Experiment

"An experiment is a process in which we obtain results"

Random Experiment

In our daily life, we perform many activities which have a **fixed result** no matter any number of times they are repeated. For example given any triangle, without knowing the three angles, we can definitely say that the sum of measure of angles is 180°. We also perform many experimental activities, where the **result may not be same**, when they are repeated under identical conditions. For example, when a coin is tossed it may turn up a head or a tail, but we are not sure which one of these results will actually be obtained. Such experiments are called random experiments.

A random experiment satisfies the following three **properties**:

- It can be repeated any number of times.
- It has more than one possible outcome.
- It is not possible to predict the outcome in advance.

Hence we may define the random experiment as ***"An experiment that generates uncertain results under similar conditions, is called random experiment"***

- Tossing of a coin
- Rolling of a dice
- Drawing a card from a pack of 52 playing cards etc.

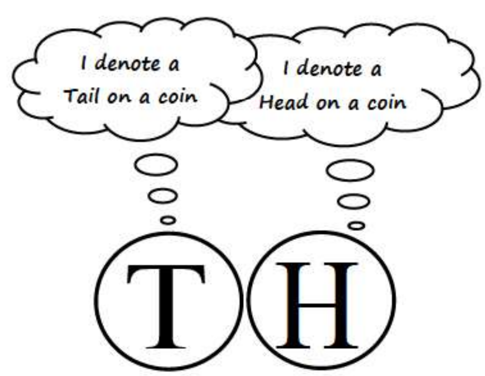
Trail

"A single performance of an experiment is called a trial"

Outcome

"A possible result of a random experiment is called outcome"

If we toss a coin then "H" or "T" may be the outcomes.



Sample space

"A set consisting of all possible outcomes of a random experiment is called a sample space". It is denoted by "S" and each element of a sample space is called a sample point.

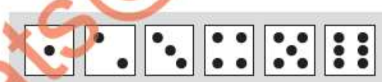
Number of sample points in a sample space for coin tossing experiment can be determined by 2^n*, where "n" is the number of coin. And for die rolling experiment* 6^n*, where "n" is the number of dice.*

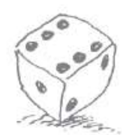
- If a coin is tossed
  Then $S=\{H,T\}$

Head *Tail*

- If two coins are tossed
  Then $S=\{HH,HT,TH,TT\}$
- If three coins are tossed
  Then $S=\{HHH,HHT,HTH,THH,TTH,THT,HTT,TTT\}$

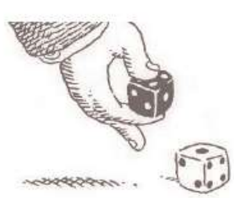
- If a dice is rolled
  Then $S=\{1,2,3,4,5,6\}$

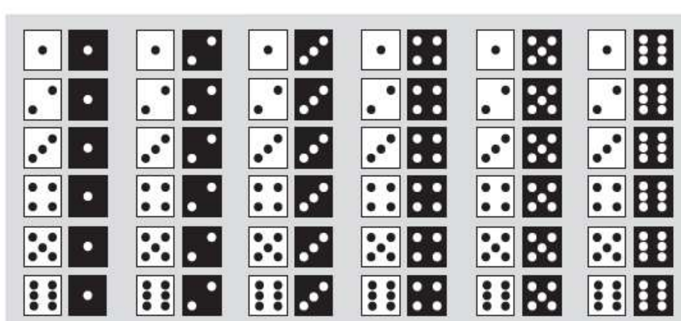




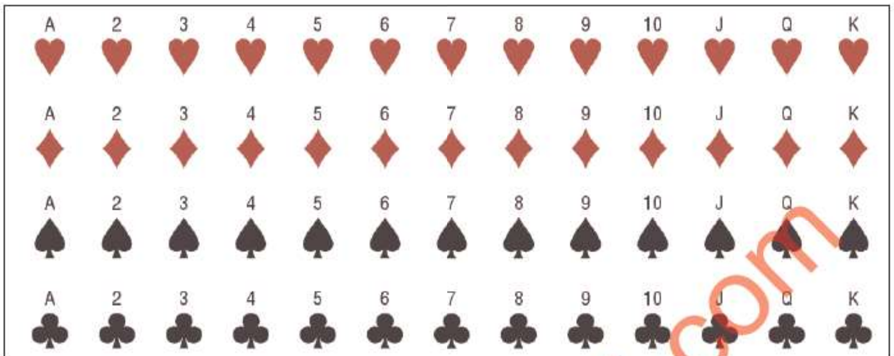
- If two dice are rolled, then

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



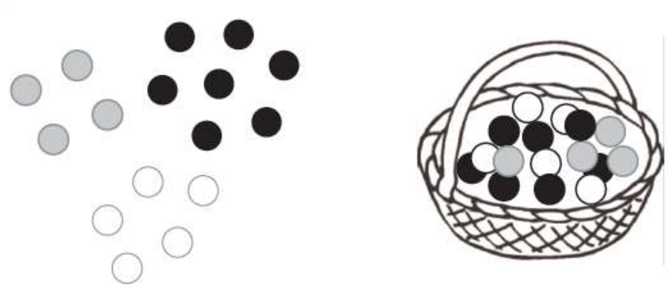


- If we draw a card from a deck of 52 playing cards then the sample points in the sample space are:



Hearts *Diamonds* *Spades* *Clubs*

- If we draw a ball from a basket having 3 different color balls then the sample points in the sample space may be as follows:



Event

"Any sub set from a sample space is called an event"

Events are usually denoted by A, B, C etc.

EXAMPLE

If we toss two coins
Then $S=\{HH,HT,TH,TT\}$
Now if $A=\{HH\}$, then "A" is called an event.

REMEMBER

- *Each element of a sample space "S" is called sample point.*
- *Total number of sample points in sample space is denoted by n(S)*
- *Favorable cases of an event "A" is denoted by n(A)*

Simple Event

"If an event contains only one sample point from the sample space then it is called simple event"

EXAMPLE

If we toss two coins then $S=\{HH,HT,TH,TT\}$
If $A=\{HH\}$, then "A" is called a simple event.

Compound Event

"If an event contains two or more sample points from the sample space then this is called a compound event"

EXAMPLE

If we toss two coins then $S=\{HH,HT,TH,TT\}$
If $A=\{HT,TH\}$, then "A" is called a compound event.

The Certain or Sure Event

"An event consisting of the sample space itself is called the sure event"

Impossible event

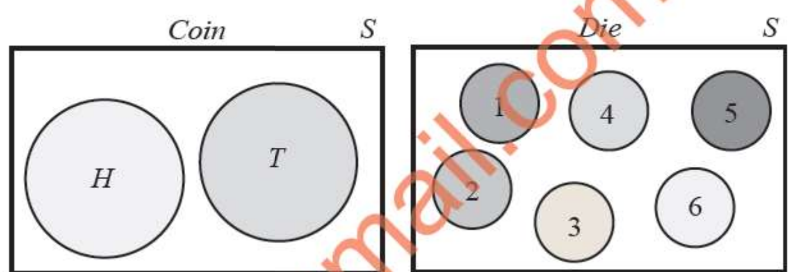
"An event consisting of the null set is called the impossible event"

Mutually Exclusive (Disjoint) Events

"Events in a same sample space are said to be mutually exclusive if they cannot occur together"

For two mutually exclusive events "A" and "B" $A \cap B = \phi$

If we toss a coin then "H" and "T" are mutually exclusive because if "H" occurs then "T" cannot take place; similarly 1, 2, 3, 4, 5 and 6 are mutually exclusive when a dice is rolled. In other words they **exclude** each other.

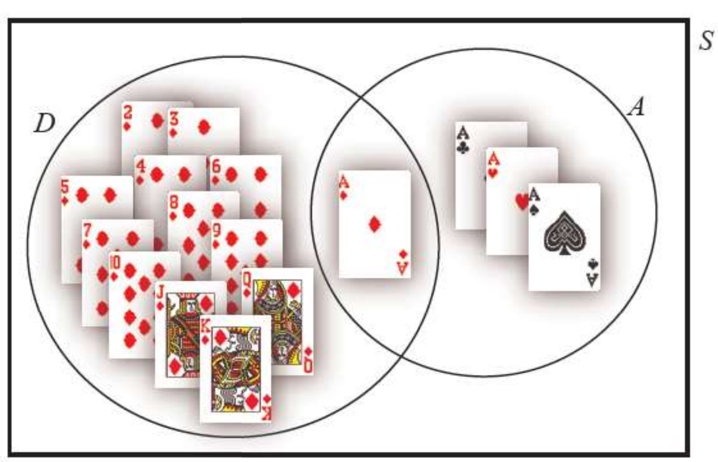


Not Mutually Exclusive (Overlapping) Events

"Events in a same sample space are said to be not mutually exclusive if they can occur together"

For two not mutually exclusive events "A" and "B" $A \cap B \neq \phi$

If a card is drawn at random from a pack of 52 playing cards then it may be at the same time an "Ace" and a "Diamond"; therefore "Ace" and "Diamond" are not mutually exclusive.



Equally likely Events

"Events are said to be equally likely if they have the same chances of occurrence"

EXAMPLE

If we toss a fair coin then "H" and "T" are equally likely; because they have the same chances of occurences.

Exhuastive Events

"Two or more events defined in the same sample sapce are said to be exhaustive if their union is equal to the sample space"

EXAMPLE

If $S=\{1,2,3,4,5,6\}$
Let $A=\{1,3,5\}$ and $B=\{2,4,6\}$
Then $A\cup B=\{1,2,3,4,5,6\}=S$
Therefore "A" and "B" are exhaustive events.

REMEMBER

An event "A" and its compliment "$\bar{A}$" are always exhaustive i.e.
$A\cup\bar{A}=S$

Counting Techniques

Sometimes it is very difficult **to list all the sample points** of a sample space; therefore we use some mathematical techniques for finding the number of sample points of the sample space. These techniques are called counting techniques i.e.

- Factorial
- Rule of Multiplication
- Permutation
- Combination

Factorial

"The product of first "n" natural numbers is called Factorial and is denoted by n!"

EXAMPLE

$2!=2\times1=2$
$5!=5\times4\times3\times2\times1=120$

In general $n!=n(n-1)(n-2)(n-3).....3..2.1$

$0!=1$
$1!=1$