

Applications of matrices

Year 11 General Maths
Units 1 and 2

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Learning Objectives

By the end of the lesson, I would hope that you have an understanding and be able to apply to questions the following concepts:

- To be able to apply matrices to a range of questions.
- Know that matrices are uses to model real world problems.



Recap

In previous lessons, we have looked at how matrices can be used to model real world situation. By using some pretty simple mathematics (and our CAS!), we can model changes to systems and predict how our system might look in the long term.

We are now going to conclude this series of videos by looking at how we can apply matrices to some more “real world” situations.



Example 1

Freddy and George's store has a sales promotion. One free cinema ticket is given with each DVD purchased. Two cinema tickets are given with the purchase of each game.

The number of DVDs and games sold by Freddy and George is given in matrix S.

The selling price of a DVD and a game, together with the number of free tickets, is given by matrix P.

$$S = \begin{matrix} \\ \textit{Freddy} \\ \textit{George} \end{matrix} \begin{matrix} \begin{matrix} \textit{DVDs} & \textit{Games} \end{matrix} \\ \begin{bmatrix} 7 & 4 \\ 5 & 6 \end{bmatrix} \end{matrix} \qquad P = \begin{matrix} \\ \textit{DVDs} \\ \textit{Games} \end{matrix} \begin{matrix} \begin{matrix} \$ & \textit{Tickets} \end{matrix} \\ \begin{bmatrix} 20 & 1 \\ 30 & 2 \end{bmatrix} \end{matrix}$$

Find the matrix product, $S \times P$, and interpret.

$$S = \begin{matrix} \\ F \\ G \end{matrix} \begin{matrix} \begin{matrix} D & G \end{matrix} \\ \begin{bmatrix} 7 & 4 \\ 5 & 6 \end{bmatrix} \end{matrix} \quad \begin{matrix} \begin{matrix} \$ & Tic \end{matrix} \\ \begin{matrix} D \\ G \end{matrix} \begin{bmatrix} 20 & 1 \\ 30 & 2 \end{bmatrix} \end{matrix} = \begin{matrix} \\ F \\ G \end{matrix} \begin{matrix} \begin{matrix} \$ & Tick \end{matrix} \\ \begin{bmatrix} 260 & 15 \\ 280 & 17 \end{bmatrix} \end{matrix}$$



Example 1: Be careful with interpret questions

Freddy and George's store has a sales promotion. One free cinema ticket is given with each DVD purchased. Two cinema tickets are given with the purchase of each game.

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Find the matrix product, $S \times P$, and interpret.

Freddy had sales of $260 and gave out 15 tickets.
George had sales of $280 and gave out 17 tickets.

Note: When you are asked to interpret a matrix you **must always use the numbers in the matrix.**



Adding rows and columns

There will be times when we want to add rows and columns of matrices. Now, it seems a little pointless to do this using matrices, when you can simply add them using a CAS! But, you have to show **understanding** and so let's make sure you understand.

When you sum a **row,** you need to use a **column** summing matrix.
When you sum a **column,** you need to use a **row** summing matrix.

$$D = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$



A row summing matrix

A row summing matrix is a row matrix where each element is a '1'.

If I wanted to add 4 numbers together, the row matrix would have 4 one's.
If I wanted to add 10 numbers together, the row matrix would have 10 one's.

$$A = [1 \quad 1 \quad 1]$$

(1×3)

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

This would sum a column with 3 numbers.

(3×3)

$$[1 \quad 1 \quad 1]\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} = [12 \quad 15 \quad 18]$$



A column summing matrix

A column summing matrix is a column matrix where each element is a '1'.

If I wanted to add 4 numbers together, the column matrix would have 4 one's.
If I wanted to add 10 numbers together, the column matrix would have 10 one's.

$$B = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

(4×1)

This would sum a row with 4 numbers.

$$\begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

4×4

Remember that a matrix must always be named

$$= \begin{bmatrix} 10 \\ 26 \\ \vdots \\ \vdots \end{bmatrix}$$



Example 2

Three rangers completed their monthly park surveys of feral animal sightings, as shown in Matrix S.

$$S = \begin{array}{c} \\ Aaron \\ Barry \\ Chloe \end{array} \begin{array}{c} \begin{array}{cccc} cats & dogs & foxes & rabbits \end{array} \\ \begin{bmatrix} 27 & 9 & 34 & 59 \\ 18 & 15 & 10 & 89 \\ 35 & 6 & 46 & 29 \end{bmatrix} \end{array} \quad A = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

a Evaluate $S \times B$.

b What information about matrix S is given in the product $S \times B$?

a $\begin{bmatrix} 129 \\ 132 \\ 116 \end{bmatrix}$ A B C



Example 2

Three rangers completed their monthly park surveys of feral animal sightings, as shown in Matrix S.

$$S = \begin{array}{c} \\ \text{Aaron} \\ \text{Barry} \\ \text{Chloe} \end{array} \begin{array}{c} \begin{array}{cccc} \textit{cats} & \textit{dogs} & \textit{foxes} & \textit{rabbits} \end{array} \\ \begin{bmatrix} 27 & 9 & 34 & 59 \\ 18 & 15 & 10 & 89 \\ 35 & 6 & 46 & 29 \end{bmatrix} \end{array} \quad A = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

c Evaluate $A \times S$.

d What information about matrix S is given in the product $A \times S$?

c d f r

c $\begin{bmatrix} 80 & 30 & 90 & 177 \end{bmatrix}$



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