CHAPTER 15
PROBABILITY

⮞ **Terms related to Probability:**

- **Trial:** A trial is an experiment whose outcomes can be labeled either a success or a failure.

- **Event:** An event is an outcome or collection of outcomes of a trial.

- **Randomness:** A trial is said to be random if there is no pre-arrangement to get a particular outcome.

- **Biased case:** When the arrangements of a trial are such that there is inclination towards or against the happening of an event, then we say that the trial is biased towards or against the event.

- **Equally likely events:** Events are said to be equally likely if there is no reasonable ground to believe that one event is more likely to happen than the other.

- **Mutually Exclusive events:** Events are said to be mutually exclusive if the occurrence of one forecloses the occurrence of all the other events.

⮞ The empirical probability P(E) of the occurrence of the events E is given by

$$P(E) = \frac{The\ number\ of\ trials\ in\ which\ E\ happened}{Total\ number\ of\ trials}$$

Note: $0 \leq P(E) \leq 1$ for any event E.

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SOLUTIONS

EXERCISE 15.1

1. **From among the consumers considered in problem no. 7 of exercise 14.1 if one is chosen at random find the probability that he belongs to the group using the highest amount of energy. Also find the most probable class of monthly rate of energy consumption to which he/she can belongs.**

Solution:

Units of Energy Consumed	Number of Consumers
1 – 10	20
11 – 20	35
21 - 30	42
31 - 40	70
41 - 50	100
51 - 60	120
61 - 70	110
71 - 80	65
81 - 90	36
91 - 100	20
101 - above	10
Total	628

The probability that the chosen consumer belongs to the group using the highest amount of energy

$$= \frac{10}{628} = \frac{5}{314} = 0.016$$

The most probable class of monthly rate energy consumption to which the chosen consumer can be belong is 51 – 60 as the probability that he/she can belong to this group is the highest.

2. **Consider two candidate X and Y with reference to problem number 3 of Exercise 14.1. X says he will get A^+ and Y says he will get C^+. Find who is more realistic.**

Solution:

Grades	No. of Students
A^+	6
A	5
B^+	10
B	8
C^+	4
C	9
D	3
Total	**45**

The probability of getting the grade $A^+ = \dfrac{6}{45}$

The probability of getting the grade $C^+ = \dfrac{4}{45}$

As $\dfrac{6}{45} > \dfrac{4}{45}$, X is more realistic.

3. **The following is the data of height and the corresponding weight of the members of a sample of 20 adults at random form a group of parents of the pupils of a school.**

Height in Metres	Weight in Kg.	No. of persons
1.5	60	5
1.6	65	8
1.7	70	7

A parameter ζ called body – mass ratio of a person is given by $\zeta = \dfrac{Weight\ in\ Kg.}{(Height\ in\ metre)^2}$

For a person if $\zeta > 25$ he/she is considered overweight. Find the probability that a person chosen at random from the sample is not overweight.

Solution:

Height in Metre	Weight in Kg.	No. of persons	$\zeta = \dfrac{Weight\ in\ Kg.}{(Height)^2}$
1.5	60	5	26.66
1.6	65	8	25.39
1.7	70	7	24.22
		20	

The probability that a person chosen at random from the sample is not over weight

$$= \frac{7}{20} = 0.35$$

4. **A printer declares that his machine has a chance of less than 0.001% of committing typographical mistake of printing misspelt words. In actual counting there were 3 misspelt words in a dictionary of 1 million words printed by his machine. Determine whether the printer keeps his words or not.**

Solution:

Total number of words in the dictionary $= 1000000$

Number of misspelt words $= 3$

Percentage of printing misspelt words $= \dfrac{3}{1000000} \times 100\%$

$$= 0.0003\%$$

As $0.0003\% < 0.001\%$, the printer keeps his words.

5. **In a grouped frequency table of n classes if Pi is the probability that an observation may belong to the ith class with frequency fi show that $\sum_i^n p_i = 1$. Also, for a variate assuming the constant C show that $E(x) = C$.**

Solution: $\sum_i^n p_i = P_1 + P_2 + \cdots \ldots \ldots \ldots + P_n$

$$= \frac{f_1}{N} + \frac{f_2}{N} + \cdots \ldots \ldots \ldots + \frac{f_n}{N}$$

$$= \frac{f_1 + f_2 + \cdots \ldots \ldots + f_n}{N}$$

$$= \frac{N}{N} = 1$$

$$E(x) = \frac{C + C + C \ldots \ldots \ldots \ldots + C \ (n \ times)}{n}$$

$$= \frac{nC}{n} = C$$

$$\therefore E(x) = C$$

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