AI1103: Assignment 6

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PROBLEM GATE 2013 (ME), Q.45:

The probability that a student knows the correct answer to a multiple choice question is $\frac{2}{3}$. If the student does not know the answer, then the student guesses the answer. The probability of the guessed answer being correct is $\frac{1}{4}$. Given that the student has answered the question correctly, the conditional probability that the student knows the correct answer is

1) $\frac{2}{3}$ 2) $\frac{3}{4}$ 3) $\frac{5}{6}$ 4) $\frac{8}{9}$

SOLUTION:

Let the following random variables and their values denote:

A : Knows correct answer = 1

B : Marks correct answer = 1

$$\therefore \Pr(A=1) = \frac{2}{3} \tag{0.0.1}$$

$$\Pr(B=1|A=1) = 1 \tag{0.0.2}$$

$$\Pr(B=1|A=0) = \frac{1}{4} \tag{0.0.3}$$

Applying Bayes Theorem, the value of $\Pr(B=1)$ is :

$$\Pr(B=1) = \Pr(B=1|A=1)\Pr(A=1) \tag{0.0.4}$$

$$+ \Pr(B=1|A=0)\Pr(A=0) \tag{0.0.5}$$

$$= 1 \cdot \frac{2}{3} + \frac{1}{4} \cdot \frac{1}{3} = \frac{3}{4} \tag{0.0.6}$$

Applying Bayes Theorem, calculating the value of $\Pr(B=1, A=1)$ is:

$$= \Pr(B=1|A=1)\Pr(A=1) \tag{0.0.7}$$

$$= 1 \cdot \frac{2}{3} \tag{0.0.8}$$

Applying Bayes Theorem, we need to find the value of $\Pr(A=1|B=1)$. Upon substituting from (0.0.8) and (0.0.6), we get

$$= \frac{\Pr(B=1, A=1)}{\Pr(B=1)} \tag{0.0.9}$$

$$= \frac{8}{9} \tag{0.0.10}$$

The correct answer is **Option 4**.