

Supplementary Lecture on section 2.4

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Definition of a Matrix.

The aim of this supplementary lecture is to help you understand the “practical meaning” of the matrix product. We discuss the related problems in homework B1. We assume that **you are familiar with the usual matrix operations** already. Compare this lecture with Lecture 3, where we did similar work, without bringing in the formalism of matrices. The following is based on **WHS problem 12 on B1 (common)**. **Suppose** that Bill holds 12, 12, 15, 16 stocks respectively of IBM, Google, Toyota and Texaco. **Suppose** that Jim holds 15, 11, 16, 17 stocks of same companies respectively. If the prices of these stocks are 5, 1, 2, 3 respectively, then we use matrices to organize the information and calculate.

Organization of the data.

- We begin by building a matrix to record the above data as follows. We have added in row and column titles for understanding, but they do not take part in matrix operations.
- **The holding Matrix.**

	IBM	Google	Toyota	Texaco
Bill	12	12	15	16
Jim	15	11	16	17

- **The price matrix.**

IBM	5
Google	1
Toyota	3
Texaco	2

- We respectively write $A = A_{2 \times 4}$ and $B = B_{4 \times 1}$ for the two matrices.

Meaning of the product AB .

- Note that we have

$$A = \begin{bmatrix} 12 & 12 & 15 & 16 \\ 15 & 11 & 16 & 17 \end{bmatrix} \text{ and } B = \begin{bmatrix} 5 \\ 1 \\ 3 \\ 2 \end{bmatrix}.$$

- And we have:

$$AB = \begin{bmatrix} 12 \cdot 5 + 12 \cdot 1 + 15 \cdot 3 + 16 \cdot 2 \\ 15 \cdot 5 + 11 \cdot 1 + 16 \cdot 3 + 17 \cdot 2 \end{bmatrix} = \begin{bmatrix} 149 \\ 158 \end{bmatrix}.$$

The calculation clearly shows that it is giving us the values of the holding of Bill and Jim respectively. This answers the questions.

Another Example.

- The following is based on **WHS problem 8 on B1 (common)**.
- we are given matrices (with informative headers):

Demands	Type I	Type II	Type III	Type IV
IL	22	22	5	23
OH	17	25	24	23
SC	14	21	12	20
TN	23	12	12	18

and

Profits	Thousand \$
Type I	19
Type II	11
Type III	15
Type IV	9

Meaning of the product.

- As before, if we name the matrices $A = A_{4 \times 4}$ and $B = B_{4 \times 1}$, then AB has type 4×1 . Its four rows correspond to the four rows of A , thus belong to the indicated states.
- The resulting column gives the profit totals.
- Thus the $(2, 1)$ entry of AB gives the profit made in OH(IO) and is equal to: $17 \cdot 19 + 25 \cdot 11 + 24 \cdot 15 + 23 \cdot 9 = 1165$.
- Similar interpretations can be made by using the meanings of the rows and columns of the matrix.
- Various examples in Chapter 2.4 should be reviewed to understand this concept.