

# 理學院

## 110 學年度第一學期模組化課程

最佳決策-數學模式理論與實作

Optimal Decisions – Mathematical models, Theories and Practices

授課教師

任職單位

畢業學校

王逸琳

國立成功大學  
工業與資訊管理學系

喬治亞理工學院

課程類別	學分數	選必修	開課人數	其他注意事項
Lecture + Recitation	1.5	選修	30	若因 COVID-19 疫情導致無法實體授課，本課程改以線上授課。

先修課程或先備能力

需已熟悉 python、有線性代數、邏輯推理能力尤佳

課程難易度

難  中偏難  中偏易  易

建議修課學生背景

適合各領域學生修習

教學方法

講授 65%，實作 25%，報告 10%

評量方式

問題考試 60%，報告 40%

補充說明：

We will have in-class quiz every day(around 10-15min at most), and two reports which require coding in python to call GuRoBi functions. More details are as follows:

1. In the first day, we will have a quiz (8%) to check whether a student can use python and GuRoBi to code and run a simple linear programming example.
2. In day 2-5, the lecturer will give at least one in-class quiz every day, to test the course taught in previous days and that day. (each quiz is around 8% of the grade. The precise percentage will be announced in class.)
3. In day 6 (Sat), we will hold an 1-hr on-line exam (20%) on moodle.
4. There are 2 reports (20% each) which should submit to moodle by the 13:00 of the next Tuesday.
  - (i) one is to solve (model/implement python code) a given problem, upload your codes/report to moodle.
  - (ii) the other is to design a problem of your own (with python code and report), upload them to moodle

All the lectures can be conducted by on-line video streaming using Microsoft Teams. The lectures will be recorded and uploaded to MS Stream or Youtube as off-line videos. Some off-line tutorial videos will also be provided beforehand. All the Quizzes, reports and homework will be done on-line, too. In the TA recitation session, TAs will try to answer questions on-line.

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### 學習規範

This course requires each student to use the optimization software GuRobi and python language. Each student should use his/her own computer, install Anaconda/GuRobi/Python in advance. The course is very intense (will have a quiz to verify whether one can use GuRoBi and python in the 2<sup>nd</sup> day; will have at least 2 coding assignments that require a student to demonstrate how a mathematical model is implemented), so it is not suitable for those who are unfamiliar with python coding or without a computer.

### 課程概述

人類無時無刻在做決策，日常生活中有許多決策問題常因其選項或規範限制過多，導致決策者難以做出最佳決策。本課程將以數類可量化的決策問題為例，以數學技巧將決策與限制規範化成數學規劃模式，在早上3小時課程中將教授相關的數學與演算法基礎、決策模式設計的原理與其利弊得失；而下午則讓學生用電腦程式與軟體練習實作數學模式，以求解不同應用的最佳決策數學模式。

### 課程概述(英文)

People make decisions all the time, yet optimal decisions are often difficult to make, mostly due to numerous choices with consideration on many inter-related factors. In this course, we focus on the decision-making problems whose factors can be quantified. By correctly defining the decision variables, we will learn how to build a mathematical programming model that includes an objective function to achieve and constraints to follow. The purpose of this course is to provide students with the tools and knowledge necessary to model practical optimization problems. In the morning, we will spend 3 hours learning the theories of the mathematical modeling and algorithms for decision making models. In the afternoon, we will spend another 2.5 hours in practicing how to implement the mathematical models by Python and the software GuRoBi.

### 課程進度

堂次	時間	進度說明
8/30(一)	9:00 - 12:00	Introduction to some applications of optimal decision making problems, and how to use the software GuRoBi by python to solve them.
	12:00-13:00	Break
	13:00-15:30	Recitation in using Python/GuRobi: installation, how to define problems
8/31(二)	9:00 - 12:00	Basics of the mathematical properties and theorems behind linear programming (LP) and integer programming (IP).
	12:00-13:00	Break
	13:00-15:30	Recitation in using Python/GuRobi: mapping codes and models, Quiz
9/1(三)	9:00 - 12:00	Techniques to make LP and IP models
	12:00-13:00	Break
	13:00-15:30	Recitation in using Python/GuRobi: simple LP/IP models, Quiz

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9/2(四)	9:00 - 12:00 12:00-13:00 13:00-15:30	IP modeling Practices (I): facility location, logistics network flows Break Recitation in using Python/GuRobi: more complicated LP/IP models, Quiz
9/3(五)	9:00 - 12:00 12:00-13:00 13:00-15:30	IP modeling Practices (I): scheduling, routing problems Break Recitation in using Python/GuRobi: challenging LP/IP models, Quiz.

### 課程學習目標

1. To understand the basics of the mathematics behind the mathematical models and solution methods for solving an optimization decision making problem.
2. To learn how to model an optimization decision making problem by using mathematical variables and constraints.
3. To learn how to implement a mathematical programming model for an optimization decision making problem by computer language (python/julia) and software (GuRoBi).

### 課程的重要性、跨域性與時代性

Optimal decision making problems appear often as real-world applications in the fields of Engineering, Management, and Science. How to make the decision in a scientific way is the main theme of this course, where we will learn how to define decision variables, how to derive constraints and objective functions, and how to solve them by computer programs.

### 其他備註

#### 參考書目：

Model Building in Mathematical Programming, by H. Paul Williams, 5th Edition 2013, Wiley