# ① An Experiment :

Tossing a coin, Rolling a dice, Rolling two dice, Tossing 3 coins Drawing a card from a standard deck.

# ② Sample Space: A set of all possible outcomes of an experiment.

ex:

| Experiment | sample space |
|---|---|
| Tossing a coin | {H, T} |
| Rolling a dice | {1, 2, 3, 4, 5, 6} |
| Tossing two coins | {HH, HT, TH, TT} |

# ☆ Event (or event space): A subset of sample space.

Ex:

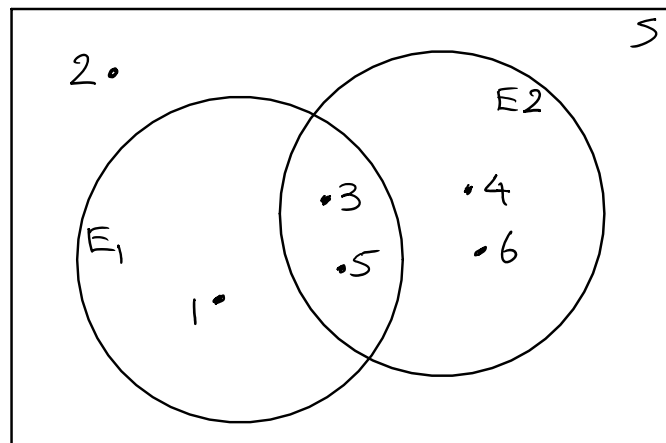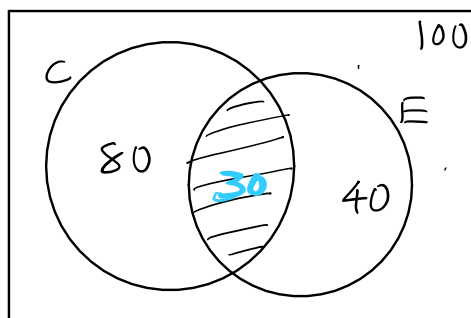| Event Name | Event Space |
|---|---|
| ① Getting a head while tossing a coin | {H} |
| ② Getting at least one head when two coins are tossed | {HT, TH, HH} |

<u>Experiments as Venn Diagrams</u>

① Experiment: Rolling a dice.

$E_1$ = Getting an odd number
$$= \{1, 3, 5\}$$

$E_2$ = Getting at least 3
$$= \{3, 4, 5, 6\}$$

[Venn diagram: Universal set $S$ with point $2$ outside both circles. $E_1$ circle contains $1$; overlap of $E_1$ and $E_2$ contains $3, 5$; $E_2$ circle contains $4, 6$.]

**It is known that 80% people like cappuccino, 40% people like espresso, and 30% like both. What percentage of the people like cappuccino, but do not like espresso?**

[Venn diagram: Universal set $100$, circle $C$ contains $80$, overlap (shaded) contains $30$, circle $E$ contains $40$.]

Click on an option to submit your answer

| | | |
|---|---|---|
| A | 50% | |
| B | 40% | |
| C | 30% | |
| D | 80% | |

★ An important result about cardinality

$$n(A \cup B) = n(A) + n(B) - n(A \cap B) \qquad \underline{OR}$$

$$|A \cup B| = |A| + |B| - |A \cap B|$$

★ Mutually Exclusive Events

Events A & B are M.E. events if & only if $A \cap B = \phi$

ex: A = Getting a number less than 3 $= \{1, 2\}$

B = Getting an odd number greater than 1 $= \{3, 5\}$

★ Exhaustive Events

Events A & B are Exhaustive events if & only if $A \cup B = S$

ex: A $= \{1, 2, 3, 4\}$

$B = \{2,4,5,6\}$

Give examples of the following events:

① M.E. but not exhaustive : $A = \{1,2,3\}$ , $B = \{4,5\}$

② Exhaustive but not M.E. : $A = \{1,2,3,5\}$ , $B = \{2,4,6\}$

③ M.E. as well Exhaustive : $A = \{1,2,3\}$ , $B = \{4,5,6\}$

④ Neither M.E. nor Exhaustive : $A = \{1,2,3\}$ , $B = \{2,4\}$

## ☆ Probability of an event

$$P(E) = \frac{|E|}{|S|} = \frac{n(E)}{n(S)}$$

Ex.        Events                                                      Probability

① Getting at least one Tails                                    $\frac{3}{4}$
   when two coins are tossed
   $E = \{HT, TH, TT\}$                                              $= 0.75$
   $S = \{HT, TH, TT, HH\}$                                          $= 75\%$

② Getting a face card when                                    $= \frac{\overset{3}{\cancel{12}}}{\underset{13}{\cancel{52}}}$
   a card is drawn at random
   from a standard deck.
   4 suits : clubs, diamonds,                    $P(E) = \frac{3}{13}$
              hearts, spades

   2 colors : Black, Red

   3 face cards in each suit :
       Jack, Queen, King

3 face cards in each suit ~

Jack, Queen, King

$|E| = 12$     $|s| = 52$

$|P \cup n| = 90$  $\Rightarrow$  $|P \cup n| + |n \cup d| = 120$          $|P| + |n| + |d| = 100$ ∴ Exhaustive

$|n \cup d| = 30$      $|P| + |n) - |P \cap n| + |n| + |d| - |n \cap d| = 120$ $\Rightarrow$  $|n| + 100 = 120$

                                 $\underbrace{}_{0 \leftarrow M.E.} \quad \underbrace{}_{\longrightarrow 0}$              ∴ $|n| = 120 - 100 = 20$

**In an NPS survey, it is seen that 90% are either promoters or neutral. 30% percent are neutral or detractor. What percent of people are neutral?**

Click on an option to submit your answer

| | |
|---|---|
| A | 10% |
| B | 20% |
| C | 30% |
| D | 70% |

$d$      $n$ 20  $P$     $s$
10      30      90    70