial firms. These categories are: **market, credit, liquidity, operational, and model risks**. Asset and liability (A/L) risk, which references elements of market and credit risks, will not be addressed. These risk classes are not fully independent of each other, and some are quite complex. Other types of emerging corporate risks include cyber, pandemic, AI/ML, climate and geopolitical risks. As time permits these topics may be introduced ad hoc during the semester and during the May 8 class.

Weekly lectures will include reading assignments, student presentations, and case studies drawn from both financial and non-financial industries.

Instructors
Leon Tatevossian (lt56@nyu.edu / 917-699-6400)
Jon Hill (jh7050@nyu.edu / 732-995-2279)

Teaching assistant
Arunav Mallik (am12442@nyu.edu)

Meeting time
Wed, 2:00 – 4:30 pm.
First meeting: Wed, Jan 24th.

Classroom
Rogers Hall (Tandon). 6 MetroTech Center. Room 216.

Textbook

GARP Financial Risk and Regulation Series (4 books). Recommended, but not mandatory. The texts may be ordered directly from GARP at an estimated cost of $75 for e-books and $125 for print. Additional readings as well as added links to useful articles or resources will be provided during the lectures and/or posted on Brightspace.

Note on Model Risk

The GARP books on Financial Risk and Regulation do not specifically address model risk (a relatively new, emerging class of risk). Model risk has received greatly increased scrutiny at leading banks since the 2008 Global Financial Crisis and now has equal visibility and importance as Market, Credit, Liquidity and Operational Risks at most leading financial institutions. Model risk may be considered as a form of operational risk, but it is not specifically included in any of the standard operational risk categories.

Class Participation

Instructors will deliver lectures on risk management designed to share their knowledge and experience gained from working in the financial industry. This is a graduate-level class and students are expected to have professional demeanor and a sense of responsibility. Lectures are created for the student's benefit and attendance at every session is strongly recommended to ensure mastery of the material and a successful completion of the course.

Class Research Presentations

The instructors also encourage class participation and view student oral presentations as a crucial part of the learning process. To this end, 40% of the final grade will be based on in-depth research presentations (15-30 minutes) on selected topics. A list of 20+ suggestions for research topics will be provided by the instructors, but students are free to pursue other relevant topics of their own choosing.

Group presentations will be made at the beginning of each class, beginning on Wed, Mar 13th.

Pop Quizzes

To encourage attendance, two unannounced in-class pop quizzes will be given during the semester which will count for a total of 5% of the final grade. The in-class quizzes will be open book, **given out on paper at the beginning of a class,** and composed of 3 – 5 questions which students should be able to readily answer if they have been attending class and keeping up with reading assignments. Students who miss the class or arrive late will not be allowed to make up the quiz. Completed quizzes will be collected by the class TA, Arunav Mallik, at the end of the allotted time. Since these will be hand-written exams, students are advised to always bring writing implements to each class.

Students unable to attend a class may be exempted from a missed pop quiz only if they notify the TA, Arunav Mallik, **in advance** of the class and have an acceptable reason for not attending, such as illness, a family emergency or special events. Note that the notification of absence must be received before the class begins at 2:00 PM on Wednesdays.

Guest Speakers

Your instructors believe that students will benefit by hearing from more than one lecturer on a given topic. To that end, one or more outside guest speakers may be scheduled during each semester to share their knowledge with the class.

In previous semesters Agus Sudjianto, head of model risk management at Wells Fargo Bank, has appeared as a guest speaker, lecturing on Machine Learning and Bias and Fairness in Model Risk Management. David Palmer (chief model-risk analyst for the Federal Reserve Bank), Jerome Evrard (NATO security officer, who lectured on geopolitical risk), and Ken Abbott (distinguished professor of risk at Baruch College) have also participated as guest speakers. Guest speakers are scheduled during the semester as they become available.

Grading

Students can earn a maximum of 100 points for the course weighted as follows:

a) Homework 10%
b) In-class pop quizzes 5%
c) Midterm 20%
d) Group Research Project 40%
e) Final Exam 25%

Total course points are ranked and graded on a curve with a 3.5 average.

Student Groups

During the first two weeks of the semester students are expected to form working groups of two to three students for the in-depth group research projects (40% of the final grade).

Homework/Midterm/Final Exam

Midterm Exam (20%)

Take-home exam. Distributed on Wed, Mar 6th; due back to the course TA by 11:59 pm on Wed, Mar 13th (week before spring break).

Final Exam (25%)

Take-home exam. Distributed on Wed, May 1st; due back to the course TA by 11:59 pm on Wed, May 8th.

Homework (10%)

Homework assignments will be posted on Brightspace and should be submitted electronically (two homework assignments over the term). You can work in groups of two or three students, but each student will hand in an individual paper.

Assigned work over the semester will include two take-home open-book homework assignments (5% each). Homework assignments will be distributed two weeks before each of the two exams (midterm and final) and will be due one week before the exam dates (Mar 6th and May 1st). Due dates for homework will be monitored, and students will be penalized a point per day for late submissions.

Group Research Projects

The project will consist of a written and in-class PowerPoint presentation on a subject relevant to the course topics.

Topics can range from recent events such as the 2023 related collapses of Silicon Valley, Signature and First Republic banks, the 2021 collapse of the Archegos Private Office, the FTX crypto exchange collapse, the Southwest Airlines flight scheduling disaster (Operational Risk) over the 2022 Christmas-New Year's holiday period, or earlier events such as the 2008 Global Financial Crisis, the 1998 collapse of the hedge fund LTCM, or even the 17th-century "tulip bubble" in the Netherlands. A list of possible research topics will be provided at the beginning of the semester, but students are also free to choose their own preferred topics with prior instructor approval.

Details of the project will be shared separately in class and on NYU Brightspace. Students must form groups of 3-4 and submit a written proposal with the subject and a bullet point summary of their proposed group research project by Sept. 20. Group research projects will count for 50% of each student's final grade as follow:

5% Initial proposal submission – Due Feb 14th
5% Revised proposal submission – Due Feb 28th
15% Final written presentation – Due Mar 13th
15% In-class oral presentations – Beginning March 13th (maximum of two per session)

Students unable to form a group and/or find a subject on their own may be assigned to a group and/or topic. Each group member is expected to contribute equally to the project, and no work for this project may be all or part of an assignment prepared for another course. Peer evaluations may be used to provide constructive feedback but will not count towards the final grade.

Part I

Risk Management Overview: Five Categories
Prof. Hill and Tatevossian

Lecture 1, Jan. 24th

Introduction - A crash course overview of the different forms of financial risk encountered by banks. This will cover the five major risk categories (market, credit, liquidity, operational and model risks) as well as asides on newly emergent risks such as climate change, cyber risk and rapidly evolving geopolitical risks.

Part II
Operational Risk
Prof. Hill

Lecture 2, Jan. 31

Introduction to Operational Risk - What is operational risk; what are the consequences of ignoring it? Real world historical examples. Operational risk measurement, mitigation, and control. Seven categories of operational risk loss attribution. Model risk viewed as a dimension of operational risk.

Basel II requirements for estimation of Operational Risk. The prescribed Basel II Accord. Basic Indicator simplified approach to calculating Operational Risk Capital requirements and its shortcomings. The Basel III standardized approach (TSA), and advanced measurement approach (AMA). Inputs for estimating OpVaR: Internal loss data (ILD) history, external loss data (ELD), scenario analysis (SA), Business environment and internal control factors (BCEIF Standardized formulas, the Advanced Measurement Approach (AMA), the Modified Standard formula. Key Risk Indicators (KRIs), Key Performance Indicators (KPIs) and Key Control Indicators (KCIs) for Operational Risk.

Difficulties with the AMA method. Unstable outputs. Basel III guidance for operational risk (OpRisk) estimation, mitigation, and control.

Part III:
Market Risk
Prof. Tatevossian

Lecture 3, Feb 7th

What is market risk? Motivation via examples across different constituencies (individual consumer, corporation, asset manager, hedge fund) and different asset classes. Identify the uncertainties we need to quantify: value, future cash flows, probabilities of loss. Introduce background on some of the case studies we will reference during the course.

Lecture 4, Feb 14th

Introduction to basic products in the equity, fixed-income, currency, and commodity markets. Look across product types to isolate the notion of "risk factors" and risk-factor sensitivities. Discuss how holistic risk management must capture risk factors consistently among the different product types.

Lecture 5, Feb 21st

Introduce three basic types of market-risk statistics. Sensitivities, value-at-risk (VaR) and its variants, and stress-scenario price responses. Show how they are complementary and interdependent. Emphasize that the information content and forward-looking reliability of these statistics depend on portfolio composition (and can also depend on the market backdrop).

Lecture 6, Feb 28th

Specialize the Lecture 4 discussion. Prototypical portfolios in the fixed-income, equity, and (possibly) other asset sectors. Develop intuition on how the risk statistics shift with adjustments in portfolio composition. Using real-world examples to motivate the impact of correlation of risk factors. Introduce concepts of risk reduction and hedging via derivatives.

First homework assignment distributed. Due by 11:59 pm, Wed, Mar 6th.

Part IV
Model Risk
Prof. Hill

Lecture 7, Mar 6th

Part 1: The Long and Curious History of Model Risk (approximately 1 hour)
Why is model risk important in everyday life? This presentation will address that question with a romp through 400 years of history identifying very recognizable examples of model risk events ranging from planet earth to the planet Mars. Some of the incidents described are amusing and some are terrifying, but all are historically factual.

Part 2: Introduction to SR11-7, Federal Reserve Bank guidance on model risk management for all conforming banks. What is a financial model and why should financial firms care about model risk? What are the sources and consequences of unmitigated model risk? The traditional three Lines of Defense (LOD) against model risk.

Part 3: Introduction to Model Risk, Governance and Validation. How is model risk different from other forms of risk? Why model risk is increasingly important. Essential elements of Model Risk Management. What is a model and what is model risk? The fourteen foremost challenges faced by today's model risk managers.

Review for midterm exam. Midterm exam distributed. Due by 11:59 pm on Wed, Mar 13th.

Lecture 8, Mar 13th

Part 4: Model Risk (continued). What is model validation and what are the best practices that have been developed by leading financial institutions? Can model risk ever be eliminated completely? Going beyond SR11-7. Examples of model-risk debacles in finance: The global financial crisis of 2007-2008. The 2012 London Whale disaster at JPM (or why we never learn from history), the 2021 Greensill and Archegos episodes at Credit Suisse (model risk, operational risk, or both?)

Class Research Project Presentations begin.

March 18-22

Spring Break – No classes.

Lecture 9, Mar 27th

Part 5: Model Risk (continued). Selected advanced topics in model risk management. The model “ecosystem”; inter-dependencies between data and models within the ecosystem; challenges of large model inventories; quantifying model risk; aggregation of model risk to firmwide levels. Building a smarter model risk management discipline by building smarter models.

Discussion of homework and midterm exam questions.

Part V
Credit Risk
Prof. Tatevossian

Lecture 10, Apr 3rd

Introduction to credit risk. How is lending priced? How are prices quoted? Examples from the syndicated loan market and the corporate bond market. What are the other domains in which credit risk is present? Introduce the concept of “trading” credit risk.

Lecture 11, Apr 10th

Measuring credit risk. What concepts can be adapted from our discussion of market risk? Credit ratings. EL and UL. Credit risk in a portfolio context. Breakdown of credit risk into components (default risk, ratings migration risk, etc.) Third-party credit models.

Lecture 12, Apr 17th

Mitigation of credit risk. Introduction to credit derivatives (CDSs). Basics of CDS pricing. Extraction of market-implied probabilities of default. How could CDSs be deployed in hedging counter-party risk in swaps? Springboard for an introduction to CVA and its related concepts.

Examples of credit risk management failures. Global financial crisis of 2007-8 triggered by initial defaults in equity tranches of credit derivative waterfalls followed by liquidity squeezes up to the super senior tranches. Failure of Silicon Valley Bank (SVB). What is a bank run and what triggers it? Examples of credit risk contamination in the related, subsequent failures of Silvergate bank in California (crypto bank) and Signature bank in New York city, both within days of SVB's failure.

Part VI
Liquidity Risk and those "Other" Risks
Prof. Hill

Lecture 13, Apr 24th

Introduction to Liquidity Risk. What is meant by "liquidity"? Market and funding liquidity concepts. Measurements of liquidity, bid-ask spread, market depth, immediacy, resilience. liquidity "squeezes" during market crises. Liquidity risk metrics. Liquidity horizons. Methods to mitigate liquidity risk. Case studies in liquidity mismanagement: Amaranth Advisors (2006), Northern Rock (2007), Long Term Capital Management (1998).

Second homework assignment distributed. Due by 11:59 pm on May 1st.

Lecture 14, May 1st

Other Risks. Various classes of emerging risks that are not typically captured in today's financial risk management metrics and reports. Examples are:

- AI/ML models; challenges of understanding and validating them.
- Dire warnings about risks associated with AI/ML models.
- Artificial general intelligence and the AGI alignment problem.
- Pandemic risk.
- Climate change risk.
- Cyber risk.
- Geopolitical risks.

… and the most important of all risks … can humanity hope to survive its own technology? The 21st century may finally decide this ultimate question.

What is "The Great Filter" concept that astronomers are currently exploring? Can answers be found among the stars? The extra-terrestrial search for bio-signatures and techno-signatures.

Review for take-home final exam. Distribution of final exam. Due back by 11:59 pm on Wed, May 8th.

Family, Health or Other Issues Arising During the Semester

If you encounter any unforeseen family, health or other issues during the semester which create circumstances that prevent you from meeting course requirements, please raise them directly with Deanna Rayment in the Office of Student Affairs at 646-997-3046 (deanna.rayment@nyu.edu) before requesting any accommodation from the instructors.

Moses Center Statement of Disability

If you are student with a disability requesting accommodations, please contact NYU's Moses Center for Students with Disabilities (CSD) at 212-998-4980 (mosescsd@nyu.edu). You must be registered with CSD to receive accommodations. Information about the Moses Center can be found at www.nyu.edu/csd. The Moses Center is located at 726 Broadway on the 2nd floor.

NYU Tandon
Policies and Procedures on Academic Misconduct

A. Introduction: NYU Tandon encourages academic excellence in an environment that promotes honesty, integrity, and fairness; students are expected to exhibit those qualities in their academic work. It is through the process of submitting their own work and receiving honest feedback on that work that students may progress academically. Any act of academic dishonesty is seen as an attack upon NYU Tandon and will not be tolerated. Furthermore, those who breach NYU Tandon's rules on academic integrity will be sanctioned under this Policy. Students are responsible for familiarizing themselves with the Policy on Academic Misconduct.

B. Definition: Academic dishonesty may include misrepresentation, deception, dishonesty, or any act of falsification committed by a student to influence a grade or other academic evaluation. Academic dishonesty also includes intentionally damaging the academic work of others or assisting other students in acts of dishonesty. Common examples of academically dishonest behavior include, but are not limited to, the following:

1. **Cheating:** intentionally using or attempting to use unauthorized notes, books, electronic media, or electronic communications in an exam; talking with fellow students or looking at another person's work during an exam; submitting work prepared in advance for an in-class examination; having someone take an exam for you or taking an exam for someone else; violating other rules governing the administration of examinations.

2. Fabrication: including but not limited to, falsifying experimental data and/or citations.

3. Plagiarism: intentionally or knowingly representing the words or ideas of another as one's own in any academic exercise; failure to attribute direct quotations, paraphrases, or borrowed facts or information.

4. Unauthorized collaboration: working together on work that was meant to be done individually.

5. Duplicating work: presenting for grading the same work for more than one project or in more than one class, unless express and prior permission has been received from the course instructor(s) or research adviser involved.

6. Forgery: altering any academic document, including, but not limited to, academic records, admissions materials, or medical excuses.

Disability Disclosure Statement

Academic accommodations are available for students with disabilities. Please contact the Moses Center for Students with Disabilities (212-998-4980; mosescsd@nyu.edu) for further information. You must be registered with CSD to receive accommodations. Students requesting accommodations are advised to reach out to the Moses Center as early as possible in the semester. The Moses Center is located at 726 Broadway on the 2nd floor.

Inclusion Statement

NYU Tandon values an inclusive and equitable environment for all our students. The instructors hope to foster a sense of community in this class and consider it a place where individuals of all backgrounds, beliefs, ethnicities, national origins, gender identities, sexual orientations, religious and political affiliations, and abilities will be treated with respect. It is our intent that all students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength, and benefit. If this standard is not being upheld, please feel free to speak with the instructors.