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

5-3 Day 1: Conditional Probability + Independence

the prob. that one event happens given another happened

Class Rock, Paper, Scissors

	R	P	S	
W	28	25	21	74
L	26	20	25	71
	54	45	46	145

$P(W) = \frac{74}{145} \approx 0.510$

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

$\boxed{\text{Ex 1}}$ If we throw paper, what is the probability we win?

$$P(W|P) = \frac{25}{45} \approx 0.5\bar{5}$$

"given that"

$$= \frac{\frac{25}{145}}{\frac{45}{145}} = \frac{25}{\cancel{145}} \cdot \frac{\cancel{145}}{45}$$

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

"under the condition"

"if"

$$P(P|W) = \frac{25}{74} \approx 0.338$$

General Multiplication Rule

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

Independence : A + B are independent if knowing one event happens does not change the probability of the other happening.

(flipping coins)

Let A be event that first flip is heads

Let B be the event that second flip is heads

$\}$ **Independent**

However A & C are NOT Independent.

because if first flip is tails then $P(C) = 0$.

$P(C|A^c)$

if first flip is heads then $P(C) = 0.5$

$P(C|A) =$

Let C be the event that both flips are heads.

NOT Independent

=

"association"

A & B are independent if

$$P(A) = P(A|B) = P(A|B^c)$$

$$P(B) = P(B|A) = P(B|A^c)$$

$\boxed{Ex2}$ Are W and R independent

$$P(W) = \frac{74}{145} \approx 0.5102$$

$$P(W|R) = \frac{28}{54} \approx 0.518$$

$$P(W|R^c) = \frac{25+21}{45+46} = \frac{46}{91} = 0.5054$$

They are Not independent since $P(W) \neq P(W|R^c)$