

# Probability – Adding Probabilities

## Probability of Mutually Exclusive Events →

If two events, A and B, are mutually exclusive (two events cannot occur at the same time),

then the probability of one event or another event is  $P(A \text{ or } B) = P(A) + P(B)$

**Example 1:** Complete each problem about finding the probability of mutually exclusive events.

a.) Keisha has a stack of 8 baseball cards, 5 basketball cards, and 6 soccer cards. If she selects a card at random from the stack, find the probability of the situations below. <i>19 cards total</i>		b.) A card is drawn from a standard deck of cards. Determine the probability. <i>52 cards total</i>	
i.) P (baseball or soccer) $P(\text{base}) + P(\text{soccer})$ $= \frac{8}{19} + \frac{6}{19}$ $= \frac{14}{19} = \boxed{73.7\%}$	ii.) P (football or basketball) $P(\text{foot}) + P(\text{basket})$ $= \frac{0}{19} + \frac{5}{19}$ $= \frac{5}{19} = \boxed{26.3\%}$	i.) P (6 or king) $P(6) + P(K)$ $= \frac{4}{52} + \frac{4}{52}$ $= \frac{8}{52} = \boxed{15.4\%}$	ii.) P (red or black) $P(\text{red}) + P(\text{black})$ $= \frac{26}{52} + \frac{26}{52}$ $= \frac{52}{52} = \boxed{100\%}$

## Probability of Inclusive Events →

If two events, A and B, are inclusive (two events can occur at the same time),

then the probability one event or another event is  $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

**Example 2:** Complete each problem about finding the probability of inclusive events.

a.) The enrollment at South High School is <u>1400</u> . Suppose 550 students take French, 700 take Algebra, and <u>400</u> take both French and Algebra. <i>total</i>		b.) A card is drawn from a standard deck of cards. Determine the probability. <i>52 cards total</i>	
i.) Draw a Venn Diagram to illustrate situation.  <i>French + Alg</i> <i>150 300 400</i> <i>550 700</i> <i>= 1400 b/c not everyone takes French + Alg</i>	ii.) P (French or Algebra) $P(F) + P(A) - P(F \text{ and } A)$ $= \frac{550}{1400} + \frac{700}{1400} - \frac{400}{1400}$ $= \frac{850}{1400}$ $= \boxed{60.7\%}$	i.) P (queen or diamond) $P(Q) + P(D) - P(Q \cap D)$ $= \frac{4}{52} + \frac{13}{52} - \frac{1}{52}$ $= \frac{16}{52} = \boxed{30.8\%}$	ii.) P (black or ace) $P(B) + P(A) - P(B \cap A)$ $= \frac{26}{52} + \frac{4}{52} - \frac{2}{52}$ $= \frac{28}{52} = \boxed{53.8\%}$

**Example 3:** Two cards are drawn from a standard deck of cards. Find each probability.  
*use nCr (combinators)*

a.) P (2 kings or 2 black) $P(\text{2 Kings}) + P(\text{2 black}) - P(\text{2 black Kings})$ $\frac{4C2}{52C2} + \frac{26C2}{52C2} - \frac{2C2}{52C2}$ $= \frac{6 + 325 - 1}{1326} = \boxed{24.9\%}$	b.) P (both 8 or both jacks) $P(\text{2 8's}) + P(\text{2 Jacks})$ $\frac{4C2}{52C2} + \frac{4C2}{52C2}$ $= \frac{6 + 6}{1326} = \boxed{.9\%}$	c.) P (both 3's or both < 5) $P(\text{2 3's}) + P(\text{2 < 5's}) - P(\text{2 3's < 5's})$ $\frac{4C2}{52C2} + \frac{12C2}{52C2} - \frac{4C2}{52C2}$ $= \frac{6 + 66 - 6}{1326} = \boxed{5\%}$	d.) P (2 face or 2 red) $P(\text{2 face}) + P(\text{2 red}) - P(\text{2 red face})$ $\frac{12C2}{52C2} + \frac{26C2}{52C2} - \frac{6C2}{52C2}$ $= \frac{66 + 325 - 15}{1326} = \boxed{28.2\%}$
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**Example 4: Determine whether the events are exclusive or inclusive. Then find the probability.**

- a.) There are 3 literature books, 4 algebra books, and 2 biology books on a shelf. *9 books total*  
If a book is randomly selected, what is the probability of selecting a literature book or an algebra book?

$$E_{(\text{no both})} \rightarrow P(L) + P(A) = \frac{3}{9} + \frac{4}{9} = \frac{7}{9} = \boxed{77.8\%}$$

- b.) A die is rolled. What is the probability of rolling a 5 or a number greater than 3? *6 total #s*

$$I_{(\text{both})} \rightarrow P(5) + P(>3) - P(5 \text{ and } >3) = \frac{1}{6} + \frac{3}{6} - \frac{1}{6} = \frac{3}{6} = \boxed{50\%}$$

- c.) In the Math Club, 7 of the 20 girls are seniors, and 4 of the 14 boys are seniors. What is the probability of randomly selecting a boy or a senior to represent the club at a statewide math contest? *34 ppl total, 11 seniors total*

$$I \rightarrow P(B) + P(S) - P(B \text{ and } S) = \frac{14}{34} + \frac{11}{34} - \frac{4}{34} = \frac{21}{34} = \boxed{61.8\%}$$

- d.) Jamie reaches into a dish and selects a token at random. Find the probability of each situation. *14 tokens total*

- i.) What is the probability of Jamie picking a circle or heart token?

$$E \rightarrow P(\bigcirc) + P(\heartsuit) = \frac{5}{14} + \frac{4}{14} = \frac{9}{14} = \boxed{64.3\%}$$

- ii.) What is the probability of Jamie picking a triangle or blue token?

$$I \rightarrow P(\triangle) + P(\text{Blue}) - P(\triangle \text{ and Blue}) = \frac{3}{14} + \frac{4}{14} - \frac{1}{14} = \frac{6}{14} = \boxed{42.9\%}$$

- iii.) What is the probability of Jamie picking an orange or hexagon token?

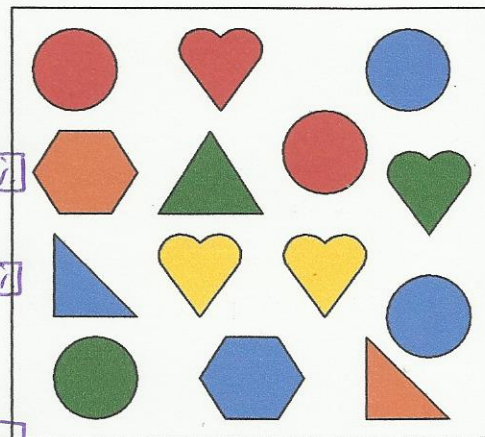
$$I \rightarrow P(\text{orange}) + P(\hexagon) - P(\text{orange hexagon}) = \frac{2}{14} + \frac{2}{14} - \frac{1}{14} = \frac{3}{14} = \boxed{21.4\%}$$

- iv.) What is the probability of Jamie picking a blue heart or green triangle?

$$E \rightarrow P(\heartsuit \text{ and Blue}) + P(\triangle \text{ and Green}) = \frac{0}{14} + \frac{1}{14} = \frac{1}{14} = \boxed{7.1\%}$$

- v.) What is the probability of Jamie picking a red or yellow token?

$$E \rightarrow P(\text{red}) + P(\text{yellow}) = \frac{3}{14} + \frac{2}{14} = \frac{5}{14} = \boxed{35.7\%}$$



- e.) One tile with each letter of the alphabet is placed in a bag, and one is drawn at random. *26 total letters, 5 vowels*  
What is the probability of selecting a vowel or a letter from the word EQUATION?

$$I \rightarrow P(\text{vowel}) + P(\text{letter from word}) - P(\text{vowels in word}) = \frac{5}{26} + \frac{8}{26} - \frac{5}{26} = \frac{8}{26} = \boxed{30.8\%}$$

- f.) There are 7 girls and 6 boys on the junior class homecoming committee.

A subcommittee of 4 people is being chosen at random to decide the theme for the class float.

What is the probability that the subcommittee will be 3 girls or 2 boys? *13 ppl total, 4 will be selected*

$$P(3 \text{ girls (and 1 boy)}) \text{ or } P(2 \text{ boys (and 2 girls)})$$

$$E \rightarrow = \frac{{}^7C_3 \cdot {}^6C_1}{{}^{13}C_4} + \frac{{}^6C_2 \cdot {}^7C_2}{{}^{13}C_4} = \frac{35 \cdot 6}{715} + \frac{21 \cdot 15}{715} = \frac{525}{715} = \boxed{73.4\%}$$

- g.) The Venn Diagram below represents senior citizens and their music preferences.

The number of senior citizens surveyed was 60. Determine the probability of each situation.

- a.) P (only Western or only Classical)

$$E \rightarrow P(\text{only W}) + P(\text{only C}) = \frac{6}{60} + \frac{3}{60} = \frac{9}{60} = \boxed{15\%}$$

- b.) P (Classical or 1940's Pop)

$$I \rightarrow P(C) + P(P) - P(C \text{ and } P) = \frac{3+7+6+5}{60} + \frac{5+6+4+9}{60} - \frac{5+6}{60} = \frac{21+24-11}{60} = \frac{34}{60} = \boxed{56.7\%}$$

- c.) P (Classical and Western and 1940's Pop)

$$E \rightarrow P(C \cdot W \cdot P) = \frac{6}{60} = \boxed{10\%}$$

