Instructor information

- **Instructor:** Ahmad Peivandi, Ph.D.
- **Office:** RCB 1137 (35 Broad Street)
- **Email:** apeivandi@gsu.edu
- **Office Hours:** Wednesdays 2 pm - 4 pm.

Class information

- **Location:** Aderhold 429
- **Schedule:** W 4:30 - 7:00 pm
- **Prerequisites:** MBA 8135.
- **Catalog description:** Stochastic Risk Management Models. This course introduces stochastic models for risk management, broadly defined. The course has two main components. The first component covers single-period models including severity models, frequency models, compound distributions, and aggregate loss models. The second component covers multi-period models by introducing stochastic processes with emphasis on Markov chains, Poisson processes, and Brownian motion. Applications to insurance appear throughout the course. The second component adds applications to finance such as the Black/Scholes/Merton model and credit loss models. 3.000 Credit Hours.

How to do well in this class?

1. Come to class sessions prepared.
2. Engage in discussions in the class, you learn by explaining to others.
3. Study the textbook and solve the assignments. Work with a study partner and explain the process to each other.
4. Solve practice problems.
5. Ask questions when you are confused.

Course objectives student learning outcome

1. Severity loss models
   - (a) Describe how changes in parameters affect the distribution.
   - (b) Recognize classes of distributions and their relationships.
   - (c) Create new families of distributions by multiplying by a constant, raising to a power, via exponentiation and via mixing.
   - (d) Calculate various measures of tail weight and interpret the results to compare the tail weights.
   - (e) Evaluate the effect of coverage modifications (deductibles, limits, coinsurance) and inflation.
   - (f) Calculate the loss elimination ratio.

2. Frequency Models
   - (a) Describe how changes in parameters affect the distribution.
   - (b) Apply truncated or modified distributions to an application given the parameters.
   - (c) Evaluate the effect of coverage modifications (deductibles, limits, coinsurance) and inflation.

3. Compound (aggregate) models
   - (a) Compute relevant parameters and statistics for collective risk models.
(b) Evaluate compound models for aggregate claims.
(c) Compute aggregate claims distributions.
(d) Evaluate the effect of coverage modifications (deductibles, limits, coinsurance) and inflation.

4. Discrete time Markov chain models
(a) Define homogeneous and non-homogeneous discrete-time Markov chain models.
(b) Calculate the probabilities of being in a particular state, and of transitioning between particular states.
(c) Calculate actuarial present values of cash flows at transitions between states.
(d) Calculate actuarial present values of cash flows while in a state.
(e) Applications to Credit Risk models.

5. Poisson processes
(a) Define a Poisson process (homogeneous and non-homogeneous) and a compound Poisson process.
(b) Describe the distribution of the increments of claim frequency in the homogeneous case.
(c) Describe the distribution of the inter-arrival times for claims in the homogeneous case.
(d) Describe the distribution of the increments of claim frequency in the homogeneous case.

6. Continuous time models
(a) Define models of option pricing based on geometric Brownian motion (Black/Scholes/Merton model) and based on approximations (the Binomial model).
(b) Define models of stochastic interest rates based on Brownian motion (Ho and Lee model), and based on fractional distributions (Vasicek and CIR models).

Method of instruction

- Lectures: The course material is presented in lecture form.
- Student participation: It is strongly suggested that students do not miss classes as, historically, students with multiple absences perform poorly on examinations and have extreme difficulty in completing the course successfully. However, grades will not be subject to students attendance or participation.
- Course assignments: There will be five class assignments in the term. Due dates are:

<table>
<thead>
<tr>
<th>Assignment</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Due on</td>
<td>02/03</td>
<td>02/24</td>
<td>03/09</td>
<td>04/13</td>
<td>04/20</td>
</tr>
</tbody>
</table>

Assignments must be submitted at the beginning of the class, or before 4:30pm on the due date. You may work in groups with at most three members. Each group may submit one copy of the assignment. No late assignment will be accepted. Only in special cases you can submit your assignment by email (in those cases, use a pdf file and write MRM8320 in the email subject). Assignments will be graded in a 100 point scale. Cleanliness, legibility and order are important. Messy and illegible assignments will cost you up to 10 points off the assignment grade (staple your assignments!). Do not forget to include the course name, group member names and the assignment number. The average assignment grade is worth 20% of the final grade.

- Examinations: The course has two exams:

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Midterm exam</td>
<td>March 23, 2016</td>
<td>40% of the final grade</td>
</tr>
<tr>
<td>Final exam</td>
<td>April 27, 2016</td>
<td>40% of the final grade</td>
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</tbody>
</table>

Students who miss examinations should contact me immediately. There are not make-up exams for the Midterm examination. If you miss the midterm exam, the 60% of your final grade will be obtained from your assignments’ grades and the final exam grade. That is, assignments will be worth 20%, and the final exam, 80%. Make-up exams for the Final examination are offered only under extraordinary circumstances. The final exam covers the entire course with emphasis put on the material not covered by the Midterm exam.
• **SOA Exams preparation:** Most of the questions I will give as homework exercises and in lists of exercises are practice questions for SOA Exam C and SOA Exam MLC (Markov chains and Poisson processes). However, not all the topics required to take those Exams are covered by this course. I recommend reviewing the Student’s guides for SOA Exams by Cox and Pai. They cover all the different topics required in the Exams and have plenty of sample questions and exercises. Moreover, I strongly recommend you to form study groups for the Exams outside the class.

• **Grading policy:** The final grade for the course is given by the weighted average of the grades of assignments (20%), midterm exam (40%) and final exam (40%). Grades will be converted to a letter grade using the following scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>A+</th>
<th>A-</th>
<th>B+</th>
<th>B-</th>
<th>C+</th>
<th>C-</th>
<th>D</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>98-100</td>
<td>93-98</td>
<td>90-93</td>
<td>87-90</td>
<td>83-87</td>
<td>80-83</td>
<td>77-80</td>
<td>73-77</td>
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</tbody>
</table>

• **Attendance policy:** Class attendance is not mandatory. However, experience shows that students that miss too many classes (and/or too often) perform poorly on examinations. In addition, students that miss class cannot make up class participation. Attendance to office hours does not count as student participation if you are not also attending class.

**Textbooks**


Study notes:


Research papers: The following papers are available from the University Library website. Students are expected to have read the papers before the class in which they will be discussed.


Recommended:

Additional information

- Do not be late to class.
- Turn off your cell phones. They disrupt the class and distract me. If the call is really important, you can answer it outside the classroom.
- Please not food in class, unless you want to share. Coffee is fine though.
- Be advised that the last day to withdraw from a course with a possibility of receiving a 'W' is March 1st, 2016. If a student withdraws by this date but is failing the course, he/she will receive a 'WF'. All students who withdraw after this date will receive a 'WF'.
- The course syllabus provides a general plan for the course; deviations may be necessary.
- Please review the University’s Policy on Academic Honesty (section 409). You can find it on the website http://www2.gsu.edu/~wwfhb/sec409.html
- Please let me know if you have any documented disability that needs to be accommodated.

Course outline:

The following is a general outline for the course. It may be adjusted as we advance.

<table>
<thead>
<tr>
<th>Dates</th>
<th>Topic</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/13</td>
<td>Review of basic (Probability) concepts</td>
<td>[K] Ch. 2-3.3</td>
</tr>
<tr>
<td>01/20</td>
<td>Loss (parametric) distributions</td>
<td>[K] Ch. 4-5.4</td>
</tr>
<tr>
<td>01/27</td>
<td>Loss (parametric) distributions</td>
<td>[K] Ch. 4-5.4</td>
</tr>
<tr>
<td>02/03</td>
<td>Discrete distributions</td>
<td>[K] Ch. 6.1-6.4,6.7,6.8</td>
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<tr>
<td></td>
<td><strong>Assignment 1 due</strong></td>
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<tr>
<td>02/10</td>
<td>Coverage modifications</td>
<td>[K] Ch. 8</td>
</tr>
<tr>
<td>02/17</td>
<td>Coverage modifications</td>
<td>[K] Ch. 8</td>
</tr>
<tr>
<td>02/24</td>
<td>Aggregate loss models</td>
<td>[K] Ch. 9.1-9.3,9.7,9.11</td>
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<tr>
<td></td>
<td><strong>Assignment 2 due</strong></td>
<td></td>
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<tr>
<td>03/02</td>
<td>Aggregate loss models</td>
<td>[K] Ch. 9.1-9.3,9.7,9.11</td>
</tr>
<tr>
<td>03/09</td>
<td>Multi-state models. Markov chains</td>
<td>[D1]</td>
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<tr>
<td></td>
<td><strong>Assignment 3 due</strong></td>
<td></td>
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<tr>
<td>03/16</td>
<td>Spring Break</td>
<td>No Class</td>
</tr>
<tr>
<td>03/23</td>
<td>Midterm Exam</td>
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<tr>
<td>03/30</td>
<td>Multi-state models. Markov chains Poisson processes</td>
<td>[D1] [K] Ch. 11.1,[D2]</td>
</tr>
<tr>
<td>04/06</td>
<td>Poisson processes</td>
<td>[K] Ch. 11.1,[D2]</td>
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<tr>
<td>04/13</td>
<td>Decision Under Uncertainty</td>
<td>Notes will be provided</td>
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<tr>
<td></td>
<td><strong>Assignment 4 due</strong></td>
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<tr>
<td>04/20</td>
<td>Review of practice problems</td>
<td>Assignment 5 due</td>
</tr>
<tr>
<td>04/27</td>
<td>Final Exam</td>
<td></td>
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</tbody>
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