

Assignment 6

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May 16, 2022

Problem-CBSE-12 Q)Example-20

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Problem

Q) A doctor is to visit a patient. From the past experience, it is known that the probabilities that he will come by train, bus, scooter or by other means of transport are respectively $\frac{3}{10}$, $\frac{1}{5}$, $\frac{1}{10}$ and $\frac{2}{5}$. The probabilities that he will be late are $\frac{1}{4}$, $\frac{1}{3}$ and $\frac{1}{12}$, if he comes by train, bus and scooter respectively, but if he comes by other means of transport, then he will not be late. When he arrives, he is late. What is the probability that he comes by the train?

Solution

Let $X \in \{0,1,2,3\}$ be the random variables defined by that doctor chooses train $\Rightarrow X = 0$, doctor chooses bus $\Rightarrow X = 1$, doctor chooses scooter $\Rightarrow X = 2$ and doctor chooses other means of transport $\Rightarrow X = 3$. And let $Y \in \{0,1\}$ be that doctor being late i.e., $Y = 0$ if doctor is on time and $Y = 1$ if doctor is being late

Then, probability that doctor chooses particular mode of transport

- Probability of choosing train $\Rightarrow Pr(X = 0) = \frac{3}{10}$
- Probability of choosing bus $\Rightarrow Pr(X = 1) = \frac{1}{5}$
- Probability of choosing scooter $\Rightarrow Pr(X = 2) = \frac{1}{10}$
- Probability of choosing other means $\Rightarrow Pr(X = 3) = \frac{2}{5}$

Probability that doctor late by that particular mode of transport

- Probability of being late by train $\implies Pr(Y = 0|X = 0) = \frac{1}{4}$
- Probability of being late by bus $\implies Pr(Y = 0|X = 1) = \frac{1}{3}$
- Probability of being late by scooter $\implies Pr(Y = 0|X = 2) = \frac{1}{12}$
- Probability of being late by other means $\implies Pr(Y = 0|X = 3) = 0$

∴ by Baye's Theorem, we have

$Pr(X = 0|Y = 0)$ = Probability that the doctor arriving late comes by train

$$Pr(X = 0|Y = 0) = \frac{Pr(X = 0)Pr(Y = 0|X = 0)}{\sum_{i=0}^4 Pr(X = i)Pr(Y = 0|X = i)} \quad (1)$$

$$Pr(X = 0|Y = 0) = \frac{\frac{3}{10} \times \frac{1}{4}}{\frac{3}{10} \times \frac{1}{4} + \frac{1}{5} \times \frac{1}{3} + \frac{1}{10} \times \frac{1}{12} + \frac{2}{5} \times 0} \quad (2)$$

$$= \frac{3}{40} \times \frac{120}{18} \quad (3)$$

$$= \frac{1}{2} \quad (4)$$

Hence, the required probability is $\frac{1}{2}$

PMF Graph

The PMF graph is:

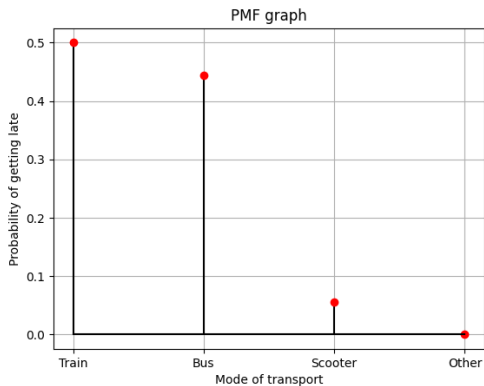


Figure: Probability Mass Function

CODES

Python

Download python code from - Python

Beamer

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