ISM-AIML CZC418
Assignment - 1

Name: MANJUNATH S
ID: 2025AA05935
Section: 7

Q1) Dataset = {28, 35, 40, 42, 45, 50, 52, 55, 60, 65, 70, 75}

$n = 12$

i) a) Mean $= \frac{\sum_{i=1}^{n} x_i}{n} = \frac{617}{12} = 51.416 = \boxed{\bar{x} \text{ or } \mu = 51.42}$

b) Median = For even 'n' average of middle 2 terms

$= \frac{x_6 + x_7}{2} = \frac{50+52}{2} = 51$

c) Variance $\sigma^2 = \frac{\sum (x_i - \bar{x})^2}{n}$

$$\sigma^2 = \frac{548.5 + 269.62 + 130.42 + 88.74 + 41.22 + 2.02 + 0.34 + 12.82 + 73.62 + 184.42 + 345.22 + 556.02}{12}$$

$\sigma^2 = \frac{2252.96}{12}$ $\boxed{\sigma^2 = 187.75}$

d) $\boxed{SD = \sqrt{\sigma^2}} = \sqrt{187.75}$

$\boxed{SD = 13.70}$

e) Range $= x_{max} - x_{min} = 75 - 28$

$\boxed{Range = 47}$

f) $IQR = Q_3 - Q_1$

$= 62.5 - 41$

$\boxed{IQR = 21.5}$

Q_1 = Median of 1st half = 28, 35, 40, 42, 45, 50

$Q_1 = \frac{40+42}{2} = 41$

Q_3 = Median of 2nd half = 52, 55, 60, 65, 70, 75

$Q_3 = \frac{60+65}{2} = 62.5$

Name: MANJUNATH · S
ID: 2025AA 05935
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Q1)

ii) Skewness

Mean = 51.42   Median = 51

here $\boxed{\text{Mean} > \text{Median}}$ Mean is slight Positive

Hence it is Right skewed .

iii) Outliers:

Lower bound = Q1 − 1.5 IQR = 41 − 1.5 × 21.5 = 41 − 32.25

Lower bound = 8.75

Upper bound = Q3 + 1.5 IQR = 62.5 + 1.5 × 21.5 = 62.5 + 32.25

Upper bound = 94.75

All the data set points lie in between upper and lower bounds hence

There are no Outliers by 1.5 IQR rule .

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Q2) Given, Sensitivity = 90% = 0.90
Specificity = 95% = 0.95. , Both the tests are independent.

Hence: True positive = Sensitivity = P(Positive | Disease) = 0.90
False negative = 1- sensitivity. = P(Negative | Disease) = 0.10
True negative = Specificity = P(Negative / No Disease) = 0.95
False positive = 1-Specificity = P(Positive / No Disease) = 0.05

when Events are Independent,

$$\boxed{P(A \cap B) = P(A) \times P(B)}$$

a) P(Positive) when person has disease = 2 x True positive

P(Both Pos | Disease) = P(T_1 Pos | Disease) x P(T_2 Pos | Disease)

T_1 & T_2 are 2 independent tests

= 0.90 x 0.90

$$\boxed{P(\text{Both positive} \mid \text{Disease}) = 0.81}$$

b) P(Positive) when person does not have disease = 2 x False positive

$$P(\text{Both pos} \mid \text{No disease}) = \underbrace{(1 - \text{specificity})}_{T_1} \times \underbrace{(1 - \text{specificity})}_{T_2}$$

T_1 & T_2 are 2 independent tests

= 0.05 x 0.05

$$\boxed{P(\text{Both positive} \mid \text{No disease}) = 0.0025}$$

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Q3)

Plan	Support calls	churn
Basic	Low	No
Premium	High	Yes
Basic	High	Yes
Premium	Low	No
Basic	Low	No

$P(Yes) = \frac{2}{5} = 0.4$ $P(No) = 3/5 = 0.6.$

Max Likelihoods - class churn = Yes.

a) Plan = Premium $P(Premium/Yes) = 1/2 = 0.5$

b) Support calls = High $P(High/Yes) = \cancel{2}/2 = 1$

class churn = No

a) Plan = Premium = $P(Premium/No) = 1/3 = 0.33$

b) Support = High = $P(High/No) = 0$.

Likelihood of Churn - Yes = $P(Yes) \times P(Premium/Yes) \times P(High/Yes)$

$= 0.4 \times 0.5 \times 1$

$\boxed{Yes = 0.2}$

Likelihood of churn = No = $P(No) \times P(Premium/No) \times P(High/No)$

$= 0.6 \times 0.33 \times 0$

$\boxed{No = 0}$

Yes > No = Hence churn = Yes.

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Applying Laplace smoothing.

$$\boxed{\hat{P}(\text{value} \mid \text{class}) = \frac{\text{Count} + 1}{\text{class\_count} + k}}$$ where $k \rightarrow$ Category count

a) Likelihood of churn = Yes (class count = 2)

* $P(\text{Premium} \mid \text{Yes}) = \frac{1+1}{2+2} = 2/4 = 0.5$
* $P(\text{High} \mid \text{Yes}) = \frac{2+1}{2+2} = 3/4 = 0.75$

$P(\text{Churn Yes}) = P(\text{Yes}) \times P(\text{Premium} \mid \text{Yes}) \times P(\text{High} \mid \text{Yes})$

$= 0.4 \times 0.5 \times 0.75$

$$\boxed{P(\text{churn Yes}) = 0.15}$$

b) Likelihood of churn = No (class count = 3)

* $P(\text{Premium} \mid \text{No}) = \frac{1+1}{3+2} = 2/5 = 0.4$
* $P(\text{High} \mid \text{No}) = \frac{0+1}{3+2} = 1/5 = 0.2$

$P(\text{Churn} \mid \text{No}) = P(\text{No}) \times P(\text{Premium} \mid \text{No}) \times P(\text{High} \mid \text{No})$

$= 0.6 \times 0.4 \times 0.2$

$$\boxed{P(\text{Churn No}) = 0.048}$$

$P(\text{churn Yes}) > P(\text{churn No})$

Hence the predict is <u>churn = Yes</u>

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Q4) Let A = event that product is Electronics

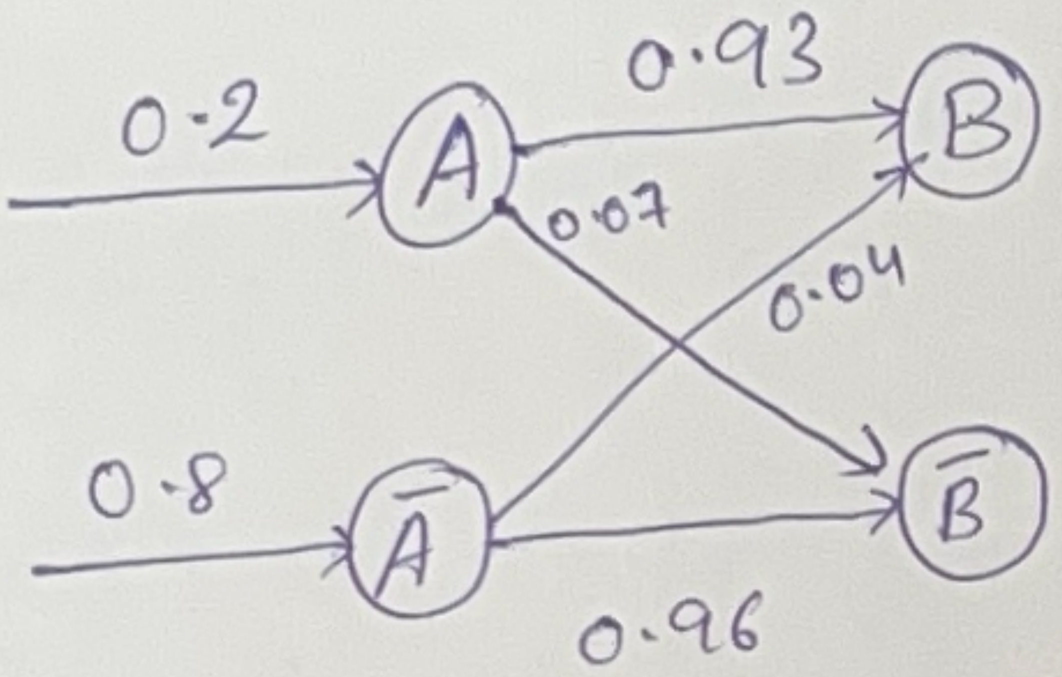
$\bar{A}$ = event that product is not Electronics

B = event product identified as Electronics

$\bar{B}$ = event product identified as Not Electronics

Given: $P(A) = 0.2$, $P(\bar{A}) = 0.8$, $P(B/A) = 0.93$, $P(B/\bar{A}) = 0.04$

$P(\bar{B}/A) = 0.07$, $P(\bar{B}/\bar{A}) = 0.96$.



Find $P(A/B)$.

$$P(A/B) = \frac{P(A \cap B)}{P(B)} = \frac{P(A) \times P(B/A)}{P(B)}.$$

$$P(B) = P(B/A)P(A) + P(B/\bar{A}) \times P(\bar{A})$$

$$= 0.93 \times 0.2 + 0.04 \times 0.8 = 0.186 + 0.032$$

$$P(B) = 0.218$$

$$P(A/B) = \frac{P(A) \times P(B/A)}{P(B)}$$

$$= \frac{0.2 \times 0.93}{0.218}$$

Hence $\boxed{P(A/B) = 0.8532}$

85.32% probability the product is actually Electronics and model has labelled it as Electronics.