Basic Probability Theory: Rules and Formulas

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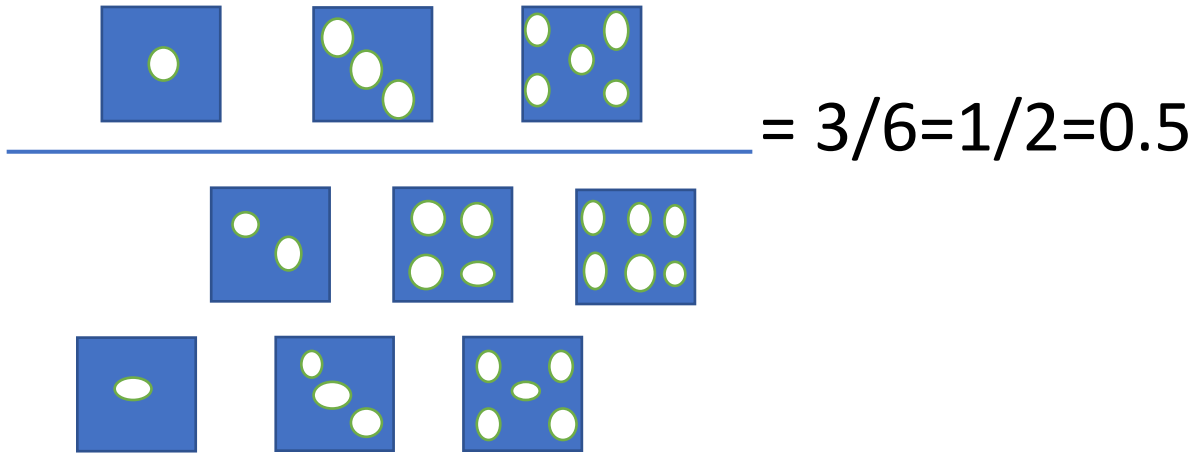
Probability

- Probability is the measure of the likelihood(possibility) that an event will occur in a Random Experiment.
- A number between 0 & 1 representing the likelihood of an event happening.
- Probability of 0 indicated no chance of that event occurring.
- While a probability of 1 means that event will occur.
- If negative answer comes i.e. -0.3 or greater than 1 i.e. 67 you have made a mistake in calculation.

Visualizing probability

- You can visualize probability into fraction method: dividing the number of desirable outcomes by the total number of possible outcomes.
- This will always give you a number between 0 & 1.
- E.g. Chances of rolling a odd number of six sided die.



= 3/6=1/2=0.5

Trail – Any particular performance of a random experiment is called a trail.

By experiment of trail in the subject of probability, we mean a random experiment unless otherwise specified.

Each trail results in one or more outcomes.

Examples

1. Tossing a coin the possible outcomes and Head, Tail means 2
2. Tossing 4 coins
3. Rolling a die.
4. Picking 3 balls from a bag containing 10 balls 4 of which are red and 6 are blue.

Random Experiment: possibility of coming outcomes but not sure what is to come.

Trail vs experiment

- In the experiment of tossing 4 coins, we may consider tossing each coin as a trail and therefore say that there are 4 trails in the experiment.
- In the experiment of picking 3 balls from a bag containing 10 balls 4 of which are red and 6 blue, we can consider picking each ball to be an event and therefore say that there are 3 trails in the experiment.

Event or outcomes

- Something that results
- A result that is caused by some previous action.
- The result or outcomes or observations of an experiment are called events.
- They are generally represented by capital letters of English alphabets

Though we know the possible outcomes of a random experiment, we cannot predict which of these will occur/ happen in a conduct of the experiment/ trial

Example: in the experiment of “tossing a coin”

These are two possible event or outcomes

1. Event “A”: the event of getting Head.
2. Event “B”: the event of getting Tail.

Example: in the event of “throwing a die”

Sample Space

A sample space is a collection or a set of possible outcomes of a random experiment. The sample space is represented using the symbol, “S”. The subset of possible outcomes of an experiment is called events. A sample space may contain a number of outcomes that depends on the experiment. If it contains a finite number of outcomes, then it is known as discrete or finite sample spaces.

The samples spaces for a random experiment is written within curly braces “ { } “. There is a difference between the sample space and the events. For rolling a die, we will get the sample space, S as {1, 2, 3, 4, 5, 6 } whereas the event can be written as {1, 3, 5 } which represents the set of odd numbers and { 2, 4, 6 } which represents the set of even numbers. The outcomes of an experiment are random and the sample space becomes the universal set for some particular experiments. Some of the examples are as follows:

Tossing a Coin

When flipping a coin, two outcomes are possible, such as head and tail. Therefore the sample space for this experiment is given as

Sample Space, S = { H, T } = { Head, Tail }

Tossing Two Coins

When flipping two coins, the number of possible outcomes are four. Let, H1 and T1 be the head and tail of the first coin and H2 and T2 be the head and tail of the second coin respectively and the sample space can be written as

Sample Space, S = { (H1, H2), (H1, T2), (T1, H2), (T1, T2) }

In general, if you have “n” coins, then the possible number of outcomes will be 2^n.

Example: If you toss 3 coins, “n” is taken as 3.

Therefore, the possible number of outcomes will be $2^3 = 8$ outcomes

Sample space for tossing three coins is written as

Sample space S = { HHH, HHT, HTH, HTT, THH, THT, TTH, TTT}

A Die is Thrown

When a single die is thrown, it has 6 outcomes since it has 6 faces. Therefore, the sample is given as

$S = \{ 1, 2, 3, 4, 5, 6\}$

Two Dice are Thrown

When two dice are thrown together, we will get 36 pairs of possible outcomes. Each face of the first die can fall with all the six faces of the second die. As there are 6 x 6 possible pairs, it becomes 36 outcomes. The 36 outcome pairs are written as:

$$\begin{Bmatrix} (1,1) & (1,2) & (1,3) & (1,4) & (1,5) & (1,6) \\ (2,1) & (2,2) & (2,3) & (2,4) & (2,5) & (2,6) \\ (3,1) & (3,2) & (3,3) & (3,4) & (3,5) & (3,6) \\ (4,1) & (4,2) & (4,3) & (4,4) & (4,5) & (4,6) \\ (5,1) & (5,2) & (5,3) & (5,4) & (5,5) & (5,6) \\ (6,1) & (6,2) & (6,3) & (6,4) & (6,5) & (6,6) \end{Bmatrix}$$

If three dice are thrown, it should have the possible outcomes of 216 where n in the experiment is taken as 3, so it becomes $6^3 = 216$.