12/05/2020 Date.....

# LESSON 6 : CONDITIONAL PROBABILITY

## MEDICAL EXAMPLE

P(cancer) = 0.1

P(¬cancer) = 0.9

Blood test :

P(POSITIVE | CANCER) = 0.9

P(NEGATIVE | CANCER) = 0.1

(conditional probability)

P(POSITIVE | ¬cancer) = 0.2

P(Negative | ¬cancer) = 0.8

From the above data, making truth table.

| CANCER | TEST | P( ) |
|---|---|---|
| Y | P | 0.09 |
| Y | N | 0.01 |
| N | P | 0.18 |
| N | N | 0.72 |
| | | $\sum$ = 1.00 |

P(POSITIVE RESULT) = 0.27

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∴ $P(C) \rightsquigarrow P(\neg C)$

$P(P|C) \rightsquigarrow P(N|C)$

$P(P|\neg C) \rightsquigarrow P(N|\neg C)$

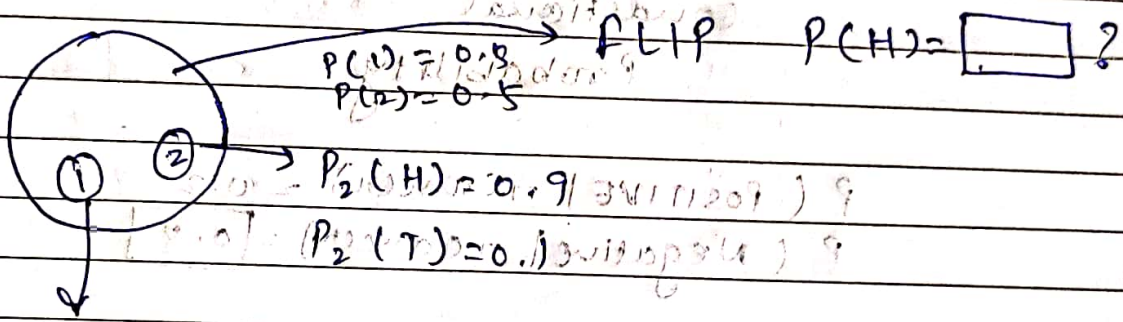
$$P(P) = P(P|C) \cdot P(C) + P(P|\neg C) \cdot P(\neg C)$$

Positive

↓

Total Probability

∴ Coins




$P(H) = P(H|1) \cdot P(1) + P(H|2) \cdot P(2)$

$= 0.5 \times 0.5 + 0.9 \times 0.5$

$= 0.25 + 0.45$

$= 0.70$

TRUTH TABLE

| PICK | FLIP | |
|---|---|---|
| 1 | H | 0.25 ← |
| 1 | T | 0.25 |
| 2 | H | 0.45 ← |
| 2 | T | 0.05 |

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Q. FLIP + FLIP

$P(H, T) = \boxed{0.17}$ ?

TRUTH TABLE

| | PICK | FLIP1 | FLIP-2 | |
|---|---|---|---|---|
| | 1 | H | H | |
| → | 1 | H | T | 0.5, 0.5, 0.5 = 0.125 |
| | 1 | T | H | |
| | 1 | T | T | |
| | 2 | H | H | |
| → | 2 | H | T | 0.5 × 0.9 × 0.1 = 0.045 |
| | 2 | T | H | |
| | 2 | T | T | = 0.17 |

Q. Both coins are loaded now

$P(1) = 0.5$

$P(H|1) = 1$

$P(H|2) = 0.6$

$P(T, T) = \boxed{0.08}$ ?

$P(T,T) = P(T|1) \cdot P(1) \cdot P(T|2) + P(T|2) \cdot P(2) \cdot P(T|2)$

$= 0 \times 0.5 + 0.4 \times 0.5 \cdot 0.4$

$= 0.08$

TRUTH TABLE

| | PICK | FLIP1 | FLIP-2 | |
|---|---|---|---|---|
| | 1 | H | H | |
| | 1 | H | T | |
| | 1 | T | H | |
| Bcoz $P(T) = 0$ → | 1 | T | T | |
| | 2 | H | H | |
| | 2 | H | T | |
| | 2 | T | H | |
| → | 2 | T | T | = 0.5 × 0.4 × 0.4 = 0.08 |

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→ Conditional Probability

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

In this case, we could have this as

$$P(\text{Positive} | \text{disease}) = \frac{P(\text{positive} \cap \text{disease})}{P(\text{disease})}$$

where,

| → represents given

$\cap$ → and