5.4 – Mutually Exclusive Events

Date: April.3

Recall - **mutually exclusive events** are events that have no elements in common.

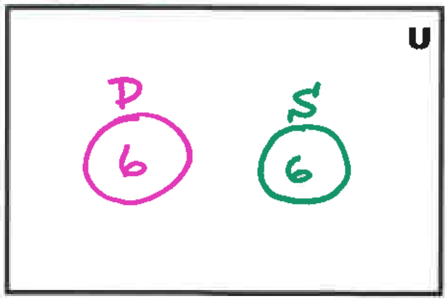
Example: Find the probability of throwing either doubles or a sum of seven using two standard six-sided dice.

D S = +

MUTUALLY EXCLUSIVE (no overlap)

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

36 possible outcomes



$n(D) = 6$

$n(S) = 6$

$n(D \cup S) = 6 + 6$
$= 12$

$P(D \cup S) = \frac{12}{36}$
$= \boxed{\frac{1}{3}}$

Determining the probability of events that are not mutually exclusive:

Recall: **The principle of inclusion and exclusion:** The number of elements in the union of two sets is equal to the sum of the number of elements in each set, less the number of elements in both sets.

$$n(A \cup B) = n(A) + n(B) - n(A \cap B)$$

F + ~~13~~ H

Example: What is the probability of pulling a face card or a heart from a standard deck of cards? Solve using set theory. Include a Venn diagram.

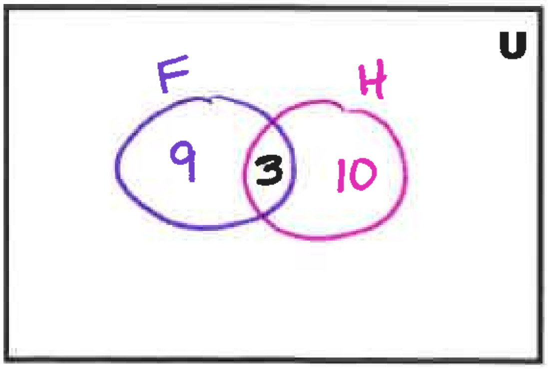
NOT MUTUALLY EXCLUSIVE (overlap)

$n(F) = 12$

$n(H) = 13$

$n(F \cap H) = 3$

$P(F \cup H) = \frac{22}{52}$
$= \boxed{\frac{11}{26}}$



$n(F \cup H) = 9 + 3 + 10$
OR
$= 12 + 13 - 3$ } 22

Example: What is another set theory formula that would work to solve the previous example? (work with probabilities)

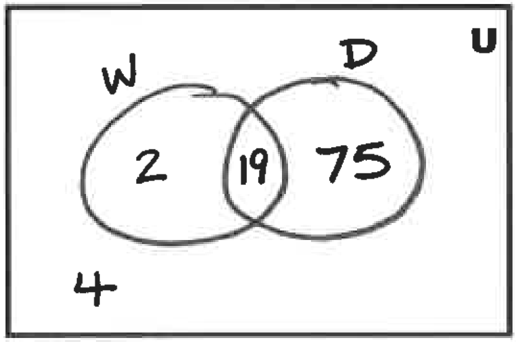
$$P(F\cup H) = P(F) + P(H) - P(F\cap H)$$
$$= \frac{12}{52} + \frac{13}{52} - \frac{3}{52}$$
$$= \frac{22}{52} = \boxed{\frac{11}{26}}$$

Using a Venn diagram to solve a probability problem that involves two events:

94-19=75

Example: A study published the following results:

- $P(W)$ 21% of adults walk to work
- $P(D)$ 94% of adults drive to work
- $P(W\cup D)'$ 4% of adults neither drive nor walk to work



$P(U) = 100$

a. Determine the probability that a randomly selected adult either walks **or** drives to work.

$$P(W\cup D) = P(U) - P(W\cup D)'$$
$$= 100 - 4$$
$$= \boxed{96\%}$$

b. Determine the probability that a randomly selected adult both walks **and** drives to work.

$\boxed{\text{find } P(W\cap D)}$

$$P(W\cup D) = P(W) + P(D) - P(W\cap D)$$
$$96 = 21 + 94 - P(W\cap D)$$
$$96 = 115 - P(W\cap D)$$
$$P(W\cap D) = \boxed{19\%}$$

c. Determine the probability that a randomly selected adult walks but does not drive to work.

$$P(W/D) = P(W) - P(W\cap D)$$
$$= 21 - 19$$
$$= \boxed{2\%}$$

Determining the probability of two events:

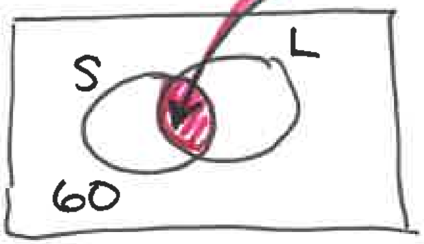
Example: Pokemon cards distribute special cards randomly in their packs. The probability of a specialty card being in a deck is 35%. The probability of a limited edition card being in a deck is 20%. 60% of packages will contain neither type of card. What is the probability of a single deck having both a specialty card and a limited edition card?

$P(S) = 35\%$

$P(L) = 20\%$

$P(S \cup L)' = 60\%$

want to find $\boxed{P(S \cap L)}$



$P(U) = 100\%$

$P(S \cup L) = 100 - 60$

$= 40\%$

$$P(S \cup L) = P(S) + P(L) - P(S \cap L)$$

$$40 = 35 + 20 - P(S \cap L)$$

$$40 = 55 - P(S \cap L)$$

$$P(S \cap L) = \boxed{15\%}$$