

Cambridge International AS & A Level

Mathematics

9709/52

Paper 5 Probability & Statistics 1

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Question No (1)

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Question No (1)

Rachel has three coins. The first coin is biased so that the probability of obtaining a head when it is thrown is $\frac{1}{3}$. The second coin is biased so that the probability of obtaining a head when it is thrown is $\frac{1}{4}$. The third coin is fair.

Rachel throws the three coins at the same time. The random variable X is the number of tails that she obtains.

Draw up the probability distribution table for X .

Solution:

Given data

First coin $P(H) = \frac{1}{3} \Rightarrow P(T) = 1 - \frac{1}{3} = \frac{2}{3}$

Second coin $P(H) = \frac{1}{4} \Rightarrow P(T) = 1 - \frac{1}{4} = \frac{3}{4}$

Third coin $P(H) = \frac{1}{2} \Rightarrow P(T) = 1 - \frac{1}{2} = \frac{1}{2}$

Let X be the variable for number of tails, then X can have values,

0, 1, 2, 3 (0 $\Rightarrow$ no tail, 3 $\Rightarrow$ All tails)

$P(X=0) = P(H) P(H) P(H)$
 $P(X=0) = \left(\frac{1}{3}\right) \left(\frac{1}{4}\right) \left(\frac{1}{2}\right) = \frac{1}{24}$

$P(X=3) = \left(\frac{2}{3}\right) \left(\frac{3}{4}\right) \left(\frac{1}{2}\right) = \frac{6}{24}$

$P(X=2) = P(TTH) + P(THT) + P(HTT)$
 $= \frac{2}{3} \times \frac{3}{4} \times \frac{1}{2} + \frac{2}{3} \times \frac{1}{4} \times \frac{1}{2} + \frac{1}{3} \times \frac{3}{4} \times \frac{1}{2}$
 $= \frac{1}{4} + \frac{1}{12} + \frac{1}{8}$
 $P(X=2) = \frac{6+2+3}{24} = \frac{11}{24}$

$P(X=1) = P(THH) + P(HTH) + P(HHT)$
 $= \frac{2}{3} \times \frac{1}{4} \times \frac{1}{2} + \frac{1}{3} \times \frac{3}{4} \times \frac{1}{2} + \frac{1}{3} \times \frac{1}{4} \times \frac{1}{2}$

$$= \frac{2}{24} + \frac{3}{24} + \frac{1}{24}$$

$$P(X=1) = \frac{6}{24}$$

probability distribution table

X (number of tails)	0	1	2	3
P(X)	$\frac{1}{24}$	$\frac{6}{24} = \frac{1}{4}$	$\frac{11}{24}$	$\frac{6}{24} = \frac{1}{4}$