

Engineering Systems Analysis for Design

Introduction

GOOD MORNING!

**BONJOUR !
GUTEN MORGEN !
O HAYO GOZAIMASU!
SELAMAT DATANG!
¡BUENOS DIAS!
KAH MEPA!
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...**