STATISTICS FOR DATA SCIENCE

Probability

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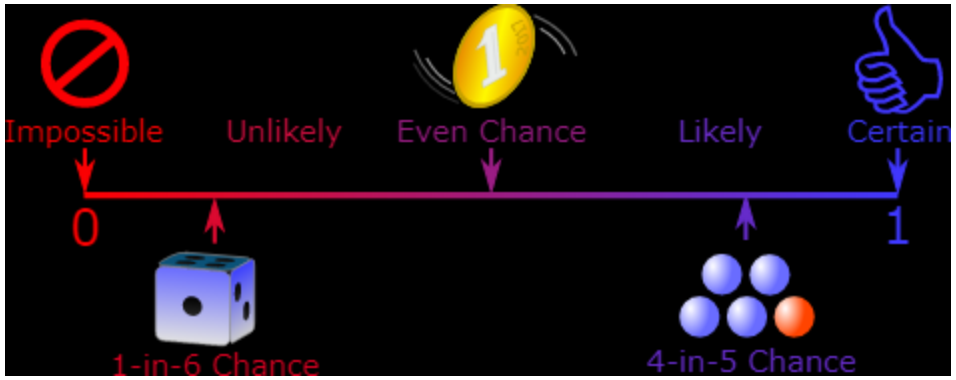
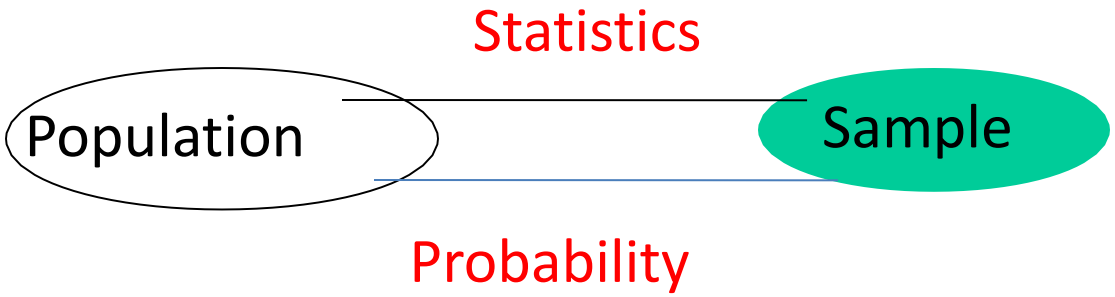
Why should we learn Probability?

- A probability provides a quantitative description of the chances or likelihoods associated with various outcomes.





Source: https://www.toppr.com/

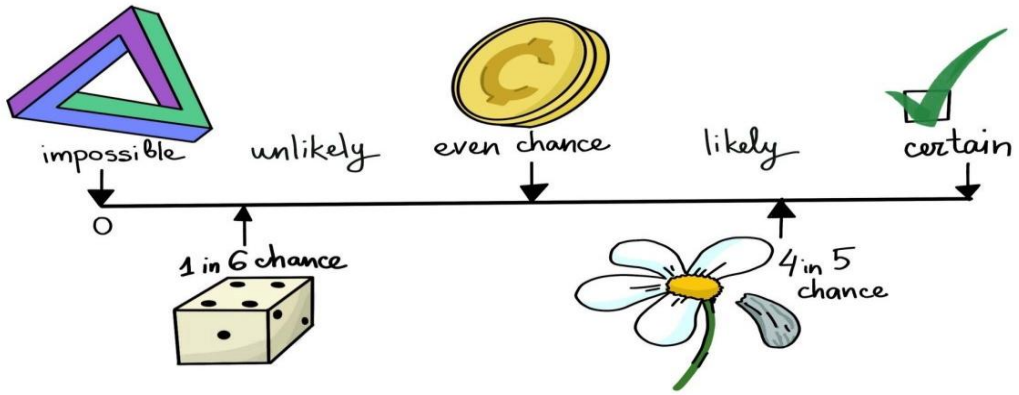
Probability:

Definition: Probability is a numerical index of the likelihood that a certain event will occur.

Examples:

What is the probability that Good Friday will come on a Monday?

What is the probability that Deepawali will come on a Friday?



Source: KDnuggests.com

Experiment:

Definition: An **experiment** is a process that results in an **outcome** that **cannot be predicted** in advance with certainty.

Examples:

Rolling a die
Tossing a coin
Weighing the contents of a box of cereal

Note: Experiment indicates a process that can result in **only one** of several **possible outcomes**.

Outcome: The **result of a single trial** of an **experiment**.

Ex : Getting **Head or Tail** is a result when you toss a coin.

Event : A collection of one or more outcomes of an experiment.

(or) A subset of a sample space is called an **event.**

Ex : Getting a sum as 6 when we roll dice.

A={(1,5),(2,4),(3,3),(4,2),(5,1)}

Sample Space: The set of **all possible outcomes** of an experiment is called the **sample space** for the experiment.

dgf

Ex : S={1,2,3,4,5,6}

Note: For any sample space, the **empty set ϕ** is an event, as is the **entire sample space**.

Experiment	Outcomes	Event	Sample Space
Tossing a coin	Head, Tail	Getting a Head or Getting a Tail	S={Head, Tail}
Rolling a Die once	1, 2, 3, 4, 5 or 6	Getting an even number or Getting an odd number	S={1,2,3,4,5,6}
Taking a Test	A, B, C, D, E or F	Passing the Test	S={A,B,C,D,E,F}
Tossing a coin twice	(H,H),(H,T),(T,H),(T,T)	Getting at least one head Getting two tails	S={(H,H),(H,T), (T,H),(T,T)}
Rolling Dice		Dice add to 6	

Types of Probability

- **Subjective Probability**
  - Likelihood of a particular event estimated on the basis of individual intuition or some general information or some expert judgement.

Ex. : The probability that Yahoo will buy Google within the next 2 years is 0.1 or 10%.

The probability that RCB wins IPL next time is 0.8 or 80%.

- **Objective Probability**

The **relative possibility of occurrence** of an event defined as

P(A) = number of favorable outcomes/total number of outcomes
= m / n

Ex. : Let A= Getting 5 when you roll a die.
P(A) = 1/6

- **Event Relations**

The **intersection of two events**, A and B, is the event that both A and B occur when the experiment is performed and denoted by A∩B.

Ex.: Let A= An even number turns up

A = {2,4,6}

B= The number that turns up is divisible by 4

B={4}

A∩B = {4}

If two events A and B are **mutually exclusive**, then **P(A∩B)=0**.

Ex. : Drawing a king or an ace from a deck of cards.

The **complement of an event** A consists of all outcomes of the experiment that do not result in event A and written as A^c.

- **The Additive Rule for Unions**

For any two events A and B, the probability of their union, P(AUB) is

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

When two events A and B are mutually exclusive,

$$P(A \cup B) = P(A) + P(B) \quad \text{and} \quad P(A \cap B) = 0$$

- **Probability for Complement**

For any event A

$$P(A^c) = 1 - P(A)$$

- **Independent Events**

Two events A and B, said to be **independent** if the occurrence or non-occurrence of one of the events does not change the probability of the occurrence of the other event.

Ex. : Toss a fair coin twice.
Define A : head on first toss
B : head on second toss

P(A) does not change whether B happens or not.

- **Conditional Probability**

The probability that A occurs, given that event B has occurred is called the **conditional probability of A given B** and is defined as

$$P(A|B) = P(A \cap B) / P(B) \quad \text{if } P(B) \neq 0$$

- **Conditional Probability**

Example : In a group of 100 sports car buyers, 40 bought alarm systems, 30 purchased bucket seats, and 20 purchased an alarm system and bucket seats. If a car buyer chosen at random bought an alarm system, what is the probability they also bought bucket seats?

A : Bought bucket seats
B : Bought alarm systems

$P(A|B) = P(A|B) = P(A \cap B) / P(B) = 0.2 / 0.4 = 0.5 =$ **50%**

The **probability that a buyer bought bucket seats**, **given that** they **purchased an alarm system**, is **50%.**

Do It Yourself !!!!

Example: In the process of tossing two coins.

- What is an experiment?
- What is an outcome?
- What is an event?
- What is a sample space?

Example: In rolling a six-sided die.

- What is an experiment?
- What is an outcome?
- What is an event?
- What is a sample space?

Do It Yourself !!!!

In the process of rolling a pair of fair dice.

- What is an experiment?
- What is an outcome?
- What is an event?
- What is a sample space?

THANK YOU

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