Engineering Systems Analysis for Design

Introduction

GOOD MORNING!

BONJOUR !
GUTEN MORGEN !
SALAAM ALEIKUM !
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

Today's class has 2 sections

- General Organization Introduction
- Discussion of Paradigm Shift

Introduction of Teachers

- Richard de Neufville
  - Prof. of Engineering Systems and Civil Eng'r'g
  - Sabbaticals abroad: England, France, Japan, Australia … latest Portugal… and California
  - Current appointments also at U. of Cambridge, Harvard, Instituto Superior Técnico de Lisboa
- Michel-Alexandre Cardin
  - Teaching Assistant – recitations and portfolios
  - Doctoral Student in ESD, 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: Configure Engineering Systems for best expected long- term performance**
- **Means: Flexibility physical things system designers and managers can do to enable**
  - **Avoiding bad outcomes (acts like insurance)**
  - **Seizing 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 needs**

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 identify, choose, and implement flexibility?**
- **Course shows how to Determine Answers**

New Material

- New Approach to Engineering Design
  - Recognition of Uncertainty and Use of Flexibility may lead to Paradigmatic Change in Engineering Design Process
- Revolutionary possibilities
  - Explicit consideration of flexibility, not possible earlier => savings (or increase in expected performance/unit cost) of order of 30% !
- Related to "Real Options", but different
- Procedures developed to fit engineering realities
  - Lack of historical data ; Need for Approximate Procedures
- Idea is to develop coherent road-map for design

New Course Structure

- 2009 is deeply reorganized and improved (I hope!)
- This new version represents content of new textbook written for MIT Press as part of ESD Series
  - Over 90% in draft, will be submitted in November
- Your help is appreciated! Thank you in advance!! Please provide feedback on your experience
  - Too fast? too slow? Logic needs improvement?
  - Errors on Slides? Better examples needed?
- You are partners in developing cutting-edge learning

Structure of Material – 6 Parts

1. Overview of Flexibility in Design – road map of course
   - Paradigm shift, Uncertainty, Garage Case example
2. Basic Concepts of Valuation
   - Discounted Cash Flows, Alternative Valuation Measures, Technical Efficiency, Economies of Scale, Phasing
3. Forecasting and Dynamic Modeling
   - Simulation, Dynamic Models, Decision Analysis, Dynamic Programming
4. Identification of Candidate Flexibilities
   - Screening Models
5. Evaluation and Choice of Preferred Alternatives
   - Multi-dimensional Measures, selection criteria, sensitivity analysis
6. Implementation
   - Theory, Practice and Case studies

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 Is Web-based

- All materials at: http://ardent.mit.edu/Real_Options
  - Draft Chapters of Text, Professional Papers
  - Lecture Handouts; Assignments
  - Detailed Course schedule
  - Note carefully: Site updated weekly!
- Stellar Forum is available for class discussions
  - http://stellar.mit.edu/S/course/ESD/fa09/ESD.71/index.html
  - Instructors will answer questions directly here
  - Students can provide each other tips
- Announcements sent out and posted by Stellar

Assignments

- See Web site for details
- Focus on "Application Portfolio" -- designed to help you apply course to your interests – Hope you like it
- Exercises to support above
- Problem Sets – do on your own, solutions on web for immediate feedback (to be posted)
- Submit via Stellar
- Mid-semester Quiz

Grading

- Final Application Portfolio – 65%
- Class Participation and Assignments – 10%
- Mid-Semester quiz -- 25%

Academic Honesty

- To avoid confusion, note the standards that apply in this subject:
- 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 or cheating in quiz 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

Meeting with Instructors

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

H1N1 Instructions

- My information is that present form of this flu is "mild" but very quickly contagious. Therefore, if you get it, stay at "home", away from others
- I have been instructed to give this guidance:
  - Do not come to class if you have symptoms
  - Let us know – by Stellar -- that you are out and we will make accommodations
  - I am directed to ask students with symptoms to leave class.
- Thank you for your understanding!

Questions ?

THANK YOU FOR YOUR ATTENTION

WE ARE NOW AVAILABLE FOR DISCUSSIONS

Times for Recitations?

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

- Tuesday 3… Nominal Time

- Thursday 3…

- Friday 11…
- Friday 12…