理 學 院
107 學年度第一學期模組化課程

理解並使用線性錐規劃
Modeling and Understanding conic linear programming

授課教師：

許瑞麟
國立成功大學數學系

課程類別	學分數	選必修	開課人數	開課日期及上課時間	上課地點
講義+演習	1	選修	35	2018/07/16(一)~2018/07/20(五) 下午 14:00-17:30	成功校區

先修課程或先備能力：

初等微積分

建議修課年級：

大二、大三、大四、碩士班

建議修課學生背景：

適合各領域學生修習

教學方法：

講授 70 %、報告/討論/測驗 30 %

評量方式：

問題考試 40 %、期末報告 20%、出席率 20%、其他：發問問題 20%
補充說明：
星期二、三、四、五每天 14:00-14:40 先小考，考試內容為前一天上課內容。考試目的是為了提示課程重點，並確保學習成效。考試方式為開放式引導式考試。學生可於考試時舉手發問，老師或助教會趨前給予適當提示並引導作答。不舉手發問視為自動放棄權利。每次小考佔 10%，四次共 40%。期末報告主要是撰寫課程 1000 字心得報告，內容必須包含「課程總結」、「數學結構與解法自我整合筆記」、以及「學習心得」三部分，於課程結束後隔周一繳交，繳交方式另行通知。

學習規範：

無

課程概述：

A quantitative description of a natural phenomenon, or human behavior, or some large industrial system is called a mathematical model. The keyword here is “quantitative’’. That is how mathematics gets involved. Not everything can be suitably described quantitatively. For example, it might be very difficult to construct a mathematical model to describe “月落烏啼霜滿天，江楓漁火對愁眠”. It is better off to use a poem rather than mathematics expressing nostalgia by frustration. On the other hand, if you want to describe a chain of reaction in a nuclear power plant, it is easier to use a geometrical series rather than composing a poem.

However, many systems (indeed most systems) are very complicate. To model them into any

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kind of mathematical formulations is indeed an "art'', by which I mean that there exists no standard step-by-step procedure. In spite of it, there is still some fundamental technique in modeling that you should understand and should learn, in particular, (conic) linear programming, which is the basis of everything in the area.

This course will deliver linear programming (LP) in a much wider framework, that is, emphasizing the underlined conic structure. By doing so, we not only include the classical linear programming, but also incorporate with the second order cone programming (SOCP) and the semi-definite programming problem (SDP). Both (SOCP) and (SDP) are special cases of convex Optimization and they are very useful tools in modeling real world optimization problems. ALL (LP), (SOCP) and (SDP) can be solved by Interior Point Methods. Particularly, we will cover examples of (LP), (SOCP) and (SDP); focus on the duality theorems; mentioning ideas of Interior Point Methods and the cvx solver.

課程進度：

堂次	時數	進 度 說 明
1	**3.5**	Various examples for modeling an application into linear programming problems.
2	**3.5**	Linear duality and Farkas' lemma.
3	**3.5**	Interior point methods for solving LP.
4	**3.5**	The conic structure in LP and its extension to SDP and SOCP.
5	**3.5**	Examples of SDP and SOCP with conic duality theory.

課程學習目標：

1. Modeling an application problem into linear programming.
2. Understanding mathematical structure of linear programming and its dual problem.
3. Understanding Farkas' lemma and its proof.
4. Recognizing the conic structure of a problem and its convexity.
5. Understanding the idea and steps of the Interior Point Method.

課程的重要性、跨域性與時代性：

This course bridges between calculus and linear algebra; between mathematics and physics; and between mathematics and applied mathematics. It focuses on equilibrium equations for physical phenomena, from mechanics to electrical networks; and from discrete to continuous. Solution methods for solving the Laplace equation on the unit disc delivers a concise and complete introduction to the theory of Fourier series.

其他備註: