COURSE
Course: ECON 6295 Section xx Applied Quantitative Risk Management
CRN: 47374
Semester: Spring 2019
Time: Tuesday, 6:10 PM – 8:40 PM
Location: TBD

INSTRUCTOR
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Time and Location: M/R: 4:30 – 6:00, Monroe 324

COURSE DESCRIPTION
The objective of this course is to give students the tools required to understand and implement quantitative techniques commonly used in modern enterprise risk management (ERM) practice. A particular focus of this course is the financial institutions such as commercial banks, but many techniques covered in the syllabus were originated and are in use outside financial industry. The emphasis is placed on applications, but a theory and models underpinning modern risk management are covered in sufficient detail. Students interested in obtaining PRM (PRMIA) or FRM (GARP) certifications – two most widely recognized designations in the field – may find the content of the course helpful in preparations to the exams.

The course will have two kinds of learning outcomes: risk management concepts and quantitative techniques implementing them. Each lecture will have no more than a handful of both outcomes. Since the emphasis is on applications, theory will be accompanied with a small but complete demonstration in Excel, or, in some cases, Python programming language. Students will be able to download brief lecture notes and demo examples after the classes. Assignments will be based on the examples covered in classroom, e.g. tasking students to modify or extend the demo codes to implement more realistic assumptions. Students will have an option to complete the assignments either in Excel or Python.

Risk management topics covered include the financial institutions, banks and their regulation such
as Basel and Dodd-Frank Act Stress Testing (DFAST) and Comprehensive Capital Analysis and Review (CCAR), financial instruments and markets, market risk, credit risk, operational risk, liquidity risk, model risk and the selected cases in risk management such as the downfall of Riggs Bank. Quantitative techniques include Monte-Carlo simulations, copulas, principal component analysis (PCA), correlated random number generation, extreme value theory (EVT), value-at-risk (VaR) and compound distributions.

COURSE PREREQUISITES
There are no formal pre-requisites for the students admitted to Applied Economics program. The course is designed to be self-contained. However, students are expected to be familiar with basic statistical concepts such as probability distributions and central limit theorem (CLT).

Excel is the most widely used tool in the industry, students should be familiar with it. Although not strictly required, programming skills in any computer programming language will be helpful, especially in either Excel VBA or Python.

TEXTS
The primary text is Risk Management and Financial Institutions, (Wiley) Fourth Edition, JOHN C. HULL. You may use any edition as they are very similar. The references correspond to the 4th edition of the text. The course textbook is available online from under $30.

Recommended optional texts:

LEARNING OUTCOMES:
As a result of completing this course, students will be able to understand the following risk management concepts:
1. risk and reward relationship, fundamentals of portfolio theory
2. quantification of risk, the role of volatility, risk factor mapping
3. the modern ERM framework in financial institutions.
4. balance sheet and income of commercial banks, capital allocation
5. asset liability management (ALM), liquidity risk
6. financial markets and most common financial instruments
7. VaR framework, expected shortfall, tail risk and rare events
8. market and interest rate risk, hedging
9. options and derivatives uses and risks
10. operational risk
11. credit risk
12. model risk, lines of defense
13. cases in risk management, best practices and lessons learned
14. regulation in financial industry, stress testing
as well as the following quantitative techniques:
1. bootstrapping and Monte Carlo simulations
2. parametric VaR techniques
3. loss distributions and forecasting
4. correlated random number generation
5. copulas
6. compound distributions
7. sensitivity, duration, convexity and option “greeks”
8. volatility models, GARCH
9. PCA
10. moment matching
11. parametric vs. nonparametric estimation
12. stable distributions
13. EVT and fat tails

AVERAGE MINIMUM AMOUNT OF INDEPENDENT, OUT-OF-CLASS, LEARNING EXPECTED PER WEEK:
In a 15-week semester, including exam week, you should expect to spend about 2 hours a week for each hour of instruction. For a 2 ½ hour course worth three credits this means that you should expect to study a minimum of 5 hours outside of class each week. Students with strong quantitative background and good programming skills may spend less than that.

GRADING
- Quizzes 30%
- Problem Sets 30%
- Project 1 (Risk Model) Midterm Presentation 20%
- Project 2 (Model Risk) Final Presentation 20%

Quizzes: Quizzes will be handed out at the start of the classes without prior announcement, don’t be late. Each quiz will be worth 10 points. There will be 5 quizzes. The 3 highest grades will be counted toward the course grade.

Problem Sets: Each assignment will be worth 10 points. There will be 5 assignments. The 3 highest grades will be counted towards the course grade. Please see the schedule for problem set due dates. Download the problem sets and the code example (if any). Please upload solutions to Blackboard. Each solution submission has to have at most two page outline in PDF, including the results. Your name should be in the header of the page or the first line of the text.

If the assignment includes programming then the submission should additionally include a) either Excel workbook or annotated (a lot of comments) Python source code file accompanied with b) readme.txt file. The readme file should contain instructions how to configure and run the code, e.g. which Python packages are to be installed. All solution file names should contain your name.

Identical or substantially similar answers may be considered to be a violation of the GW Code of Academic Integrity.

Project 1 Midterm Presentation (Risk Model): You will have to implement a risk management
model for one of the risk areas by applying quantitative techniques, such as loss distribution approach (LDA) in operational risk, based on the content of the first 9 classes of the course. Students will prepare the slides and present the model in front of the class. Students will receive 50% of the grade (i.e. the best score is 15 points) on the presentation day of the model. The remaining 50% of the grade (i.e. up to additional 15 points) will be received after the model “white paper” is evaluated by a fellow student who assumed a role of model risk manager in Project 2.

The presentation length is strictly less than 10 minutes. The intended audience is the business users of the risk model, upper management of the enterprise and regulators. The objective at this stage is to present the work to people who may not have strong quantitative background but understand business. Only the slides are due at the time of the project presentation, the white paper must be ready no later than the time of the Project 2, see next section.

The model white paper must contain a full description of the model sufficient to implement it independently. The paper must contain the following sections: business case, model description, exploratory analysis, description of data, model estimation, assumptions, limitations and back testing. The total length of the white paper should be ideally around 5 pages, and not exceed 10 pages. An example white paper and the template will be provided.

**Project 2 Final Presentation:** You will assume a role of a model risk manager and evaluate one of the risk models presented during Project 1 Midterm by your fellow students. You will negotiate with a modeler to obtain the model white paper prior to your evaluation. Timely delivery of the model artifacts to you is one of the criteria of evaluation. Model risk assessment will be covered after week 9 of the course. Your grade of the risk model should be based on the quality of white paper as well as the results of independent verification of results. Your evaluation will form a basis of the remaining 50% of grade that the model receives for Project 1.

You will present the findings in front of the class. The intended audience is the modelers, business users and external regulators. The length of the presentation is no more than 10 minutes. You must submit the model validation report prior to the presentation. The report must not exceed 5 pages and should contain the following sections: recommendation to use or not use the model in business, issues found during evaluation and their ratings, modeler responses to the issues, back testing performance assessment, independent verification process and results. Conceptual soundness of the model, data used for estimation and documentation are among most important aspects to be assessed in the report. An example and a template of the report will be provided.

Both the model white paper and the validation report are proprietary technical reports for internal distribution within the enterprise. These are not academic papers. These types of documents are often treated as *company confidential*. There are no standard formats and templates for them, e.g. w.r.t. citations or table layouts. Business writing styles are quite different from academic styles. The provided templates will help you to cover the most essential common sections found in similar text in the industry.

**BEFORE THE FIRST CLASS**
To complete this course you will need to perform computations. You can choose either Excel or Python programming language. During the class I will run the demonstrations using one of these tools. You may choose to follow along, in which case you will need to install the software on your
laptop. If you plan to use Python then it helps to get familiar with the language and its environment, but you will not need advanced programming skills and all assignments will have example code to help you start with solutions.

These two books are absolutely optional but enjoyable readings to get yourself into the groove before the classes start: *Plight of the Fortune Tellers: Why We Need to Manage Financial Risk Differently* by Riccardo Rebonato; and *The Black Swan: Second Edition: The Impact of the Highly Improbable* by Nassim Nicholas Taleb.

**CLASS POLICIES**
Attendance is not tracked but is strongly recommended, especially because occasionally there will be quizzes during the classes. Like in real world outside classroom, late work is not accepted and deadlines should be honored. Answers to problem sets and presentation materials must be submitted through Blackboard.

**UNIVERSITY POLICY ON RELIGIOUS HOLIDAYS**
1. Students should notify faculty during the first week of the semester of their intention to be absent from class on their day(s) of religious observance;
2. Faculty should extend to these students the courtesy of absence without penalty on such occasions, including permission to make up examinations;
3. Faculty who intend to observe a religious holiday should arrange at the beginning of the semester to reschedule missed classes or to make other provisions for their course-related activities

For GW’s teaching policies, see [http://www.gwu.edu/~academic/Teaching/main.htm](http://www.gwu.edu/~academic/Teaching/main.htm)

**ACADEMIC INTEGRITY**
I personally support the GW Code of Academic Integrity. It states: “**Academic dishonesty is defined as cheating of any kind, including misrepresenting one's own work, taking credit for the work of others without crediting them and without appropriate authorization, and the fabrication of information.**” Please note that allowing another student to copy your work is defined as cheating under the Academic Integrity code.

Common examples of academically dishonest behavior include, but are not limited to
1) Cheating
2) Fabrication
3) Plagiarism
4) Falsification and forgery of University academic documents
5) Facilitating academic dishonesty

Sanctions range from failure of the assignment, to failure of the course, to suspension or expulsion from the University. For the remainder of the code, see: [http://www.gwu.edu/~ntegrity/code.html](http://www.gwu.edu/~ntegrity/code.html)

All students need to be familiar with GW's Code of Academic Integrity. Item 3 in Section 1 of Article II of the Code deals with plagiarism.

“Plagiarism - intentionally representing the words, ideas, or sequence of ideas of another as one's own in any academic exercise; failure to attribute any of the following: quotations, paraphrases, or
borrowed information.”

For a full set of definitions, see: http://www.gwu.edu/~ntegrity/code.html#definition

For the full Code, see: http://www.gwu.edu/~ntegrity/code.html

**Plagiarism and How to Avoid It**

Plagiarism is a serious matter both inside and outside academia. Students are responsible for becoming familiar with the different forms that plagiarism can take. Ignorance doesn’t exempt students from being penalized for plagiarism. It is essential to educate yourself about what constitutes plagiarism before writing an essay for a take-home exam, a term paper, a dissertation, or a report in the workplace. Students have failed the course or been expelled because of plagiarism.

You can find a good overview of plagiarism and how to avoid it at http://widstudents.wordpress.com/tag/plagiarism/

It’s worth reading through the entire web page, including the section titled "Plagiarism Tales at GW." The following document has good examples of the different forms that plagiarism can take (in Section 4). You should read 1-4 carefully. The document should dispel the possible misconception that plagiarism is committed only when an entire paper, or large parts of a paper, are copied. That is NOT the case. Copying a sentence or even a phrase without properly attributing it constitutes plagiarism.

http://www.ece.msstate.edu/~fowler/Classes/plagiarism.pdf

On the important distinctions among quoting, paraphrasing, and summarizing, see http://owl.english.purdue.edu/owl/resource/563/01/

On the proper use of quotations, see http://writingcenter.unc.edu/resources/handouts-demos/citation/quotations

**SUPPORT FOR STUDENTS OUTSIDE THE CLASSROOM**

**DISABILITY SUPPORT SERVICES (DSS)**

Any student who may need an accommodation based on the potential impact of a disability should contact the Disability Support Services office at 202-994-8250 in Rome Hall, 801 22nd St., NW, Suite 102, to establish eligibility and to coordinate reasonable accommodations. For additional information, please refer to https://disabilitysupport.gwu.edu/

Students must arrange with the DSS office well in advance of needing the service.

**UNIVERSITY COUNSELING CENTER (UCC) 202-994-5300**

The University’s Mental Health Services offers 24/7 assistance and referral to address students' personal, social, career, and study skills problems. Services for students include crisis and emergency mental health consultations, confidential assessment, counseling services (individual and small group), and referrals. For additional information see: https://healthcenter.gwu.edu/mental-health
SECURITY
In the case of an emergency, if at all possible, the class should shelter in place. If the building that
the class is in is affected, follow the evacuation procedures for the building. After evacuation, seek
shelter at a predetermined rendezvous location.
CLASS SCHEDULE
The class schedule is designed to cover the main areas of risk management, such as market and operational risk, in first 9 weeks. This will allow you to implement a risk model for an area of your choice and prepare the presentation for Project 1 (Risk Model). The second part of the class will start with a model risk subject, which is the topic of the Project 2 (Model Risk). This will give you ample time to prepare the second presentation and finish the model white paper from Project 1 (in case you haven’t written it yet).

NOTE: In accordance with university policy, the final exam will be given during the final exam period and not the last week of the semester. For details and complete policy, see: provost.gwu.edu/administration-final-examinations-during-examination-period

<table>
<thead>
<tr>
<th>Meeting</th>
<th>Date</th>
<th>Topic</th>
<th>Reading-Enders</th>
<th>Problem Set Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Introduction, LDA in Ops Risk</td>
<td>Ch. 1,13,23</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Operational Risk, stress testing and intro to VaR</td>
<td>Ch. 22,23</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Commercial Banks, Trading</td>
<td>Ch. 2,5,6</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>How traders manage risks</td>
<td>Ch. 7,8,9</td>
<td></td>
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<tr>
<td>5</td>
<td></td>
<td>Volatility, correlation, and copulas</td>
<td>Ch. 10,11</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Market risk VaR</td>
<td>Ch. 12</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>The regulation of financial institutions</td>
<td>Ch. 15-17</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Credit risk: estimating default probabilities</td>
<td>Ch. 18-21</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Liquidity risk, ALM</td>
<td>Ch. 24</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Project 1 Mid (Risk Model)</td>
<td>slides</td>
<td></td>
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<tr>
<td>11</td>
<td></td>
<td>Model Risk</td>
<td>Ch. 25</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>economic capital and its allocation</td>
<td>Ch. 26</td>
<td></td>
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<tr>
<td>13</td>
<td></td>
<td>ERM, Cases in risk management</td>
<td>Ch. 27-28</td>
<td>5</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Project 2 Final (Model Risk)</td>
<td></td>
<td>Model validation report, Project 1 “white paper”</td>
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<tr>
<td>15</td>
<td></td>
<td>Additional topics</td>
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READING ASSIGNMENTS – Tentative and subject to later revision
TBD


Cases, download from: https://www.prmia.org/Public/PRM/Case_Studies_and_Standards.aspx
- Riggs Bank
- WorldComm
- LTCM
- Fannie Mae and Freddie Mac
- China Aviation Oil