Wallaga University
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Training on **Quantitative Reasoning for GAT: Focus on Statistical Quantitative Reasoning and Related Concepts.**

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Focus of the training:

- Introduction;
- Basic concepts;
- Descriptive Statistics;
- Measure of central tendency and variation;
- Measure of ratio;
- Charts/Graphs;
- Probability;
- Other Problems involving Statistical Concepts.

1. Introduction:

- The **Graduate Admission Test (GAT)** is a general aptitude test designed for screening candidates who wish to pursue their post graduate studies.

- The GAT is composed of three sections:

  a) Verbal Reasoning (60 questions);

  b) Quantitative Reasoning (40 Questions) and ;

  c) Analytical Reasoning (25 Questions).

- Each of these tests lasts for one hour and you will need to stay working on the actual exams for three hours.

Quantitative reasoning:

- Quantitative reasoning - measures the test takers' proficiency in understanding and interpreting numerical data, solving problems, and applying quantitative concepts.

- Quantitative reasoning questions focus on numerical data analysis, problem-solving using mathematical concepts, and the application of statistical concepts.
- In this training, we try focus on numerical data and solving problems from Statistical concept.
- This training focuses on the analysis of numerical data, with an emphasis on solving problems through the application of statistical concepts.
- **Quantitative reasoning focus on the application of Statistics includes:**
  - Measure of Central Tendency (Mean, Median, Mode, …);
  - Measure of variability (variance, standard deviation, range, …);
  - Percentages, Ratio, age problems;
  - Chart/graphs interpretation;
  - Problems involving different statistical concepts
  - Others.

Important tips for Statistical Data:

- Knowing the general concepts about statistics/data/.
- Understand the measurements:
  - Numbers;
  - Percentages;
  - Ratio;
  - Rates;
  - Measure of Center (Mean, Median, Mode);
  - Measure of variation (Range, Variance, Standard deviation);
  - Others.
- Identify the key word or number as given and required;
- Identify the key data features in the word problems;
- Others.

2. Basic Concepts:

Statistics: Branch of science focused on data collection, analysis, interpretation, presentation, and organization.

- Provides tools for summarizing datasets and making data-driven decisions.

Two main types:

Descriptive Statistics:

- Summarizes and describes dataset features.
- Tools: Mean, median, mode, range, variance, standard deviation, etc.

Inferential Statistics:

- Makes predictions/inferences about a population from a sample.
- Techniques: Confidence intervals, hypothesis testing, regression analysis, ANOVA.

- Statistical data is applicable in nearly all fields of study.
- Fields include Economics, Agriculture, Education, Health, Engineering, etc.
- Data in these fields can be represented as: Numbers, graphs, charts, figures, ..
- Types of measurements in these fields are expressed as: Percentages, rate, variations, numbers, etc.
- Understanding these key data features is crucial for grasping general concepts.

3. Measure of Central Tendency (Descriptive Statistics) for Raw data:

- Involves summarizing & organizing data so that it can be easily understood.

- Different types of **Measures of Central Tendency**:

  - **Mean:** averages of all data points.
  - **Median:** the middle value when data points are ordered from least to greatest.
  - **Mode:** the most frequently occurring value(s) in a dataset.

- **Measures of Variability (or Spread)**:

  - **Range:** The difference between the highest and lowest values.
  - **Variance**: The average of the squared differences from the mean.
  - **Standard deviation:** the square root of variance.

a) The mean/Average/ of raw data:

- is the sum of all values in a dataset divided by the number of values.
- The mean can be calculated from data in different forms.

i. Arithmetic Mean = Add all the values and divide by number of values.

Example 1: Consider the dataset: 4, 8, 15, 16, 23, 42.

- **Solution: Mean** = add all values/number of values = 108/6 = 18.

Question 1: A teacher has recorded the scores of 5 students on a math test as follows: 72, 85, 90, 88, 75. What is the mean score of the students?

A) 80

B) 82

C) 84

D) 86

Answer: B. 82

Question 2: A company has recorded the monthly sales (in thousands of dollars) for five consecutive months as follows: 45, 50, 60, 55, and 40. What is the mean monthly sales figure for these five months?

A) 50

B) 51

C) 52

D) 53

- **Mean monthly sales** = add all values/number of values.
- Mean monthly sales = (45 + 50 + 60 + 55 + 40) /5 = 50.
- **Answer: A. 50**

ii. Weighted Mean

- If x_1 , $x_2, \ldots, x_n$ represent values of the items and w_1 , $w_2, \ldots, w_n$ are the corresponding weights, then the weighted mean, ($\bar{x}_w$) is given by

$$\bar{x}_w = \frac{w_1x_1 + w_2x_2 + \ldots + w_nx_n}{w_1 + w_2 + \ldots + w_n} = \frac{\sum w_i x_i}{\sum w_i}$$

Example: A student's final mark in Mathematics, Physics, Chemistry and Biology are A, B, D and C respectively. If the respective credits received for these courses are 4, 4, 3 and 2, determine the approximate average mark the student has got for the course.

Solution:

x_i	**4**	**3**	**1**	**2**
w_i	4	4	3	2
x_iw_i	16	12	3	4

$$\bar{x}_w = \frac{w_1x_1 + w_2x_2 + \ldots + w_nx_n}{w_1 + w_2 + \ldots + w_n} = \frac{\sum w_i x_i}{\sum w_i}$$

$= \frac{16+12+3+4}{13} = \frac{35}{13}$ **= 2.69. That is, Average mark of the student is 2.69.**

Question 1: The scores obtained by students in a test and the number of students receiving each score are Score: 80, 85, 90, 95 and Number of students: 5, 10, 15, 20. What is the weighted mean score?

A) 90
B) 80
C) 100
D) 70

Solution:

1. Multiply each score by the number of students:

- 80×5 = 400
- 85×10 = 850
- 90×15 = 1350
- 95×20 = 1900

2. Sum these products: 400 + 850 + 1350 + 1900 = 4500.

3. Sum the weights (number of students): 5 + 10 + 15 + 20 = 50.

4. Weighted Mean = 4500/50 = **90.**

Question 2: A company wants to calculate the average salary of its employees, but it has employees in different roles with varying numbers of employees in each role. The salaries are as follows:

Role A: $40,000 with 10 employees;

Role B: $60,000 with 5 employees;

Role C: $100,000 with 2 employees.

What is the weighted mean salary of the employees?

A) 62 B) 53 C) 63 D) 60

Solution:

1. Multiply each salary by the corresponding number of employees:

- 40,000×10=400,000.
- 60,000×5=300,000.
- 100,000×2=200,000.

2. Sum these values/total number of employees = 900,000/17 **= 52.94**

iii. Combined mean

- When a set of observations is divided into k groups and $\bar{x}_1$ is the mean of n_1 & group 1, $\bar{x}_2$ is the mean of n_2 & group2, …, $\bar{x}_k$ is the mean of n_k & group k, then the combined mean, denoted by $\bar{x}_c$, of all observations taken together is given by

$$\bar{x}_c = \frac{\bar{x}_1 n_1 + \bar{x}_2 n_2 + \cdots + \bar{x}_k n_k}{n_1 + n_2 + \cdots + n_k}$$

Example: There are two classes, Class A and Class B. Class A has 30 students with an average score of 70 on a test. Class B has 20 students with an average score of 80. What is the combined average score for both classes?

Solution:

$$\bar{x}_c = \frac{\bar{x}_1 n_1 + \bar{x}_2 n_2}{n_1 + n_2} = \frac{70x30 + 20x80}{30 + 20} = \frac{3700}{50} = 74.$$

The combined mean of the entire students will be 74.

Question 1: A school has three sections, Section A, Section B, and Section C, of the same grade. The average score in Section A with 40 students is 75. The average score in Section B with 50 students is 70. The average score in Section C with 60 students is 80. What is the combined average score for all three sections?

A) 70.50
B) ~~75.33~~
C) 80.33
D) 85

Solution: Combined mean = $$\frac{\bar{x}_1 n_1 + \bar{x}_2 n_2 + \bar{x}_3 n_3}{n_1 + n_2 + n_3}$$

$$= \frac{40x75 + 50x70 + 60\,x\,80}{40 + 50 + 60} = \frac{11300}{150} = \mathbf{75.33.}$$

Note:

- If a constant c is added to or subtracted from every value in the data set, the mean increases or decreases by that constant:
  - ✓ New Mean=Old Mean + c, for added;
  - ✓ New Mean=Old Mean - c, for subtracted
- If each value in the data set is multiplied by a constant k, the mean is also multiplied by k: **New Mean=k × Old Mean.**

Question 1: If the mean of a data set is 50, what will the new mean be if a constant value of 5 is added to every value in the data set?

A) 55
B) 65
C) 45
D) 60.

Given mean = 50 and constant = 5; New mean = 50 + 5 = **55.**

Question 2: A data set has a mean of 72. If each data point is decreased by a constant value of 10, what will the new mean be?

A) 82
B) 62
C) 70
D) 60

Given mean = 72 and constant = 10; New mean = 72 – 10 = **62.**

b) Median: represents the middle value in a dataset when the values are arranged in ascending or descending order.

- **Median for data:** Steps to Find the Median:

- **Order the data:** Arrange the data in ascending or descending order.

- **Find the Middle Position:**

  - If the number of observations (n) is odd, the median is the value at the ((n + 1)/2)th position.

  - If the number of observations (n) is even, the median is the average of the values at the (n/2)th and (n/2 + 1)th position.

Example: Consider the following dataset of employee salaries (in thousands of dollars): 45, 50, 52, 55, 60. What is the median salary.

A) 50

B) 52

C) 55

D) 60

Answer: B) 52

Question 1: Assume that six employers, A, B, C, D, E, and F, have annual salaries (in $1000s) as follows: 55, 60, 48, 70, 65, 52. What is the median annual salary?

A) 55

B) 57.5

C) 60

D) 62.5

Solution:

1. **Order the Salaries**: 48, 52, 55, 60, 65, 70.
2. **Find the Median**: The two middle numbers are 55 and 60.
   - Median = (55 + 60) / 2 = 115 / 2 = 57.5.
   - So, the median annual salary is **$57,500**.

Question 2: Suppose five customers, A, B, C, D, and E, are being served at the same bank window. The following information is given:

1. Customer A is served 1st.
2. Customer C is served immediately after Customer A.
3. Customer E is served before Customer D.
4. Customer B is served after Customer D.

Which customer will be served in the middle position?

A. A

B. C

C. D

D. E

Answer: Possible valid orders are:

- A, C, E, D, B

Identify the middle position (3rd):

- For **A, C, E, D, B**, the 3rd position is E.

In the possible middle in arrangements is **Customer E**.

c) Mode: The most frequently values in a dataset.

- To calculate the mode, follow these steps:

1. **Organize the Data:** Arrange the data in ascending order.
2. **Count Frequencies:** Determine how often each value appears in the dataset.
3. **Identify the Most Frequent Value(s):** The mode is the value (or values) that has the highest frequency.

Question 1: Consider the following dataset of test scores for a class: 78, 82, 85, 90, 82, 95. What is the mode of the dataset?

A. 82

B. 85

C. 90

D. 78

Answer A. 82.

Question 2: There are five teachers at a school, each teaching a different subject: Mathematics, English, Biology, Chemistry, and Physics. The number of periods per week for these subjects is as follows: 5 periods for Mathematics, 4 periods for English, 3 periods for Biology, 4 periods for Chemistry, and 2 periods for Physics. Based on the number of periods per week, what is the mode of the subjects?

A) 5
B) 4
C) 3
D) 2

To answer the question based on the information in the image:

- Mathematics: 5 periods.
- English: 4 periods
- Biology: 3 periods.
- Chemistry: 4 periods.
- Physics: 2 periods.

To find the mode, count the frequency of each number of periods: **The mode is 4 periods.**

4. Measure of Central Tendency (Descriptive Statistics) for grouped frequency distributions.

Basic Concepts of grouped frequency distributions:

- **Grouped Frequency Distribution (GFD): -** is a frequency distribution having several values grouped into one class.
- GFD is usually used when the range of the data is large. It must be inclusive i.e., classes must not be overlap one to the other.

- **Inclusive:** In inclusive type of frequency distribution, the upper limit of one class does not coincide with the lower limit of the next class.

- **Exclusive:** In exclusive type of frequency distribution, the upper limit of one class coincides with the lower limit of the next class.

Definition of some basic terms in GFD:

- **Grouped frequency distribution** is a frequency distribution when several numbers are grouped into one class.
- **Class limits (CL):** It separate one class from another. The limits could actually appear in the data and have gaps between the upper limits of one class and the lower limit of the next class.
- **Class width**: - is the difference between the upper-class boundary and the lower-class boundary of a class is known as a class width (size).
- **Unit of measure (U):** is the possible difference between successive values or the smallest positive possible difference between successive values in data set.
- **Class boundaries:** Separate one class in a grouped frequency distribution from the other with no gap between the upper boundaries of one class and the lower boundaries of the succeeding class.
- **Class mark (Midpoint):** It is found by adding the lower- and upper-class limit (boundaries) and divided the sum by two.

- **Frequency*:*** is the number of times a certain value or class of values occurs.
- Frequency is always counting numbers.
- **Cumulative Frequency Distribution - i**s a frequency distribution that displays the sum of frequencies of consecutive classes of above or below a given classes.

There are two types of cumulative frequency: -

i) **Less than cumulative frequency (Lcf):** it used interest focuses on the total number of observations below a specified value.

i) **More than cumulative frequency (Mcf):** it used when frequency interest focuses on the total number of observations above a specified value. **Example.**

Class	Frequency	LCF	MCF
0	3	3	20
1	4	7	17
2	6	13	13
3	4	17	7
4	3	20	3
Total	20		

Question 1: The following table shows the distribution of marks obtained by 50 students in a test:

Marks (x)	**Frequency (f)**
0 – 10	5
10 – 20	8
20 – 30	12
30 -40	15
40 -50	10

a) The Cumulative frequency for class interval for 20 – 30 is

A) 13

B) 25

C) 40

D) 12

Answer: CF for 20 – 30 is 5 + 8 + 12 = 25.

b) What is the cumulative frequency for the highest-class interval.

Answer: CF for highest class (40 – 50) = 5 + 8 + 12 + 15 + 10 = 50

Question 2: A teacher recorded the number of books read by students in a class during the summer vacation. The data is as follows:

- 5 students read 1 book each;
- 8 students read 2 books each;
- 12 students read 3 books each;
- 10 students read 4 books each;
- 5 students read 5 books each.

What is the total number of students in the class?

A) 35

B) 40

C) 45

D) 50

Answer: Total number of students = 5 + 8 + 12 + 10 + 5 = **40**.

a) Mean for Grouped Continuous Frequency Distribution

- If data are given in the form of continuous frequency distribution, the sample mean can be computed as

$\bar{x} = \frac{\sum_{i=1}^{k} x_i f_i}{\sum_{i=1}^{k} f_i} = \frac{x_1 f_1 + x_2 f_2 + \ldots + x_k f_k}{f_1 + f_2 + \ldots + f_k}$, $x_i f_i$ - is the product of mid-point & freq.

Class boundary	**60-62**	**62-64**	**64-66**	**66-68**	**68-70**	**70-72**	**Total**
Frequency (f_i)	5	18	42	20	8	7	100

Solution:

The formula to be used for the mean is as follows:

$$\bar{x} = \frac{\sum_{i=1}^{k} x_i f_i}{\sum_{i=1}^{k} f_i}$$

$$\bar{x} = \frac{\sum_{i=1}^{k} x_i f_i}{\sum_{i=1}^{k} f_i} = \bar{x} = \frac{6558}{100} = 65.58.$$

b) Median for grouped data

- **Median for grouped continuous data: -**For continuous data, the median is obtained by the following formula.

$$\text{Median} = \text{L} + \frac{\text{w}}{\text{f}_{\text{med}}}\left(\frac{n}{2} - CF\right) = \tilde{x}$$

- Where: L = the lower-class boundary of the median class; w = the class width of the median class; CF = the cum. freq. corresponding to the class preceding the median class.
- Median class is the class which contains the $(n/2)^{th}$ observation whether n is odd or even, since the items have already lost their originality once they are grouped into continuous classes.

Example: Water percentage in the body of species of Fish is given below. Calculate the median.

Class interval	15-24	25-34	35-44	45-54	55-64	Total
Frequency	7	17	16	6	4	50

Solution: Construct the less than cumulative frequency distribution, then:

Class Interval	15-24	25-34	35-44	45-54	55-64	Total
Frequency	7	17	16	6	4	50
Cumulative Freq.	7	24	40	46	50	

- Since n = 50, 50/2 = 25, and the smallest Less than cumulative frequency (CF) greater than or equal to 25 is 40.

$$\text{Median} = \text{L} + \frac{\text{w}}{\text{f}_{\text{med}}}\left(\frac{n}{2} - CF\right) = \tilde{x}$$

Median = 35.1.

C) The Mode or Modal value for Grouped frequency distr.

- is the value with the highest frequency and denoted by $\hat{x}$.
- A data set **may not have a mode or may have more than one mode.**
- A distribution is called a bimodal distribution if it has two mode.

$$\text{Mode} = \text{L} + \frac{\Delta_1}{\Delta_1 + \Delta_2} \times w$$

- where L = the lower-class boundary of the modal class;
- w = the common class width; $\Delta_1 = f_{\text{mod}} - f_1 \quad \Delta_2 = f_{\text{mod}} - f_2$
- Modal class is the class with the highest frequency.

Question1: The following table shows the distribution of scores obtained by students in an exam:

Score Range	Number of Students (Frequency)
50 – 60	8
60 – 70	12
70 – 80	25
80 – 90	10
90 - 100	5

What is the mode of the exam scores?

A) 65
B) 70
C) 75
D) 80

Answer:

- L = lower boundary of the modal class = 70
- f = frequency of the modal class = 25
- f1 = frequency of the class before the modal class = 12
- f2 = frequency of the class after the modal class = 10
- w = class width = 10
- **Using formula: Mode = 75.**

Question 2: The following table shows the distribution of the number of hours spent studying per week by a group of students:

Hours Spent (Range)	Number of Students (Frequency)
5 – 10	8
10 – 15	12
15 – 20	20
20 – 30	15
30 - 40	5

If the median of the above distribution is 17.6, then what are the median and modal class respectively?

A) 15 – 20 and 15 – 20

B) 10 – 15 and 15 – 20

C) 20 – 30 and 30 – 40

D) 15 – 20 and 20 – 30.

Answer: A) 15 – 20 and 15 – 20.

d) Relationships Between Mean, Median and Mode:

- The relationships between mean, median & mode is defined as Mode is equal to the difference between 3 times the median & 2 times the mean.

- That is, Mean – Mode = 3 (Mean – Median) OR;

- Mode = 3 Median – 2 Mean.

Question: If the difference between mean and mode of a population is 48 and the median is 12, then the mean is

A) 28 B) 38 C) 42 D) 52.

Solution:

- Mean – Mode = 3(Mean – Median);
- 48 = 3(Mean – 12);
- 16 = Mean – 12;
- **Mean = 28.**

e) Quartiles and Interquartile Range (IQR):

- Quartiles divide a data set into four equal parts.
- **First Quartile (Q1)**: Also known as the lower quartile, it marks the 25th percentile of the data.
- **Second Quartile (Q2)**: This is the median of the entire data set, marking the 50th percentile.
- **Third Quartile (Q3)**: Also known as the upper quartile, it marks the 75th percentile of the data.

- The first quartile (Q1) is the median of the lower half of the data (excluding the median if the number of observations is odd).

- The third quartile (Q3) is the median of the upper half of the data.

- The interquartile range (IQR) is the range within which the middle 50% of the data values lie.

Formulas:

- **First Quartile (Q1):** Median of the first half of the data.
- **Third Quartile (Q3):** Median of the second half of the data.
- **Interquartile Range (IQR):** Q3−Q1.

Example: For data set [4, 6, 8, 10, 12]; Q1 = 6, Q3 = 10

IQR = Q3 − Q1 = 10 − 6 = 4.

5. Measure of variability:

a) Range: The difference between the maximum and minimum values.

Question 1: The ages of a group of 6 children are as follows: 5, 8, 4, 10, 7, and 6. What is the range of their ages?

A) 5

B) 6

C) 7

D) 10

Answer:

- Highest age = 10;
- Lowest age = 4;
- Range = 10 - 4 = 6;
- **Correct answer: B) 6.**

Question 1: The following are the scores obtained by 8 students in a Statistics exam: 78, 85, 91, 73, 88, 94, 77, 89. If the highest score was incorrectly recorded as 94 instead of the actual 96, what would be the new range?

A) 21
B) 23
C) 20
D) 25

Answer:

- The new highest score = 96.
- Range = New highest score - Lowest score.
- Range = 96 - 73 = 23.
- So, the new range of the scores is **23**.

Question 2: A student scored the following marks in five subjects: 67, 82, 75, 89, and 95. However, the score of 67 was found to be incorrect and was updated to 72. What is the difference in the range before and after the correction?

A) 28
B) 5
C) 23
D) 20

Answer

Before the correction:

- Highest score = 95
- Lowest score = 67
- Range = 95 - 67 = 28

After the correction:

- Highest score = 95
- New lowest score = 72
- Range = 95 - 72 = 23

Difference in range: 28−23=5

Question 3: In a survey, the ages of participants were recorded as follows: 22, 29, 34, 28, 31, 25, and 40 years. Due to an error, the age of 22 years was recorded as 32 years. What are the correct and incorrect range of ages respectively?

A) 15 and 18

B) 18 and 15

C) 10 and 15

D) 15 and 20

Answer: Correct range:

- Highest age = 40
- Lowest age = 22
- Range = 40 - 22 = 18

Correct range = **18**

Incorrect range due to error:

- Incorrect lowest age = 25 (with 32 instead of 22)
- Range = 40 - 25 = 15
- **Incorrect range** = **15**

b) Variance: Measures the spread of data points from the mean.

- The formula for the sample variance is given by:

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x}), \qquad i = 1, 2, \dots, n$$

Example: Given the following set of numbers: 4, 8, 6, 5, and 7, calculate the variance. **Variance = 2.5.**

Standard deviation: Square root of variance; indicates the dispersion of data.

- **Standard Deviation:** – is a square root of variance.

Note:

- Variance and Standard deviation are always > = 0, non-negative.
- Variance >= Standard deviation.
- Variance is equal Standard deviation when variance = 0 and 1.

6. Measure of Ratio:

- **Ratio** is an expression that compares two quantities, showing the relative size of one quantity to another.
- **Notation**:
  - **Fraction**: A/B
  - **Colon**: A:B
  - **Word Form**: "A to B”

Example:

- If there are 3 apples and 5 oranges, the ratio of apples to oranges is 3:5.
- If there are 12 red balls and 8 blue balls in a bag, what is the ratio of red balls to blue balls?

Calculating Ratios:

- **Simplify the Ratio**: Reduce the ratio to its simplest form by dividing both quantities by their greatest common divisor.

  Example: The ratio 8:12 simplifies to 2:3.

- **Proportions**: If two ratios are equal, they are said to be in proportion.

  Example: If A/B = C/D, then A:B = C:D;

- **Finding Missing Values**: Use the property of proportions to find missing values. **Example:** If 2:3 = x:6, solve for x.

More examples:

- Simplify the ratio 16:24.
- Express the ratio 5:7 as a fraction.
- **Find Missing Values in Proportions:** If 3:5 = x:20, find the value of x

Question1: The ratio of boys to girls in a class is 4:5, and the ratio of students who like math to those who do not is 3:2. If there are 120 students in total, how many students like math?

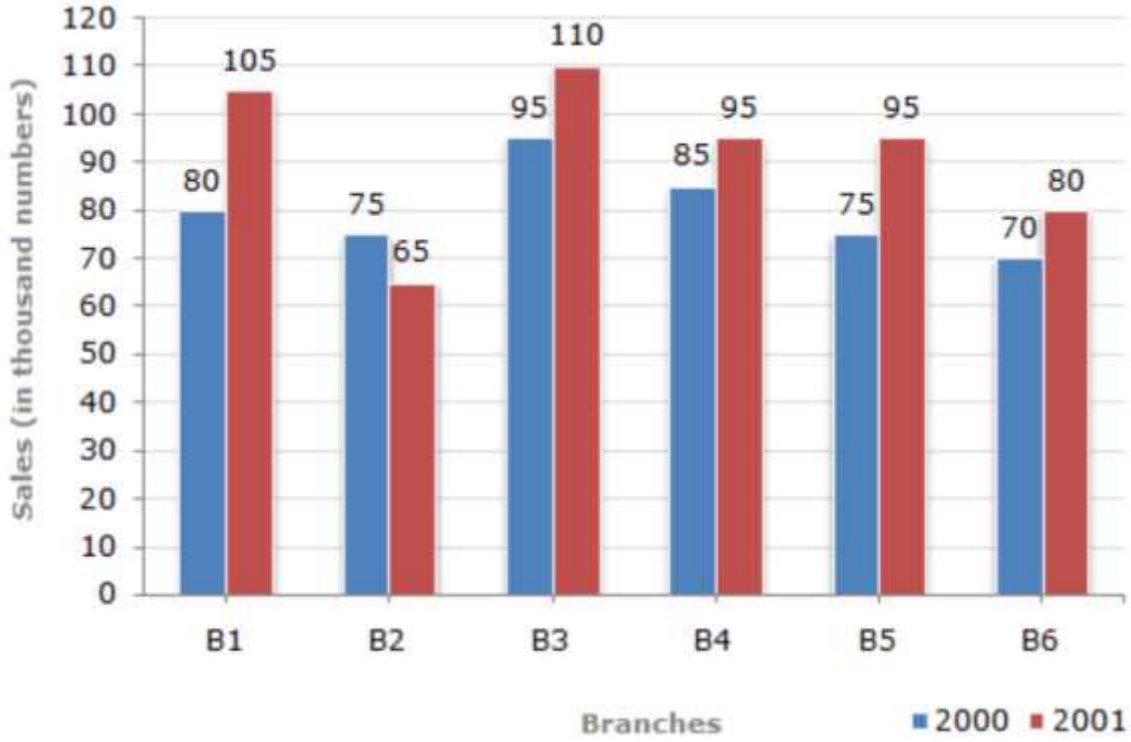
A) 75 B) 72 C) 70 D) 60

Solution:

- Calculate the total number of groups: 2 + 3 = 5 parts.
- Find the number of students per part:120/5 = 24.
- Calculate the number of students who like math:3 X 24 = **72.**

Question2: The bar graph given below shows the sales of books (in thousand numbers) from six branches of a publishing company during two consecutive years 2000 and 2001. Answer questions (24-28) based on the bar graph.

Sales of Books (in thousand numbers) from Six Branches - B1, B2, B3, B4, B5 and B6 of a publishing Company in 2000 and 2001.



What is the ratio of the total sales of branch B2 for both years to the total sales of branch B4 for both years?

A) 2:3 B) 3:5 C) 4:5 D) 7:9

- **Different types of ratio:**

i) Percentage (%) - is a way of expressing a number as a fraction of 100.

- **Steps to Calculate a Percentage:**
  - Identify the Part and the Whole;
  - Divide the Part by the Whole;
  - Multiply by 100
- To calculate a percentage, percentage = (part/whole)X100%.

Note:

✓ The maximum value of percentage is out of 100.

✓ The sum of the percentages of the items within the same group equals 100%.

- ✓ Percentages can be converted to decimal & decimal can be converted to percentages.

Conversions:

  - **Percentage to Decimal**: Divide the percentage by 100 (e.g., 25% = 0.25).
  - **Decimal to Percentage**: Multiply the decimal by 100 (e.g., 0.75 = 75%).

Interpretation:

- **Increase/Decrease**: A percentage increase or decrease describes how much something has grown or shrunk relative to its original amount.
- **Comparison**: Percentages are often used to compare proportions between different groups or data sets.

- **Percentage can be calculated in different scenarios:**

  a) **Finding a Percentage of a Given Number** - To find what percentage one number is of another:

  - **Percentage =** (given number/other number) X 100%.
  - **Example:** What percentage is 30 of 150?
  - **Solution:** Percentage = (30/150) X 100% = 20%.

  b) Finding the Value Given a Percentage - To find the value given a percentage of a number:

  - **Value** = percentage X given number.
  - **Example:** What is 25% of 200?
  - **Solution:** Value = (25/100) X 200 = 50.

  c) Finding the whole value: Whole = (part/Percentage)X100%.

d) Increasing or Decreasing a Number by a Percentage - To increase or decrease a number by a given percentage:

- **Percentage Increase** = 100% X (new value – initial value)/initial value.
- **Example:** Suppose the price of a product increased from $50 to $65. You want to calculate the percentage increase.
- **Solution:** Initial value = $50 and new value = $65.
- Percentage increase = 100% X ($65 - $50)/$50 = $30%.
- **Percentage decreases =** 100% X (initial value – New value)/initial value.
- **Example:** Suppose the number of students in a class decreased from 40 to 30. You want to calculate the percentage decrease.
- **Solution:** Initial value = 40 and new value = 30.
- **Percentage decreases** = 40 – 30 = (10/40) X 100% = 25%.

Question 1: A jacket is originally priced at $80. During a sale, the price of the jacket is reduced by 25%. What is the sale price of the jacket?

A. $50

B. $60

C. $65

D. $70

To find the sale price after a 25% reduction:

1. **Calculate 25% of $80:** 25% of 80 = (25 X 80)/100 = 20.

2. **Subtract this amount from the original price:** 80 – 20 = 60.

So, the sale price of the jacket is **$60**.

Question 2: The price of a laptop is $1,200. If the price increases by 15%, what will the new price be?

A. $1,320

B. $1,350

C. $1,380

D. $1,400

To find the new price after a 15% increase:

1. **Calculate 15% of $1,200:** 15% of 1,200 = (15 X 1200)/100 = 180
2. **Add this amount to the original price:** 1,200+180 =1,380.

So, the new price of the laptop is **$1,380**.

Question 3: Ethiopian Airways is selling tickets from Addis Ababa to Beijing. It has sold 40% of the available tickets and still has 420 tickets available to sell. How many tickets were original available on this flight?

A) 535
B) 650
C) 700
D) 850

Answer: According to the problem, Ethiopian Airways has sold 40% of the tickets and still has 420 tickets available.

- ✓ This means that 60% of the tickets are unsold, and 60% of T equals 420.
- ✓ We can write the equation: $0.6T = 420$.
- ✓ To find the total number of tickets T, divide both sides of the equation by 0.6.
- ✓ So, there were originally **700 tickets** available on this flight.

Question 4: Students ranked 17 from top and 13 from bottom. How many students are there in class?

A) 30

B) 29

C) 32

D) 35

- To find the total number of students in the class, add the rank from the top and the rank from the bottom, then subtract 1.
- This is because the student counted in both ranks is counted twice.
- If a student is ranked 17th from the top and 13th from the bottom, then:
- Total no. of students = Rank from the top + Rank from the bottom−1.
- Substitute the given values: Total no. of students = 17 + 13 −1 = 29.
- **So, there are 29 students in the class.**

7. Chart/graphs form of data presentation:

- Presenting data in a chart can effectively communicate complex information in a visually appealing and easily understandable format.

Types of Charts

- **Bar Chart**
  - **Purpose**: Compares quantities across different categories.
  - **Features**: Vertical or horizontal bars representing values.
  - **Example**: Comparing sales figures across different months.
- **Pie Chart**
  - **Purpose**: Shows proportions or percentages of a whole.
  - **Features**: A circular chart divided into slices representing different categories.
  - **Example**: Market share distribution among different companies.

- **Line Chart**
  - **Purpose**: Displays trends over time or continuous data.
  - **Features**: Points connected by lines to show changes or trends.
  - **Example**: Tracking the stock price of a company over a year.
- **Histogram**
  - **Purpose**: Shows the distribution of a dataset.
  - **Features**: Bars representing the frequency of data within specific ranges.
  - **Example**: Distribution of exam scores among students.
- **Scatter Plot**
  - **Purpose**: Illustrates the relationship between two variables.
  - **Features**: Points plotted on a Cartesian plane to show correlations.
  - **Example**: Relationship between hours studied and test scores.

8. Probability:

- is a measure of the likelihood that a given event will occur.
- It quantifies uncertainty and ranges from 0 (impossible event) to 1 (certain event).
- Let E be an experiment and S be a sample space associated with EWith each event A in S we associate a real number designated by P (A) and called the probability of A.
- **Experiment: -** Any process of observation or measurement or any process which generates well defined outcome.
- **Sample space**: - is the collection of all possible outcomes or sample points of a random experiment.
- **Sample point**: -Each element of sample space is called Sample point.
- **Impossible event**: -this is an event which will never occur.
- **Mutually exclusive event**: - two events A and B are said to be mutually exclusive if there is no sample point which is common to A and B. That is, $A \cap B = \emptyset$.

- **Equally likely outcomes**: if each outcome in a sample space has the same chance to be occurred.

Basic Probability Rule:

- The probability of an event A occurring is given by: P(A) =

  Number of favorable outcomes/Total number of outcomes.

- The probability of the complement of an event A, denoted as A′ or A^{-} is P(A) = 1 – P(A′)

- If events A and B cannot occur simultaneously (they are mutually exclusive): $P(A \cup B)=P(A)+P(B)$

- If events A and B are independent (the occurrence of one does not affect the occurrence of the other): $P(A \cap B) = P(A) \times P(B)$

- The probability of event A occurring given that event B has occurred is: $P(A|B) = P(B)/P(A \cap B)$

Question1: A bag contains 3 red balls and 5 blue balls. If a ball is drawn randomly, what is the probability of drawing a red ball?

A) 3/8 B) 1/8 C) 2/8 D) ½

Solution:

- There are 3 red balls out of a total of 8 balls.
- The probability is 3/8.

Question 2: The probability of it raining today is 0.3. What is the probability that it will not rain today?

Solution:

- The probability of not raining is $1 - 0.3 = 0.7$

Question 2: In a class of 30 students, 12 are girls and 18 are boys. One student is chosen at random. What is the probability that the student chosen is a girl?

A) 2/5

B) 3/5

C) 4/5

D) 1/2

Answer: To find the probability of choosing a girl:

- Calculate the number of girls and total number of students:
- Number of girls = 12 and Total number of students = 30
- Probability = Number of girls / Total number of students.
- **Probability = 12/30 = 2/5.**

Questions 3: A student has a bag with 5 red pens, 3 blue pens, and 2 green pens. One pen is picked at random. What is the probability that the pen picked is green?

A) 1/5
B) 2/10
C) 1/4
D) 2/5

Answer: To find the probability of picking a green pen:

- Calculate the number of green pens and total number of pens:
- Number of green pens = 2
- Total number of pens = 5 red + 3 blue + 2 green = 10
- Probability = Number of green pens / Total number of pens = 1/5.
- Thus, the correct option is: **1/5.**

Tips for the Exam:

- **Practice Problem-Solving**: Focus on practicing a wide range of problems.
- **Memorize Key Formulas**: Keep the most important formulas at your fingertips.
- **Understand Concepts**: Don’t just memorize—understand why and how formulas work.
- **Time Management**: Practice under timed conditions to improve speed and accuracy.
- Read the concepts and practice more Questions.
- Develop the habit of reading & understand long statement &/or paragraphs

Good luck with your preparation!

The End

Thank You!