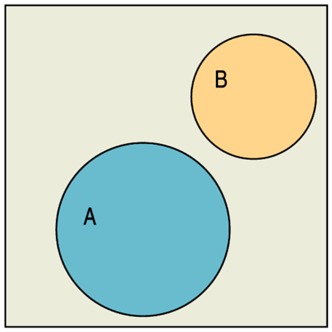
Chapter 13 - Probability Rules!

13.1 The General Addition Rule

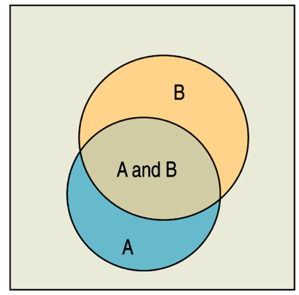
Addition Rule: For two disjoint events A and B,

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

What happens if A and B are not disjoint?



Two disjoint sets, **A** and **B.**



Two sets **A** and **B** that are not disjoint. The event (**A** and **B**) is their intersection.

Notice the area that includes A and B is included twice.

General Addition Rule: For any two events A and B,

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

Examples:

1. Using a standard deck of 52 cards (2 colors {Black and Red}, 4 suits {Clubs, Spades, Diamonds, and Hearts}, 13 types {Ace-10, Jack, Queen, King}, draw a card at random and find the following probabilities.

   - The card is a 10 or a 3.

   - The card is a 10 or a Spade.

2. p. 357, #16

3. p. 357, #20

College		Birth Order		
		1 or only	2 or more	Total
	Arts & Sciences	34	23	57
	Agriculture	52	41	93
	Human Ecology	15	28	43
	Other	12	18	30
	Total	113	110	223

13.2 Conditional Probability and the General Multiplication Rule

Conditional Probability gives the probability of one event under the condition another event has occurred.

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

Examples:

1. p. 357, #22

2. p. 357, #26

College		Birth Order		
		1 or only	2 or more	Total
	Arts & Sciences	34	23	57
	Agriculture	52	41	93
	Human Ecology	15	28	43
	Other	12	18	30
	Total	113	110	223

Multiplication Rule: For two independent events A and B,

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

What happens if A and B are not independent?

General Multiplication Rule: For any two events A and B,

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

Or

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

13.3 Independence

Events A and B are **independent** if the probability of one does not change if the other event has already occurred – i.e., $P(B \mid A) = P(B)$.

Example:
p. 359, #36

Independent ≠ Disjoint

13.4 Picturing Probability

The General Multiplication Rule can be seen in **Drawing Without Replacement.** This just means that once an object is drawn it is not put back into the pool. This is not a problem for large populations, but it is important when working with small populations.

Example: A jar contains 6 Blue Marbles, 4 Red Marbles, and 5 Green Marbles. What is the probability of randomly pulling out 2 Blue Marbles?

- With Replacement:

- Without Replacement:

Tree Diagrams can also help in working with conditional probabilities. The branches of the trees are the different events given that other events have occurred.

Example: p. 360: 48 & 50