# Random phenomenon

### Random experiment (phenomenon)

An experiment or phenomenon which produces different outcomes, even though it is repeated in same manner every time, is called a random experiment or a random phenomenon

Examples: throw a die, sensor reading, defects in a product

## Prediction perspective:

### Random phenomenon

Any phenomenon that cannot be predicted accurately given infinite past is said to be random. Alternatively, there exists no known mathematical function that can accurately describe the process

# Sample Space / Population

## Sample Space / Population

It is the set of all possible outcomes of a random phenomenon. It is usually denoted by “S”

* If the outcomes are discrete-valued, we have a discrete sample space (eg: throw of a die, scores in a game)
* When the outcomes are continuous-valued, we have a continuous sample space (eg: ambient temperature, gas pressure)

Sample space for rainfall is {“yes”,“no”}, here the event is just one either “yes” or “no”. Sample space is all possible options which could be the outcome. Similarly for a single die, sample space = {1,2,3,4,5,6}, however the event is just one of the possible options, or if we are only interested in outcomes which are less than 4, then the event would {1,2,3}

An event is a subset of a sample space.

* In a two coin toss experiment, an event is , while , here I am only interested in scenarios where only one head shows up
* A collection of sets (events) is said to be exhaustive if

# Probability Basics and Axioms

Whenever outcomes that are equally likely, the probability of each outcome is 1/N

For a discrete sample space, the probability of an event , denoted as , is the sum of the probabilities of the outcome in .

## Axioms

If is the sample space and is an event in any random experiment,

1. (one of the events has to occur!)
2. (probabilities are always non-negative values less than unity)
3. For two mutually exclusive events and ,
4. If is the complement of an event ,

Probabilities on sets:

## Conditional probability:

The conditional probability of an event given an , , denoted as is

Example:

A = event that it rains,

B = event that Rahul is carrying an umbrella

= what is the probability that Rahul is carrying an umbrella, given it is raining

Example:

Table below lists the classification of 940 wafers in a semiconductor manufacturing process>

|  |  |  |  |
| --- | --- | --- | --- |
| Contamination | Center | Edge | Total |
| Low | 514 | 68 | 582 |
| High | 112 | 246 | 358 |
| Total | 626 | 314 | 940 |