学神教育

每个人都可以是学神

悉尼大学本科

2020.S1

免费预习课

Bachelor of Commerce

*QBUS2310

*Management

Science

by *zoe

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QBUS2310 Week 1-2

Terminology

- **Management Science** is a scientific approach to decision making that seeks to best design and operate a system, usually under conditions requiring the allocation of scarce resources.
- **Mathematical model** is a mathematical representation of the actual situation.
- **Analytics**
    - Descriptive analytics: what happened and why?
    - Predictive analytics: what might happen?
    - Prescriptive analytics: what should we do?

Prescriptive analytics and Mathematical Models

- Prescriptive analytics uses mathematical optimization models to prescribe behaviour for an organisation to best meet its goals.
- Components of these models
    - objective function: a function we wish to optimise
    - decision variables: variables whose values are under our control and influence system performance
    - constraints: restrictions on the decision variable values

QBUS1040 material

- Least squares
- Vectors
    - A **vector** is an ordered finite list of numbers
    - **Element**s of a vector are the values in the array
    - The **size (dimension)** of the vector is the number of elements it contains
    - **zero vector** is a vector with all elements equal to zero

- **unit vector** is a vector with all elements equal to zero, except one element which is equal to one

- Matrices
  - A matrix is a rectangular array of numbers written between rectangular brackets. $\begin{bmatrix}1 & 2 & 3\\4 & 5 & 6\end{bmatrix}$
  - The matrix above has 2 rows and 3 columns so its **size** is 2*3.
  - The number in the i-th row and j-th column of a matrix A is called the **ij-th element** and is denoted a_{ij}
  - In the matrix above, $A_{12} = 2$, $A_{23} = 6$.
  - **square matrix** has an equal number of rows and columns (size n*n)
  - **tall matrix** has more rows than columns (size m*n with m>n)
  - **wide matrix** has more columns than rows (size m*n with n>m)
  - **zero matrix** is a matrix with all elements equal to zero
  - **identity matrix:** diagonal elements of a square matrix are those elements a_{ij} such that i= j (denotes as I_n or I). $\boldsymbol{I_2} = \begin{bmatrix}\mathbf{1} & \mathbf{0}\\\mathbf{0} & \mathbf{1}\end{bmatrix}$

Linear programming (LP)

$$\begin{array}{ll}\text{minimize} & f_0(x)\\ \text{subject to} & f_i(x) \leq 0, \quad i = 1, \ldots, m\\ & h_i(x) = 0, \quad i = 1, \ldots, p\end{array}$$

- f_0, f_i, h_i are linear (or affine)
- convex problem with affine objective and constraint functions
- feasible set is a polyhedron
- often write as:

$$\begin{array}{ll}\text{minimize} & c^T x + d\\ \text{subject to} & Gx \leq h\\ & Ax = b\end{array}$$

- it is common to omit the constant d in the objective function, since it does not affect the feasible set.

Linear programming - example

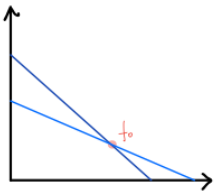
$$
\begin{aligned}
&\underset{\boldsymbol{x}}{\text{Minimise}} && 8x_1 + 10x_2 + 11x_3 + 14x_4 && (1)\\
&\text{subject to} && 0.03x_1 + 0.06x_2 + 0.1x_3 + 0.12x_4 \geq 80 && (2)\\
& && 0.02x_1 + 0.04x_2 + 0.03x_3 + 0.09x_4 \geq 40 && (3)\\
& && 0.01x_1 + 0.01x_2 + 0.04x_3 + 0.04x_4 \geq 20 && (4)\\
& && x_1 + x_2 + x_3 + x_4 = 1000 && (5)\\
& && x_2 \geq 100 && (6)\\
& && x_i \geq 0 \ \ \forall i && (7)
\end{aligned}
$$

- $x = \{x_1, x_2, x_3, x_4\}$ is the **decision variable**
- $f_0 = 8x_1 + 10x_2 + 11x_3 + 14x_4$ is the **objective function** we wish to minimise
- there are five inequality constraints and one equality constraint

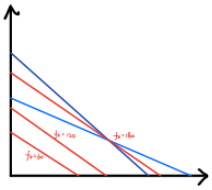
Multiple solutions, infeasibility and unboundedness

Every LP must fall into one of the following four cases:

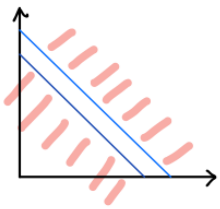
Case 1: LP has a unique solution



Case 2: LP has multiple solutions



Case 3: LP is infeasible



Case 4: LP is unbounded