

Quiz #1	Start Thursday, September 24, 5:00 pm	Due Friday, September 25, 5:00 pm
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## Question 1:

The number of people in a town, who have completed a college degree, are categorized as shown in the table below.

	Employed	Unemployed	Total
Male	460	40	500
Female	140	260	400
Total	600	300	900

Suppose one of these individuals is to be selected at random for a tour to publicize the advantages of establishing new industries in the town. Answer the following:

	Marks
(a) Evaluate the probability that the individual is employed $P[E] = \frac{600}{900} = \frac{2}{3} \approx 0.67$	/1
(b) Evaluate the probability that the individual is unemployed $P[U] = \frac{300}{900} = \frac{1}{3} \approx 0.33$	/1
(c) Evaluate the probability that the individual is a male $P[M] = \frac{500}{900} = \frac{5}{9} \approx 0.56$	/1
(d) Evaluate the probability that the individual is female $P[F] = \frac{400}{900} = \frac{4}{9} \approx 0.44$	/1
(e) Evaluate the probability that the individual is a male given that he is employed $P[M E] = \frac{\text{Number of male and employed}}{\text{number of employed}} = \frac{460}{600} = \frac{23}{30} \approx 0.77$	/1
(f) Evaluate the probability that the individual is a male and is employed $P[M \cap E] = P[M E] \cdot P[E] = \frac{23}{30} \times \frac{2}{3} = \frac{23}{45} \approx 0.51$	/1
(g) Evaluate the probability that the individual is employed given that he is a male $P[E M] = \frac{P[M \cap E]}{P[M]} = \frac{\frac{23}{45}}{\frac{5}{9}} = \frac{23}{25} \approx 0.92$	/1

	$P[E M]$ (prev. page) ( $\approx 0.92$ )	
(h)	Evaluate the probability that the individual is a female and is unemployed $P[F \cap U] = P[F U] \cdot P[U] = \frac{260}{300} \cdot \frac{1}{3} = \frac{13}{45}$ $\approx 0.29$	/1
(i)	Evaluate the probability $P[M \cup E] = P[M] + P[E] - P[M \cap E]$ $= \frac{5}{9} + \frac{2}{3} - \frac{23}{45} = \frac{32}{45} = 0.71$	/2
(j)	Evaluate the probability $P[\overline{M \cap E}] = P[\overline{M \cap E}] = 1 - P[M \cap E] = 1 - \frac{23}{45} = \frac{22}{45}$ $\approx 0.49$	/1.5
(k)	Evaluate the probability $P[\overline{M \cap E}] = P[\overline{M \cap E}] = 1 - P[M \cap E] = 1 - \frac{32}{45} = \frac{13}{45}$ $\approx 0.29$	/1.5
(l)	Show whether $E$ and $M$ are independent	/1
	$P[E \cap M]$ must equal $P[E] \cdot P[M]$ to be independent	/14

$$\downarrow$$

$$\frac{23}{45}$$

$$\neq$$

$$\downarrow$$

$$\frac{10}{27}$$

NOT INDEPENDENT



**Question 2:**

A company employs two sales engineers  $A$  and  $B$ . Engineer  $A$  does the work of estimating cost for 70% of jobs bid by the company while Engineer  $B$  does the work for 30% of jobs bid by the company. From past studies, it is known that the error rate when Engineer  $A$  does the work is 2%, whereas when Engineer  $B$  does the work it is 4%. Define the event  $E$ : Error occurs in estimating cost. Answer the following questions:

		Marks
(a)	Write down the values of the given or known probabilities	/1
(b)	Evaluate the probability of an error occurring in estimating cost	/2
(c)	A bid arrives and there is an error in estimating cost. What is the probability that the bid came from Engineer $A$ ?	/1.5
(d)	A bid arrives and there is an error in estimating cost. What is the probability that the bid came from Engineer $B$ ?	/1.5

$$a) P[A] = 0.7, P[B] = 0.3, \\ P[E|A] = 0.02, P[E|B] = 0.04$$

$$b) P[E] = P[E \cap A] + P[E \cap B]$$

$$P[E \cap A] = P[E|A] \cdot P[A] = 0.02 \times 0.7 = 0.014$$

$$P[E \cap B] = P[E|B] \cdot P[B] = 0.04 \times 0.3 = 0.012$$

$$P[E] = 0.014 + 0.012 = \boxed{0.026} \text{ or } 2.6\%$$

$$c) P[A|E] = \frac{P[E|A] \cdot P[A]}{P[E]} \text{ or } \frac{P[A \cap E]}{P[E]} = \frac{0.014}{0.026} \\ = \frac{7}{13} \boxed{= 0.54}$$

$$d) P[B|E] = \frac{P[E|B] \cdot P[B]}{P[E]} \text{ or } \frac{P[B \cap E]}{P[E]} = \frac{0.012}{0.026} \\ = \frac{6}{13} \boxed{= 0.46}$$