Bayes Thm Application

Agenda :-

1. Problem Solving
2. Mini - Case Study.

Imp formulas :-

① Conditional Prob

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

② Multiplication Rule

$$P(A \cap B) = P(A|B) * P(B)$$

③ Law of Total Prob

$$P(B) = P(B \cap A) + P(B \cap A')$$

(4) Independent Events

$$P(A \cap B) = P(A) * P(B)$$

(5) Disjoint Events (ME)

$$P(A \cap B) = 0 \quad [\because A \cap B = \phi]$$

Exp :- Coin Toss + Rolling a dice

(Q1) $\Rightarrow S = \{(H,1), (H,2) \ldots (H,6)$
$(T,1), (T,2) \ldots (T,6)\}$

$|S| = 12$

A: Event of getting a heads

$P(A) = \frac{6}{12}$ $\quad 1/2$

B: Event of getting 3 on a dice.

$P(B) = \frac{2}{12} \rightarrow 1/6$

(Q.3) $P(A \cap B) = \frac{1}{12}$

$A \cap B = \{(H,3)\}$

(Q.4) $P(A|B) = \frac{P(A \cap B)}{P(B)}$

$= \frac{1/12}{1/6}$

$= 6/12 = \frac{1}{2}$

$$P(A|B) = 1/2$$

Obs: $P(A/B) = P(A)$

(Q.5)

$$P(B|A) = \frac{P(A \cap B)}{P(A)} = \frac{1/12}{1/2}$$

$$= 1/6$$

Obs: $P(B|A) = P(B)$.

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

$$P(A \cap B) = P(A|B) * P(B)$$

$$P(A \cap B) = P(A) * P(B)$$

(*) If A & B are mutually Exclusive, then A & B are not independent.

If A & B are ME

$A \cap B = \phi$

$P(A \cap B) = 0$

Independent

$P(A \cap B) = P(A) * P(B)$

✗

Alternative way:

$$P(A|B) = \frac{P(A \cap B)}{P(B)} \quad (P(A \cap B) \to 0)$$

$$P(A|B) = \frac{0}{P(B)} \longrightarrow 0$$

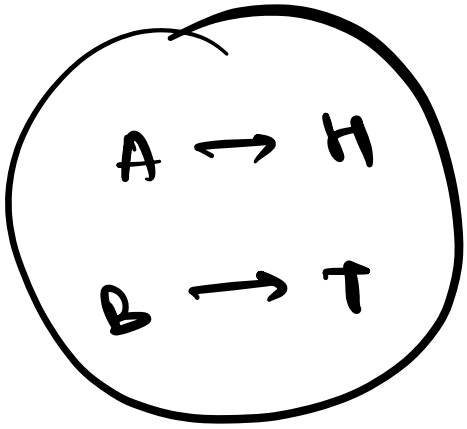
If A & B are independent

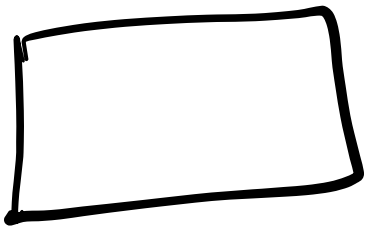
$$P(A \cap B) = P(A) * P(B)$$

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

$$= \frac{P(A) * P(B)}{P(B)}$$

$$P(A|B) = P(A)$$





$A \cap B = \phi \longrightarrow ME$

Quiz):-

CV → A

NLP → B

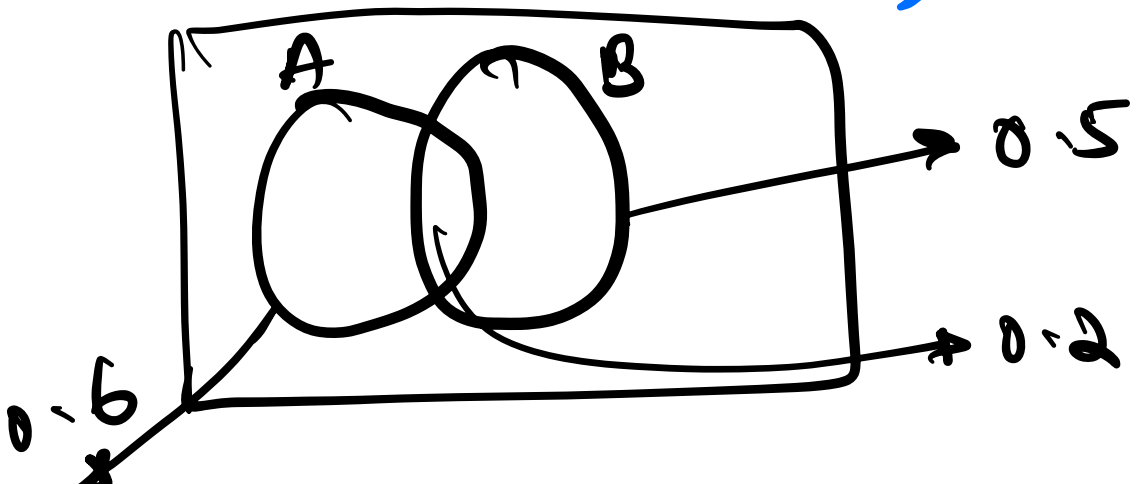
$$P(A) = \frac{60}{100} = 0.6$$

$$P(B) = \frac{50}{100} = 0.5$$

$A \cap B \rightarrow$ both

$$P(A \cap B) = \frac{20}{100} = \underline{\underline{0.2}}$$

$$P(A|B) = \frac{P(A \cap B)}{P(B)} = \frac{0.2}{0.5}$$



(9)

Event → 2 children → B, G

$S = \{BB, GG, GB, BG\}$

A: Both children are girls.

$\Rightarrow \{GG\} \rightarrow P(A) = 1/4$

B: Atleast 1 Girl

$\Rightarrow \{BG, GG, GB\}$

$P(B) = 3/4$

$A \cap B \longrightarrow \{GG\}$

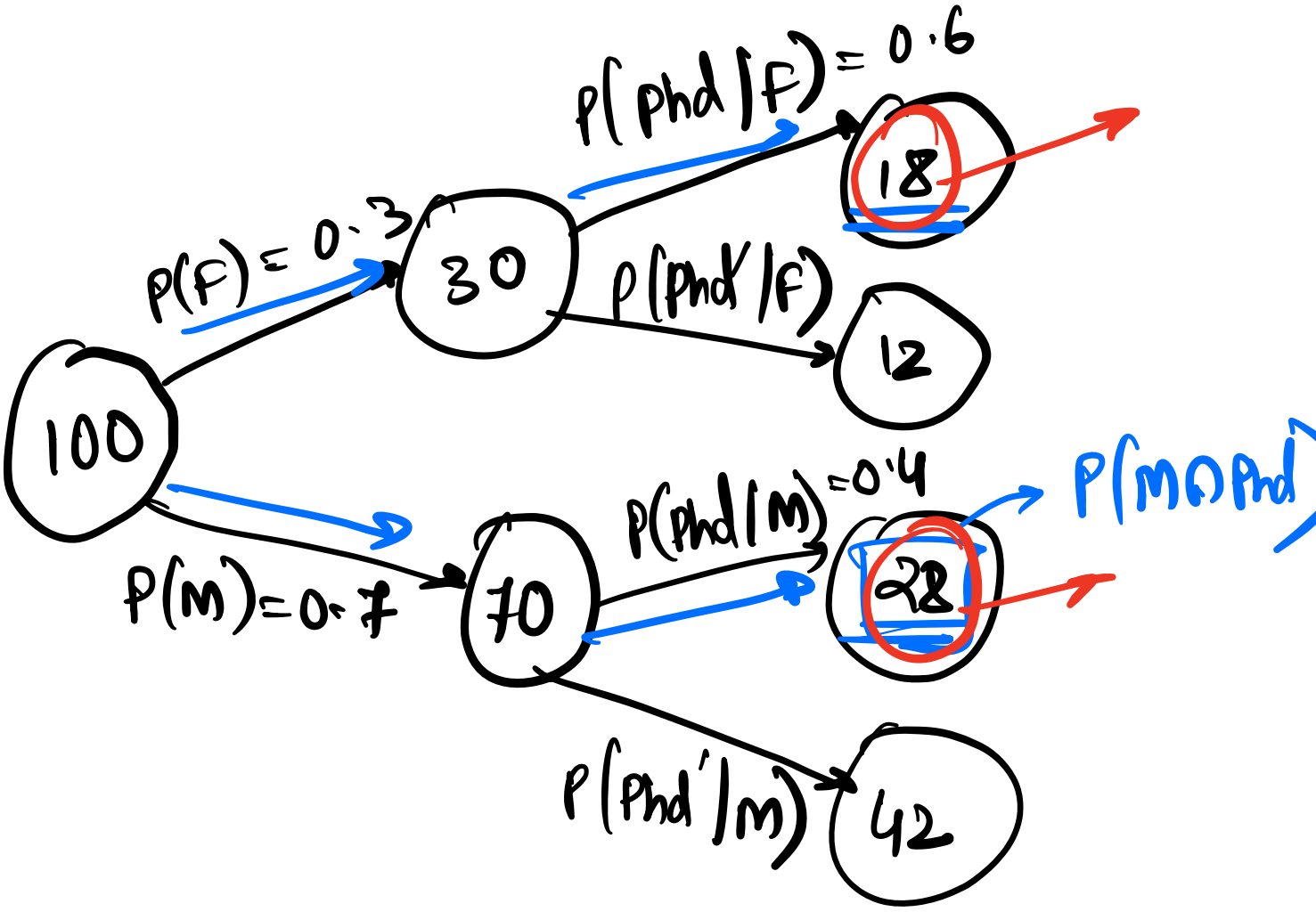
$P(A \cap B) = 1/4$

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

$$= \frac{1/4}{3/4}$$

$$= \boxed{1/3}$$

(9) University → Male/Female



(Q.1) $P(F \cap phd) = \frac{18}{100} = 0.18$

(Q.2) $P(M \cap phd) = \frac{28}{100} = 0.28$

(9.3) $P(\text{phd}) = \frac{18+28}{100}$

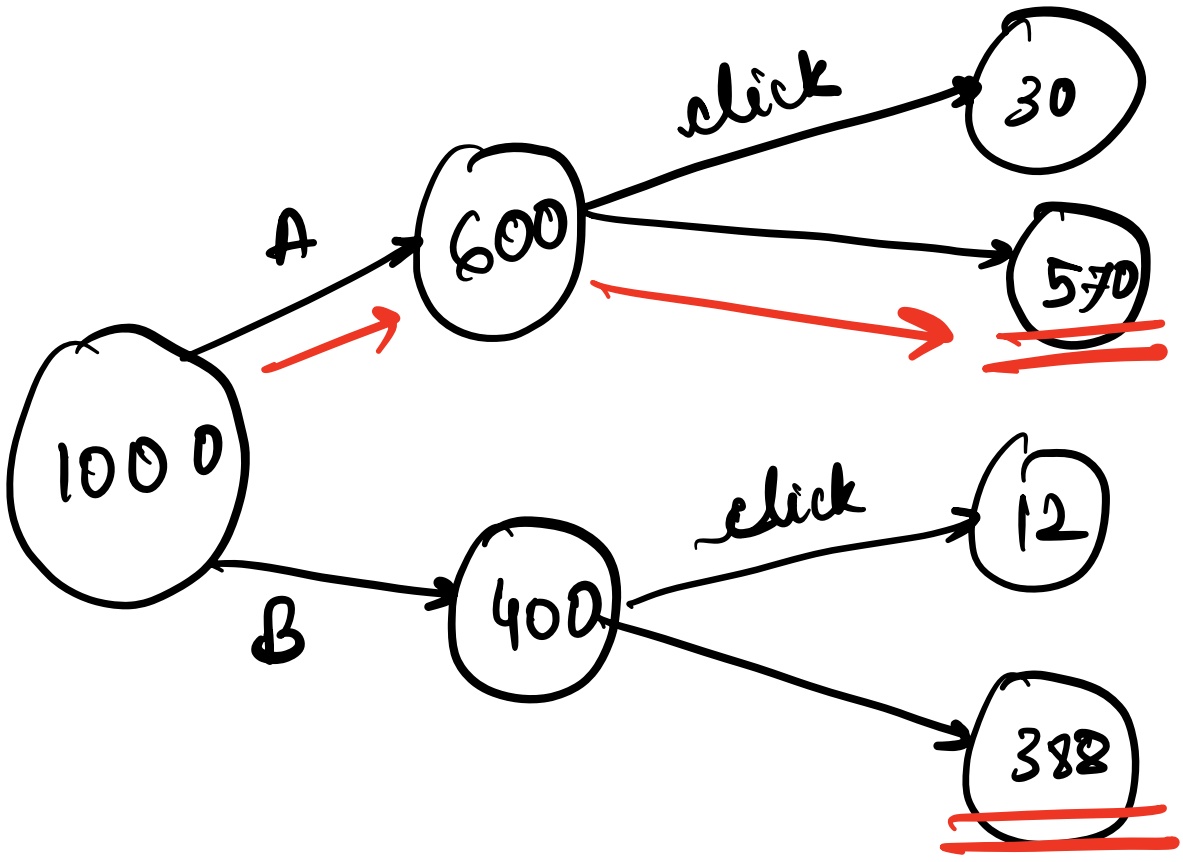
$= \underline{0.46}$

(9.4) $P(f \mid \text{phd}) = \frac{P(f \cap \text{phd})}{P(\text{phd})}$

$= \frac{0.18}{0.46}$

$= \boxed{18/46}$

Quiz 3:-



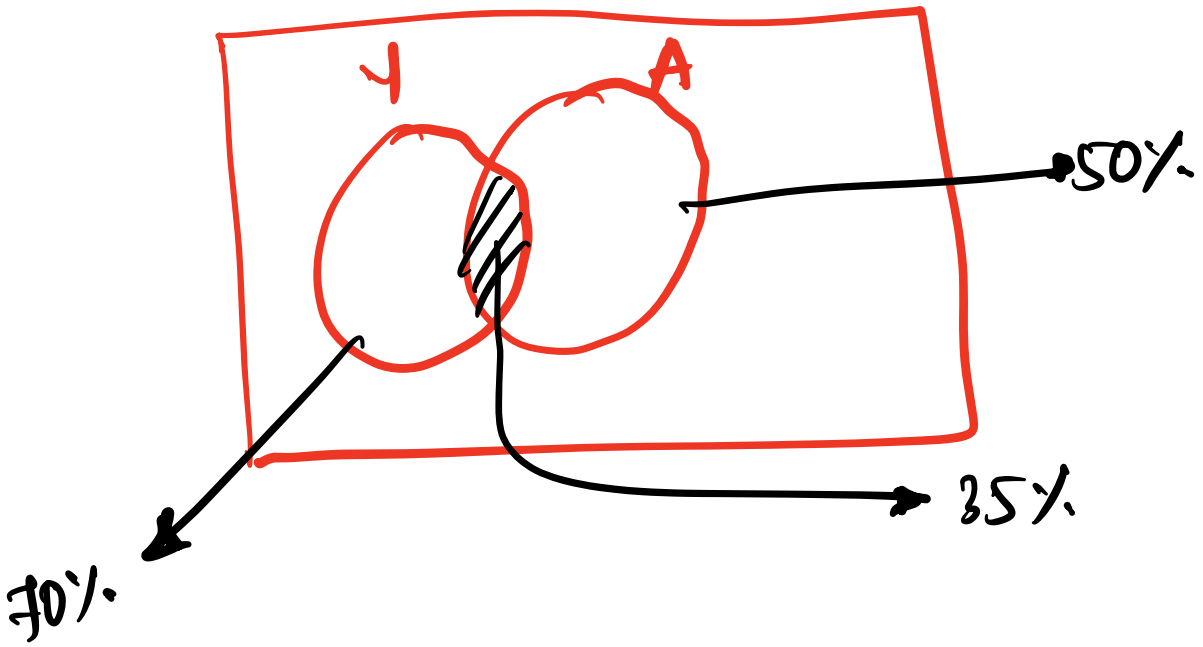
$$P(A \mid \text{click}') = \frac{P(A \cap \text{click}')}{P(\text{click}')}$$

$$P(\text{click}') = \frac{570+388}{1000}$$

$$P(A \cap \text{click}') = \frac{570}{1000}$$

$$P(A \mid \text{click}') = \frac{570}{570+388}$$

Quiz 4 :



$P(Y/A) = ?$

$P(Y) = 0.7$

$P(A \cap Y) = 0.35$

$P(A) = 0.5$

→ Indpnd Events

$$P(Y|A) = \frac{P(Y \cap A)}{P(A)} = \frac{0.35}{0.5}$$

$$= 0.7$$

$$P(Y|A) = P(Y) \quad \rightarrow (1)$$

$$P(A|Y) = \frac{P(A \cap Y)}{P(Y)}$$

$$= \frac{0.35}{0.7}$$

$$= 0.5$$

$$P(A|Y) = P(A) \quad \rightarrow (2)$$

$$P(A \cap Y) = P(A) * P(Y)$$