

# Assignment-3

## (CBSE 12th Ex 23)

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### Problem 13:

Fill in the blanks in the following Table 1:

$P(A)$	$P(B)$	$P(A \cap B)$	$P(A \cup B)$
$\frac{1}{3}$	$\frac{1}{5}$	$\frac{1}{15}$	...
0.35	...	0.25	0.6
0.5	0.35	...	0.7

Table 1:

### Solution:

The given inputs of probabilities involving events  $A$  and  $B$  vary among  $P(A)$ ,  $P(B)$ ,  $P(AB)$  and  $P(A + B)$  with one of them being an unknown. We know, if events  $E_1$  and  $E_2$  were disjoint, we get

$$P(E_1 + E_2) = P(E_1) + P(E_2) \quad (1)$$

$$P(E_1 E_2) = 0 \quad (2)$$

Now, for events  $A$  and  $B$ ,

$$A + B = A + (B - A)$$

$$B - A = B - AB$$

Here,  $A$  and  $B - A$  are disjoint. And from equation (1)

$$\begin{aligned} P(A + B) &= P(A + (B - A)) \\ &= P(A) + P(B - A) \\ &= P(A) + P(B - AB) \end{aligned}$$

$B$  and  $AB$  are also disjoint, so again using equation (1)

$$P(A + B) = P(A) + P(B) - P(AB) \quad (3)$$

This is the General Probability Addition Rule.

Using the above formulae (3) we can find the unknown probabilities in the question,

- (a) Given values from the question are in Table 2:

Event	Probability	Value
$A$	$P(A)$	$\frac{1}{3}$
$B$	$P(B)$	$\frac{1}{5}$
$AB$	$P(AB)$	$\frac{1}{15}$
$A + B$	$P(A + B)$	?

Table 2:

Substituting the values above into the formulae (3),

$$\begin{aligned} P(A + B) &= P(A) + P(B) - P(AB) \\ &= \frac{1}{3} + \frac{1}{5} - \frac{1}{15} \\ &= \frac{7}{15} \end{aligned}$$

Therefore from above, we get the desired probability,

$$P(A + B) = \frac{7}{15}$$

- (b) Given values from the question are in Table 3:

Event	Probability	Value
$A$	$P(A)$	0.35
$B$	$P(B)$	?
$AB$	$P(AB)$	0.25
$A + B$	$P(A + B)$	0.6

Table 3:

Substituting the values above into the formulae (3),

$$\begin{aligned}
 P(A + B) &= P(A) + P(B) - P(AB) \\
 P(B) &= P(A + B) + P(AB) - P(A) \\
 &= 0.6 + 0.25 - 0.35 \\
 &= 0.5
 \end{aligned}$$

Therefore from above, we get the desired probability,

$$P(B) = 0.5$$

- (c) Given values from the question are in Table 4:

Event	Probability	Value
$A$	$P(A)$	0.5
$B$	$P(B)$	0.35
$AB$	$P(AB)$	?
$A + B$	$P(A + B)$	0.7

Table 4:

Substituting the values above into the formulae (3),

$$\begin{aligned}
 P(A + B) &= P(A) + P(B) - P(AB) \\
 P(AB) &= P(A) + P(B) - P(A + B) \\
 &= 0.5 + 0.35 - 0.7 \\
 &= 0.15
 \end{aligned}$$

Therefore from above, we get the desired probability,

$$P(AB) = 0.15$$