

A1110 Assignment 6

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Exercise 13.1 Q4: Evaluate $\Pr(A \cup B)$, if $2\Pr(A) = \Pr(B) = \frac{5}{13}$ and $\Pr(A|B) = \frac{2}{5}$.

Solution: Consider the random variable $X \in \{0, 1\}$, where $X = 0$ denotes the event A and $X = 1$ denotes the event B.

$$\implies \Pr(X = 0|X = 1) = \Pr(A|B) \quad (1)$$

$$\therefore \Pr(X = 0|X = 1) = \frac{\Pr(X = 0, X = 1)}{\Pr(X = 1)} \quad (2)$$

$$\begin{aligned} \implies \Pr(X = 0, X = 1) \\ = \Pr(X = 0|X = 1) \times \Pr(X = 1) \end{aligned} \quad (3)$$

$$\Pr(X = 0, X = 1) = \frac{2}{5} \times \frac{5}{13} = \frac{2}{13} \quad (4)$$

Now,

$$\begin{aligned} \Pr(X = 0 + X = 1) &= \Pr(X = 0) + \Pr(X = 1) \\ &\quad - \Pr(X = 0, X = 1) \end{aligned} \quad (5)$$

$$2\Pr(X = 0) = \frac{5}{13} \quad (6)$$

$$\implies \Pr(X = 0) = \frac{5}{26} \quad (7)$$

$$\Pr(X = 1) = \frac{5}{13} \quad (8)$$

$$\Pr(X = 0, X = 1) = \frac{2}{13} \quad (9)$$

$$\therefore \Pr(X = 0 + X = 1) = \frac{5}{26} + \frac{5}{13} - \frac{2}{13} \quad (10)$$

$$= \frac{11}{26} \quad (11)$$

$$\therefore \Pr(A + B) = \boxed{\frac{11}{26}} \quad (12)$$