Iowa State University
Department of Industrial and Manufacturing Systems Engineering
IE 560X: Engineering Risk Analysis
Fall 2015

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Meeting Times: Tue Thur 9:30-10:50
1242 Howe

Office Hours: 3029 Black Engineering   Tue 11:00-12:30   Wed 3:30-4:30
or by appointment

This course focuses on building mathematical models to assess and quantify risk principally by following the methodologies of probabilistic risk analysis. We will examine different models to help us quantify risks and explore how to solve these models both analytically and through simulation. Because many risk problems involve societal and human behavioral issues, the course will also explore how humans naturally perceive risk, communicating risk issues to a non-technical public, and accounting for intelligent adversaries. Ultimately, risk analysis is used to make better risk management decisions, and the course will teach how to incorporate analysis into good decision making, while accounting for a decision maker's risk attitude. Examples from business, engineering systems, critical infrastructure, defense and security, cybersecurity, and health systems will be discussed. Students will be required to apply the tools and methodologies to a problem that interests them.

Learning outcomes:

1. Ability to quantify risk as a function of probability and consequences
2. Ability to build and apply probabilistic models to complex problems even when little data is available
3. Make sound decisions that account for uncertainty
4. Make good risk management decisions that incorporates the multi-faceted nature of many risk problems and accounts for the human perception of risk

Prerequisites: Coursework in probability and basic statistics

Textbooks (required):
1. Bedford, T. and Cooke, R. *Probabilistic Risk Analysis: Foundations and Methods.* Cambridge: Cambridge University Press, 2001. [also on reserve at the library]
2. Hubbard, D. W. *The Failure of Risk Management: Why It's Broken and How to Fix It.* Hoboken, N.J.: John Wiley & Sons, 2009.

In addition to these textbooks, there will be required journal articles and possibly other optional material which will be available online through the Iowa State library.

Grading:

Homework	20%
Group case study	35%
Research paper	45%

Grading scale:

Grade	Percent range	Grade	Percent range
A	92 – 100	C	73 – 76
A-	90 – 91	C-	70 – 72
B+	87 – 89	D+	67 – 69
B	83 – 86	D	63 – 66
B-	80 – 82	D-	60 – 62
C+	77 – 79	F	< 60

This scale represents the worst possible grading scale I will use, and the grades may be rounded up to benefit the students.

Homework: There will be several (probably about 5-6) homework assignments during the semester consisting of problems. Students can work together on the homework, but each student must hand in his or her own work. Each homework will have a due date, but I will be flexible on many of the due dates. It is the student's responsibility to ask for an extension (preferably before the due date), and it is my discretion to grant an extension. No homework will be accepted after solutions to that homework are posted. There will be more homework in the beginning of the semester and less homework towards the end of the semester. The homeworks will help to assess the students' achievements of learning outcomes 1, 2, and 3.

Group case study: There will be a group case study in which each group will analyze and quantify the risks of the same problem. More details about the case study will be given later in the semester. I will ask each group to make a presentation either in person or online in early November. The case study will serve as a pseudo-examination. The group case study will help to assess the students' achievements of learning outcomes 2 and 4.

Research paper: Each student is required to submit a research paper on a topic of his or her choice. The student will be required to analyze the risks of a particular problem and develop a model to quantify those risks. Students will be required to submit a paper proposal about midway through the semester and a rough draft of the paper about two-thirds of the way through the semester. The final version of the paper will be due at the end of the semester. More details will follow on the research paper. The research paper will help to assess the students' achievements of learning outcomes 1, 2, and 4.

Participation and discussion: Although there is no graded participation, as graduate students, you should be self-motivated to ask and answer questions. To encourage both in-class and out-of-class discussion, I will assign journal articles and chapters from the Hubbard textbook to read during the semester, and I will pose questions about those readings on Blackboard. If you are a distance learning student, you should read the articles and respond to the questions (and respond to other people's comments on Blackboard). If you are an in-class student, you have the option of

responding via Blackboard or during class. At the end of the semester if you are close to the percentage cutoff for a letter grade and you were an active participant (either online or in person), you will receive the higher letter grade.

Use of Blackboard: I will be using Blackboard to make announcements about the class and post homework and reading assignments. If you are a distance learning student, you should submit your homework via Blackboard, and I will grade it and post your grade on Blackboard. If you are an in-class student, you can either submit your homework in person or via Blackboard.

If you have a question that is appropriate for the entire class (e.g., questions about homework or lectures), please post that question on Blackboard in the discussion section, and I will answer it there. If you have a question that is private (e.g., request for an extension on a homework, questions about grading an assignment), please email me. You can always ask me any type of question in person or via phone.

Notional lesson plan (will almost certainly change)**:**

Week	Topics
8/25	Definition of risk, What is risk analysis?
9/1	Probability review, Probability distributions
9/8	Influence diagrams
9/15	Influence diagrams continued, Event trees
9/22	Fault tree analysis
9/29	Risk analysis examples
10/6	Bayesian probability, Expert opinion
10/13	Utility theory and risk attitude
10/20	Utility theory and risk attitude, continued
10/27	Risk management
11/3	Risk measurement and regulation
11/10	Financial risk analysis
11/17	Risk perception
12/1	Risk communication
12/8	Intelligent adversary

My commitment to you: I will do my best to respond to your questions quickly, whether you email me, post a question on Blackboard, or leave a phone message. You are welcome to contact me by any of these methods, and you can come to my office or call me at any time (not just during office hours). I will also come to class prepared and work to give stimulating lectures while teaching the material that I think is important for you to learn. As the lesson plan changes, I will update you both verbally and via Blackboard.

Except for the first assignment (which is not graded), you will have at least a week to complete homework, and you usually will have longer than a week. I will strive to grade homework within a week, and I will provide feedback on your group case study and on your research paper. In summary, I am committed to helping you learn the material and improve your mathematical modeling, problem-solving, and communication skills.

Academic Dishonesty: The class will follow Iowa State University's policy on academic dishonesty. Anyone suspected of academic dishonesty will be reported to the Dean of Students Office. http://www.dso.iastate.edu/ja/academic/misconduct.html

Disability Accommodation: Iowa State University complies with the Americans with Disabilities Act and Sect 504 of the Rehabilitation Act. If you have a disability and anticipate needing accommodations in this course, please contact me to set up a meeting within the first two weeks of the semester or as soon as you become aware of your need. Before meeting with me, you will need to obtain a SAAR form with recommendations for accommodations from the Disability Resources Office, located in Room 1076 on the main floor of the Student Services Building. Their telephone number is 515-294-7220 or email disabilityresources@iastate.edu. Retroactive requests for accommodations will not be honored.

Dead Week: This class follows the Iowa State University Dead Week policy as noted in section 10.6.4 of the Faculty Handbook http://www.provost.iastate.edu/resources/faculty-handbook.

Harassment and Discrimination: Iowa State University strives to maintain our campus as a place of work and study for faculty, staff, and students that is free of all forms of prohibited discrimination and harassment. Any student who has concerns about such behavior should contact me, Student Assistance at 515-294-1020 or email dso-sas@iastate.edu, or the Office of Equal Opportunity and Compliance at 515-294-7612.

Religious Accommodation: If an academic or work requirement conflicts with your religious practices and/or observances, you may request reasonable accommodations. Your request must be in writing, and I will review the request. You may also seek assistance from the Dean of Students Office or the Office of Equal Opportunity and Compliance.

Contact Information: If you are experiencing, or have experienced, a problem with any of the above issues, email academicissues@iastate.edu.