

MSCI 7140 (G01) (3.0 CH)
QUANTITATIVE ANALYSIS FOR MANAGEMENT
WINTER 2021

INSTRUCTOR

Name: Dr. Yuvraj Gajpal	Office Location: 622 Drake
Phone: 204-474-7421	Office Hours: Tuesday 2-3 pm or by appointment
Email: Yuvraj.Gajpal@umanitoba.ca	Class Room: Online through Zoom
	Class Time: Tuesday 6.15 - 9.30p, online

COURSE DESCRIPTION

Introduction to the use of quantitative techniques, and computers to solve management problems. Mathematical optimization models, network analysis, and probability models.

BACKGROUND

A pre-requisite of course MSCI 5110 is required. This will provide a fundamental knowledge of college mathematics such as linear algebra, calculus, descriptive statistics and some probability. Also, the participants should have a basic knowledge of spreadsheets and Microsoft Excel.

COURSE OBJECTIVES

- To introduce students to the subject of Management Science, and a variety of management science models, methods and computational procedures that are helpful in solving management problems in Finance, P.O.M., Accounting, M.I.S., Marketing, Operational Research, Actuarial Science, etc. Emphasis is placed on models and their solutions.
- To give students a good foundation in basic problem solving as a preparation for upper level quantitative courses (Finance, Production/ Operations Management, Accounting, M.I.S., Marketing, Operational Research, Supply Chain Management etc.).
- To develop in students an appreciation of the management science approach to problem formulation and solution, so important in the modern business and industrial world with the increased use of computers. The students will learn to formulate the mathematical models in a variety of sectors, such as Finance, Production, Marketing, Insurance, and supply Chain Management etc., and solve them by a computational procedure or by computer.
- This course is designed to provide students with a conceptual understanding of the role that management science plays in the decision-making process. Quantitative methods will be discussed and there will be emphasis on modeling, problem solving, and showing how quantitative approaches can be used in decision making process.

- Upon completion of this course, students will be able to: Define and use Management Science terminology, formulate basic models for problem solving techniques, use quantitative methods to solve typical decision making problems that arise in business and industry and recognize applications of Management Science concepts and techniques.

AACSB Assurance of Learning Goals and Objectives.			
<p>The Asper School of Business is proudly accredited by AACSB. Accreditation requires a process of continuous improvement for the School and our students. Part of “student improvement” is ensuring that students graduate with the knowledge and skills they need to succeed in their careers. To do so, the Asper School has set the learning goals and objectives listed below for the MBA Program. The checked goal(s) and objective(s) will be addressed in this course and done so by means of the items listed next to the checkmark.</p>			
	Goals and Objectives in the MBA Program	Goals and Objectives Addressed in this Course	Course Item(s) Relevant to these Goals and Objectives
1	Strategic Thinking Students will think critically and creatively about solutions to organizational problems, considering short-term and long-term goals, resources, risks, and opportunities.		
	A. Students are able to identify situations where strategic thinking is necessary.		
	B. Students are able to identify different strategies.		
	C. Students are able to perform a basic strategic analysis.		
	D. Students are able to recommend strategic alternatives and their implementations.		
2	Global Perspective Students will adopt a global mindset in considering organizational decisions.		
	A. Students have an awareness of global diversity, and multicultural awareness.		
	B. Students have an awareness of different global perspectives.		
	C. Students have been exposed to global business environments through course materials		
3	Ethical Mindset Students will consider ethical and moral issues when analyzing and recommending solutions to organizational problems.		
	A. Students demonstrate an understanding of the responsibility of business in society.		
	B. Students demonstrate an understanding of ethical decision making.		
	C. Students demonstrate moral development in ethical decision making.		
	D. Students demonstrate an understanding of the responsibilities of a leader’s role as it relates to ethics.		
4	Quantitative and Financial Proficiency Students will demonstrate the ability to approach organizational issues using quantitative and financial analysis.		
	A. Students are able to identify that a problem containing a quantitative aspect exists.	✓	Assignments, Quizzes, and Exams
	B. Students are able to apply financial methodologies in the answering of business questions.		
	C. Students are able to demonstrate a basic financial proficiency in understanding the role and flow of money in an organization.		
	D. Students are able to interpret the results of a financial analysis.		

COURSE FORMAT AND ONLINE ACCESS

This course will be conducted “live” via videoconferencing using “Zoom” and will not involve in-person instruction. Zoom link for the class will be posted in UM Learn. Classes will be during the scheduled class time.

To join the class from your computer, install Zoom Client for Meetings from zoom.us/download. To join from your smartphone, install the Zoom app. Detailed instructions are available here. Zoom link will be available in homepage of UMLearn.

For recording attendance and class participation, you will be expected to have your camera and microphone on during class time and exams. The instructor may tell you to leave your camera/mic on for the duration of the class or may require you to mute yourself and unmute yourself only at certain times.

COURSE MATERIALS

As classes will be delivered synchronously via videoconferencing, a device enabled with a camera and microphone is required. Further, you are expected to be in a location with a reliable Internet connection that is strong enough for streaming video. You may also want to consider using earphones/headset with a mic, unless you have a computer/tablet with good speakers/mic.

Exams, which will be administered via the Respondus Lockdown browser, you will need a device (computer or tablet; smartphone will not work) with one of the following operating systems:

- Windows 10, 8, or 7
- Mac OS 10.15 to 10.12, OS X 10.11, or OSX 10.10
- iOS: 11.0+ (iPad only)

Text book is only available in digital versions of Introduction to Management Science 13th edition:

[Introduction to Management Science 13th edition – 180 day subscription; ISBN 9780134731254; retail price \\$63.00](#)

[Introduction to Management Science 13th edition – downloadable \(perpetual\) version; ISBN 9780134731230; retail price \\$95.30](#)

https://www.campusbookstore.com/integration/AccessCodes/default.aspx?bookseller_id=33&Course=MSCI+2150&frame=YES&t=permalink

Please respect copyright laws. Photocopying textbooks or other reading material is a violation of copyright laws and is unethical, unless permission to copy has been obtained.

The Introduction to Management Science is a well written book with lots of example questions. The modelling techniques presented in this book are explained with straightforward examples that avoid

lengthy written explanations. The examples presented in the book are organized in a logical step-by-step fashion that the student can subsequently apply to the problems at the end of each chapter.

COURSE ASSESSMENT

- Assignment 1 (worth 5%)
- Assignment 2 (worth 5%)
- Assignment 3 (worth 5%)
- Class Exercise (worth 10%)
- Midterm (worth 15%)
- Project (worth 15%)
- Final (worth 45%)

Final grades will be assigned as follows;

Cumulative Marks	Grade	GPA	Performance
91-100	A+	4.5	Excellent
85-90	A	4.0	Very Good
76-84	B+	3.5	Good
71-75	B	3.0	Satisfactory
65-70	C+	2.5	Marginal
60-64	C	2.0	Unsatisfactory
50-59	D	1.0	Unsatisfactory
Below 50	F	0.0	Unsatisfactory

NOTE: Class attendance is required. Missing more than 20% of this course due to absences may result in a failing grade. It is your responsibility to inform your professor in advance of your absence and the reason for it (medical documentation or employer note if away for a work commitment) is required. The professor decides how to deal with the impact of missed classes on your final grade.

To protect the academic integrity of education at the Asper School, certain protocols will be observed for online exams. For instance, the online exam will set up such that each student will get a random subset of questions from a larger question bank, which means no two students will get exactly the same exam. Further, a very small number of questions will appear on a screen and you may not have the option to move back to questions you have already answered. The instructor may require your camera be on and directed at you for the entire duration of the exam.

Late Assignment Submission Policy

Late submissions of assignments are penalized 10 % per day including weekends unless an extension has been arranged in advance for a legitimate reason.

Class Exercises

The “Class Exercise” are based on the lecture taught in that day. You need to finish these exercises in the class. There is no fixed schedule for class exercises; hence, your attendance is required to complete the class exercises. Your attendance is required to complete the class assignments. If you miss the class, you will miss the class assignment. All class assignments will be conducted through Quiz section of UM Learn

ATTENDANCE POLICY

You are expected to attend the classes. While your absences will not directly influence your grades, you are responsible for all material covered in class whether you attend classes regularly or not. Ultimately, the final grade will depend on how much you have learned and not how often you came to class (although the two are usually highly correlated since missing classes may impair your understanding of the material). If you need my help and are unable to come to my office hours, don't hesitate to schedule an appointment to see me some other time. The best way to contact me outside of office hours is by e-mail. Feel free to interrupt me (as long as you don't overdo it) during class and talk to me after class if you have questions. You are expected to be in a professional business manner in asking questions and replying to questions from both the instructor and other classmates.

ELECTRONIC DEVICE POLICY

This class requires the use of computer or smartphone with a camera/mic during class.

You are NOT allowed to audio/video record any lectures.

Although this course is taught in a remote teaching format, we will observe the protocols that would be expected during in-person classes. Please make sure your cellphone does not ring during class. No frivolous posting of messages in the Chat area during class. Practice self-control—don't browse the Internet or check your e-mail/social media/text messages while class is in progress. Do not video/audio record class lectures or take pictures of the screen without the instructor's permission

OUT-OF-CLASS COMMUNICATION

PowerPoint files, assignment/project guidelines, other class-related files, and grades will be posted on UM Learn. Moreover, any announcements outside of class will be sent by e-mail from UM Learn. It is your responsibility to check your UofM e-mail account frequently so that you don't miss these emails.

There are many questions that cannot be answered succinctly over email. If you email me a question, please consider whether it can be easily and effectively answered by email. If it cannot, please talk to me before or after class. If I receive a question that is difficult to answer electronically or will require a lengthy response, I will ask you to meet with me to discuss instead.

COURSE SCHEDULE

- **Chapter 1**, Components of Break-Even Analysis are presented. The three components of break-even analysis are volume, cost, and profit. Graphical illustration and profit analysis will be discussed.

- **Chapter 2**, Linear programming formulation and graphical approach to solve linear programming model. The graphical approach is limited to models with only two decision variables. The analysis of the graphical approach provides valuable insight into linear programming problems and their solutions. In the graphical approach, once the feasible solution area and the optimal solution point have been determined from the graph, simultaneous equations are solved to determine the values of x_1 and x_2 at the solution point. We will also discuss slacks, surplus variables and standard form solution to a linear programming model. We will also learn how to write a linear programming model in standard form.
- **Chapter 3**, Sensitivity Analysis and Model Formulation. Chapter 3 demonstrated how a linear programming model is formulated and how a solution can be derived from a graph of the model. Graphing can provide valuable insight into linear programming and linear programming solutions in general. However, the fact that this solution method is limited to problems with only two decision variables restricts its usefulness as a general solution technique. In this chapter we will show how linear programming problems can be solved using Excel computer software packages. We will also describe how to use a computer solution result to experiment with a linear programming model to see what effect parameter changes have on the optimal solution, referred to as sensitivity analysis. Students are also exposed to Excel formulation to linear programming model.
- **Chapter 4**, Linear programming has proven to be one of the most successful quantitative approaches to decision making. Applications have been reported in almost every industry. These applications include production scheduling, media selection, financial planning, capital budgeting, transportation, distribution system design, product mix, staffing, and blending.
- **Chapter 6 A**, In this chapter, we examine three special types of linear programming model formulations transportation, transshipment, and assignment problems. They are part of a larger class of linear programming problems known as network flow problems. These problems have special mathematical characteristics that have enabled management scientists to develop very efficient, unique mathematical solution approaches to them. Given the supply at each origin, the demand at each destination, and unit shipping cost between each origin and each destination, the transportation model determines the optimal amounts to ship from each origin to each destination. The assignment problem is a special case of the transportation problem in which all supply and all demand values are 1. The transshipment problem is an extension of the transportation problem involving transfer points referred to as transshipment nodes. Excel formulation for transportation model and assignment model will also be discussed in class. Modified transportation model will also be discussed.
- **Chapter 6 B**, In this chapter we examined a class of models referred to as network flow models. These included the shortest route network, the minimal spanning tree network model. These network models are all concerned with the flow of an item (or items) through an arrangement of paths (or routes). The shortest-route problem finds the shortest route or path between two nodes of a network. Distance, time, and cost are often the criteria used for this model. The shortest-route problem can be expressed as a transshipment problem with one origin and one destination.
- **Chapter 7**, In this chapter we discuss a class of problems that are modeled as linear programs with the additional requirement that one or more variables must be integer. Such problems are

called integer linear programs. If all variables must be integer, we have an all-integer linear program. If some, but not all, variables must be integer, we have a mixed-integer linear program. In many applications of integer linear programming, one or more integer variables are required to equal either 0 or 1. Such variables are called 0-1 or binary variables. If all variables are 0-1 variables, we have a 0-1 integer linear program. We will show that simply rounding of non-integer simplex solution values for models requiring integer solutions is not always appropriate. Rounding can often lead to suboptimal results.

- **Chapter 14**, This chapter introduced the concept of making decisions when there is more than one objective or criterion to consider. Three specific modeling techniques will be presented to solve decision-making problems with multiple criteria: Goal programming, the Analytical hierarchy process (AHP), and Scoring methods. These techniques can be applied to a wide variety of decision-making situations when there are objectives besides just profit or cost. They are often applicable to decision-making problems in public or governmental organizations in which the levels of service or efficiency in carrying out numerous goals are more important than are profit or cost. In all the linear programming models presented in Chapters 2 through 8, a single objective was either maximized or minimized. However, a company or an organization often has more than one objective, which may relate to something other than profit or cost. In fact, a company may have several criteria, that is, multiple criteria that it will consider in making a decision instead of just a single objective. For example, in addition to maximizing profit, a company in danger of a labor strike might want to avoid employee layoffs, or a company about to be defined for pollution infractions might want to minimize the emission of pollutants. The model solutions are very much like the solutions to linear programming models. The format for the analytical hierarchy process and scoring models, however, is quite different from that of linear programming. These methods are based on a comparison of decision alternatives for different criteria that reflects the decision maker's preferences. The result is a mathematical "score" for each alternative that helps the decision maker rank the alternatives in terms of preferability.
- **Chapter 13**, Decision Analysis In actual practice, however, many decision-making situations occur under conditions of uncertainty. Several decision-making techniques are available to aid the decision maker in dealing with this type of decision situation in which there is uncertainty. Decision situations can be categorized into two classes: situations in which probabilities cannot be assigned to future occurrences and situations in which probabilities can be assigned. In this chapter we will discuss each of these classes of decision situations separately and demonstrate the decision-making criterion most commonly associated with each. The purpose of this chapter is to demonstrate the concepts and fundamentals of decision making when uncertainty exists. Within this context, several decision-making criteria will be presented. The maximax, maximin, minimax regret, equal likelihood, and Hurwicz decision criteria were demonstrated for cases in which probabilities could not be attached to the occurrence of outcomes. The expected value criterion will be discussed for cases in which probabilities could be assigned to the states of nature of a decision situation.
- Additional Topic: Formulation of the data envelopment analysis problem as a linear programming model.
- Goal Programming Versus Linear Programming, Deviation Variables Model Formulation,

Graphical Solutions Solving Goal Programming Problems Using Excel, Weighted Goals. More emphasis will be placed on model formulation.

(Due to time constraints, all topics may not be covered)

Tentative Course Schedule – Winter 2021

Date	Topics
Jan 26	Ch1: Introduction, Break Even Analysis (Brief discussion)
Feb 2	Ch2: Introduction to Linear Programming Model Formulation and Graphical Solution
Feb 9	Ch3: Linear Programming: Computer Solution and Sensitivity Analysis
Feb 23	Ch4: Linear Programming: Modelling Examples Applications in various business areas
Mar 02	Mid-Term Exam: Chapter 2, 3 and 4
Mar 09	Ch6A: Transportation, Transshipment and Assignment Problems Ch6 B: Network Flow Models. Shortest Route Problem, Minimal Spanning Tree Problem
Mar 16	Ch7: Integer Programming
Mar 23	Ch14: Multi criteria Decision Making
Mar 30	Ch13 : Decision analysis
April 6	Project presentation

ACADEMIC REGULATIONS AND STUDENT SERVICES

HUMAN ETHICS APPROVAL FOR DATA COLLECTION

As part of coursework, if you will be collecting data from people who are not students in this class, you must obtain Human Ethics approval from the UofM's Research Ethics Board (REB) prior to data collection. This applies to data collection such as surveys, interviews, focus groups, experiments, video recording, etc., where a respondent is solicited for participation.

If the entire class will be working on the same project, your instructor will apply for human ethics approval from the REB. If individuals or small groups of students will be working on different projects, it is the responsibility of the students to obtain approval (only one group member needs to apply). Your instructor will tell you whether s/he will be or you need to. When in doubt, please talk to your instructor.

Instructions and forms to apply for human ethics approval can be found at:
<http://umanitoba.ca/research/orec/ethics/guidelines.html>

In most cases, you will be using the "Protocol Submission Form" which is under the "REB Forms - Fort Garry Campus" heading.

It can take up to six weeks to process human ethics applications and obtain approval. Therefore, plan early. Note that approval must be obtained prior to data collection and cannot be obtained during the data collection phase or retroactively. Violation can get you, your instructor, and the Asper School in serious trouble with the REB.

If you will be collecting data only from other students in the class, you do not need REB approval. If you have any questions, please contact humanethics@umanitoba.ca or your instructor.

UNCLAIMED ASSIGNMENT POLICY

Pursuant to the FIPPA Review Committee's approved recommendations of August 15, 2007, all unclaimed student assignments will become the property of the faculty and will be subject to destruction six months after the completion of any given academic term.

STUDENT SERVICES AND SUPPORTS

The University of Manitoba provides many different services that can enhance learning and provide support for a variety of academic and personal concerns. You are encouraged to visit the below websites to learn more about these services and supports. If you have any questions or concerns, please do not hesitate to contact your instructor or the Graduate Program Office.

For Information on...	...follow this link
Course Outlines, Year-at-a-Glance, Concentrations, Textbooks, VW Dates and Final Exams	MBA Course Information
Exam Rescheduling Policy - <i>Please refer to Missing a Test/Exam on page 14 of the MBA Student Handbook</i>	MBA Student Handbook
Help with research needs such as books, journals, sources of data, how to cite, and writing	Library Resources
Tutors, workshops, and resources to help you improve your learning, writing, time management, and test-taking skills	Writing and Learning Support
Support and advocacy for students with disabilities to help them in their academic work and progress	Student Accessibility Services
Copyright-related questions and resources to help you avoid plagiarism or intellectual property violations	Copyright Office
Student discipline bylaws, policies and procedures on academic integrity and misconduct, appeal procedures	Academic Integrity
Policies & procedures with respect to student discipline or misconduct, including academic integrity violations	Student Discipline
Students' rights & responsibilities, policies & procedures, and support services for academic or discipline concerns	Student Advocacy
Your rights and responsibilities as a student, in both academic and non-academic contexts	Your rights and responsibilities
Full range of medical services for any physical or mental health issues	University Health Service
Information on health topics, including physical/mental health, alcohol/substance use harms, and sexual assault	Health and Wellness
Any aspect of mental health, including anxiety, stress, depression, help with relationships or other life concerns, crisis services, and counselling.	Student Counselling Centre
Support services available for help regarding any aspect of student and campus life, especially safety issues	Student Support Case Management
Resources available on campus, for environmental, mental, physical, socio-cultural, and spiritual well-being	Live Well @ UofM
Help with any concerns of harassment, discrimination, or sexual assault	Respectful Work and Learning Environment
Concerns involving violence or threats, protocols for reporting, and how the university addresses them	Violent or Threatening Behaviour

ACADEMIC INTEGRITY

I.H. Asper School of Business, The University of Manitoba

It is critical to the reputation of the I. H. Asper School of Business and of our degrees that everyone associated with our faculty behaves with the highest academic integrity. As the faculty that helps create business and government leaders, we have a special obligation to ensure that our ethical standards are beyond reproach. Any dishonesty in our academic transactions violates this trust. The University of Manitoba Graduate Calendar addresses the issue of academic dishonesty under the heading "Plagiarism and Cheating." Specifically, acts of academic dishonesty include, but are not limited to:

- using the exact words of a published or unpublished author without quotation marks and without referencing the source of these words
- duplicating a table, graph or diagram, in whole or in part, without referencing the source
- paraphrasing the conceptual framework, research design, interpretation, or any other ideas of another person, whether written or verbal (e.g., personal communications, ideas from a verbal presentation) without referencing the source
- copying the answers of another student in any test, examination, or take-home assignment
- providing answers to another student in any test, examination, or take-home assignment
- taking any unauthorized materials into an examination or term test (crib notes)
- impersonating another student or allowing another person to impersonate oneself for the purpose of submitting academic work or writing any test or examination
- stealing or mutilating library materials
- accessing tests prior to the time and date of the sitting
- changing name or answer(s) on a test after that test has been graded and returned
- submitting the same paper or portions thereof for more than one assignment, without discussions with the instructors involved.

Many courses in the I. H. Asper School of Business require group projects. Students should be aware that group projects are subject to the same rules regarding academic dishonesty. Because of the unique nature of group projects, all group members must exercise extraordinary care to insure that the group project does not violate the policy on Academic Integrity. Should a violation occur on a group project, all group members will be held jointly accountable, no matter what their individual level of involvement in the specific violation.

Some courses, while not requiring group projects, encourage students to work together in groups (or at least do not prohibit it) before submitting individual assignments. Students are encouraged to discuss this issue as it relates to academic integrity with their instructor to avoid violating this policy.

In the I. H. Asper School of Business, all suspected cases of academic dishonesty involving a graduate student (i.e. MBA, MSc or PhD student) will be reported directly by the instructor to the Dean of the Faculty of Graduate Studies.

FACULTY BIOGRAPHY

I.H. Asper School of Business, The University of Manitob

Dr. Yuvraj Gajpal

Department of Supply Chain Management
I.H. Asper School of Business

Research Interests:

Application of heuristics and meta-heuristics on transportation and logistics management. Using different metaheuristics such as Ant colony optimization, tabu search, simulated annealing, genetic algorithm, adaptive large neighborhood search, particle swarm optimization and iterative local search to solve supply chain problems. Using linear and integer programming to formulate the problems arising in supply chain management. Scheduling issues in manufacturing industry, healthcare, cloud computing and project management. Vehicle route design for city delivery distribution such as parcel delivery, garbage collection and meal delivery distribution.

Background:

Yuvraj Gajpal is an Associate Professor of Supply Chain Management at Asper School of Business, University of Manitoba Winnipeg, Canada. He holds a PhD in Management Science from DeGroote School of Business at McMaster University Hamilton, Canada and Master in Industrial Management from Indian Institute of Technology (IIT) Madras, India. Prior to joining University of Manitoba, he worked as an assistant professor at King Fahd University of Petroleum and Minerals (KFUPM), Saudi Arabia. He also taught courses at McMaster University as a sessional lecture. He has worked as a postdoctoral fellow at Interuniversity Research Center on Enterprise Networks, Logistics and Transportation (CIRRELT), University of Ontario Institute of Technology (UOIT) and McMaster University. He is a member of Institute for Operations Research and the Management Sciences (INFORMS); Canadian Operational Research Society (CORS); Administrative Sciences Association of Canada (ASAC); Society of Operations Management, India (SOM) and Soft Computing Research Society (SCRS).

He has published papers in leading research journals such as Computers and Operations Research, European Journal of Operations Research, International journal of Production Economics, annals of Operations Research, Reliability Engineering and Systems Safety, Construction Management and Economics and Journal of the Operational Research Society. He is a reviewer of many international journals such as Computers and Operations Research, European Journal of Operations Research, Computers and Industrial Engineering, Journal of Heuristics and Transportation Research Part E.

He has taught wide variety of courses in Engineering and Management. He has taught courses in Introduction to Management Science, Operations Management, Simulation, Mathematical Optimization Models, Statistics, Global Supply Chain Management, Engineering Economics, Cost accounting; and Methods engineering.