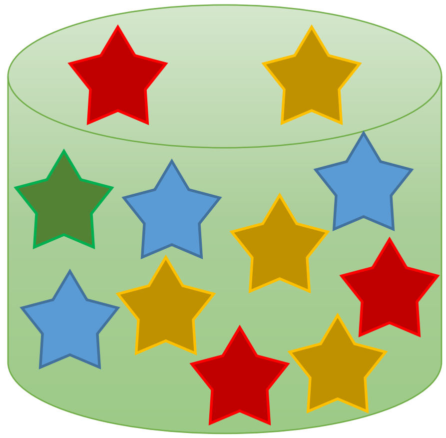
PROBABILITY

In the real world, some events happen by chance. In mathematics, we study those possibilities through probability. First, we'll look at simple probability and how to represent probability problems mathematically.

Compound probability is the probability of independent events occurring more than once. We'll look at the possible outcomes of tossing two coins. One useful tool for working with probability is to list all of the possible outcomes using a tree diagram. Once we list all possible outcomes, we determine the probability of each outcome.

Knowing the odds of the outcome of an event may increase your chances of predicting probable outcomes more accurately. We'll look at the theoretical probability of outcomes, and then test the theoretical with actual trials to see how close the theoretical probability matches the actual outcomes.

Simple Probability



The probability of selecting a gold star out of the entire container of stars is 4 out of 11.

Probability can be written as a **ratio** as the **number of outcomes desired : all possible outcomes**. The probability of selecting a gold star can be written as **4 : 11**.

Probability can be written as a fraction. $\dfrac{\textbf{Number of outcomes desired}}{\textbf{All possible outcomes}}$

The probability of selecting a **gold star** can be written as $\frac{4}{11}$.

Another way to write out a probability statement is to say **P(gold star) =** $\frac{4}{11}$.

What is the probability of selecting a **black star**?

Since there are no black stars, then the probability would be 0 : 11 or $\frac{0}{11}$ or **no** chance of happening.

Another way to write out a probability statement is to say **P(black star) =** 0.

What is the probability of selecting a **any color** of star in the jar?

Since this covers all of the stars, then the probability would be 11 : 11 or $\frac{11}{11}$ or 1 a **sure thing** that it would happen.

Another way to write out a probability statement is to say **P(any star) =** 1.

Theoretical Probability

When flipping two coins, list all possible outcomes.

Solution 1: Solve by making a chart and filling in all possibilities.

Theoretically, what is the probability of tossing two "heads"? *Since there is only one outcome out of four with two "heads", the probability is* $\frac{1}{4}$.

What is the probability of tossing a head and a tail? *Since there are two outcomes out of four a "head" and a "tail", the probability is* $\frac{2}{4}$ *or* $\frac{1}{2}$.

What is the probability of tossing two tails? *Since there is only one outcome out of four with two "tails", the probability is* $\frac{1}{4}$.

Coin 1	Coin 2	Theoretical Outcome Possibility (as a fraction)
H	H	$\frac{1}{4}$
T	H	$\frac{1}{4}$
H	T	$\frac{1}{4}$
T	T	$\frac{1}{4}$

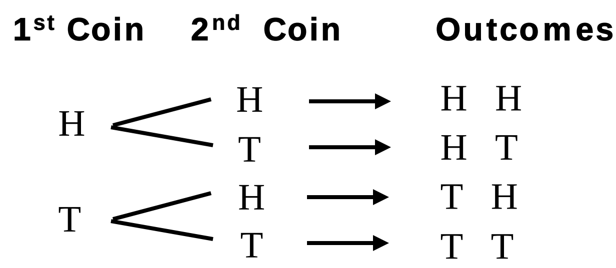
***Note*:** A head tossed on Coin 1 and a tail tossed on Coin 2 is a different outcome than a tail tossed on Coin 1 and a head tossed on Coin 2.

Summary of Outcomes

Possibilities	Outcome (as a fraction)
Two Heads	$\frac{1}{4}$
Heads/Tails	$\frac{1}{2}$
Two Tails	$\frac{1}{4}$

$$\left(\frac{1}{4}+\frac{1}{4}=\frac{2}{4}=\frac{1}{2}\right)$$

Solution 2: Make a tree diagram to list all possible outcomes, and then solve the problem.



Theoretical Probability Compared to Actual Results

Knowing the theoretical probability of tossing two coins, April predicted that if she tossed two coins 100 times, she would get a tail/head combination 50 times. She organized her data in the table below. Was her prediction accurate?

Possibilities	Theoretical Outcome as a Fraction and Decimal	Actual Tally	Actual Outcome as a Fraction and Decimal
Two Heads	$\frac{1}{4} = 0.25$	卌 卌 卌 卌 |||	$\frac{23}{100} = 0.23$
Heads/Tails	$\frac{1}{5} = 0.50$ or 0.5	卌 卌 卌 卌 卌 卌 卌 卌 卌 卌 |	$\frac{51}{100} = 0.51$
Two Tails	$\frac{1}{4} = 0.25$	卌 卌 卌 卌 卌 |	$\frac{26}{100} = 0.26$

Even though the actual prediction was not exactly the same as the theoretical outcomes, the actual tosses closely approached the value of the theoretical probability.

A summary of the results would be that if two coins were tossed, the most likely outcome is a head/tail combination.