Engineering Systems Analysis for Design

Introduction

GOOD MORNING!

BONJOUR!
GUTEN MORGEN!
O HAYO GOZAIMASU!
SELAMAT DATANG!
¡BUENOS DIAS!
ΚΑΛΗ ΜΕΡΑ!
NI HAO MA!
BOM DIA!
Welcome!

- It is a pleasure to be with you
- We will be covering much new material
- Looking forward to learning with you
- Hope to make some long-term friends

Introduction of Teachers

- Richard de Neufville
  - Prof. of Engineering Systems and of Civil and Environmental Engineering
  - Course Organizer
  - Sabbaticals abroad: England, France, Japan, Australia ... soon Portugal... and California

- Michel-Alexandre Cardin
  - Teaching Assistant – recitations and portfolios
  - Doctoral Student in Engineering Systems Division (TPP graduate)
  - work experience in Canada, Singapore and UK
Introduction of Students

- Please fill out sign-up sheets being passed around

- Please indicate if you are
  - taking course
  - shopping around

ENGINEERING SYSTEMS ANALYSIS FOR DESIGN

- Central Idea: Using Analysis to Configure Engineering Systems for best expected long-term performance

- Means: “Real Options”, i.e., physical things that system managers and designers can do to add flexibility
  - To avoid bad outcomes (acts like insurance)
  - To seize opportunities for improvement
  - Overall, to maximize expected performance in uncertain world

- MIT School-Wide Elective, with many numbers:
  ESD 71, 1.146, 3.56, 16.861, 22.821

Choose number that meets your course requirements
Logic of the Course

- Engineering Systems exist in Uncertainty
  - Technical – New Developments
  - Economy – Boom, Recession, Prices, Competition
  - Social – New Regulations, Political Changes

- Engineering Systems Need to Adapt
  - Take advantage of Opportunities
  - Avoid Hazards, Risks

- Flexibility is Essential Part of Design
  - How do we value flexibility?
  - How much is enough?

- “Real Options” provides Answers

New Material

- New Approach to Engineering Design
  - Use of “Real Options” may lead to Paradigmatic Change

- Revolutionary possibilities
  - Explicit consideration of flexibility, not possible earlier
  => savings (or increase in expected performance/unit cost)
  of order of 30% !

- Approach derived from “Options Theory”
  - Nobel Prize-winning development in finance

- Modified to fit engineering realities
  - Lack of historical data
  - Need for Approximate Procedures

- Idea is to develop coherent road-map for design
New Course Structure

- Field is moving rapidly...

- ... So 2007 is changed from 2006 (and before)

- The hope is to make it much better for everyone

- Your help is needed – please provide feedback on your experience
  - Too fast? Or too slow?
  - Something missing? Errors on Slides?
  - Better examples needed?

- You are partners in this cutting-edge learning

Structure of Material – 5 Parts

1. Benchmark: Analysis Assuming Certainty
   -- this is the traditional standard

2. Analysis Recognizing Uncertainty
   -- this shift alone leads to different solutions

3. Decision Analysis Approach
   -- A practical approach to uncertainty

4. Real Options Analysis: Theory
   -- The sophisticated approach

5. Real Options Analysis: Models for Engineering
   -- Adapting theory to practice – current examples
Prerequisites

- Syllabus assumes
  - comfort with basic calculus, probability, statistics
  - familiarity with some advanced concepts of Excel used in course

- To see if you are sufficiently on top of Excel material, take self-assessment test posted on course site at http://ardent.mit.edu/real_options/ROcse_Excel_latest/Excel_class.html

- If exercise is too difficult for you, come to:
  ESD 70 – next Mon, Tues, Wed, Thurs; 5:30 – 7:30 pm;
  Room 32-155
- Listener is recommended, 3 units credit possible

Course Materials

- Many lectures refer to chapters from my text, Applied Systems Analysis (out of print) and research articles. All can be downloaded in pdf from course web site:

- Web: http://ardent.mit.edu/Real_Options

- Detailed Syllabus, assignments accessible directly from here. Note carefully: Site updated weekly!

- Bulletin Board: under web site. Will be used to make announcements, respond to questions. CONSULT REGULARLY!!
Assignments

- See Web site for details
- Focus on “Application Portfolio” -- designed to help you apply RO to your interests – Hope you like it
- Exercises to support above
- Problem Sets – do on your own, consult solutions on web for immediate feedback (to be posted)
- Mid-semester Quiz
- Final Exam -- Registrar sets Date September 20

Academic Honesty

- To avoid confusion with expectations elsewhere, note the standards that apply in this subject:

- Anyone found cheating will get ZERO for quiz or exam.

- Do graded Assignments individually. We expect students to discuss course and issues. However, you should then prepare your own reports for each assignment, in your own format and words.

- Demonstrated evidence of copying will result in zeros for EACH paper with this evidence.
Weekly Recitation Sessions

- They will show how to solve problems
- Give alternative explanations of concepts
- Review for Quiz and Final

Meeting with Instructors

- Use Bulletin Board at any time
  - Answers should be prompt
  - Share information with others
- Teaching Assistant office hours to be arranged
- Prof. de Neufville “office hours” after class; “office” in Stata Center café
- Appointments Tuesdays and Thursdays for specific issues.
QUESTIONS?

- THANK YOU FOR YOUR ATTENTION

- WE ARE NOW AVAILABLE FOR DISCUSSIONS

Times for Recitations?

- Wednesday 1...
- Wednesday 2....
- Wednesday 3....

- Tuesday 1....
- Tuesday 2....
- Tuesday 3...
- Tuesday 4...

- Thursday 9...