Cambridge International AS & A Level

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Mathematics 9709/52

Paper 5 Probability & Statistics 1 October/November 2021

Question No (1)

1 Each of the 180 students at a college plays exactly one of the piano, the guitar and the drums. The numbers of male and female students who play the piano, the guitar and the drums are given in the following table.

	Piano	Guitar	Drums
Male	25	44	11
Female	42	38	20

A student at the college is chosen at random.

(a) Find the probability that the student plays the guitar.

(b) Find the probability that the student is male given that the student plays the drums.

(c) Determine whether the events 'the student plays the guitar' and 'the student is female' are independent, justifying your answer.

Solution:

$(\boldsymbol{a})$

$$Total\ Number\ of\ students = 180$$

$$Number\ of\ student\ playing\ guitar = 44 + 38 = 82$$

$$P(guitar) = \frac{favourable\ item}{total\ items}$$

$$= \frac{44 + 38}{180} = \frac{82}{180} = 0.456$$

$$\boldsymbol{P(guitar) = 0.456}$$

$(\boldsymbol{b})$

Conditional Probability

$$P\left(\frac{A}{B}\right) = \frac{P(A \cap B)}{P(B)}$$

If M denote the male student and D denote the drum then

$$P\left(\frac{M}{D}\right) = \frac{P(M \cap D)}{P(D)} = \frac{(Student\ is\ male\ and\ playing\ drum)}{Student\ playing\ drum}$$

$$= \frac{\frac{11}{180}}{\frac{11}{180} + \frac{20}{180}}$$

$$= \frac{\frac{11}{180}}{\frac{31}{180}} = \frac{11}{31} = 0.355$$

$$\boldsymbol{P\left(\frac{M}{D}\right) = 0.355}$$

$(\boldsymbol{C})$

Let G be the event that the student plays guitar. and F be the event that the student is female.

$$P(G) = \frac{44 + 38}{180} = \frac{82}{180} = \frac{41}{90}$$

$$P(F) = \frac{42 + 38 + 20}{180}$$

$$= \frac{100}{180}$$

$$P(F) = \frac{50}{90}$$

both event G and F are independent if

$$\boldsymbol{P(F \cap G) = P(F) \times P(G)} \qquad \rightarrow (\mathbf{1})$$

Now

$$P(F \cap G) = \frac{38}{180} = \frac{19}{90}$$

putting the value of $P(F \cap G)$, $P(F), P(G)$ *in* (1)

$$\frac{19}{90} = \frac{50}{90} \times \frac{41}{90}$$

$$\frac{19}{90} = \frac{41}{162} \quad \textit{not equal}$$

$$=> P\,(F \cap G) \neq P(F) \times P(G)$$

So both event F and G are not independent.