

**Iowa State University**  
**Department of Industrial and Manufacturing Systems Engineering**  
**IE 564: Decision Analysis in System Design**  
**Spring 2021**

**Class Time and Location:** Tue Thur 8:00-9:15 am Marston 3300

**Instructor:** Dr. Cameron MacKenzie  
Office: 3029 Black Engineering  
Virtual Office Hours via WebEx: Mon 10-11 am, Wed 3-4 pm, or by appointment  
Email: [camacken@iastate.edu](mailto:camacken@iastate.edu) Phone: 515-294-6283

This course focuses on making good decisions especially when those decisions have uncertainty and/or multiple objectives. We will explore good techniques to structure a decision by thinking about the decision maker's preferences, alternatives, and information. The first decision framework will be a single-objective decision problem with uncertainty that takes into account a decision maker's attitude towards risk. The second decision framework will be a multi-criteria decision problem in which a decision maker has multiple objectives. We will examine the multi-criteria decision problem in the context of certainty and with uncertainty. Other topics to be explored include value-focused thinking, value of information, sensitivity analysis, and influence diagrams. Examples will principally be drawn from business, systems engineering and design, and public policy.

**Educational objectives:**

1. Make sound decisions that account for uncertainty and an individual's risk attitude
2. Structure a decision for another individual
3. Create an objectives hierarchy to trade off among objectives in a multi-criteria decision problem
4. Employ sensitivity analysis and value of information to understand key factors influencing the decision

**Prerequisites:** None (although some coursework in probability is useful)

**Textbooks**

There is one required textbook: Howard, R. A. and Abbas, A. E. *Foundations of Decision Analysis*. Boston: Pearson Education, 2016. [on reserve at the library]

One drawback with the Howard and Abbas textbook is that it does not cover multi-criteria decision making very well. Students may also want to have access to one of the following books to supplement the information for multi-criteria decision making [all books will be on reserve at the library]:

1. Keeney, R. L. *Value-Focused Thinking: A Path to Creative Decisionmaking*. Cambridge, MA: Harvard University Press, 1992. [highly recommended, can buy used copies for cheap online]

2. Chelst, K. R. and Canbolat, Y. B. *Value-Added Decision Making for Managers*. Boca Raton, FL: CRC Press, 2012. [Chapters 4-6 are quite good for multi-criteria decision making.]
3. Hammond, J. S., Keeney, R. L., and Raiffa, H. *Smart Choices: A Practical Guide to Decision Making Better Decisions*. Boston, MA: Harvard Business School Press, 1999. [A small book that gives a good general overview but does not have a lot of technical detail.]

A few articles will also be provided for more background on multi-criteria decision making.

**Grading:**

Homework	15%
Quizzes	15%
Case studies	30%
Term paper	40%

**Grading scale:**

Grade	Percent range	Grade	Percent range
A	94 – 100	C	73 – 76
A-	90 – 93	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 approximately 6-8 homework assignments during the semester. The goals of the homework will be on conceptual understanding, solving problems in Excel, and preparation for the case studies. Unless otherwise stated, 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 me 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.

**Quizzes:** There will be 3-5 quizzes throughout the semester. The goal of these quizzes will be on ensuring students can implement the mechanics of what is taught. These quizzes will be provided on Canvas and will have a due date. You will be able to take the quiz as many times as you wish until the due date. More details will be provided about the quizzes. You will have either a quiz or homework assignment (but not both) due during Prep Week.

**Case studies:** There will be two case studies during the semester, which will require each student to individually put together a PowerPoint presentation. For each case study, half of the students will be randomly chosen to present his or her presentation to me online. The case studies will serve as a sort of examination, and students are forbidden from discussing the case study with other students.

**Term paper:** Each student will be required to submit a term paper analyzing a decision that is derived from his or her research or professional experience. The term paper will be written in three sections during the semester with opportunities to receive feedback and to revise the first two sections. The final version of the term paper will be due on Wednesday, May 5.

**Use of Canvas:** I will be using Canvas to make announcements about the class and to post homework assignments, additional reading, and notes from the class. Students should submit their homework via Canvas.

If you have a question that is appropriate for the entire class (e.g., questions about homework or lectures), please post that question on Canvas 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.

**Topics covered in this class** (in roughly this order)

- Structuring a decision
- Probability basics
- Decision trees
- Utility theory
- Value of clairvoyance and information
- Sensitivity analysis
- Structuring multi-objective decisions
- Multi-attribute value theory
- Tornado diagrams
- Probability encoding
- Influence or decision diagrams
- Multi-attribute utility theory

**My commitment to you:** I will do my best to respond to your questions quickly, whether you email me, post a question on Canvas, or leave a phone message. You are welcome to contact me by any of these methods. 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 Canvas.

I will strive to grade homework within two weeks, and I will provide feedback on your case study presentations and term papers. 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](#).

*Note:* Copying and pasting from the Internet is considered plagiarism and is academically dishonest. If you do it for an assignment or for the term paper, you will receive a 0 for that assignment. You must write things in your own words!

**COVID-19 Health and Safety Requirements:** Students are responsible for abiding by the university's [COVID-19 health and safety expectations](#). All students attending this class in-person are required to follow university [policy](#) regarding health, safety, and face coverings.

**Accessibility:** Iowa State University is committed to assuring that all educational activities are free from discrimination and harassment based on disability status. Students requesting accommodations for a documented disability are required to work directly with staff in Student Accessibility Services (SAS) to establish eligibility and learn about related processes before accommodations will be identified. I will work with students to identify a specific, timely plan to deliver/receive the indicated accommodations in the Notification Letter. Additional information or assistance is available online at [www.sas.dso.iastate.edu](http://www.sas.dso.iastate.edu), by contacting SAS staff by email at [accessibility@iastate.edu](mailto:accessibility@iastate.edu), or by calling 515-294-7220. SAS is a unit in the Dean of Students Office located at 1076 Student Services Building.

**Prep Week:** This class follows the Iowa State University Dead Week policy as noted in section 10.6.4 of the [Faculty Handbook](#).

**Discrimination and Harassment:** Iowa State University does not discriminate. Inquiries regarding non-discrimination policies may be directed to the Office of Equal Opportunity, 3410 Beardshear Hall, Tel. 515-294-7212, Hotline 515-294-1222, email [eoffice@iastate.edu](mailto:eoffice@iastate.edu).

**Religious Accommodation:** Iowa State University welcomes diversity of religious beliefs and practices. 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](#).

**Free Expression:** Iowa State University supports and upholds the First Amendment protection of [freedom of speech](#) and the principle of [academic freedom](#) in order to foster a learning environment where open inquiry and the vigorous debate of a diversity of ideas are encouraged. Students will not be penalized for the content or viewpoints of their speech as long as student expression in a class context is germane to the subject matter of the class and conveyed in an appropriate manner.

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