Course Title: ITAP 2381: Operations Research

Semester Credit Hours: 3 (3,0)

I. Course Overview

This course introduces some of the basic concepts in operations research and quantitative analysis. Students gain a working knowledge of operations research techniques that are used extensively in organizations to solve large, structured problems. Coverage includes the use of optimization (linear, integer, and non-linear programming) models, network models, simulation and risk analysis in developing optimal solutions to operational and strategic problems in modern organizations.

II. PMU Competencies and Learning Outcomes

This course introduces students to the importance and use of mathematical models to formulate and develop optimal solutions to structured problems. Therefore, the most important competencies addressed by this course include critical, logical and analytical thinking skills. Students develop both the conceptual basis and the practical skills in problem solving. Secondly, formulating and solving complex mathematical models necessarily require the use of computers. Therefore, students are able to strengthen their computing skills. Further, the course involves analysis of cases for which students submit written reports to communicate results of technical analysis. The course therefore provides an opportunity to enhance students' technical writing skills. Finally, this course makes an extensive use of the PMU technology infrastructure to provide communication between faculty and students.

III. Detailed Course Description

Operations research (OR) involves formulation of problems into mathematical models, and then developing optimal solutions by application of various techniques such as mathematical programming. The course introduces methods that are used extensively in business organizations to solve large, structured and semi-structured problems. Such methods generate results that support decision-making at all levels of the organization over various time horizons. Students are exposed to an approach to problem solving that helps the decision-maker to (a) consider a richer set of alternatives, (b) understand and question assumptions, and (c) consider diverse measures of performance. The course stresses model formulation, solution methods, and managerial interpretation of the results through a series of examples that emphasize multi-disciplinary nature of business problems. Students complete several skill-building exercises and cases with the support of several software packages available in Microsoft Excel.

IV. Requirements Fulfilled

ITAP 2381: Operations Research satisfies three hours of the requirements for a Bachelor of Science degree in Information Technology and is required of all students pursuing this degree program within the College of Information Technology. The course is also recommended as an elective for students majoring in computer science and management information systems. It should be taken no earlier than the first semester of the sophomore year.

V. Required Prerequisites

- GEIT 1412: Computer Science II
- MATH 1312: Calculus for Students of Business
- MATH 1321: Statistical Methods

VI. Learning Outcomes

In this course, students learn:

- To develop an understanding of and facility in mathematical modeling of structured and semi-structured problems.
- To gain a working knowledge of OR techniques as problem solving and decision support tools.
- To be able to interpret solutions and perform sensitivity analysis on these solutions.
- To strengthen skills in the use of computers and software to perform analyses involving OR techniques.
- To strengthen technical writing and communication skills.

VII. Assessment Strategy

The student's performance in this course is assessed on the basis of:

- Three (two term and a final) examinations.
- Approximately 8-10 skill-building exercise taken from the textbook to be completed by each student.
- Two cases to be completed in self-selected groups of 4-5 students.

Relative weights assigned to these items in determining student's final grade are suggested as follows:

- Each term examination accounts for 20 % of the final grade. The final examination accounts for 25%. Combined, the three examinations account for 65% of the final grade.
- Skill-building exercises account for a total of 15% of the grade.
- Each case accounts for 10%, for a combined 20% of the grade.

Problem-oriented examinations are used to assess mastery of model formulation and problem solution process. Skill-building exercises are used to measure the understanding of OR-oriented modeling and problem-solving approaches. Cases based on real-to-life situations are used to assess students' ability to identify problem(s) and constraints; develop and evaluate alternatives; formulate appropriate mathematical model(s); and reach rational, reasonable or optimal solutions.

VIII. Course Format

This course utilizes a mix of lectures and out of class assignments designed to help students develop a firm foundation in the use of operations research techniques to solve structured and semi-structured problems. Lectures are utilized to introduce students to mathematical modeling as a means to formulate and solve problems. A significant portion of this course is devoted to building critical thinking, analytical, and problem solving skills. To that end, skill-building exercises and cases are assigned throughout the semester. Skill-building exercise are completed by each student individually. Students submit a written summary of their results for each exercise. Generally, at least one skill-building exercise is due during each class meeting. .

Cases, on the other hand, are completed in self-selected groups of 4-5 students. Two such cases are assigned during the term. Students submit written reports to communicate results of their technical analyses. Following format is suggested for this technical document:

- Executive Summary. A one page executive summary should include a clear statement of the problem; discussion of alternatives evaluated; and a discussion of final recommendations, all using non-technical language.
- Analysis section. This section should include details of process followed, analyses performed, and a summary of findings.
- Appendix. All detailed supporting material such as computer printouts, tables, and equations should be relegated to the appendix.

In addition, the instructor should consider creating a Web site for this course using Web technologies such as WebCT or BLACKBOARD. At minimum, the site should include:

- Course syllabus
- Lecture material (for example, PowerPoint slides, lecture notes, etc.). These should be placed on the site ahead of class meeting so that students may use the material to prepare for the lecture
- Out-of-class assignments
- Suggested Solution to out-of-class assignments (after graded assignments have been returned)

- Keys to exams (after students have completed them)
- Mechanism for students to digitally submit their assignments
- Course calendar
- Mechanism to communicate electronically (for example e-mail)
- Discussion groups for on-line collaboration.
- Students course performance measures

IX. Topics to be Covered

A. Introduction to Operations Research
   1. What is OR
   2. Importance of OR in developing optimal solutions
   3. Types of Business Problems suitable for OR solution
   4. Introduction to Modeling

B. Optimization techniques for resource allocation
   1. Linear programming
      a. Graphical analysis
      b. Simplex algorithm
      c. Modeling in spreadsheets
      d. Sensitivity analysis
   2. Integer and binary integer programming
   3. Transportation and assignment models

C. Network optimization models
   1. Shortest path
   2. Minimum cost
   3. Maximum flow
   4. PERT/CPM

D. Simulation and risk analysis
   1. Risk assessment
   2. Computer simulation

X. Laboratory Exercises

This course does not require a separate lab.

XI. Technology Component

A. In class, the instructor makes use of state-of-the art multimedia projection equipment and software. These are used to project slides and Web-based content relevant to the concepts of and use of OR techniques.

B. Outside class, the instructor uses Web-based course management software (for example WebCT, BLACKBOARD) to interact with students as described under course format section.

C. All skill-building exercise and case studies assigned in this class require students to use software packages available in Microsoft Excel or specialized OR software.

D. When working on case assignments, each team is set up an on-line discussion group and repository to facilitate collaboration among team members.

XII. Special Projects/Activities

There are no special projects or activities assigned in this course.

XIII. Textbooks and Teaching Aids

A. Required Textbook

Fred S. Hillier and Mark S. Hillier; *Introduction to Management Science: A Modeling and Case Study Approach,* McGraw-Hill, 2nd Edition, 2002
ISBN: 0072833475

B. Alternative Textbooks

Cliff T. Ragsdale; *Spreadsheet Modeling and Decision Analysis: A Practical Introduction to Management Science*; Southwestern College Publishing, 4th edition, 2003
ISBN: 0324183992

C. Supplemental Print Materials

As available from publisher.

D. Supplemental Online Materials

As available from publisher.