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.

$$\implies \Pr(X = 0|X = 1) = \Pr(A|B) \tag{1}$$

$$\therefore \Pr(X = 0|X = 1) = \frac{\Pr(X = 0 \cap X = 1)}{\Pr(X = 1)} \tag{2}$$

$$\implies \Pr(X = 0 \cap X = 1) = \Pr(X = 0|X = 1) \times \Pr(X = 1) \tag{3}$$

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

Now,

$$\Pr(X = 0 \cup X = 1) = \Pr(X = 0) + \Pr(X = 1) - \Pr(X = 0 \cap X = 1) \tag{5}$$

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

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

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

$$\Pr(X = 0 \cap X = 1) = \frac{2}{13} \tag{9}$$

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

$$= \frac{11}{26} \tag{11}$$

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