Engineering Systems Analysis for Design

Introduction

GOOD MORNING

BON JOUR!
GUTEN MORGEN!
O HAYO GOZAIMASU!
G’DAY, MATES!
BUENOS DIAS!
NI HAO MA!
BOA DIA!
What’s with the Filming?

- MIT has entered into a long-term relationship with Government of Malaysia
- Object is to work with them to set up a new University...
- Malaysian University of Science and Technology, known as “MUST”

- This course will be part of their core curriculum, it is being filmed for their use in January
- There are several cameras and resulting tape will be edited by the AV people you met coming in

Let’s greet our colleagues in Malaysia...

SALAMAT DATUNG!
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

- Dr. Frank Field
  - Associate Director for Education, Technology and Policy Program; Principal Research Engineer

- Tao Wang
  - Teaching Assistant, for 2nd time -- also web master
  - 3rd year TPP student
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

- Emphasis
  - Use of Analysis to Configure Engineering Systems
  - “Real Options”, that is, physical things that system managers and designers can do to add flexibility
  - To avoid bad outcomes (acts like insurance)
  - To seize opportunities for improvement
  - In general to maximize performance in uncertain world

- MIT School-Wide Elective, with many numbers:
  ESD 71, 1.146, 2.192, 3.5613.62, 16.861, 22.821

  Choose what meets your course requirements
Logic of the Course

- **Engineering Systems exist in Uncertainty**
  - Loads -- Physical and Market Size
  - Technical -- New Developments
  - Organizational -- New Regulations, Competitors

- **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

- **Brand-new Approach to Engineering Design**
  - Use of “Real Options”

- **Revolutionary possibilities**
  - Explicit consideration of flexibility, not possible earlier

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

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

1. Engineering Systems Analysis -- Certainty
2. ESA for Uncertainty

Part 1 Integrated Perspective on Basics
- Evaluation over time -- Major projects
- Concepts for Modeling Systems
- Optimization -- Linear and Dynamic Programming

Part 2 Systems Analysis under Uncertainty
- Decision and Utility Analysis
- Real Options Analysis
- Examples of Actual Applications
- To help you choose which method works best for you

Approach to Learning

Part 1
- Assumes that all participants have had some of the material somewhere
- Aims to provide a coherent view
- Moves fairly rapidly

Part 2
- Crux of course
- Emphasis on Understanding Applications
- Many issues subject of ongoing research
- Will show recent results through examples
- Gives you basis for further learning
Course Materials

- Xerox of Text from Minuteman in Kendall Square -- about $20
- Tree-Age Software -- get direct, about $30

- Web: http://ardent.mit.edu/Real_Options
- Bulletin Board: under web site. Will be used to make announcements, respond to questions

- Excel capability -- sessions on advanced topics (Data Tables; What’s Best) will be arranged

Assignments

- See Web site for details
- Problem Sets, Exercises throughout semester
- Best to do them as you go along
- However, only need to turn in on due date
- Mid-semester Quiz
- Final Exam
Academic Honesty

- To avoid possible confusion resulting from expectations elsewhere, note the standards that apply in this subject.

- Anyone found cheating in a quiz or examination will receive a zero for the event.

- Assignments turned in for grading are to be done individually. We expect that students will discuss the problem sets. However, students should ultimately prepare their own reports for each assignment individually, in their 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

- Demonstrate Software
  - Advanced Excel Sessions
  - Tree-Age

- 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 (TBA)

- Prof. de Neufville “office hours” after class;
  “office” in Building 7, 4th floor coffee shop.
  Appointments Tuesdays and Thursdays for specific issues.

Times for Recitations?

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

- Wednesday 9.....
- Wednesday 10...
- Wednesday 11...

- Thursday 2.....
- Thursday 3.....
- Thursday 4.....
QUESTIONS?

- THANK YOU FOR YOUR ATTENTION

- WE ARE NOW AVAILABLE FOR DISCUSSIONS