Hwa Chong Institution 华侨中学
Mathematics (SMTP)

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MA302.5.1 – Rows and Columns

At the end of this unit, you should be able to

- **identify rows and columns in matrices**
- **interpret information given into matrix form**

If you have seen the movie 'The Matrix', you would be familiar with the strings of columns of alpha-numeral characters appearing on the screen. The strings of characters are also known as **arrays** and consist of rows and columns.

A matrix is an array of rows and columns of data. General matrices consist of m rows and n columns. For example, the matrix

$$\begin{array}{r l} & \left(\begin{array}{ccccc} 2 & -1 & 0 & b & -3 \\ -2 & c & 1 & 4 & 2 \\ 5 & 4 & a & 7 & d \end{array}\right) \\ \text{row!} & \end{array}$$

has 3 rows and 5 columns.

Definition: The **order** of a matrix with m rows and n columns is $m \times n$.

One major use of matrices in real life problems is in representing information in a neat and systematic manner.

Matrices are unitless.

E1. Consider the table of results of the following tests in 3N and 3M for 2004.

	Term Test 1	Class Test 1	Term Test 2	Class Test 2	Term Test 3
3M	75.1	67.3	75.9	69.1	71.9
3N	74.4	62.3	75.1	70.6	68.9

(a) Express in matrix form, the above data. What is the *order*?

$$\begin{bmatrix} 75.1 & 67.3 & 75.9 & 69.1 & 71.9 \\ 74.4 & 62.3 & 75.1 & 70.6 & 68.9 \end{bmatrix}$$

Order: 2×5

(b) Write down two *column* matrices **T** and **C** showing the average marks for term tests and class tests separately for the two classes.

$$T = \begin{bmatrix} 74.3 \\ 72.8 \end{bmatrix}$$

$$C = \begin{bmatrix} 68.2 \\ 66.45 \end{bmatrix}$$

(c) Explain how, using the two matrices above, the average mark can be computed for each class for the combined data. Write down a new matrix **M** such that it shows the average mark, and express **M** in terms of **T** and/or **C**.

$$M = \begin{bmatrix} 74.3 & 68.2 \\ 72.8 & 66.45 \end{bmatrix} \begin{bmatrix} \frac{3}{5} \\ \frac{2}{5} \end{bmatrix}$$

$$= \begin{bmatrix} 71.86 \\ 70.26 \end{bmatrix}$$

$$M = \frac{3}{5}T + \frac{2}{5}C$$

P1. Three chains of supermarket give different prices for some items:

Chain X sells a loaf of bread for \$1.20, a bar of chocolate for \$0.80 and a bottle of oil for \$4.30.

Chain Y sells a loaf of bread for \$1.00, a bar of chocolate for \$0.60 and a bottle of oil for \$4.10.

Chain Z sells a loaf of bread for \$1.30, a bar of chocolate for \$0.70 and a bottle of oil for \$4.30.

John needs to buy 2 loafs of bread, 3 bars of chocolate and a bottle of oil.

(a) Write down three column matrices, **B**, **C** and **O** which represents the three different prices from the supermarkets for bread, chocolate and oil respectively.

$$B = \begin{bmatrix} 1.20 \\ 1.00 \\ 1.30 \end{bmatrix} \qquad C = \begin{bmatrix} 0.80 \\ 0.60 \\ 0.70 \end{bmatrix} \qquad O = \begin{bmatrix} 4.30 \\ 4.10 \\ 4.30 \end{bmatrix}$$

(b) Let **M** denotes the matrix that represents the total cost of purchasing the items by John. Express **M** in terms of **B**, **C** and **O**.

$$M = 2B + 3C + O$$

(c) By evaluating **M**, determine which supermarket John should go to such that he can spend the least.

$$M = \begin{bmatrix} 1.20 \\ 1.00 \\ 1.30 \end{bmatrix} \times 2 + \begin{bmatrix} 0.80 \\ 0.60 \\ 0.70 \end{bmatrix} \times 3 + \begin{bmatrix} 4.30 \\ 4.10 \\ 4.30 \end{bmatrix} \times 1$$

$$= \begin{bmatrix} 2.40 \\ 2.00 \\ 2.60 \end{bmatrix} + \begin{bmatrix} 2.40 \\ 1.80 \\ 2.10 \end{bmatrix} + \begin{bmatrix} 4.30 \\ 4.10 \\ 4.30 \end{bmatrix}$$

$$= \begin{bmatrix} 9.10 \\ 7.90 \\ 9.00 \end{bmatrix}$$

He should go to chain Y.

P2. The 4 by 3 matrix below shows the prices, in dollars, of cameras at various shops. The rows represent the models of camera: digital, professional, film and Polaroid in that order. The columns represent the shops: X, Y and Z in that order.

$$\begin{pmatrix} 450 & 460 & 450 \\ 800 & 780 & 810 \\ 220 & 250 & 260 \\ 350 & 350 & 320 \end{pmatrix}$$

(a) How much does a professional camera cost at Shop Y?

\$780

(b) At which of these three shops is a film camera cheapest?

Shop X.

(c) Linda bought 2 Polaroid cameras and 3 digital cameras from Shop Z. Did she get the best deal?

$\begin{bmatrix} 350 & 350 & 320 \end{bmatrix} \times 2 + \begin{bmatrix} 450 & 460 & 450 \end{bmatrix} \times 3$

$= \begin{bmatrix} 700 & 700 & 640 \end{bmatrix} + \begin{bmatrix} 1350 & 1380 & 1350 \end{bmatrix}$

$= \begin{bmatrix} 2050 & 2080 & 1990 \end{bmatrix}$

Yes she did.

(d) Simon wants to buy 2 digital cameras, a film camera, 2 professional cameras and 3 Polaroid cameras. Find out which shop costs the most and which shop he should visit so that he can pay the least.

Cost of cameras $= \begin{bmatrix} 450 & 460 & 450 \end{bmatrix} \times 2 + \begin{bmatrix} 220 & 250 & 260 \end{bmatrix} + \begin{bmatrix} 800 & 780 & 810 \end{bmatrix} \times 2 + \begin{bmatrix} 350 & 350 & 320 \end{bmatrix} \times 3$

$= \begin{bmatrix} 900 & 920 & 900 \end{bmatrix} + \begin{bmatrix} 220 & 250 & 260 \end{bmatrix} + \begin{bmatrix} 1600 & 1560 & 1620 \end{bmatrix} + \begin{bmatrix} 1050 & 1050 & 960 \end{bmatrix}$

$= \begin{bmatrix} 3770 & 3780 & 3740 \end{bmatrix}$

Y cost the most and Z cost the least.

As you should have seen, it is neater and much more efficient to work with matrices for decision problems when the huge collection of data can be displayed and manipulated at the same time.