Tues_03_15

Tuesday, March 15, 2022 2:45 PM

Reminders

1. Grades (see D2L)
2. Class Note (see D2L)
3. Exam #2 Tuesday 03/29

   3.1, 3.2, 3.3, 3.4, 10.1, 10.2, 10.3, 10.5
4. study guide for Exam #2
5. Office Hours (see Syllabus TR, 10–12 noon
   Lib RM 402
   Liverpool FC)

   visit the Tutoring Lab
6. Mid-semester write up due tonight 11:59 pm
7. hw 10.1, 10.2 due 03/8

10.2 The Fundamental Counting principle

Uniformity Criterion

In a multiple part task

If the # of choices of each part does not depend on the # of choices of the other parts selected previously

Suppose we have a 3 part task

$\boxed{9} \cdot \boxed{10} \cdot \boxed{10} = 9 \times 10^2$ (Example how many

first digit second digit third digit = 900

How many 3 digit numbers is possible?

{0, 1, 2, 3, 4, 5, 6, 7, 8, 9}

Fundamental Counting principle (FCP)

When a task consists of k separate parts and satisfies the uniformity criterion, if the first part can be done in n_1 ways, the second part in n_2 ways, ..., the Kth part in n_K ways. The total number of ways to complete the task is

$$n_1 \cdot n_2 \cdots n_K$$

Exercise

1. How many ways can you arrange 3 people in a line

$$\boxed{3} \cdot \boxed{2} \cdot \boxed{1} = 6 \text{ ways}$$

1st position 2nd position 3rd position

2. How many 3 letters can be formed from the set {A, B, C}

$$\boxed{3} \cdot \boxed{3} \cdot \boxed{3} = 3 \cdot 3 \cdot 3 = 3^3 = 27$$

first letter second letter third letter

3. How many ways can you arrange 3 people in a line

Tom, Peter, Andrew

(given that Andrew must go first in the line)

$$\boxed{1} \cdot \boxed{2} \cdot \boxed{1} = 2 \text{ ways}$$

first position second position third position

(5) Selecting Dinner ~~Item~~ Items

- 5 choices on Soup & Salad category

(2 Soups, 3 Salad)

- 2 choices in bread category

- 4 choices in Entrée category

(a) Find the number of dinners available
one item should be included from each of the 3 categories

$$\boxed{5} \cdot \boxed{2} \cdot \boxed{4} = 40$$

Soup & Salad · Bread · Entrée

(b) Only Salad and Entrée are to be included

$$\boxed{3} \cdot \boxed{4} = 12$$

Salad · Entrée

(c) one Soup, one Salad, one Entrée

$$\boxed{2} \cdot \boxed{3} \cdot \boxed{4} = 24$$

Soup · Salad · Entrée

More Exercise

1. How many non repeating (odd) 3-digit counting numbers are there

$\{0,1,2,3,4,5,6,7,8,9\}$ $\{1,3,5,7,9\}$

$$\boxed{8} \cdot \boxed{8} \cdot \boxed{5}$$

first digit · second digit · third digit

(2) Create a four-digit number from the set

$\{1,2,3\}$

How many of these numbers are odd and less than 2000

$$\boxed{1} \cdot \boxed{3} \cdot \boxed{3} \cdot \boxed{2} = 18$$

first digit · second digit · third digit · fourth digit

Factorial

Factorial

Consider the example below

How many ways can you line up 5 friends for photograph

5	4	3	2	1
1st	2nd	3rd	4th	5th

$= 5! = 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$

$= 120$

The arrangement of n objects

The # of ways to arrange n distinct object is $n!$

$n! = n \cdot (n-1) \cdot (n-2) \cdot \ldots 2 \cdot 1$ $\qquad 0! = 1$

$5! = 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$ $\qquad 1! = 1$

Exercises

① $\dfrac{9!}{7!\,(9-7)!} = \dfrac{9!}{7! \cdot 2!} = \dfrac{9 \cdot 8 \cdot \cancel{7!}}{\cancel{7!} \cdot 2!} = \dfrac{9 \cdot 8}{2 \cdot 1} = \dfrac{9 \cdot 8}{2} = 36$

Distinguishable Arrangements

Example

How many ways can you arrange the letters in the following words

1. BANANA $= \dfrac{6!}{3! \cdot 2!} = \dfrac{6 \cdot 5 \cdot 4 \cdot \cancel{3!}}{\cancel{3!} \cdot 2!} = 60$

Home work

Raj keeps phone numbers for seven closest friends (3 men & 4 women)

in his digital phone memory. How many ways can he list them for the following conditions.

(a) men listed before women

(b) men are all listed together