Worcester Polytechnic Institute

MA 574: Portfolio Valuation & Risk Management
Department of Mathematical Sciences
Fall 2020

Instructor:
Professor Marcel Blais
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Textbook:
- *Statistics and Finance: An Introduction*, by David Ruppert, ISBN 0-387-20270-6 (available as an eBook in the Gordon Library).

Course Description:
This course is offered in online format only.

All video lectures & assignments will be posted in the Modules section of the Canvas course webpage. The lectures are asynchronously delivered & can be viewed on a computer, tablet, or smart phone. Students are expected to watch the lecture videos & maintain pace with the course lectures & assignments per the schedule as maintained in the Canvas course page.

Balancing financial risks versus returns via the use of asset diversification is one of the fundamental tasks of quantitative financial management. This course is devoted to the use of statistics and mathematical optimization to allocate assets, to construct and manage portfolios, and to measure and manage the resulting risks. Specifically, this course covers asset return modeling, time series models, Markowitz's portfolio theory, mean-variance optimization and efficient frontiers, regression, Sharpe's single index and capital asset pricing models (CAPM), structural and statistical multi-factor models, cointegration, risk allocation, and portfolio performance measures. Other topics may include GARCH models, machine learning, and the intertwining of optimization and statistical methodologies in modern portfolio management.

Prerequisite Material:
Multivariable calculus, linear algebra, calculus-based probability, and introductory statistics are required. Basic knowledge of finance & vector calculus is helpful but not necessary.

Additional References:
- *Statistics and Data Analysis for Financial Engineering with R Examples*, by David Ruppert & David S. Matteson, ISBN 978-1-4939-2613-8 (available as an eBook in the Gordon Library).
- MATLAB materials: http://www.cs.cornell.edu/courses/cs99/2003su/

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Learning Outcomes:
By the completion of this course, learners will be able to:
- Model financial & economic data using time series.
- Construct efficient portfolios based on Markowitz portfolio optimization.
- Implement & analyze the properties of regression models.
- Use the Capital Asset Pricing Model and factor models for portfolio management.
- Conduct thorough portfolio performance analysis.
- Manage a portfolio in a real paper trading brokerage account.

Communication:
The primary interface for communication with the instructor will be email, the Canvas course website, virtual office hours, & Piazza. All information about the course will be maintained on the course web page in WPI's Canvas system. Check it often.

Check your *WPI* email *daily*.

The use of Piazza in Canvas is *strongly* encouraged for discussion with the instructor and peer students. It provides a forum where students can post questions anonymously if preferred.

Office Hours & Conference Sessions:
These are interactive sessions with the instructor that will be managed in the Canvas course calendar & will be held online using Zoom. Students are *strongly* encouraged to attend these sessions.

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Course Approach:

This is a semester-long online course.

- Each week begins on Monday at 6am US Eastern Time and ends on the following Sunday at 11:59pm US Eastern Time.
- The Canvas course webpage will be used to manage all aspects of the course. Content will be managed primarily in the announcements, modules, assignments, calendar, & Piazza sections of the Canvas page. The modules section contains all asynchronous lecture videos and all homework assignments in the order in which they should be completed.
- Each week the course will consist of:
  - Up to 3 hours of lecture via online lecture modules.
  - Online office hours via Zoom.
  - At most one written homework assignment, integrated into the modules.
- All written homework will be submitted with a *single-file* PDF upload to Canvas.
- There is a midterm exam on October 16, but there is no final exam.
- There will be several projects. Students are **required to work in pairs** on projects and to submit professional quality project reports, complete with formal references & citations.
  - Project teams will formally present their course project work at the end of the course in place of a final exam.

Course Requirements:

1. **Assignments**

   There are two primary assignment categories for this course:

   o **Written Homework**

   These assignments involve handwritten solutions to problems. Solutions should be second draft and thoroughly demonstrate solutions and derivations, including justifications of steps. These assignments are to be submitted as scanned PDF files in Canvas. Each assignment should be submitted as *one* PDF file.

   Students are encouraged to discuss the homework problems with other students & in discussions on Piazza, but all homework assignments must be completed, written, and submitted independently.

Written Homework Assignment Rubric:

Each homework problem is graded out of 10 points according to the criteria below:

Grade	
10	Completely correct, clear, & thorough write-up of problem solution, citing appropriate rules & theorems where appropriate. Quality is neat and easily readable.
9	Correct, clear, & thorough write-up of methodology & problem solution, citing appropriate rules & theorems where appropriate, with 1 minor mistake or omission. Quality is neat and easily readable.
6-8	Mostly correct write-up of methodology & problem solution with a few minor mistakes or omissions. Quality is neat and readable.
2-5	Incorrect solution. Partial credit is given according to key insights for the problem. Quality is readable.
0-1	Little to no work shown, giving only answers.

o **Projects**

These constitute the bulk of the work for the course. Students will work in pairs on course project work, maintaining the same project team for all course projects. Each major topic for the course will have a project component.

These projects are similar to tasks one would be assigned as a quantitative analyst in an industry portfolio management role. Real data will be used to implement models covered in class in a real-world setting.

Students are required to compose professional quality project reports for each project assigned. Each project report should

- Be structured using sections or chapters.
- Include sections for introduction, background, methodology, data, implementation, results, and conclusions. The conclusions sections should be thorough and contain many insights and reflections on the work.
- Include visual representations of the models and results, such as graphs, tables, histograms, and charts.
- Include a formal references section with formal citations using MLA format to those references where appropriate. Note that **any** work that is not the students' own original work **must be properly cited**. WPI's policies on citations can be found here: https://libguides.wpi.edu/friendly.php?s=citingsources

Examples of quality project reports will be provided.

3. **Exams**

There is one exam in this course. The exam will be administered remotely using remote proctoring software.

Midterm Exam   Friday, October 16

Make-up Exam Policy:
Make-up exams will only be allowed in the event of a documented emergency. You are responsible for avoiding conflicts with the exams.

4. **Final Presentation**

Each student team will present their course project work virtually to the instructor in the last week of the course.

5. **Late Work Policy**
   Late assignments without prior consent of the professor will not be accepted and will receive a grade of 0. Extensions will be granted only in the event of unforeseen emergencies or extenuating situations that you discuss with the professor in advance.

POLICIES

Grading Policy:

The numerical course grade will be determined by the maximum of Scheme A and Scheme B below:

	Weight
Homework Average	25%
Midterm Exam	30%
Project Work	45%

Each homework grade will be converted to a percentage, and then those percentages are averaged to compute the homework average.

Final course letter grades are based on a student's performance as follows:

Letter Grade	Percentage
A	90 - 100
B	80 - 89
C	70 - 79
D	60 - 69
F	0 - 59

The instructor may adjust these grade cutoffs at the end of the course, but such an adjustment can only happen in the students' favor. For example, the minimum score for a grade of B could be decreased from 80 to 79, but it would never increase above 80.

Course incompletes may be granted if the major part of the course is completed; however, no additional credit can be given for missed work beyond the end of the course. In addition, in the case of an incomplete, the student is responsible for handing in the final work within the WPI required timeframe of one (1) year. After this time, an incomplete grade changes to a failing grade.

Worcester Polytechnic Institute

Accessibility Services:

Students with approved academic accommodations should plan to submit their accommodation letters through the [Office of Accessibility Services Student Portal](). Should you have any questions about how accommodations can be implemented in this particular course, please contact me as soon as possible. Students who are not currently registered with the Office of Accessibility Services (OAS) but who would like to find out more information regarding requesting accommodations and what that entails should plan to contact them via email: *AccessibilityServices@wpi.edu* and/or via phone: (508) 831-4908.

Academic Integrity:

You are expected to be familiar with the *Student Guide to Academic Integrity at WPI* that is downloadable from [here](). Consequences for violating the Academic Honest Policy range from earning a zero on the assignment, failing the course, or being suspended or expelled from WPI. Common examples of violations include:

- Copying and pasting text directly from a source without providing appropriately cited credit
- Paraphrasing, summarizing, or rephrasing from a source without providing appropriate citations
- Collaborating on individual assignments
- Turning in work where a good portion of the work is someone else's, even if properly cited

This syllabus is subject to change at the professor's discretion.