#### UNIVERSITY OF MASSACHUSETTS LOWELL Manning School of Business Operations and Information Systems

# **POMS.7300 - Prescriptive Analytics: Optimization & Simulation**

CREDITS:	3
PRE-REQUISITES:	MATH.2210 Linear Algebra I AND MATH.2830 Introduction to Statistics OR permission of the instructor and PhD coordinator
<b>PROFESSORS:</b>	<ol> <li>Belleh Fontem</li> <li>Nichalin Summerfield</li> </ol>
CLASS TIME:	Tu 6:30PM - 9:20PM
LOCATION:	PTB-320

# Spring 2023

#### **COURSE DESCRIPTION:**

In this course, we cover optimization and simulation as prescriptive analytics methodologies. This course provides an overview of optimization and simulation frameworks to solve wide range of issues in management science as well as their applications.

# **COURSE OBJECTIVES:**

At the end of the course, the students should be able to:

- 1. identify business situations in which optimization is appropriate
- 2. discuss basic optimization techniques
- 3. construct an optimization model using appropriate software
- 4. identify business situations in which simulation is appropriate
- 5. explain the capabilities and limitations of simulation methodology
- 6. construct a discrete-event simulation model using appropriate software
- 7. interpret and analyze the output of simulation models

# **COURSE MATERIAL:**

- Introduction to Linear Optimization by D. Bertsimas and J. N. Tsitsiklis
- Linear Programming and Network Flows by M. Bazaraa, J.J. Jarvis, H. D. Sherali
- Simulation Modeling & Analysis (SMA) by A. Law
- Simio and Simulation: Modeling, Analysis, Applications (S&S) by Smith, Sturrock, and Kelton

# • Additional readings on simulation:

- [S1] <u>https://link.springer.com/article/10.1057/jors.2013.148</u>
- [S2] <u>https://onlinelibrary.wiley.com/doi/book/10.1002/9781118762745</u>
- [S3] ABS: https://link.springer.com/article/10.1057/jos.2010.14
- [S4] DES: <u>https://link.springer.com/article/10.1057/jos.2013.13</u>
- [S5] https://www.sciencedirect.com/science/article/pii/S0377221718308786
- [S6] https://pubsonline.informs.org/do/10.1287/orms.2019.05.10/full/

### **CLASSROOM POLICY:**

#### **Academic Integrity Policy:**

Students are responsible for the honest completion and representation of their work and are held to the highest standards of integrity. Please review the <u>University policy regarding academic</u> <u>integrity</u>. It is the students' responsibility to familiarize themselves with these policies. If you choose to remain in this course, you must agree that you will neither give nor receive any unauthorized help on your homework, papers, exams, or other work.

#### **Students with disabilities:**

If you have a documented disability that will require classroom accommodations, please notify me as soon as possible, so that we might make appropriate arrangements. Please make an appointment to speak with me or send me an email, as I want to protect your privacy. Visit the <u>Student Disability Services webpage</u> for further information and to register with that office if you require accommodations.

#### **Student Mental Health and Wellbeing:**

We are a campus that cares about the mental health and well-being of all individuals in our campus community, particularly during this uncertain time. If you or someone you know are experiencing mental health challenges at UMass Lowell, please contact <u>Counseling Services</u>, who are offering remote counseling via telehealth for all enrolled, eligible UMass Lowell students who are currently residing in Massachusetts or New Hampshire. In addition, a crisis counsellor is available 24 hours a day, seven days a week at 855-890-2879. I am available to talk with you about stresses related to your work in my class.

#### Diversity, Inclusion, and Classroom Community Standards:

UMass Lowell—and your professor—value human diversity in all its forms, whether expressed through race and ethnicity, culture, political and social views, religious and spiritual beliefs, language and geographic characteristics, gender, gender identities and sexual orientations, learning and physical abilities, age, and social or economic classes. Diversity and individual differences are respected, appreciated, and recognized as a source of strength in this class. Please interact respectfully with one another.

#### **University Privacy Statement**

UMass Lowell recognizes the importance of mutual trust between students and faculty. Neither faculty nor students may record video or audio of a course or private conversation without all parties' consent. Massachusetts is a two-party consent state, which means it is illegal to record someone without their permission. Recordings of classroom lectures are the intellectual property of the instructor. Instructors have the right to prohibit audio and video recording of their lectures, unless the requesting student is registered with Disabilities Services and recording of class sessions is an approved accommodation. In addition, sharing of or selling recordings of classroom activity, discussions, or lectures with any other person or medium without permission of the instructor is prohibited.

#### **Syllabus Change Policy:**

This syllabus is a guide to provide an overview of the course. However, circumstances and events may make it necessary for me to modify the syllabus during the semester and may depend, in part, on the progress, needs, and experiences of the students. Changes to the syllabus will be made with advance notice.

#### **EVALUATION POLICY:**

Evaluation method	Percentage of final grade
Optimization project	40%
Simulation project	40%
Homework - Optimization	10%
Homework - Simulation	10%
Total	100%

Numeric Grade:	Letter Grade:
97 - 100	A+
93 - below 97	А
90 - below 93	A-
87 - below 90	B+
83 - below 87	В
80 - below 83	В-
77 - below 80	C+
70 - below 77	С
0 - below 70	F

# **CLASS SCHEDULE\*:**

Week	Date	Location	Торіс
1	1/17	PTB-320	Introduction
2	1/24	PTB-320	The Geometry of Linear Programming
3	1/31	PTB-320	The Simplex Method [Homework 1 Released: Due a
			week later]
4	2/7	PTB-320	Network Flow Problems/Research Paper Discussion
			[Research Project Description Released]
5	2/14	PTB-320	Modeling with CPLEX [Homework 2 Released: Due a
			week later]
6	2/28	PTB-320	Research Paper Discussion
7	3/14	PTB-320	Project Presentation
8	3/21	Virtual	S&S Ch1 Introduction to Simulation
			S&S Ch2 Basic of Queuing Theory
			S&S Ch3 Kinds of Simulation
9	3/28	Virtual	S&S Ch4 First Simio Models
			Online Simio Tutorial
10	4/4	Virtual	SMA Ch5 Building Valid, Credible, & Appropriately
			Detailed Simulation Models
			A research paper that used DES [S1]
11	4/11	Virtual	S&S Ch6 Input Analysis
			SMA Ch6 Selecting Input Probability Distributions
			SMA Ch8 Generating Random Variates (only 8.1 & 8.5)
12	4/18	Virtual	SMA Ch12 Experimental Design and Optimization (12.1,
			12.2, 12.5)
			System Dynamics (Ch3 of [S2])
13	4/25	Virtual	Agent-Based Simulation [S3, S4]
			Hybrid model [S5]
			Other simulation software:
			- AnyLogic
			- SimPy
			- Software survey [S6]
TBD			Project Presentation

\*The class schedule is tentative and is subject to change at the instructors' discretion.