Nanyang Technological University

Nanyang Business School

BC3408: Decision Modeling and Analysis

A) Course Aims/Description

In this era of big data, many businesses and public organizations are investing heavily in data analytics. However, data analytics yield zero value until they are used to improve decisions. To achieve this objective, executives must know how to obtain and transform data insights into optimal, executable actions that are evaluated by their impact on key performance metrics. Decision modelling and analysis provides a quantitative approach to decision making. This approach identifies the key objectives and variables for a decision problem, constructs a mathematical model to represent the logical relations among the objectives and variables, and uses the mathematical model and information gained from data analytics to systematically and critically evaluate decision alternatives.

This course introduces the key principles and techniques of decision modelling and analysis. It is designed for students who intend to pursue a career in or related to business analytics. While a good understanding of a range of decision modelling and analysis tools is important, the focus is on problem solving and decision making. You will be required to conduct case studies and projects to apply decision modelling and analysis to deal critically with real decision problems.

B) Intended Learning Outcomes/Objectives (ILO)

By the end of this course, students are expected to be able to

1. Explain the key challenges for making hard decisions and how decision modelling and analysis can enhance human decision making capabilities
2. Use mathematical models and analytical tools (optimization, decision analysis, game theory, etc.) to meet these challenges
3. Structure a managerial problem logically and formulate a decision model to critically and systematically evaluate the options
4. Analyse and solve a decision model, obtain solutions and translate the findings into managerial insights
5. Apply decision modelling and analysis with data analytics to the solution of real-life problems.

C) Course Content

The course consists of five parts. Part 1 reviews human decision making and how decision modelling and analysis can enhance human decision making capabilities (2 weeks). Part 2 studies mathematical optimization and (linear and non-linear) mathematical programming (4 weeks). Part 3 studies decision analysis under uncertainty and risk (3 weeks). Part 4 studies game theory models. Finally Part 5 concludes the course.

D) Assessment (includes both continuous and summative assessment)

Component	Weightage	Team/Individual
1. Class Participation	20	Individual
2. Assignments	10	Individual
3. Case Studies & Project	30	Team
4. Quiz	40	Individual
Total	100%	

K) Planned Weekly Schedule

Theme	Week	Topic
Decision Making & Data Analytics	1	**Course Overview** **The Arts and Sciences of Decision Making** • Key challenges for Making Hard Decisions • The Arts and Sciences of Decision Making • Heuristics and Analytical Solutions • Data Analytics and Artificial Intelligence
	2	**Decision Modelling and Analysis** • The Problem Solving and Decision Making Process • Modelling and Analysing Decisions
Modelling Complexity	3	**Mathematical Optimization** • Foundational Calculus • Unbounded Optimization with Calculus • Unbounded Optimization with Numerical Methods • Bounded Optimization
	4	**Mathematical Programming I** • Definition and Formulation • Linear and Non-Linear Programming • Linear Programming ▪ Basic Concepts and Graphic Solution ▪ Computer Solution ▪ Sensitivity Analysis and Interpretation
	5	**Mathematical Programming II:** • Linear Programming Applications • Integer Linear Programming • Applications of Integer Linear Programming
	6	**Mathematical Programming III:** • Non-Linear Programming • Solution with Calculus • Solution with Numerical Search • Applications

Modelling Uncertainty and Risk	7	**Decision Analysis I** • Uncertainty and Risk • Structuring Decision Problems with Influence Diagram
	8	**Decision Analysis II** • Decision Tree • Risk Analysis
	9	**Utility Theory** • The St. Petersburg Paradox • Expected Value and Risk Attitude • Utility Theory and Measurement • A Healthcare Application
Modelling Conflict and Competition	10	**Strategic Game** • Model Formulation • Nash Equilibrium • Applications
	11	**Dynamic Game** • Model Formulation • Sub-Game Perfect and Nash Equilibrium • Applications
	12	**Cooperative and Negotiation Games** • Definition • Cooperative Game and Core • Applications
Conclusion	13	• Course Summary • Group Project Presentation