PROBABILITY

Ever wondered if it'll rain tomorrow or if you'll win a game? That's probability! It's a math way to guess how likely things are to happen.

A OUTCOME

Definition Outcome

An **outcome** is one possible result of a random experiment.

Definition All Possible Outcomes

All possible outcomes are the complete list of everything that could happen in a random experiment.

Ex: What are all the possible outcomes when you flip a coin? 

Answer: All possible outcomes are Heads (H) and Tails (T).

Ex: What are all the possible outcomes when you roll a six-sided die?

Answer: All possible outcomes are 1=  ,2=  ,3=  ,4=  ,5=  ,and 6=  .

B EVENT

Definition Event

An **event** is a set of outcomes from all possible outcomes.

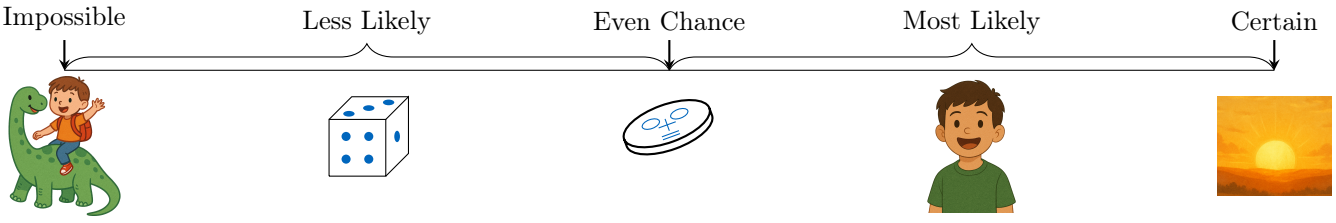
Ex: In the experiment of rolling a die, find the outcomes that correspond to rolling a number greater than 4.

Answer: The outcomes for "rolling an even number" are 2=  ,4=  ,and 6=  .

C USING WORDS TO DESCRIBE PROBABILITY

We often use words to talk about probability. If something will never happen, it's impossible. If it will definitely happen, it's certain. In between, we say things like 'likely,' '50-50 chance,' or 'unlikely.' We can line them up from least to most likely.

Definition Probability Line



- **Impossible**: It can't happen.
  Example: Riding a dinosaur.
- **Less likely**: It probably won't happen.
  Example: Rolling a die and getting a 3.
- **Even chance**: It has the same chance to happen or not.
  Example: Tossing a coin and getting head.
- **Most likely**: It will probably happen.
  Example: Smiling at school today.
- **Certain**: It will happen.
  Example: The sun will rise tomorrow.

D USING NUMBERS TO QUANTIFY PROBABILITY

When you flip a coin, there are two possible outcomes: heads or tails. The chance of getting heads is the same as getting tails—it's 1 out of 2! In math, we write:

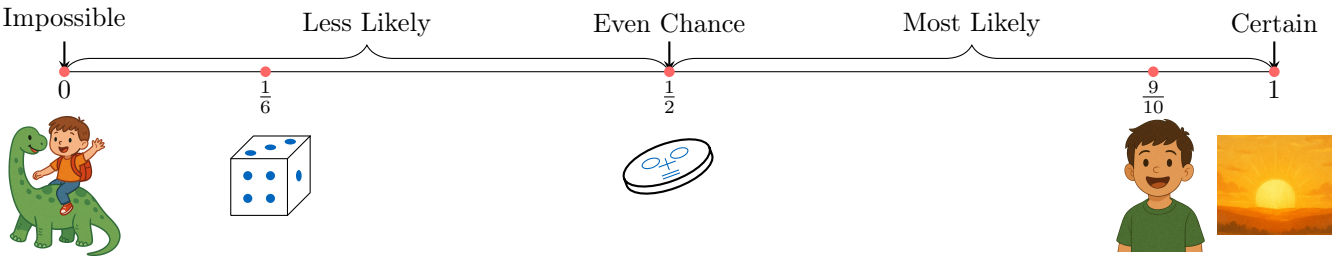
$$P\text{ ("Getting Heads")} = \frac{1}{2}$$

The probability — of getting heads — is equal — 1 chance out of 2

This means heads will happen about half the time!

Definition Probability

The **probability of an event**, written $P(\text{event})$, is a number that tells us how likely the event is to happen. It's always between 0 (impossible) and 1 (certain).



E EXPRESSING PROBABILITIES IN DIFFERENT FORMS

Method Expressing Probabilities in Different Forms

Probabilities can be expressed in multiple forms, such as fractions, decimals, or percentages, depending on the context or preference. Each form provides the same information but in a different representation, making it easier to understand or compare likelihoods.

Ex: The probability of an event "even chance" can be represented as:

- **Fraction**: $\frac{1}{2}$
- **Decimal**: To convert the fraction to a decimal, divide the numerator by the denominator: $1 \div 2 = 0.5$.
- **Percentage**: To convert the decimal to a percentage, multiply by 100: $0.5 \times 100 = 50\%$.

F CALCULATING PROBABILITIES

In some experiments, every outcome is equally likely to occur, such as when flipping a fair coin or olling a fair die. These are referred to as equally likely outcomes.

Definition Equally Likely

When all outcomes are **equally likely**, the probability of an event is given by the formula:

$$P(\text{event}) = \frac{\text{number of outcomes in the event}}{\text{total number of possible outcomes}}$$

Ex: Calculate the probability of rolling an even number with a fair six-sided die.

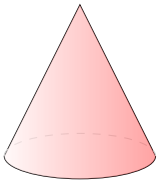
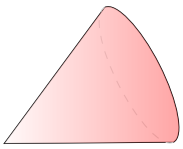
Answer:

- The total number of possible outcomes when rolling a fair six-sided die is 6, since there are 6 faces.
- The number of outcomes for the event "even number" is 3, as there are three even numbers on the die: 2, 4, and 6.
- Therefore, the probability of rolling an even number is given by:

$$\begin{aligned} P(\text{even number}) &= \frac{\text{number of outcomes in the event}}{\text{total number of possible outcomes}} \\ &= \frac{3}{6} \\ &= \frac{1}{2} \end{aligned}$$

G EXPERIMENTAL PROBABILITY

Isaac wishes to determine how a cone lands when tossed—base down or point down? The possible outcomes are as follows:

- Base down: 
- Point down: 

Due to the cone's shape potentially favoring one outcome, Isaac cannot predict the probabilities. He conducts 50 trials and records the results:

- Base down: 30 times.
- Point down: 20 times.

The chance of landing base down is approximately 30 times over 50 times. So, he estimates:

- $P(\text{"base down"}) = \frac{30}{50} = 0.6$ (60%).
- $P(\text{"point down"}) = \frac{20}{50} = 0.4$ (40%).

The more trials he conducts, the closer his estimates approach the true probabilities.

Theorem **Law of Large Numbers**

The probability of an event, $P(\text{event})$, can be estimated using the formula:

$$P(\text{event}) \approx \frac{\text{number of times the event occurs}}{\text{number of trials}}$$

Here, "trials" refer to the number of times the experiment is repeated.