

Risk and Decision Analysis & Engineering Systems Analysis for Design

Course Introduction

IDS.332J and IDS.333

Welcome!

- It's a pleasure to be with you – in person
- We will be covering much new material
- I look forward to learning with you
- Hope to make some long-term friends

GOOD MORNING!

BONJOUR !
¡BUENOS DIAS!
GUTEN MORGEN !
SALAAM ALEIKUM !
O HAYO GOZAIMASU !
SELAMAT DATANG !
KAAH MEPA !
NI HAO MA !
NAMASTE !
SHALOM !
BOM DIA !

Today's class has 4 parts

1. Brief Course Introduction
2. Review of Pre-Read Responses
3. Discussion of Paradigm Shift
4. Example Project

IDS.333J / IDS.332

- You are at opening of 2 subjects!
- IDS.332J (also 1.146, 16.861) : *Engineering Systems Analysis for Design* **12** units
- IDS.333: *Risk and Decision Analysis* **6** units
(at pace or 12 hours/week or ½ semester)
 - Methods, followed by applications in either
 - IDS.332 **for those that continue in fall**
 - IDS.330 **6** unit Spring course *Real Options for Product and System Design*
- **Which should you choose (if any)?**

IDS.332 / IDS.333, IDS.330 Choice

- Many students choose either
 - Combination of 6 unit Fall and Spring courses
 - Or 6 unit Fall course alone
- Because
 - Possibly not yet ready for a deep dive into an application project
 - They'll appreciate that course ends in October and lightens end of semester heavier loads
 - In Spring they will be ready for deep dive application, to either thesis or other project
- See Canvas sites for full details for each

IDS.333 / IDS.332 / IDS.330 Choice

- **IDS.332: Engineering Systems Analysis for Design, 12 unit, Full semester course**
- The second half of the semester will be project oriented. It will combine lectures, seminar discussions, and personal coaching on project
- Restricted to students who
 - Can develop or have a suitable personal project
 - We explore this with discussion of “Initial Project Status” form

Content: First half of Semester

➤ Main Objectives:

1. To increase your awareness and appreciation for WHY uncertainty matters in engineering design, **Being Proactive better than being Passive**
2. To give you tools to analyze effect of uncertainty on performance of design,
3. To help you appreciate how to choose best tool for your problem, and
4. To use the tools to design flexible strategies that will maximize overall expected performance

Content: Second Half of Semester

- Overall objective:
 - To give you confidence in practical application of course material to engineering design
- Topics
 - Drivers for Flexibility
 - Decision Rules
 - Real Options Theory
 - Multidimensional Choice
 - Case Examples
 - Creating a Strategy: Choice and Plan
- Project: Preparation of a Design or a Plan with Flexibility based on analysis of alternative options

Introduction of Teachers

- Richard de Neufville
 - Prof. of Engineering Systems, MIT Institute for Data, Systems, and Society (IDSS)
 - Civil Engineer by training, specialty in “airports”
 - International practice “every inhabited continent”
 - Sabbaticals: England, France, Portugal, Japan, Australia... and California
 - Rows and will participate in Head of Charles

Website: ardent.mit.edu

Introduction of Teachers

Aparna Kulkarni, Teaching Assistant

- Fellow, MIT System Design & Management
- Was Systems Engineer at Honeywell
- Worked 8+ years in Industrial, particularly Building, Automation
- Current interests: Innovations in energy industry, exploring System of Systems with emphasis on Smart Cities using platform solutions
- Academic background: Instrumentation and Controls Engineering



Logic of the Course

- Engineering Systems exist in Uncertainty
 - Technical – New Developments
 - Economy – Boom, Crisis, Prices, Competition
 - Social – New Regulations, Political Changes
- Engineering Systems Need to Adapt
 - Take advantage of Opportunities
 - Avoid Hazards, Risks
- Flexibility is an Essential Part of Design
 - How do we identify, choose, and implement flexibility?
- Course shows **how** to Determine Answers

New Material

- New Approach to Engineering Design
 - Recognizes Uncertainty and Use of Flexibility, thus Changes Engineering Design Process
- Revolutionary possibilities
 - Explicit consideration of flexibility easily increases expected performance 30% !
- Related to “Real Options”, but different
- Procedures developed to fit engineering realities
 - Little historical data ; Rapid Procedures needed
- Develops coherent road-map for strategic design

Objectives of First half of Semester

1. Conceptual framework for thinking about designing/decision-making under uncertainty.
2. Introduce useful tools for helping you think and do analysis in these situations.

Course will present 4 elements:

- Uncertainty
- Value over Time
- Simulation over Spreadsheet
- Decision Analysis, Value of Information

Prerequisites

- Syllabus assumes:
 - comfort with basic calculus, probability, statistics
 - familiarity with some advanced concepts of Excel used in course
 - Presentation of necessary Excel material built into course

Courses “Flipped”; on Canvas

- In general “lecture material” distributed on web in advance, and discussed in-person classes
- Students review “lecture material” before class, and respond to it via “Pre-Read” forms
- Pre-Read responses form basis for in-person discussion of questions, and lead to further clarifications and extensions
- Pre-Read assignments are not graded but each earns full points for participation
- Canvas is course management system

Questions?

THANK YOU FOR YOUR ATTENTION

NOW AVAILABLE FOR DISCUSSION

MIT OpenCourseWare
<https://ocw.mit.edu/>

IDS.333 Risk and Decision Analysis
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