TOPIC: PROBABILITY

Introduction to Probability

◆ How likely an event is to happen is called the **probability** of the event, written as $P(event)$

- In general, $P(event) = \frac{\#\ of\ times\ event\ occurs}{TOTAL}$

Theoretical Probability

$P(heads) =$ _____

- Based on what **[COULD | DID]** happen
- Calculated **[BEFORE | AFTER]** events occur

$$P(event) = \frac{\#\ of\ outcomes\ with\ event}{\#\ of\ TOTAL\ possible\ outcomes}$$

EXAMPLE

When rolling a six-sided die, what is the probability of rolling a number greater than 3?

Empirical (Experimental) Probability

Toss #	1	2	3
Result	T	H	H

$P(heads) =$ _____

- Based on what **[COULD | DID]** happen
- Calculated **[BEFORE | AFTER]** events occur

$$P(event) = \frac{\#\ of\ times\ event\ occured}{TOTAL\ \#\ of\ trials}$$

EXAMPLE

The table below shows the results of rolling a six-sided die 10 times. Given that data, what is the probability of rolling a number greater than 3?

Roll	1	2	3	4	5	6	7	8	9	10
Outcome	6	4	2	5	5	5	6	1	4	5

◆ You may see the possible outcomes of an event expressed as a *set*, referred to as a **sample space**.

- For example, the **sample space** of flipping a coin is S = {_____}

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PRACTICE

Given the data below, determine the probability that a person randomly selected from Group 1 will be wearing jeans.

	Group 1	Group 2	Group 3
Wearing Jeans	68	27	17
Not wearing jeans	63	36	89

PRACTICE

In your coin purse, you have 3 quarters, 4 nickels, & 2 dimes. If you pick a coin at random, what is the probability that it will be a quarter?

EXAMPLE

When playing a particular lottery game, you must choose 5 numbers between 1 and 40. You win if the 5 numbers you choose match those drawn in the lottery. What is the probability that you will win if you purchase…

(***A***)
1 lottery ticket?

(***B***)
50 different lottery tickets?

Recall

$$P(event) = \frac{\#\ of\ outcomes\ with\ event}{\#\ of\ TOTAL\ outcomes}$$
(*Probability*)

$${}_nC_r = \frac{n!}{(n-r)! \cdot r!}$$
(*Combinations*)

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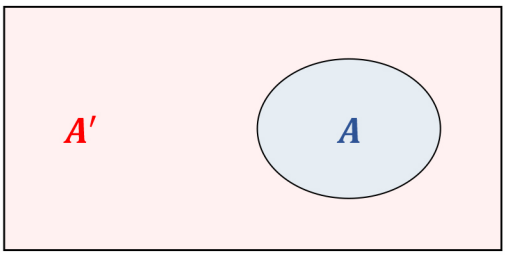
Complementary Events

◆ All outcomes where an event ***A*** does **NOT** occur is the **complement** of ***A*** (written as ____, ____ or ____).

- The total probability of ALL possible events is *ALWAYS* _____.

Rolling a Six-Sided Die



$$P(A) + P(A') = \_\_\_$$

New

$$P(A') = \_\_\_\_\_$$

EXAMPLE

(A) When rolling a six-sided die, probability that you will roll a 4?

What is the probability that you will NOT roll a 4?

Recall

$$P(event) = \frac{\#\ of\ outcomes\ with\ event}{\#\ of\ TOTAL\ outcomes}$$

(B) When drawing a single card from a standard deck of 52, what it the probability that you will NOT draw a queen?

PRACTICE When drawing a marble out of a bag of red, green, and yellow marbles 8 times, a red or yellow marble is drawn 6 times. What is the probability of drawing a green marble?

PRACTICE A weatherman states that the probability that it will rain tomorrow is 10%, or 0.1, & the probability that it will snow is 25%, or 0.25. What is the probability that it will not rain or snow?

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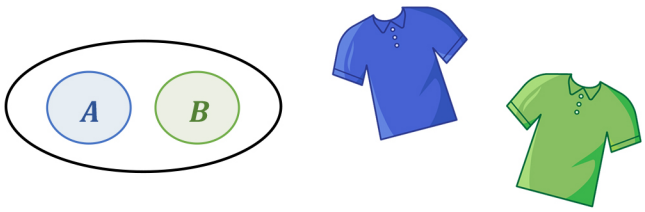
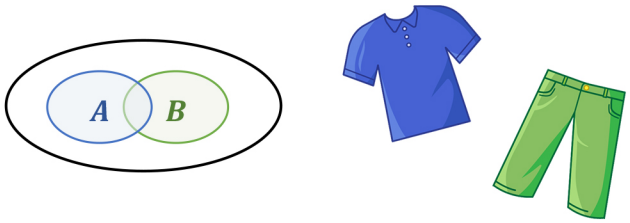
Probability of Mutually Exclusive Events

◆ Events which **CANNOT** happen at the same time are **mutually exclusive**.

Mutually Exclusive Events



NOT Mutually Exclusive



EXAMPLE Identify whether each set of events is mutually exclusive or not.

(A) Getting heads when flipping a coin vs getting tails

Events **[ARE | ARE *NOT*]** mutually exclusive

(B) Getting a 6 when rolling a die vs getting a number higher than 3

Events **[ARE | ARE *NOT*]** mutually exclusive

◆ To find the probability of *any* one of multiple mutually exclusive events occurring, _____ the probability of each.

- $A \cup B$ means any event in A **OR** B

New

$$P(A \cup B) = \_\_\_\_\_$$

EXAMPLE You roll a six-sided die. What is the probability of getting a 3 **OR** a 5?

Recall

$$P(event) = \frac{\#\ of\ outcomes\ with\ event}{\#\ of\ TOTAL\ outcomes}$$

PRACTICE If a single card is randomly selected from a deck of cards, what is the probability of selecting an ace or a king?

PRACTICE For two mutually exclusive events A and B, compute $P(A \cup B)$ if $P(A) = 0.15$ and $P(B) = 0.32$

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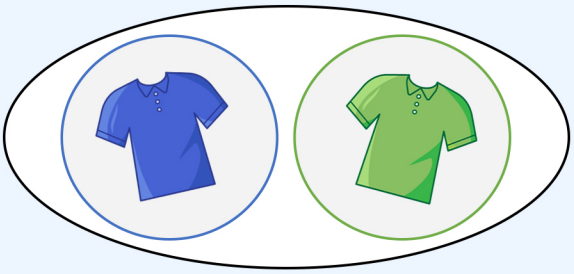
Probability of Non-Mutually Exclusive Events

◆ For events which are **NOT** mutually exclusive, there is overlap in which both events can occur at the same time.

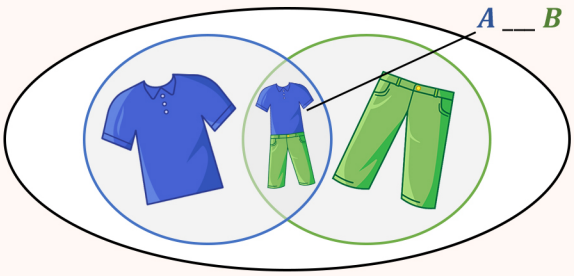
- We must subtract the probability of the _____, so it doesn't get counted twice.

Recall Mutually Exclusive



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

New NOT Mutually Exclusive

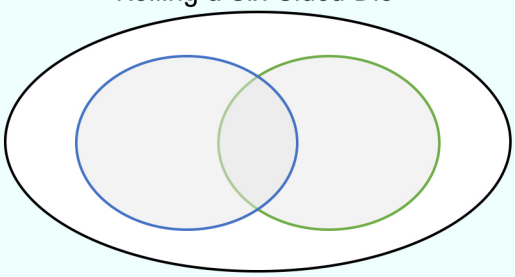


$$P(A \cup B) = P(A) + P(B) - \_\_\_\_\_$$

"or" "and"

EXAMPLE When rolling a six-sided die, what is the probability of rolling a number greater than 3 **OR** an even number?

Rolling a Six-Sided Die



$P(\_\_\_\_\_ \cup \_\_\_\_\_) =$ $+$ $-$

◆ The equation for $P(A \cup B)$ is the same for *all* events, but for mutually exclusive events, $P(A \cap B)$ is always ___.

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EXAMPLE

The table below shows the outfits of 300 observed people on a given day. Of one person randomly selected from this group, what is the probability that they will be wearing shorts or a green shirt?

	Wearing a red shirt	Wearing a blue shirt	Wearing a green shirt	Total
Wearing Pants	68	27	17	112
Wearing Shorts	63	36	89	188
Total	131	63	106	300

PRACTICE

A card is drawn from a standard deck of 52 cards. What is the probability that the card is a diamond or a king?

TOPIC: PROBABILITY

Probability of Multiple Independent Events

◆ Events which do **NOT** depend on each other at all are called **Independent Events**.

EXAMPLE Identify whether each set of events is independent or dependent.

(A) Getting tails on the first toss of a coin
Getting tails on the second toss of a coin

[INDEPENDENT | DEPENDENT]

(B) Drawing and keeping a blue marble from a bag
Drawing a blue marble again

[INDEPENDENT | DEPENDENT]

◆ For independent events, find the probability of event A *AND* event B occurring by _____ their probabilities.

New

$$P(A \cap B) = P(A) \_\_\_ P(B)$$

EXAMPLE Find the probability of each set of events.

(A) Getting heads on two consecutive coin flips

(B) Rolling an even number on the first roll of a six-sided die and rolling a 3 on the second roll

◆ For any number of **independent events**, multiply _____ probabilities to find $P(A \cap B \cap C \cap \ldots)$.

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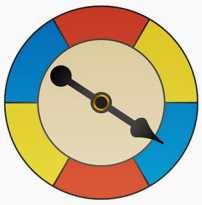
PRACTICE

The spinner below has 6 equal regions. Find the probability of landing on yellow for the first spin and not landing on yellow on the second spin.



PRACTICE

The spinner below has 6 equal colored regions numbered 1-6. Find the probability of stopping on yellow for the first spin, stopping on an even number on the second spin, and stopping on blue or red on the third spin.