

# Finite Math - Spring 2019

Lecture Notes - 4/11/2019

## HOMework

- Section 7.2 - 31, 33, 34, 35, 36, 40
- Section 7.3 - 7, 8, 9, 10, 13, 17, 19, 35, 36, 52

## SECTION 7.2 - SETS

The last operation we have on sets here is to count the number of elements in a set. We will denote the number of elements in a set  $A$  by  $n(A)$ . In our running example of  $A = \{1, 2, 3, 4, 5\}$ ,  $B = \{3, 4, 5, 6, 7\}$ , and  $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ , we have the following facts:

$$\begin{aligned}n(A) &= \\n(B) &= \\n(A \cap B) &= \\n(A \cup B) &= \\n(A') &= \\n(A \cap B') &= \\n(\emptyset) &= \end{aligned}$$

**Example 1.** *Let the universal set  $U$  be the set of positive integers less than or equal to 100. Let  $A$  be the set of multiples of 3 in  $U$ , and let  $B$  be the set of multiples of 5 in  $U$ .*

- Find  $n(A \cap B)$ ,  $n(A \cap B')$ ,  $n(B \cap A')$ , and  $n(A' \cap B')$ .*
- Draw a Venn diagram with circles labeled  $A$  and  $B$ , indicating the numbers of elements in the subsets of part (a).*

**Solution.**

**Example 2.** Let the universal set  $U$  be the set of positive integers less than or equal to 100. Let  $A$  be the set of multiples of 4 in  $U$ , and let  $B$  be the set of multiples of 7 in  $U$ .

- (a) Find  $n(A \cap B)$ ,  $n(A \cap B')$ ,  $n(B \cap A')$ , and  $n(A' \cap B')$ .
- (b) Draw a Venn diagram with circles labeled  $A$  and  $B$ , indicating the numbers of elements in the subsets of part (a).

## SECTION 7.3 - BASIC COUNTING PRINCIPLES

**Addition Principle.** Suppose that there are 15 male and 20 female Physics majors at a university. How many total Physics majors are there?

Now, suppose that every freshmen who is majoring in Chemistry is enrolled in Calculus or in History. If there are 20 freshmen Chemistry majors enrolled in Calculus and 15 freshmen Chemistry majors enrolled in History. How many total freshmen Chemistry majors are there?

**Theorem 1** (Addition Principle for Counting). *For any two sets  $A$  and  $B$ ,*

**Example 3.** *According to a survey of business firms in a certain city, 345 firms offer their employees group life insurance, 285 offer long-term disability insurance, and 115 offer group life insurance and long-term disability insurance. How many firms offer their employees group life insurance or long-term disability insurance?*

## Multiplication Principle.

**Example 4.** *Suppose a store has 3 types of shirts, and in each type of shirt, they have 4 colors available. How many options are available?*

**Solution.**

**Theorem 2** (Multiplication Principle for Counting).

- (1) *If two operations  $O_1$  and  $O_2$  are performed in order, with  $N_1$  possible outcomes for the first operation and  $N_2$  possible outcomes for the second operation, then there are*

*possible combined outcomes of the first operation followed by the second operation.*

- (2) *In general, if  $n$  operations  $O_1, O_2, \dots, O_n$  are performed in order, with possible number of number of outcomes  $N_1, N_2, \dots, N_n$ , respectively, then there are*

*possible combined outcomes of the operations performed in the given order.*

**Example 5.** *Suppose a 6-sided die and a 12-sided die are rolled. How many different possible outcomes are there?*

**Example 6.** *Suppose we have a list of 8 letters that we wish to make code words from. How many possible 4-letter code words can be made if:*

- (a) *letters can be repeated?*
- (b) *no letter can be repeated?*
- (c) *adjacent letters cannot be alike?*

**Example 7.** *Repeat the above example, but with a list of 10 letters to choose from and with code words that are 5 letters long.*