REVIEW EXAMPLES

1. In Mr. Mabry's class, there are 12 boys and 16 girls. On Monday, 4 boys and 5 girls were wearing white shirts.
   a. If a student is chosen at random from Mr. Mabry's class, what is the probability of choosing a boy or a student wearing a white shirt?
   b. If a student is chosen at random from Mr. Mabry's class, what is the probability of choosing a girl or a student not wearing a white shirt?

Solution:

a. Apply the Addition Rule, $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$, where A is the set of boys and B is the set of students wearing a white shirt.

(A and B) is the set of boys wearing a white shirt. There are 12 + 16 = 28 students in Mr. Mabry's class.

So, $P(A) = \frac{12}{28}$, $P(B) = \frac{4+5}{28} = \frac{9}{28}$, and $P(A \text{ and } B) = \frac{4}{28}$.

$P(\text{a boy or a student wearing a white shirt}) = \frac{12}{28} + \frac{9}{28} - \frac{4}{28} = \frac{17}{28}$

b. Apply the Addition Rule, $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$, where A is the set of girls and B is the set of students not wearing a white shirt.

(A and B) is the set of girls not wearing a white shirt. There are 12 + 16 = 28 students in Mr. Mabry's class.

So, $P(A) = \frac{16}{28}$, $P(B) = \frac{8+11}{28} = \frac{19}{28}$, and $P(A \text{ and } B) = \frac{11}{28}$.

$P(\text{a girl or a student not wearing a white shirt}) = \frac{16}{28} + \frac{19}{28} - \frac{11}{28} = \frac{24}{28} = \frac{6}{7}$

2. Terry has a number cube with sides labeled 1 through 6. He rolls the number cube twice.
   a. What is the probability that the sum of the two rolls is a prime number, given that at least one of the rolls is a 3?
   b. What is the probability that the sum of the two rolls is a prime number or at least one of the rolls is a 3?

Solution:

a. This is an example of a mutually exclusive event. Make a list of the combinations where at least one of the rolls is a 3. There are 11 such pairs.

1, 3	2, 3	3, 3	4, 3	5, 3	6, 3
3, 1	3, 2	3, 4	3, 5	3, 6	

Then identify the pairs that have a prime sum.

2, 3	3, 2	3, 4	4, 3

Of the 11 pairs of outcomes, there are 4 pairs whose sum is prime. Therefore, the probability that the sum is prime of those that show a 3 on at least one roll is $\frac{4}{11}$.

b. This is an example of events that are NOT mutually exclusive. There are 36 possible outcomes when rolling a number cube twice.

List the combinations where at least one of the rolls is a 3.

1, 3	2, 3	3, 3	4, 3	5, 3	6, 3
3, 1	3, 2	3, 4	3, 5	3, 6	

$P(\text{at least one roll is a 3}) = \frac{11}{36}$

List the combinations that have a prime sum.

1, 1	1, 2	1, 4	1, 6
2, 1	2, 3	2, 5	
3, 2	3, 4		
4, 1	4, 3		
5, 2	5, 6		
6, 1	6, 5		

$P(\text{a prime sum}) = \frac{15}{36}$

Identify the combinations that are in both lists.

2, 3	3, 2	3, 4	4, 3

The combinations in both lists represent the intersection. The probability of the intersection is the number of outcomes in the intersection divided by the total possible outcomes.

P(at least one roll is a 3 **and** a prime sum) = $\frac{4}{36}$

If two events share outcomes, then outcomes in the intersection are counted twice when the probabilities of the events are added. So you must subtract the probability of the intersection from the sum of the probabilities.

P(at least one roll is a 3 **or** a prime sum) = $\frac{11}{36} + \frac{15}{36} - \frac{4}{36} = \frac{22}{36} = \frac{11}{18}$