MATH 210

FINITE MATHEMATICS

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6.3 The Multiplication Principle

A person is given a choice between 8 shirts and 3 different pants. How many different outfits can the person wear?

Definition 1: The Multiplication Principle

Suppose you have the following n tasks, T_1, T_2, ..., T_n

T_1 CAN BE PERFORMED IN N_1 WAYS

T_2 " " N_2 WAYS

AND SO ON

THE NUMBER OF WAYS TO COMPLETE ALL TASKS IS

$$N_1 \times N_2 \times N_3 \times \cdots \times N_n$$

EX) TWO TASKS

$$\frac{8}{\text{SHIRT}} \times \frac{3}{\text{PANTS}} = 24 \text{ OUTFITS}$$

Example 1

How many ways are there to fill out a 2 question multiple choice exam which has 5 possible answers A, B, C, D, E?

TWO TASKS

HOW MANY → $\underset{Q_1}{5} \times \underset{Q_2}{5} = 25$ WAYS

What about a 20 question exam? 20 TASKS

$$\underset{Q_1}{5} \times \underset{Q_2}{5} \times \underset{Q_3}{5} \times \cdots \times \underset{Q_{20}}{5} = 5^{20}$$

$$= 95,367,431,640,000 \text{ WAYS}$$

Example 2

An employee ID for a company for a company consists of the employee's first initial, last initial, and the last four digits of his/her social security number. How many possible IDs are there?

SIX TASKS

$$\underset{F}{26} \times \underset{L}{26} \times \underset{\#}{10} \times \underset{\#}{10} \times \underset{\#}{10} \times \underset{\#}{10}$$

$$= 6,760,000 \text{ POSSIBLE IDS}$$

Example 3

How many five letter code words can be constructed from only the first 15 letters of the alphabet if

5 TASKS

1. repetition of letters is allowed?

$15 \times 15 \times 15 \times 15 \times 15 = 15^5$

OR 759,375 CODEWORDS

2. no repetition is allowed?

$15 \times 14 \times 13 \times 12 \times 11 = 360,360$

Example 4

Currently my iPhone uses a 6 digit numeric code. I have the option of changing it to a custom alphanumeric password. Compare a 6 digit numeric code to a 6 character alphanumeric password.

NUMERIC $10 \quad 10 \quad 10 \quad 10 \quad 10 \quad 10$

$= 10^6$ OR 1,000,000

ALPHA NUMERIC $62 \quad 62 \quad 62 \quad 62 \quad 62 \quad 62$

$= 62^6$

5,680,023,558,00