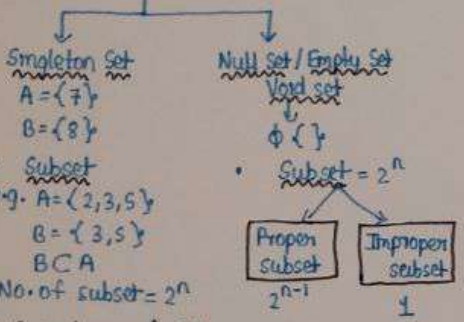
6. Set, Function & Relation

- Cardinal number = $n(A) = x$
- Types of set →



- Subset

e.g. A = {2,3,5}
B = {3,5}
B ⊂ A
No. of subset = 2^n

- Operation of set

1) Union → (A ∪ B)
2) Intersection → (A ∩ B)
3) Subtraction → A = {2,3,7,8,9}
B = {1,5,7,9,10}
A − B = {2,3,8}

★ Theorem of addition :-

1) $n(A \cup B) = n(A) + n(B) - n(A \cap B)$
2) $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(A \cap C) - n(B \cap C) + n(A \cap B \cap C)$
3) $n(A \cap B') = n(A) - n(A \cap B)$
4) $n(A' \cap B) = n(B) - n(A \cap B)$
5) Total = Atleast + Nothing.

★ Formula for three sets :-

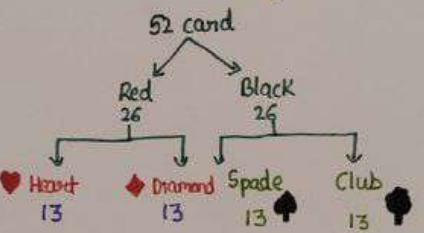
① $n(A \cap B \cap C') = n(A \cap B) - n(A \cap B \cap C)$
② $n(A \cap B' \cap C) = n(A \cap C) - n(A \cap B \cap C)$
③ $n(A' \cap B \cap C) = n(B \cap C) - n(A \cap B \cap C)$
④ $n(A \cap B' \cap C') = n(A) - n(A \cap B) - n(A \cap C) + n(A \cap B \cap C)$
⑤ $n(A' \cap B \cap C') = n(B) - n(B \cap A) - n(B \cap C) + n(A \cap B \cap C)$

★ Domain & Co-Domain

e.g. {(3,8)(5,2)(7,5)(6,1)}
Domain = input = {3,5,7,6}
Co-domain = output = {8,2,5,1}

PROBABILITY

Formula = $\frac{\text{Special way}}{\text{Normal way}}$



- $P(A) = 0.3$ $P'(A) = 1 - 0.3 = 0.7$
- $P(B) = 0.45$ $P'(B) = 1 - 0.45 = 0.55$
- $P(C) = 0.75$ $P'(C) = 1 - 0.75 = 0.25$

★ ODD's in favour of event & ODD's against event.

- ODD's in favour of event = $\frac{\text{Favourable}}{\text{Unfavourable}}$
- ODD's against = $\frac{\text{Unfavourable}}{\text{Favourable}}$
- $P(A) = \frac{F}{F+U} = \frac{3}{10}$

★ Types of event

1) Sure event → $P(A) = 1$
2) Impossible event → $P(A) = 0$
3) Exclusive event → $P(A \cap O) = 0$
4) Exhaustive event → $P(A \cup B) = 1$
5) Equally likely event → $P(A) = P(B)$
6) Dependent event = $P(A/B) = \frac{P(A \cap B)}{P(B)}$
$P(B/A) = \frac{P(A \cap B)}{P(B)}$
7) Independent event = $P(A \cap B) = P(A) \cdot P(B)$

★ Problems of expected value

Expected value → [avg. value] [mean]
$E(x) = \Sigma x \cdot P$
$E(x^2) = \Sigma x^2 \cdot P$
Variance = $E(x^2) - [E(x)]^2$

INDEX NUMBER

1) Price Index Number :-
$P_{on} = \frac{P_n}{P_o} \times 100$

2) Quantity Index Number :-
$Q_{on} = \frac{Q_n}{Q_o} \times 100$

3) Value Index Number :-
$V_{on} = \frac{V_n}{V_o} \times 100$

4) Simple Aggregative method :-
$P_{on} = \frac{\Sigma P_n}{\Sigma P_o} \times 100$

5) Simple relative method :-
$P_{on} = \frac{\Sigma \frac{P_n}{P_o}}{N} \times 100$

6) Weighted relative method :-
$P_{on} = \frac{\Sigma \frac{P_n}{P_o} \cdot W}{\Sigma W} \times 100$
$= \frac{\Sigma I \cdot W}{\Sigma W}$

7) Weighted aggregative method :-
$P_{on} = \frac{\Sigma P_n \cdot W}{\Sigma P_o \cdot W} \times 100$

8) Laspayre's method = $\frac{\Sigma P_n \cdot q_o}{\Sigma P_o \cdot q_o} \times 100$

9) Paasche's method = $\frac{\Sigma P_n \cdot q_n}{\Sigma P_o \cdot q_n} \times 100$

10) Fisher = $P_{on} = \sqrt{L \times P}$

11) Bowley = $P_{on} = \frac{L+P}{2}$

12) Marshall - Edgeworth method → $P_{on} = \frac{\Sigma P_n \cdot \left[\frac{q_o + q_n}{2}\right]}{\Sigma P_o \cdot \left[\frac{q_o + q_n}{2}\right]} \times 100$

13) CLI = $\frac{\Sigma I \cdot W}{\Sigma W}$

CENTRAL TENDENCY

1. Arithmatic Mean
- Average

$\bar{x} = \frac{\Sigma x}{N}$ .... discrete without frequency

$\bar{x} = \frac{\Sigma fx}{\Sigma f}$ .... discrete with frequency

$\bar{x} = \frac{\Sigma fx}{\Sigma f}$ .... continuous data, x = midpoint

2. Median – (Middle most value)
a) Discrete without frequency →
- first arrange data in A·O
- Median = $\left(\frac{n+1}{2}\right)^{th}$ value

N = no. of observation

b) Discrete with frequency
- Find less than C·F
- Find $\frac{N+1}{2}$ ($N = \Sigma f$)
- Check frequency ∵ C·F ≥ $\frac{N+1}{2}$
- C·F → x → median

c) Median for continuous data
- Find less than C·F.
- Find $\frac{N}{2}$ ($N = \Sigma f$)
- Check C·f. ≥ $\frac{N}{2}$
- C·F → Class → median Class
- Median = $L + \left(\frac{N}{2} - C\cdot f\right) \times \frac{h}{f}$

☆ Mode
Value having maximum frequency repetition.

- Continuous data

$$\text{Mode} = L + \frac{(f_1 - f_0)\times h}{2f_1 - f_0 - f_2}$$

L = Lower Class boundary
h = UCB - LCB
f_0 = Previous Class frequency
f_1 = maximum frequency
f_2 = next class frequency.

4) Harmonic Mean
$HM = \frac{N}{\Sigma \frac{1}{x}}$ – [Discrete without frequency]

$HM = \frac{\Sigma f}{\Sigma \frac{f}{x}}$ – [Discrete with frequency]

$HM = \frac{\Sigma f}{\Sigma \frac{f}{x}}$ – [Continuous]

5) Geometric Mean
$GM = (x_1 \cdot x_2 \cdot x_3 \ldots x_n)^{\frac{1}{N}}$ – (Without frequency)

$GM = (x_1^{f_1} \cdot x_2^{f_2} \cdot x_3^{f_3} \ldots)^{\frac{1}{\Sigma f}}$ – (With frequency)

$GM = (x_1^{f_1} \cdot x_2^{f_2} \cdot x_3^{f_3} \ldots)^{\frac{1}{\Sigma f}}$ – (Continuous)

☆ Properties of mean, median & mode
1. If all observation are same then mean, median, mode are also same. [$\bar{x}$ = median = mode]
2. Relation between mean, median & mode

   For symmetric, $\bar{x}$ = median = mode

   For asymmetric, $\bar{x}$ – mode = 3 ($\bar{x}$ – median)
3. Combine arithmatic mean

$$\bar{x}_{12} = \frac{N_1\bar{x}_1 + N_2\bar{x}_2}{N_1 + N_2}$$

4. Change of scale & change of origin

   Mean, median, mode are affected by both
   - Change of scale (×, ÷) ; $y = a + bx$
   - Change of origin (+, –) ; $\bar{y} = a + b\bar{x}$
   - ; $M_{ey} = a + b\,M_{ex}$
5. Sum of deviation of all observation about Arithmatic mean is zero.

   i.e. $\Sigma(x - \bar{x}) = 0$
6. Sum of absolute deviation of all observation is minimum when taken above median.

   Absolute = Positive = Mod

Median = Q_2 = D_5 = P_{50} are always equal

Median
He

a) Discrete without frequency
- first arrange in A·O
- Median = $\left(\frac{n+1}{2}\right)^{th}$ value

b) Discrete with frequency
- Find less than C·F
- Find $\frac{N+1}{2}$
- Check that C·F ≥ $\frac{N+1}{2}$
- Check → x → median

c) Continuous data
- Find less than c·f
- Find $\frac{N}{2}$
- C·F ≥ $\frac{N}{2}$
- C·F → Class → Median Class

Median = $L + \left(\frac{N}{2} - C\cdot f\right) \times \frac{h}{f}$

Quartile
Q_1 Q_2 Q_3

a) Discrete without freq.
- first arrange in A·O
- $Q_p = \left[\frac{(N+1)P}{4}\right]^{th}$ value

b) Discrete with freq.
- Find less than C·F
- Find → $\frac{(N+1)P}{4}$
- Check that C·F ≥ $\frac{(N+1)P}{4}$
- C·f → x → quartile

c) Continuous data
- Find less than c·f
- Find $\frac{NP}{4}$
- C·f ≥ $\frac{NP}{4}$
- C·F → Class → Quartile class

$Q_p = L + \left(\frac{NP}{4} - C\cdot f\right) \times \frac{h}{f}$

Decile
D_1 D_2 D_3 ... D_9

a) Discrete without freq.
- first arrange in A·O
- $D_p = \left[\frac{(N+1)P}{10}\right]^{th}$ value

b) Discrete with frequency
- → Find less than C·F
- → Find $\frac{(N+1)P}{10}$
- → Check that C·F ≥ $\frac{(N+1)P}{10}$
- → C·F. → x → Decile

Percentile
P_1 P_2 P_3 ..... P_{99}

a) Discrete without freq.
- → First arrange in A·O
- → $P_p = \left[\frac{(N+1)P}{100}\right]^{th}$ value

b) Discrete with freq.
- → Find less than C·F
- → Find $\frac{(N+1)P}{100}$
- → Check that C·F ≥ $\frac{(N+1)P}{100}$
- → C·F → x → Percentile