Theoretical Part A

$$P(\text{price} \mid L, S) = \frac{P(L \mid \text{price}) \cdot P(S \mid \text{price}) \cdot P(\text{Price})}{P(L) \cdot P(S)}$$

From the dataset

Total = 10

Exp = 4

Aff = 3

Cheap = 3

$\text{Probability} = \frac{\text{Count}}{\text{total}}$

$P(\text{exp}) = 4/10 = 0.4$

$P(\text{Aff}) = 3/10 = 0.3$

$P(\text{cheap}) = 3/10 = 0.3$

Conditional Probability

→ For Expensive

$P(L = \text{urban} \mid \text{price} = \text{exp}) = \frac{2}{4} = 0.5$

$P(S = \text{med} \mid \text{price} = \text{exp}) = 0/4 = 0$

→ For Affordable

$P(L = \text{urban} \mid \text{price} = \text{Aff}) = \frac{1}{3} = 0.333$

$P(S = \text{medium} \mid \text{Price} = \text{Aff}) = \frac{3}{3} = 1$

→

PTO

→ For Cheap

$P(L = \text{Urban} \mid \text{Price} = \text{cheap}) = \frac{1}{3} = 0.33$

$P(L = \text{medium} \mid \text{Price} = \text{cheap}) = \frac{0}{3} = 0$

→ Now, using Naive Bayes formula

$P(\text{Price} \mid L = \text{Urban}, S = \text{medium})$

$\propto (P(L = \text{Urban} / \text{Price}) \times P(S = \text{medium} / \text{Price}) \times P(\text{Price})$

$P(\text{Exp} \mid L = \text{Urban}, S = \text{medium})$

$= 0.5 \times 0.0 \times 0.4$

$= 0$

$P(\text{Aff} \mid L = \text{Urban}, S = \text{medium})$

$= 0.33 \times 1 \times 0.3$

$= 0.099$

$P(\text{cheap} \mid L = \text{Urban}, S = \text{medium})$

$= 0.333 \times 0.0 \times 0.3$

$= 0$

→ PTO

As, $P(Exp) = 0$ & $P(cheap) = 0$

Prediction of medium size house in Urban locality $\boxed{\text{Affordable}}$

Theoretical Part B

$$\begin{aligned} 4x_1 - 3x_2 + x_3 &= -10, \\ 2x_1 + x_2 + 3x_3 &= 0, \\ -x_1 + 2x_2 - 5x_3 &= 17, \end{aligned}$$

Matrix form

$$\left[\begin{array}{ccc|c} 4 & -3 & 1 & -10 \\ 2 & 1 & 3 & 0 \\ -1 & 2 & -5 & 17 \end{array}\right]$$

→ Apply Gaussian elimination

$R_1 \to \frac{1}{4} R_1$

$$= \left[\begin{array}{ccc|c} 1 & -0.75 & 0.25 & -2.5 \\ 2 & 1 & 3 & 0 \\ -1 & 2 & -5 & 17 \end{array}\right]$$

$R_2 \to R_2 - 2R_1$

$$= \left[\begin{array}{ccc|c} 1 & -0.75 & 0.25 & -2.5 \\ 0 & 2.5 & -2 & 5 \\ -1 & 2 & -5 & 17 \end{array}\right]$$

$$R_3 \rightarrow R_3 + R_1$$

$$= \left[\begin{array}{ccc|c} 1 & 0.75 & 0.25 & -2.5 \\ 0 & 2.5 & -2 & 5 \\ 0 & 2.75 & -4.75 & 14.5 \end{array}\right]$$

$$R_3 \rightarrow R_3 - 1.1 R_2$$

$$= \left[\begin{array}{ccc|c} 1 & 0.75 & 0.25 & -2.5 \\ 0 & -0.5 & -2 & 5 \\ 0 & 0 & -13.56 & -9 \end{array}\right]$$

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substitute values

$$R_3 \rightarrow \quad -13.66 x_3 = -9$$

$$\boxed{x_3 = -0.96 \simeq 1}$$

$R_2 - \quad - \quad .5 \quad -2x_3 = 5$

$-0.5x_2 - 2(1) = 5$

$-0.5x_2 = 5 + 2$

$x_2 = \frac{7}{0.5}$

$\boxed{x_2 = 14}$

$R_1 \rightarrow x_1 + 0.75x_2 + 0.25x_3 = 2.5$

$x_1 + 0.75(14) + 0.25(1) = 2.5$

$x_1 = 2.5 - 0.25 + 10.21$

$\boxed{x_1 = 12.46}$