Course and Contact Information:

Course: EMSE 6450.10 – Quantitative Methods in Investment Engineering  
Semester: Spring 2017  # of Credit Hours: 3.0  
Meeting Time: Wednesday from 6:10PM to 8:40PM  
Location: Tompkins Hall 406 – DSS Lab (22 Computers available)  

Instructor:  
Name: J. René van Dorp, Professor  
Campus Address: 800 22nd Street, Office 2800, Washington DC 20052  
Phone: 202-994-6638  
E-mail: dorpjr@gmail.com  
Office hours: Thursday 2:00PM to 4:00PM  

Bulletin Course Description:  
Treatment of the following introductory and more advanced investment engineering topics: Cash Flow Streams and the Basic Theory of Interest; Bond Pricing and Immunization of Bond Portfolios; the Term Structure of Interest Rates; Mean-Variance Portfolio Theory and the Capital Asset Pricing Model; Value at Risk.  

Total of 112.5 Student Engagement Hours are divided over: 2.5 hours of class instruction + midterm exam and a final report project over 15 weeks. Homework, reading assignments and preparation of final report is estimated at 5 hours per week over 13 weeks of class preparation. Studying/preparing for the midterm exam is estimated at 10 hours. Estimated student engagement hours totals to 112.5.  

Prerequisite Requirement:  
- ApSc 3115: Engineering Analysis III (or any other undergraduate Applied Statistics course from a physical or natural sciences program) and  
- EMSE 6410: Survey of Finance and Engineering Economics.
Extended Course Description:

"Investment theory currently commands a high level of intellectual attention – fueled in part by some extraordinary theoretical developments in finance, by an explosive growth in information and computing technology, and by the global expansion of investment activity. Recent development in investment theory are being infused into university class rooms, into financial service organizations, into business ventures, and into the awareness of many individual investors” - Luenberger (1998). The course emphasizes fundamental mathematical principles and how literacy in these principles allows one to solve practical investment problems. The course closely follows the first two parts of Leunberger’s (1998) book, i.e.: (i) Deterministic Cash Flow Streams and (ii) Single Period Random Cash Flows. Specific topics discussed are: Cash Flow Streams and the Basic Theory of Interest; Bond Pricing and Immunization of Bond Portfolios; Term Structure of Interest Rates Theory; Mean-Variance Portfolio Theory; The Capital Asset Pricing Model; Value at Risk.

The course is designed for individuals with a technical background at the level of a bachelor’s degree in engineering, mathematics or science. The language of investment science is predominantly mathematical. However, the mathematics used in this course is not complex – only elementary portions of calculus are required – but students must be comfortable with the use of mathematics as a method of deduction and problem solving. Students with a solid grasp of algebra, analytic geometry and knowledge of probability calculus equivalent to the level of an undergraduate probability and statistics course will find the materials in this class more accessible. Students may want to revisit some of these topics as needed.


**Electronic Lectures notes available at:**  
http://www2.seas.gwu.edu/~dorpjr/EMSE292/Intro.html

**Required Software:**  
Learning Outcomes:

As a result of completing this course, students will be able to:

1. Price fixed income securities such as annuities and bonds and evaluate price sensitivity of bonds as a result of market interest rate changes.
2. Construct a portfolio of bonds that is immunized against interest rate changes.
3. Understand and apply more advanced interest rate theory to the above three topics using the term structure of interest.
4. Perform applied interest rate analysis in a deterministic setting.
5. Construct an efficient frontier from a series of stocks using Markowitz Portfolio Theory.
6. Combine a Markowitz Stock Portfolio with a risk free asset to construct the capital market line and understand its connection to the Capital Asset Pricing Model.
7. Construct a Markowitz Portfolio avoiding short-selling of stocks to achieve a desired return.
8. Articulate topics 6-8 in an investment analysis final report of 10 stocks prices of a student’s choice.

Method of Instruction:

One hour and 15 minutes lecture including homework discussion, followed by a 15 minute break and a one hour lecture. Microsoft Excel and Minitab are used to perform analysis during the class sessions. During class sessions the only software programs that should be open on your desktop are either Adobe Acrobat (for viewing the notes) or Microsoft Excel. During the class sessions (except for the break of course) a student is not to check his e-mail, the internet and should not engage in instant messaging sessions. Basically, your attention should be directed towards the class material.

Grading:

5% - Class Attendance
20% - Homework (graded on effort only)
35% - Midterm Exam (In-Class)
40% - Markowitz Portfolio Construction + Final Report
Homework:
Homework will have to be completed prior to the next class for discussion. The homework will be graded on an effort basis. Each homework problem is worth one effort point unless otherwise specified. Partial effort points may be awarded. The homework is assigned to enhance a student’s understanding of course materials and to prepare them for the midterm exam. Electronic solutions of the homework will be provided.

Reading Assignments:
Lecture notes and recommended chapters for reading will be assigned prior to class as indicated in the outline.

Midterm Exam and Final Report:
Students will complete an in-class Midterm Exam using Microsoft Excel (using a lab computer or the student’s laptop). Theoretical questions will be answered in an exam booklet. The MS EXCEL file and the exam booklet will be part of the grading of the midterm exam. Students will be required to download stock prices of 10 stocks and use those datasets to create an efficient frontier and develop and investment stock portfolio from this efficient frontier that avoids short selling but with a desired return. Student will write a final report detailing their investment analysis steps, final analysis results and investment recommendation. Students are required to submit the electronic files associated with the final report as well as a hard copy of the final report that will be graded.
### Class Schedule:

Subject to change, please check the schedule regularly

<table>
<thead>
<tr>
<th>Session</th>
<th>Date</th>
<th>Class Topic</th>
<th>Reading Assignments (2nd Ed.)</th>
<th>Homework Assignments 1st Edition Numbering</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/18/2017</td>
<td>Cash Flow Streams and the Basic Theory of Interest</td>
<td>Chapter 1, 2</td>
<td>2.4, 2.8, 2.10</td>
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<tr>
<td>2</td>
<td>1/25/2017</td>
<td>Fixed Income Securities - Part 1</td>
<td>Chapter 3</td>
<td>3.6, 3.10</td>
</tr>
<tr>
<td>3</td>
<td>2/1/2017</td>
<td>Fixed Income Securities - Part 1</td>
<td>Chapter 3</td>
<td>3.12, 3.14</td>
</tr>
<tr>
<td>4</td>
<td>2/8/2017</td>
<td>The Term Structure of Interest Rates</td>
<td>Chapter 4</td>
<td>4.2, 4.6, 4.11, 4.14</td>
</tr>
<tr>
<td>5</td>
<td>2/15/2017</td>
<td>Applied Interest Rate Analysis - Part 1</td>
<td>Chapter 5</td>
<td>5.2, 5.7, 5.11, 5.12</td>
</tr>
<tr>
<td>6</td>
<td>2/22/2017</td>
<td>Applied Interest Rate Analysis - Part 2, Mid-term Review</td>
<td>Chapter 5</td>
<td>5.2, 5.7, 5.11, 5.12</td>
</tr>
<tr>
<td>7</td>
<td>3/1/2017</td>
<td>Mean-Variance Portfolio Theory - Part 1</td>
<td>Chapter 6, Appendix A and B</td>
<td>6.2</td>
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<tr>
<td>8</td>
<td>3/8/2017</td>
<td>Mean-Variance Portfolio Theory - Part 2</td>
<td>Chapter 6, Appendix A and B</td>
<td>6.4, 6.6</td>
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<tr>
<td>9</td>
<td>3/15/2017</td>
<td>Mean-Variance Portfolio Theory - Part 3</td>
<td>Chapter 6, Appendix A and B</td>
<td>6.7, Project Part I</td>
</tr>
<tr>
<td>10</td>
<td>3/22/2017</td>
<td>Final Project Part I - Building a Markowitz Efficient Frontier with only Risky Funds and Capital Asset Pricing Model</td>
<td>Chapter 7</td>
<td>7.6, 7.8, 8.5, 8.6</td>
</tr>
<tr>
<td>11</td>
<td>3/29/2017</td>
<td>Data and Statistics</td>
<td>Chapter 8, 2nd Edition</td>
<td>7.6, 7.8, 8.5, 8.6</td>
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</table>
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.

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 the Rome Hall, Suite 102, to establish eligibility and to coordinate reasonable accommodations. For additional information please refer to: gwired.gwu.edu/dss/

Mental Health Services 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. counselingcenter.gwu.edu/

Academic Integrity Code

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. For the remainder of the code, see:

studentconduct.gwu.edu/code-academic-integrity