# Assignment-1

## AI1110: Probability and Random Variables

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**Question:12.13.2.15:** One card is drawn at random from a well shuffled deck of 52 cards. In which of the following cases are the events E and F independent ?

(i) $E$ : 'the card drawn is a spade'
$F$ : 'the card drawn is an ace'

(ii) $E$: 'the card drawn is black'
$F$ : 'the card drawn is a king'

(iii) $E$ : 'the card drawn is a king or queen'
$F$ : 'the card drawn is a queen or jack'.

**Solution:**

(i) $E$ denotes the event that the card drawn is spade

$$\Pr(E) = \frac{13}{52} = \frac{1}{4} \tag{1}$$

$F$ denotes the event that card drawn is ace

$$\Pr(F) = \frac{4}{52} = \frac{1}{13} \tag{2}$$

$$\Pr(EF) = \frac{1}{52} \tag{3}$$

$$\Pr(E)\Pr(F) = \frac{1}{4} \times \frac{1}{13} = \frac{1}{52} \tag{4}$$

$$\therefore \quad \Pr(EF) = \Pr(E)\Pr(F) \tag{5}$$

$\therefore$ $E$ and $F$ are independent events.

(ii) $E$ denotes the event that the card drawn is black

$$\Pr(E) = \frac{26}{52} = \frac{1}{2} \tag{6}$$

$F$ denotes the event that card drawn is a king

$$\Pr(F) = \frac{4}{52} = \frac{1}{13} \tag{7}$$

$$\Pr(EF) = \frac{2}{52} = \frac{1}{26} \tag{8}$$

$$\Pr(E)\Pr(F) = \frac{1}{2} \times \frac{1}{13} = \frac{1}{26} \tag{9}$$

$$\therefore \quad \Pr(EF) = \Pr(E)\Pr(F) \tag{10}$$

$\therefore$ $E$ and $F$ are independent events.

(iii) $E$ denotes the event that the card drawn is king or queen

$$\Pr(E) = \frac{8}{52} = \frac{2}{13} \tag{11}$$

$F$ denotes the event that card drawn is a queen or jack

$$\Pr(F) = \frac{8}{52} = \frac{2}{13} \tag{12}$$

$$\Pr(EF) = \frac{4}{52} = \frac{1}{13} \tag{13}$$

$$\Pr(E)\Pr(F) = \frac{2}{13} \times \frac{2}{13} = \frac{4}{169} \tag{14}$$

$$\therefore \quad \Pr(EF) \neq \Pr(E)\Pr(F) \tag{15}$$

$\therefore$ $E$ and $F$ are not independent events.