DECISION SCIENCES AND BUSINESS ANALYTICS COURSES

Course Code: DECS-301

Title: Quantitative Decision Sciences Credit

Hours: 03

Pre requisites: Calculus 1

Course Introduction

This course is designed to provide students with a sound conceptual understanding of the role that management science plays in the decision making process. It is an important introductory course in developing decision models and understanding their application to management problems. The emphasis is on models and techniques that are widely used in all industries and functional areas, including operations, finance, accounting, and marketing.

Learning Outcomes

Upon the completion of the course, students should be able to

1. Discuss basic modeling techniques across prescriptive and descriptive decision-models in the area of management science
2. Implement these techniques as part of a spreadsheet-based decision-support tool
3. Setup and solve a range of optimization problems (in different areas of application) by correctly recognizing constraints, decision variables and objective(s)
4. Setup and solve basic predictive models by correctly identifying the appropriate technique, understanding its underlying assumptions and interpreting the results
5. Setup and solve descriptive modelling techniques including simulation and basic queuing models by correctly describing the defining features of the queuing system, including server(s), customer(s), length of the queue, arrival rate(s) and service rate(s)
6. Effectively communicate their problem-solving approach, selected tool(s), results, limitations and implications to support the decision maker.
7. Discuss basic modeling techniques across prescriptive and descriptive decision-models in the area of management science
8. Implement these techniques as part of a spreadsheet-based decision-support tool
9. Setup and solve a range of optimization problems (in different areas of application) by correctly recognizing constraints, decision variables and objective(s)
10. Setup and solve basic predictive models by correctly identifying the appropriate technique, understanding its underlying assumptions and interpreting the results
11. Setup and solve descriptive modelling techniques including simulation and basic queuing models by correctly describing the defining features of the queuing system, including server(s), customer(s), length of the queue, arrival rate(s) and service rate(s)
12. Effectively communicate their problem-solving approach, selected tool(s), results, limitations and implications to support the decision maker.

Course Contents

Introduction

- Course introduction & logistics
- Introduction to Modeling

Introduction to Optimization and Linear Programming

- The essential elements within mathematical optimization
- Characteristics of optimization problems
- Mathematical programming
- Basics of Linear programming (LP)

Solving Linear Programming problems

- Understand the approach towards modeling linear programming problems.
- Solve LP problems using simple calculus.

Modeling and Solving LPs in a Spreadsheet

- Make vs. buy decisions
- Investment problem
- Transportation problem
- Blending problem
- Production and inventory planning problem
- Multi-period cash flow problem

Sensitivity Analysis

- Understand the purpose of sensitivity analysis
- Analyze the sensitivity reports generated in Excel
- Appreciate the benefits and limitations of sensitivity analysis
- Understand shadow prices

Integer LPs, Nonlinear and Mixed LPs

- Understand the structure of IP models
- Develop and analyze graphical solutions of IPs.
- Develop and analyze Spreadsheet solutions of IPs.

Introduction to Network Flow Modeling Problems

- Transshipment problem
- Transportation problem

- Shortest path problem
- Equipment replacement problem
- Generalized network flow problem
- Maximal flow problem
- Minimal spanning trees

Introduction to Queuing theory

basic dynamics of simple queuing models, characteristics, notation and basic terminology

- common queuing models with multiple servers, different arrival and service distributions
- development of queuing models in a spreadsheet for real problems and critical assessment

Decision Analysis

- The payoff matrix
- Decision Trees
- Non-probabilistic methods
- Probabilistic methods

Teaching Methodology

The course will be taught in a student centered medium-tech approach. This would involve regular use of Microsoft Excel solver tool, along with other data analysis tools available in Excel. The teaching will involve regular group learning activities - including but not limited to - interaction amongst sub-groups of students in class, group projects, etc.

In class teaching would use a mix of power point presentations, white board, and discussions to evolve students' approach to decision making.

Special effort will be paid towards enhancing the participants' ability to develop objective approach to decision making. This would involve objectifying decision making using everyday examples as well as formally documented case studies.

Recommended Books

- Brandimarte, P. (2003) *Quantitative Methods: An Intro to Business Management* (Latest Edition)
- Ragsdale, C. T. (2000) *Spreadsheet Modeling & Decision Analysis* (5th edition)
- Render, S. Jr. (2001) *Quantitative Analysis for Management* (8th edition)
- Taylor, B. (2006) *Introduction to Management Science* (13th edition)