Probability

- Expressed as a number from 0 to 1
- An impossible event has a probability of 0
- An event that must occur has a probability of 1.
- The sum of the probabilities of all outcomes in a sample space is 1.

Definitions:

Complement of A (A')	all outcomes not in A
	Probability of the Complement of A: $P(A') = 1 - P(A)$
Conditional Probability	The probability that B will occur given that A has occurred

Dependent Events	two events for which the the occurrence of one affects the occurrence of the other

Event	an individual outcome or any specified combinations of outcomes
Experiment	one or more trials
Experimental Probability	a probability approximated by performing trials and recording the ratio of the number of outcomes of occurrences of the event to the number of trials

Fundamental Counting Principle	If there are *m* ways that one event can occur and *n* ways that another event can occur, then there are *m* x *n* ways that both events can occur.
Inclusive Events (overlapping)	events that can occur at the same time
Independent Events	two events for which the occurrence of one has no effect on the occurrence of the other
Mutually Exclusive Events	events that cannot occur at the same time
Outcome	a possible result of an experiment

Probability of *A* or *B*

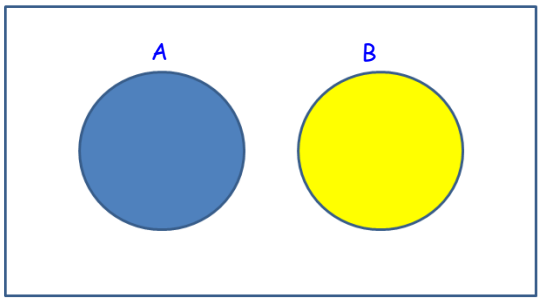
A and *B* are mutually exclusive:

$$P(A \text{ or } B) = P(A) + P(B)$$

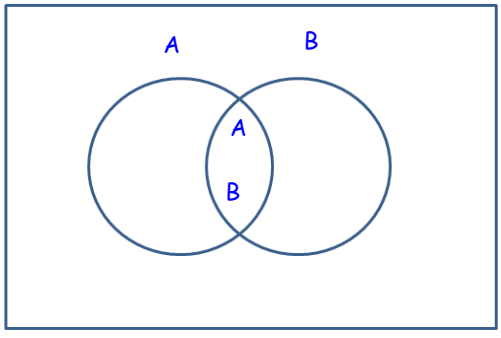
A and *B* are inclusive:

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

A or B, exclusive



A or B, inclusive



Probability of *A* and *B* if *A* and *B* are dependent:

$$P(A \text{ and } B) = P(A) \times P(B)$$

$P(B)$ given that A has happened

$$P(A \cap B) = P(A) \cdot P(B|A)$$

$$\frac{P(A \cap B)}{P(A)} = P(B|A)$$

Sample Space	the set of all possible outcomes of an event
Theoretical Probability	$\frac{\text{\# of outcomes in event A}}{\text{\# of outcomes in sample space}}$
Trial	a systematic opportunity for an event to occur

Probability of Two Independent Events

$P(A \text{ and } B) = P(A) \times P(B)$

Bag A contains 9 red marbles and 3 green marbles. Bag B contains 9 black marbles and 6 orange marbles.

Find the probability of selecting 1 green marble from bag A and one black marble from bag B in one draw from each bag.

$$\frac{3}{12} \cdot \frac{9}{15} = \frac{1}{4} \cdot \frac{3}{5} = \boxed{\frac{3}{20}}$$

Probability of Two Dependent Events

$$P(B|A) = \frac{P(A \text{ and } B)}{P(A)}$$

(given)

A bag contains 9 red marbles and 3 green marbles. Find the probability of randomly selecting a red marble on the first draw and green marble on the second draw.

a) The first marble is replaced.

$$\frac{9}{12} \cdot \frac{3}{12} = \frac{3}{4} \cdot \frac{1}{4} = \boxed{\frac{3}{16}}$$

b) The first marble is not replaced.

$$\frac{9}{12} \cdot \frac{3}{11} = \frac{3}{4} \cdot \frac{3}{11} = \boxed{\frac{9}{44}}$$