NATIONAL UNIVERSITY OF SINGAPORE
NUS Business School
Department of Analytics and Operations

DSC3214 Introduction to Optimization

Lecturer: Prof TEO Chung Piaw Email: bizteocp@nus.edu.sg

Session: Semester II, 2017/2018

Objectives

This module introduces students to the theory and applications of modern optimization techniques. Formulation and modeling of real life optimization problems via sophisticated software tools will be emphasized to strengthen students' understanding of various fields in optimization. Throughout the course, references will be made wherever appropriate, to business applications, such as portfolio selection and others. Students who are interested in computer and quantitative approaches in business will learn many useful techniques in large business system management from this course.

The module provides students an overview of the most commonly used algorithms in solving real-life optimization problems. After this module, students should be able to gain an overall knowledge of what optimization is, model some standard optimization problems, design algorithms to solve some optimization problems using different approaches, and solve optimization problems using Julia.

Prerequisite

This module assumes prior knowledge of multi-dimensional calculus and linear algebra and certain maturity in mathematics. Basic proficiency with Microsoft Excel will be assumed.

Assessment

- Class participation & Homework (20%)
- Group project and presentation (40%)
- Final Exam (40%)

Term Paper

Each group project team is required to prepare a term paper on a current topic relevant to the subjects covered in this class. Any paper used for fulfilling requirements of other courses or graduate oral exam MUST NOT be recycled in this class.

The purpose of the term paper is to demonstrate that you can apply the techniques learned in this class to an analytics problem of your choosing. The paper must include a

statement of the problem (due by mid-term), data or process(es) analyzed, and the principles learned.

The paper should be typewritten, paginated, double-spaced, in Time font, size 12, 1 inch margins (top, bottom, left, and right), and must follow the outline shown below. There is no page limitation, but a good term paper may need 8 to 14 pages of narratives to provide in-depth analysis of a selected topic

A video to present the findings of the group term paper is also required.

Required Text

Course Reading Packet

Software

Excel Open Solver/Solver Studio; Julia Programming;

Lesson Plan

"The best way to learn is to do; the worst way to teach is to talk." — Paul Halmos

The learning will be augmented with a series of cases and assignments to be discussed in class to augment the lecture notes and reading materials.

Students are expected to do these assignments and participate actively in classroom discussion.

Schedule

Lecture One **19 Jan 2018**
Overview
Introduction to Linear Optimization

Highlight: Optimization Software (eg. Julia, Gurobi, Cplex etc.)

Lecture Two **26 Jan 2018**
Geometry of Linear Optimization

Highlight: Capacity Planning Models

Lecture Three **2 Feb 2018**
Sensitivity Analysis and Duality

Highlight: Zero-Sum Game Models

Lecture Four **9 Feb 2018**
Discrete Optimization Homework #1 Due
Integer Programming Formulation
Cutting Planes

Highlight: Network Optimization Models

Lecture Five **23 Feb 2018**
Decomposition and Column Generation
Subgradient Method

Highlight: Traveling Salesman Models

Lecture Six **2 Mar 2018**
Algorithm and Heuristic Design I **(Recess Week)**
Greedy Algorithms **Group Project Proposal Due**

Highlight: Matching Models

Lecture Seven **9 Mar 2018**
Algorithm and Heuristic Design II Homework #2 Due
Dynamic Programming

Highlight: Group Testing Models

Lecture Eight **16 Mar 2018**
Non-linear Optimization – Convex Models
Karush-Kuhn-Tucker Conditions

Highlight: Portfolio Optimization Models

Lecture Nine **23 Mar 2018**
Supply Chain and Inventory Optimization
Safety Inventory

Highlight: Strategic Inventory Placement Models

Lecture Ten **31 Mar 2018 (Sat)**
Optimization under Uncertainty **(Make Up)**
Option Theory

Highlight: Two Stage Stochastic Programming Models

Lecture Eleven **6 Apr 2018**
Optimization under Ambiguity Homework #3 Due

Highlight: Robust Optimization Models

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13 Apr 2018

No Class – Group Project Video Presentation Due

Lecture Twelve **20 Apr 2018**

Class Project Discussion

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4 May 2018

Final Exam
