

MASTER SYLLABUS

QANT620: MULTI-CRITERIA DECISION MODELS

1. Course Details

Semester:	
Course Code:	QANT620
Course Name:	Multi-Criteria Decision Models
Course Prerequisites:	QANT520
Course Co-requisites:	None
Credits Hours:	One and one-half (1.5) credit hours
Classroom:	
Class Timing:	(18.75 contact hours)
Final Exam Period:	

2. Instructor Details

Professor:
Office Location:
Office Hours:
Email:
Course website:
Phone (Office):

3. Catalog Course Description

An introduction to decision sciences and the application of multi-criteria quantitative and behavioral modeling to those problems often requiring complex decisions of policy makers. Course content focuses on applications in the business environment and the use of technology as a decision support tool.

4. Course Overview

As an introduction to the decision sciences, this course familiarizes students to some of the relevant methodologies utilized in a multi-criteria decision making environment, including:

- a. Goal Programming: This module introduces the concept of satisficing (as opposed to optimizing) and builds upon presupposed foundations in linear programming to handle multiple, normally conflicting objective measures towards the satisfaction of a goal to be achieved. Variants include ordering

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priorities, using weighted coefficients, and incorporating both under and overachievement. Student teams will utilize the Excel Solver for modeling and solution analysis applied to a relevant industry example of their choice. A final written report is required. Project proposals are submitted during the second lecture; weekly updates are discussed briefly with the instructor. Classroom lectures should include a demonstration of goal programming visually using graphs, numerous examples, and the use of Excel Solver as a decision support tool.

- b. Analytical Hierarchy Process (AHP): This module presupposes foundations in matrix algebra to incorporate subjective evaluation into the multi-criterion decision-making process, and includes the traditional components of setting criterion and establishing priorities, eliciting behavioral inputs and comparisons, checking for consistencies, and deriving overall priority ranks. Student teams will consider a problem related to government, industry, healthcare, or another practical and localized domain, administer the problem as a collaborative exercise within the class, and derive the solution that best represents the class participant inputs. Microsoft Excel will be incorporated as a decision support tool for analysis. A short written report and an oral report are required from each student team, who will also compare class outcomes with industry practice.
- c. Non-Linear Optimization: This module presupposes foundations in mathematics and introductory calculus by expanding coverage to the multi-variable domain, including the introduction of Lagrange Multipliers. Lectures demonstrate how to optimize (utilizing calculus) in a multi-variable environment, incorporate determinants for the purpose of checking optimality conditions, and introduce a single constraint including the use of a Lagrange Multiplier. Discussion then proceeds to elementary comparative statics and sensitivity analysis. Classroom examples provide opportunities to utilize the methodology in various business disciplines and also utilize Excel to support solutions. A comprehensive and relevant individual student take-home assignment, chosen by the instructor, allows for the determination of a multi-variable unconstrained optimal solution, the incorporation of a capacity constraint and its impact on the solution, the application of comparative statics and sensitivity analysis, and economic implications to practice. Students will demonstrate optimality by way of second-order conditions, and also support the global optimal solution through the use of Excel. A short write-up of the technical work and outcomes is required.

Although not considered in the context of Assurance of Learning, the class also includes a final examination, requires referenced readings, and includes a quiz on the readings.

5. Course-Level Learning Goals¹

(A) Invariant Learning Goals (In support of the MBA Programmatic Learning Goal(s)):

Upon the successful completion of this course, the student will be able to:

1. Validate criteria for decision making, formulate and conduct an analysis that incorporates satisfying into the decision making methodology, and propose the impact of the outcome on management policy;
2. Lead and Organize a collaborative multi-criteria policy initiative, design a model, and appraise outcomes and comparisons to existing literature and practice; and
3. Solve non-linear math models, and evaluate and critique the economic implication of outcomes.

Assurance of Learning Validations (Linked to the MBA Programmatic Learning Goal(s))²:

- A1. Goal Programming Team Project: Each student team must analyze a real-world business and managerial decision making scenario, based on their own interest, or their working/business experience, and define and formulate a business and managerial goal-programming decision making problem, identifying the necessary data for the problem, applying the appropriate model, and providing an analysis of the solution. The student team will assume that they are hired by the company to provide an objective opinion and to provide realistic recommendations to the company. The student team will submit a written report (non-technical analysis supported by a well-defined model and its solution) at the end of the term, including the description of the scenario, the identification of decision variables, multi-criteria objective function, and constraints, as well as a sensitivity analysis and managerial implication of the recommendation. The report should be between 6 and 12 pages, and demonstrate a major effort to be as professional as possible. The report will be graded not only on the

¹ A note on School of Management Course-Level Learning Goals: Learning goals are partitioned into those that are in support of the programmatic learning goals (Invariant), specific to the localized region of delivery (Contextualized), and specific to the domain expertise of the instructor (Instructor-Specific). The former two categories are required for all courses. Invariant "Assurance of Learning Validations" are specifically linked to the associated programmatic learning goal and objective, with course-level learning goals representing the programmatic goal as it applies to the context of the course. Learning goals that focus on knowledge acquisition (Bloom's Taxonomy) are not specifically or necessarily included into the course-level learning goals, although it is assumed that knowledge acquisition of all relevant business core fundamentals is addressed within each course. Examinations in class are used to provide feedback concerning knowledge and comprehension for the purpose of ensuring that students who have not mastered these will not advance through the curriculum. Attainment of knowledge within each core area is assessed by way of standalone testing of each student as a required part of the instructional program prior to graduation (e.g. ETS).

² A note on School of Management Assurance of Learning Scoring: Scores form the metric for the degree to which the validation (e.g. learning outcome) satisfies the associated learning goal or objective. Assurance of learning validation descriptions identify the criteria for each score that is to be given. Scores are scaled using program or concentration rubrics. It must be noted that scores are to be differentiated from grades. Scores form a criterion from which an instructor will ascertain an overall grade for any instrument of assessment, and the overall assessment the student receives for an instrument is a "grade." A score is an extraction that specifically measures the degree of attainment of a learning goal and/or objective.

basis of the written presentation of the scenario, identification of the decision variables, formulation of the model, computer/technological analysis and printout of the solution, and interpretation and managerial implications of the solution, but also on the basis of the writing style and how well the team has professionally crafted the entire report, as well as a comprehensive application and demonstration of how goal programming may be utilized in the chosen business discipline.

For the purpose of assurance of learning, the Goal Programming Team Project will receive 4 scores, based on:

- a. Score 1: The quality of the criteria chosen and their validated relevance to the problem, and the appropriateness of the data inputs and model formulation (MBA-2M);
- b. Score 2: The appropriate modeling techniques and solution development (MBA-QANT); and
- c. Score 3: The strength of the managerial implications of the recommendations, relevant to existing practice (MBA-MGMT).

A2. AHP Team Project: Each student team must identify a relevant multi-criterion ethical or business environmental problem that is faced by a localized industry, governmental sector and develop a prototype AHP model. The subjective inputs of the class must be elicited (discussed in class) as a required component of the project. Hence classroom discussion and interaction is critical. Students should consider how multiple cultures across the globe might choose alternative criteria and their priorities, and understand how this diversity impacts on a firm's ability to make decisions effectively. Students must demonstrate the ability to use AHP to determine a solution to the problem that best represents the class inputs. A short written report is to be submitted near the end of the term that discusses the model and the outcomes, a review of the extant literature in the area of the problem chosen, and comparisons between class outcomes and expected or realized industry practice. Each student team may utilize Excel for modeling and analysis, although extra credit will be given for students who integrate proprietary software programs that are available on the web. Each student team will also present the outcomes of their model to the class in an oral presentation during the last lecture period, and lead a discussion of the class outcomes as compared to industry outcomes and the literature.

The AHP Team Project will receive 5 scores, based on the:

- a. Score 1: Student team's ability, both in the introductory and final oral presentation, to demonstrate a purpose and relevancy for the problem discussed, to create an interactive community for participants from which group collaboration results in criteria and inputs for resolution, and to appraise outcomes and comparison to current literature and practice (MBA-3G);

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- b. Score 2: Relevancy of the topic in the context of the localized community, including the strength of the review of the literature and validation of the importance of the issue (MBA-3M);
- c. Score 3: Impact of the problem in the ethical/environmental domain and its relevancy to emerging issues in a global environment (MBA-ETHICS);
- d. Score 4: Identification and analysis of the interaction between diversity and problem-solving perspectives within of the issue being discussed (MBA-3M); and
- e. Score 5: Appropriate technical analysis and solution using Excel as a decision support tool (MBA-1M).

A3. Nonlinear Optimization Assignment: The instructor will provide the students with a multi-variable non-linear optimization problem, with one constraint, that reflects a current localized issue. Each student must utilize classical techniques to solve the problem to optimality, both with and without the constraint, validate that optimal solution as global, and conduct a comparative statics and sensitivity analysis, as directed. A short report is submitted that provides the technical detail, as well as an executive summary providing the solution and discussing the economic implications derived from the comparative statics and sensitivity analysis.

The Nonlinear Optimization Assignment will receive two scores, based on the:

- a. Score 1: Correct solution techniques and numerical outcomes (MBA-QANT); and
- b. Score 2: Appropriate economic analysis utilizing comparative statics and sensitivity analysis and assessment and critique of the practical implication (MBA-ECON).

(B) Contextualized (Globalized) Learning Goal(s):

Upon the successful completion of this course, the student will be able to:

1. Develop a decision-making model that addresses a global issue, conduct analyses, and discuss results and their implications relevant to existing literature and current practice.

Assurance of Learning Validation (In support of the Contextualized (Globalized) Learning Goal(s)):

B1. See A2(d) above.

(C) Instructor Specific Learning Goal(s) (Optional):

None

Assurance of Learning Validation (In support of the Instructor Specific Learning Goal(s)):

None

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6. Teaching and Learning Methodology

The School of Management's teaching and learning strategy is informed by contemporary indicators/sources that derive from its target market, specifically the millennial generation. In particular, behavioral traits for this generation are identified and form the basis of emphasis for the schools' teaching and learning methodologies. These methodologies are reflected in the school's mission statement by way of its TEMPOS campaign³. In addition, teaching and learning strategies are informed by institutional indirect assessment results, periodically collected and reviewed by the Office of Planning and Assessment and the school's faculty⁴. Teaching and learning strategies are also externally referenced systematically (e.g., the Annual Stakeholder's Conference) through continuing consultations with non-board key stakeholder groups, including employers, business and community leaders, accreditation and ministerial agencies, alumni, students, peer institutions, and business and governmental agency representatives.

A component of all courses, as a part of the teaching and learning strategies, is to maintain academic rigor and to be intellectually challenging. This is validated in institutional survey results. However, School of Management faculty members utilize an overall collective portfolio of strategies/initiatives that obtain from the aforementioned sources in delineating those that are most appropriate or emphasized in the courses they lead.

In this course (QANT620), four (4) prioritized teaching and learning strategies focus on:

1. teamwork/collaborative work (interdependent learning);
2. course projects;
3. time management; and
4. student-faculty interaction.

All faculty members that instruct this course should consider how to execute the course to emphasize these key components of the strategies considered. Following a review of learning outcomes, faculty members consider how re-orientation of teaching and learning strategies might result in strengthening these outcomes, and adjustments are made, accordingly. Faculty members also consider how the School of Management Triple Platforms of Excellence (Professional Enrichment, Experiential Education, and Student Advancement) might be leveraged as a part of this strategy, and provide recommendations to the Directors of those platforms. The school also reviews the distribution of identified teaching and learning strategies periodically to ensure comprehension and the integration of each (from the designated list of

³ Teaching and Learning Strategies: "TEMPOS and the Millennials," revised September 2008.

⁴ E.g., Student Survey on Teaching Quality – Quantitative Data: School of Management.

approximately 20-25 strategies) within the curriculum. Finally, results from student teaching evaluations also provide indications of how various teaching and learning strategies are integrated into the course delivery. The following issues (indicator number is provided) are among those in the evaluations that bear on this review and analysis:

- 7. The instructor was responsive to student questions.
- 8. The instructor was available for course related consultation and advice.
- 9. The instructor graded and returned student work and exams promptly.
- 10. The instructor incorporated information technology (e.g. computer or the Internet) in the course.
- 18. The instructor was responsive to student needs and concerns.
- 21. The instructor assigned challenging course work.
- 22. The instructor provided helpful, constructive feedback on assignments and course work.
- 23. The instructor acknowledged cultural differences and diversity among students.
- 24. The instructor helped me understand the subject matter.

Along with teaching and learning strategies, the notion of student effort/time on task is also considered, although it is not necessarily driven by metrics. It is noted that the notion of student effort, specifically metric driven, is not a universally adopted approach⁵. However, if an instance occurs where student learning outcomes do not meet targeted academic standards, the School of Management utilizes indirect inputs in this area to explore the interdependencies between factors including the amount of work required in the course, the degree of challenge in the coursework, and level of critical analysis, among others⁶.

This course is primarily Socratic in teaching style and relies on applications that are brought forward by both the instructor and the students. The AHP team project requires interactive dialog in determining criteria for inclusion and additional student inputs; the end result of each AHP project is also discussed by each team at the end of the semester with oral reflection from the team and the class. Excel and Solver are integrated into the course as a technology decision support tool throughout. While the course is primarily a problem solving course, an additional emphasis on modeling problems that reflect current and contemporary issues is embedded into the instruction and the student learning outcomes. Readings are assigned weekly; the timing of the Assurance of Learning Validations is provided in Section 17.

⁵ See the Victorian TAFE Association Response – Strengthening the AQF: Proposal, June 2009. East Melbourne, Victoria, Australia, retrieved from http://www.vta.vic.edu.au/docs/PositionDiscussion%20Papers/VTA_Response_Strengthening_the_AQF.pdf on February 22, 2010.

⁶ Sample data regularly collected through the New York Institute of Technology Student Rating of Courses/Teaching Form.

7. Required Resource(s)

Ragsdale, C. (2007). *Spreadsheet Modeling & Decision Analysis: A Practical Introduction to Management Science, Revised*. 5th Edition. South-Western. ISBN: 978-0324656633

Hoffman, J., Schniederjans, M. and Sebora, T. (2004) "A multi-objective approach to CEO selection," *INFOR* Vol. 42(4); p. 237 (19 pages);

Tan, Y., Shen, L., Lu, W. and Shen, Q (2008) "A Multiple-objective bidding strategy using goal programming technique," *Management Decision*; Vol. 46(4); p. 656 (18 pages);

Lee, S. and Nicely, R. (1974) "Goal Programming for Marketing Decisions: A Case Study," *Journal of Marketing*; Vol. 38(1); p. 24 (9 pages);

Lee, G and Chan, E. (2008) "The Analytic Hierarchy Process (AHP) Approach for Assessment of Urban Renewal Proposals," *Social Indicators Research*, Vol. 89(1); p. 155 (14 pages);

Lin, G. and Tang, J. (2009) "Appraising Intangible Assets from the Viewpoint of Value Drivers," *Journal of Business Ethics*; Vol. 88(4); p. 679 (11 pages);

Dorfman, R. and Steiner, O. (1954) "Optimal Advertising and Optimal Quality," *The American Economic Review*, Vol. 44(5); p. 826 (11 pages); and

Zeithaml, V. (1988) "Consumer Perceptions of Price, Quality, And Value: A Means-end model and synthesis of evidence," *Journal of Marketing*; Vol. 52(3); p. 3 (21 pages);

<http://www.whohi.net/Course/Berbice/PPT/W12/Per.pdf>.

8. Reference Resource(s)

Saaty, T. (1990) "How to make a decision: The Analytic Hierarchy Process," *European Journal of Operational Research*, Vol. 48; p. 9 (17 pages).

9. Assessment Methodology and Grading Guidelines

Instrument	Points (i.e. weights)
Final Test (three problems)	150 points (50 points per problem)
Quiz (students asked to summarize three of the required readings; choice up to the instructor)	15 points
Goal Programming Team Project (see A1)	50 points
AHP Team Project (see A2)	50 points
Nonlinear Optimization Assignment (see A3)	50 points
TOTAL	315 points

10. Grading Guidelines: The final grade for the course will be calculated using the relevant grading scale:
N/A

11. Attendance Policy: Students are expected to attend every class session. Instructors will inform students of the exact number of absences and late-arrivals permitted during the semester. Students who exceed these limits may be subject to failure. If a student misses any class or test, the instructor has the right to either grant or deny an opportunity to make up the work that was missed. In such cases, the instructor shall be the sole judge of the validity of a student's explanation for having missed the class or test.

12. Deductions for Late Arrival, Early Departure, and Unexcused Absences:

13. Policy for Make-Up Assignments or Quizzes:

14. Classroom Behavior: Behavior that disrupts, impairs, interferes with, or obstructs the orderly conduct, processes, and functions within an academic classroom or laboratory violates the student code of conduct and may result in disciplinary action. This includes interfering with the academic mission of NYIT or individual classroom or interfering with a faculty member's or instructor's role to carry out the normal academic or educational functions of their classroom or laboratory, including teaching and research.

15. Students with Physical or Educational Challenges:

- It is the policy of New York Institute of Technology to provide reasonable accommodations for students who are otherwise qualified but have disabilities, including learning disabilities, health impairments, and other disabling conditions. Possible accommodations include, but are not limited to, test schedule modifications, class relocation, and possible assistance in acquisition of necessary equipment.
- The college has an interest in helping students with disabilities to be competitive in this academic environment. Therefore, reasonable accommodations will be made upon proof both of disability and

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need for the accommodations. It must be understood that accommodations are meant to facilitate educational opportunities. Admission to NYIT and accommodations do not guarantee success. Therefore, in addition to accommodations, the college encourages utilization of auxiliary services available to all students to maximize opportunities for success. Students whose disabilities may require some type of accommodation must complete a request for accommodations form and an intake interview with their campus services coordinator prior to the academic semester. Accommodations may be requested at any time during the semester; however, accommodations cannot be applied to past failures, only to future academic endeavors. Appropriate modifications of accommodations will be worked out on a case-by-case basis and will not necessarily incorporate all requested changes.

- Students for whom auxiliary services—such as readers, interpreters, note takers, etc.—have been approved should arrange these with their campus services coordinator. In addition to discussing appropriate educational modifications, the campus services coordinator will serve as a liaison with other college faculty and administration on behalf of students with disabilities.

16. Academic Integrity:

- Each student enrolled in a course at NYIT agrees that, by taking such course, he or she consents to the submission of all required papers for textual similarity review to any commercial service engaged by NYIT to detect plagiarism. Each student also agrees that all papers submitted to any such service may be included as source documents in the service's database, solely for the purpose of detecting plagiarism of such papers.
- Plagiarism is the appropriation of all or part of someone else's works (such as but not limited to writing, coding, programs, images, etc.) and offering it as one's own. Cheating is using false pretenses, tricks, devices, artifices or deception to obtain credit on an examination or in a college course. If a faculty member determines that a student has committed academic dishonesty by plagiarism, cheating or in any other manner, the faculty has the academic right to 1) fail the student for the paper, assignment, project and/or exam, and/or 2) fail the student for the course and/or 3) bring the student up on disciplinary charges, pursuant to Article VI, Academic Conduct Proceedings, of the Student Code of Conduct. The complete Academic Integrity Policy may be found on various NYIT Webpages, including: <http://www.nyit.edu/images/uploads/academics/AcademicIntegrityPolicy.pdf>.

17. 8 Week Topical Class Schedule

Week	Topic	Book Section
Wk 1	Goal Programming	Chapter 7
Wk 2	Goal Programming (Teams present A1 project proposals to instructor)	
Wk 3	Analytic Hierarchy Process	Chapter 15
Wk 4	Analytic Hierarchy Process (A2 initiated, including team discussion on priorities and class inputs)	
Wk 5	Nonlinear Optimization (A2 survey forms administered to class by each group for pair-wise comparisons and assigning criteria priorities)	Chapter 8
Wk 6	Nonlinear Optimization (A3 assigned)	
Wk 7	Group Presentations (A2 oral presentations are conducted; A2 written component collected; Quiz on Readings is administered)	
Wk 8	Final Examination (A1 collected)	

18. Using the NYIT Library

All students can access the NYIT virtual library from both on and off campus at www.nyit.edu/library. The same login you use to access NYIT e-mail and NYITConnect will also give you access to the library's resources from off campus.

On the left side of the library's home page, you will find the "Library Catalog" and the "Find Journals" sections. In the middle of the home page you will find "Research Guides;" select "Video Tutorials" to find information on using the library's resources and doing research.

Should you have any questions, please look under "Library Services" to submit a web-based "Ask-A-Librarian" form.

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