

# MS3601: OPTIMIZATION METHODS

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## Effective Term

Semester A 2025/26

## Part I Course Overview

### Course Title

Optimization Methods

### Subject Code

MS - Decision Analytics and Operations

### Course Number

3601

### Academic Unit

Decision Analytics and Operations (DAOS)

### College/School

College of Business (CB)

### Course Duration

One Semester

### Credit Units

3

### Level

B1, B2, B3, B4 - Bachelor's Degree

### Medium of Instruction

English

### Medium of Assessment

English

### Prerequisites

MA 2001 Multi-variable Calculus and Linear Algebra Or subject to instructor' s approval

### Precursors

Nil

### Equivalent Courses

Nil

### Exclusive Courses

Nil

## Part II Course Details

### Abstract

This course introduces students to the theory, algorithms, and applications of optimization, particularly in linear programming, integer programming, and convex (quadratic) programming. Many real-world business problems can be

modelled as an optimization problem, and it is important to choose the most appropriate formulation to ensure that a solution can be obtained efficiently. Students will learn essential theoretical and algorithmic topics, such as the Simplex method, duality, cutting planes, and optimality conditions. Applications to finance will be emphasized. The course will introduce the use of software such as Gurobi with Python to solve large optimization problems.

### Course Intended Learning Outcomes (CILOs)

CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain the fundamental concepts and principles underlying linear, integer, and convex (quadratic) programming.	x		
2	Demonstrate the ability to apply optimality conditions and solve optimization problems using appropriate methodologies, including linear, integer, and convex (quadratic) programming techniques.	x	x	
3	Formulate real-world business problems as optimization models and implement effective solutions.	x	x	x
4	Utilize industry-standard computer software, such as Gurobi with Python, to solve large-scale and complex optimization problems.	x	x	x

#### A1: Attitude

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

#### A2: Ability

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

#### A3: Accomplishments

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

### Learning and Teaching Activities (LTAs)

LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture  Students will engage in lectures to discover the theory, algorithms, and applications of optimization.  Students will work through examples to enhance understanding of the methodologies behind linear and convex optimization.	1, 2, 3, 4	3

2	Individual/Group Practice	<p>Students will build optimization models for different types of business problems.</p> <p>Students will practice with computing optimal solutions using the algorithms introduced in lectures.</p> <p>Students will utilize Gurobi with Python to practice coding and using industry-standard software for large and complex optimization problems.</p>	1, 2, 3, 4	
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**Assessment Tasks / Activities (ATs)**

	ATs	CILO No.	Weighting (%)	Remarks ("- " for nil entry)	Allow Use of GenAI?
1	Assignments	1, 2, 3, 4	30	-	Yes
2	Mid-term quiz (quizzes)	1, 2, 3	15	-	No

**Continuous Assessment (%)**

45

**Examination (%)**

55

**Examination Duration (Hours)**

2

**Assessment Rubrics (AR)****Assessment Task**

Assignments

**Criterion**

Identify and build correct models for different applications; use appropriate techniques to solve simple optimization problems by hand; use software to solve and analyze larger problems.

**Excellent (A+, A, A-)**

Strong evidence of ability to understand key concepts and methodologies; consistent ability to analyze problems and apply the most appropriate solution techniques; superior grasp of subject matter; evidence of extensive knowledge base.

**Good (B+, B, B-)**

Evidence of ability to understand key concepts and methodologies; moderately consistent ability to analyze problems and apply appropriate solution techniques; reasonable grasp of subject matter.

**Fair (C+, C, C-)**

Some familiarity with key concepts and methodologies; some ability to analyze problems and apply solution techniques; some grasp of subject matter to demonstrate that student is profiting from the university experience.

**Marginal (D)**

Basic familiarity with key concepts; grasp of subject matter sufficient to enable the student to pursue further studies.

**Failure (F)**

Little or no evidence of familiarity with the subject matter.

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**Assessment Task**

Mid-term quiz (quizzes)

**Criterion**

Understand introductory theories of optimization; apply correct algorithm and/or solution techniques for different types of problems; use appropriate techniques to solve simple optimization problems by hand.

**Excellent (A+, A, A-)**

Strong evidence of ability to understand key concepts and methodologies; consistent ability to analyze problems and apply the most appropriate solution techniques; superior grasp of subject matter; evidence of extensive knowledge base.

**Good (B+, B, B-)**

Evidence of ability to understand key concepts and methodologies; moderately consistent ability to analyze problems and apply appropriate solution techniques; reasonable grasp of subject matter.

**Fair (C+, C, C-)**

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**Assessment Task**

Exam

**Criterion**

Understand introductory theories of optimization; apply correct algorithm and/or solution techniques for different types of problems; use appropriate techniques to solve simple optimization problems by hand.

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Strong evidence of ability to understand key concepts and methodologies; consistent ability to analyze problems and apply the most appropriate solution techniques; superior grasp of subject matter; evidence of extensive knowledge base.

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**Part III Other Information****Keyword Syllabus**

- a. Linear programming: Simplex method, duality, sensitivity analysis
- b. Integer programming: Branch-and-bound, cutting planes, complexity
- c. Convex optimization: Convexity and properties, Lagrangian duality, optimality conditions, quadratic programming.
- d. Applications: Product mix, foreign exchange, investment decisions, network flows, clustering, portfolio optimization

**Reading List****Compulsory Readings**

Title	
1	Nil

**Additional Readings**

Title	
1	Guenin, B., Könemann, Un, J., & Tunçel, L. (2014). A Gentle Introduction to Optimization. Cambridge, UK: Cambridge University Press.
2	Cornuejols, G., Pen#a, J. F., & Tu#tu#ncu#, R. (2018). Optimization methods in finance (Second edition.). Cambridge, United Kingdom#; New York, NY: Cambridge University Press.
3	Boyd, S. P., & Vandenberghe, L. (2004). Convex optimization. Cambridge, UK#; New York: Cambridge.