1. Choose the correct statement/s on relative frequency.

   a. The ratio of the total frequency to the total number of observations is equal to 1.

   b. Sum of all the relative frequencies should be equal to 1.

   c. The ratio of the frequency of a particular observation to the total number of observations is the relative frequency of that observation.

   d. The multiplication of the total number of observations and relative frequency of a particular observation should be equal to the frequency of that observation.

   Answer: a,b,c,d

   **Solution:**

   Suppose we have n observations and their corresponding frequencies are $f_1$, $f_2$, $f_3$,...,$f_n$ respectively.

   As we know that the total frequency i.e. $f_1 + f_2 + ... + f_n$ = N = Total number of observations.

   Thus, the ratio of the total frequency to the total number of observations will be $\dfrac{N}{N} = 1$

   Hence, option(a) is correct.

   By definition, Relative frequency is the ratio of the frequency to the total number of observations. Therefore, for n observations Relative frequencies will be $\dfrac{f_1}{N}$, $\dfrac{f_2}{N}$,...,$\dfrac{f_n}{N}$ respectively.

   Thus, Sum of all the relative frequencies $= \dfrac{f_1}{N} + \dfrac{f_2}{N} + ... + \dfrac{f_n}{N} = \dfrac{f_1 + f_2 + ... + f_n}{N} = \dfrac{N}{N} = 1$.

   OR

   They add to 1 because each relative frequency is just the fraction of the whole for that individual outcome. And, the sum of all fractional parts must equal the whole.

   Hence, option(b) is correct.

   By the definition of Relative frequency , option(c) is also correct.

   Since, Relative frequency for $i^{th}$ observation; $R_{f_i} = \dfrac{f_i}{N}$ ; $i = 1, 2..., n$

   $f_i = R_{f_i} \times N$

   which implies that the multiplication of the total number of observations and relative

frequency of a particular($i^{th}$) observation is equal to the frequency of that observation. Hence, option(d) is correct.

2. Pie chart is used to:

    a. Show the proportions of a categorical variable.

    b. Divide a circle into pieces which is proportional to the relative frequencies of the qualitative data.

    c. Compare proportions of a whole.

    d. None of the above.

    Answer: a, b, c
    **Solution:**
    By the definition of Pie chart , it is clear that options(a), (b) and (c) are correct.

3. Which of the following can be defined for both nominal and ordinal data?

    a. Mean

    b. Median

    c. Mode

    d. All of the above

    Answer: c
    **Solution :**
    Mean is not defined for a categorical variable, hence option (a) is incorrect.
    Median is defined for a categorical variable having ordinal scale of measurement. Hence option (b) is incorrect.
    Mode is defined for a categorical variable having both ordinal and nominal scale of measurement. Hence option (c) is correct.

4. If an analyst wants to represent the revenues of various companies using graphs, then which of the following graphical representation/s is/are most appropriate for the purpose?

    a. A pie chart with a pie/slice for each company and the width corresponding to its revenue in crore rupees.

    b. A bar chart with a bar for each company on the x-axis and the length corresponding to its revenue in crore rupees on the y-axis.

    c. A bar chart with a bar for each company on the y-axis and the length corresponding to its revenue in crore rupees on the x-axis.

d. A bar chart with the minimum revenue as a baseline.

Answer: b,c
**Solution:**
Since Pie charts are best to use when we are trying to compare parts of a whole. So, in this case pie chart would not be best graphical representation.Thus, option(a) is incorrect.
Since, bar charts are best to use when we compare things between different groups.A bar chart displays the frequency or relative frequency for distinct values. Also, we can display the distinct values on x-axis as well as on y-axis and frequency or relative frequency can display on both axes. Hence, options (b) and (c) are correct.

5. Mode of a categorical variable is:

   a. The last bar in ascending order of a Pareto chart.

   b. The middle-most bar in a Pareto chart.

   c. The longest bar in a bar chart.

   d. The widest slice in a pie chart.

Answer: a, c,d
**Solution:**
The most frequently occurring category of a categorical variable is known as mode.
In the ascending order Pareto chart, last bar will always have the highest frequency which represents a mode.Thus, option (a) is correct.
In a Pareto chart, all the categories are being arranged in either an ascending or a descending order. Therefore, the middle-most bar will not have the highest frequency. Hence, option (b) is incorrect.
Also, in a bar chart the longest bar will always have the highest frequency. Thus, mode will be the longest bar. Therefore, option(c) is correct.
In a pie chart, the widest pie/slice will always have the highest frequency. Thus, mode will be the widest slice in a pie chart. Therefore, option(d) is also correct.

$x$, $y$ and $z$ are observations and the sum of their frequencies is 50 and relative frequencies corresponding to $x$ and $z$ are 30% and 40% respectively. On the basis of the given information, answer questions (6) and (7).

6. The frequency corresponding to $y$ will be:

   a. 30

   b. 40

   c. 20

d. 15

**Solution:**
Let frequencies corresponding to $x$, $y$ and $z$ be $f_x$, $f_y$ and $f_z$ respectively and the corresponding relative frequencies be $R_{f_x}$, $R_{f_y}$ and $R_{f_z}$ respectively.
Given that, $f_x + f_y + f_z = 50 = $ Total number of observations (N).
The relative frequencies for $x$ and $z$ are $30\% (= 0.3)$ and $40\% (= 0.4)$ respectively.
Since, sum of all the relative frequencies is equals to 1. Thus,

$$R_{f_x} + R_{f_y} + R_{f_z} = 1$$
$$0.3 + R_{f_y} + 0.4 = 1$$
$$R_{f_y} = 1 - 0.7 = 0.3$$

We know, $frequency = Relative frequency \times N$.
Therefore, $f_y = R_{f_y} \times N = 0.3 \times 50 = 15$.
Hence, option(d) is correct.

7. What will be the cumulative frequency of $x$ and $z$:

   a 35

   b 70

   c 50

   d 40

**Solution:**
We know, $frequency = Relative frequency \times N$.
Thus, $f_x = R_{f_x} \times N = 0.3 \times 50 = 15$ and
$f_z = R_{f_z} \times N = 0.4 \times 50 = 20$
Therefore, Cumulative frequency of $x$ and $z$ will be $15 + 20 = 35$.
Hence, option(a) is correct.

8. The distribution of grades in a Statistics class consisting of 80 students is shown by a pie chart in Figure 2.1.G. How many students have secured B grade?
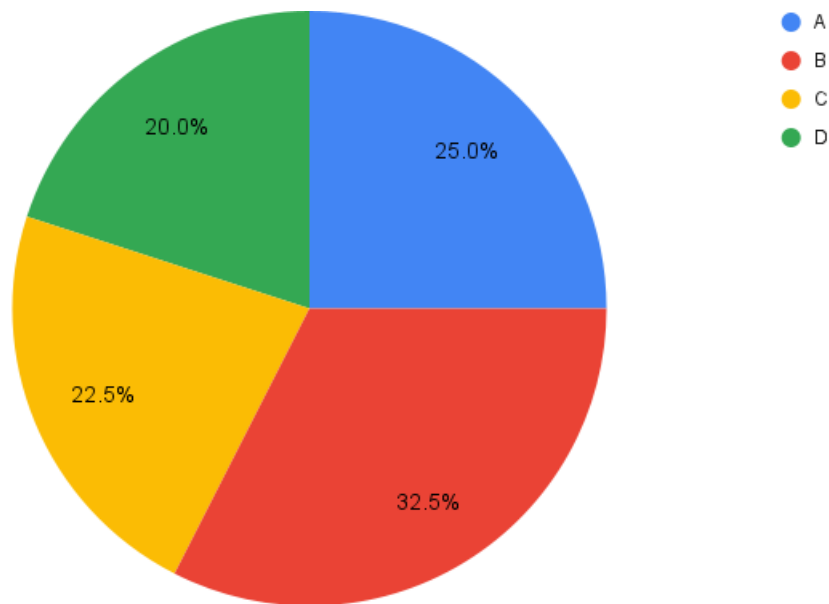


Figure 2.1.G: distribution of grades in a Statistics class

Answer: 26
**Solution:**
From the pie chart shown in Figure 2.1.G, 32.5% students secured B grade.
Total number of students in Statistics class $= 80$
Therefore, number of students with B grade $= 80 \times \dfrac{32.5}{100} = 26$

9. Which of the following statement(s) is/are true?

    a. Relative frequency is the number of observations belonging to a category.

    b. Bar charts are better than pie charts when a categorical variable contains large number of categories.

    c. The Area principle says the relative size of a bar or slice should match the count of the corresponding category in the data relative to the total number of observations.

    d. None of the above.

Answer: b,c
**Solution:**
By the definition of relative frequency,
$$\text{Relative frequency} = \frac{\text{Number of observations to particular category}}{\text{Total number of observations}}.$$

Hence, option (a) is incorrect.

For large number of categories, it is easier to show frequencies on the bar chart compared to percentage relative frequencies using the pie charts. Hence option (b) is correct.

Option (c) is correct since it is the definition of area principle.

A grocery shop has four different items listed in Table 2.1.G. The pie chart shown in Figure 2.2.G represents the percentage relative frequency of items. Based on this information, answer questions (10) and (11).

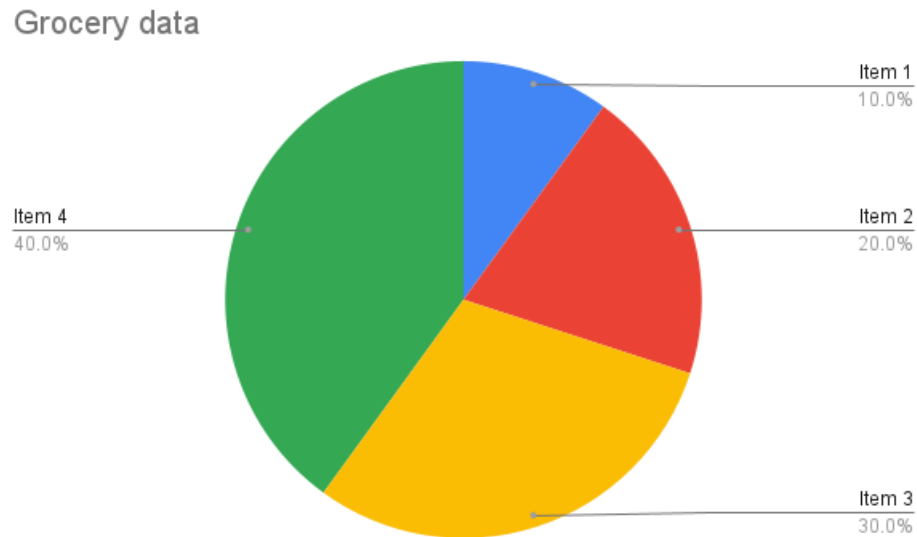| Types of items | Number of items |
|---|---:|
| Item 1 | 150 |
| Item 2 | $x$ |
| Item 3 | $y$ |
| Item 4 | 600 |

Table 2.1.G : Grocery data



Figure 2.2.G: Distribution of groceries

10. Find the value of $x$.
    Answer: 300
    **Solution:**
    From Table 2.1.G, number of items(frequency) of item 1 is 150.
    Pie chart shown in Figure 2.2.G, represents percentage relative frequency of items.

From pie chart, percentage relative frequency of item 1 is 10.

Therefore, by the definition of relative frequency

Total number of items = number of items of item 1 × percentage relative frequency of item 1

Total number of items = $150 \times 10 = 1500$

By the definition of relative frequency, number of items of item 2 is

Number of items of item 2 $(x)$ = percentage relative frequency of item 2 × total number of items

Number of items of item 2$(x) = \dfrac{20}{100} \times 1500 = 300$

11. Find the value of $y$.

    Answer: 450

    **Solution:**

    By the definition of relative frequency, number of items of item 3 is

    Number of items of item 3 $(y)$ = percentage relative frequency of item 3 × total number of items

    Number of items of item 3$(y) = \dfrac{30}{100} \times 1500 = 450$