CATapult Courseware

Module 1
DI-LR

Published by IMS Learning Resources Pvt. Ltd. in the Year 2020

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DI-1.1 | BASICS OF DATA INTERPRETATION THEORY

Introduction

Effective organization and presentation of data is required such that you are able to draw upon the information that is required with the least of effort and time. This chapter introduces you to the various methods of data representation and their uses.

Nature of Data Interpretation Questions

The questions in Data Interpretation usually test you for three different skills, namely Observation Skills, Calculation Skills and Deduction Skills. Observation based questions require you to scrutinize the given data and to make conclusions. Calculation based questions require you to find out percentages, averages, ratios, etc; in short, they test your ability to handle numbers effectively and to make quick and correct calculations. Deduction based questions are a special type of questions which demand that you reason out the hidden data by finding the relation between the given data.

Methods of Representation

Numerical Data Tables

Any statistical data pertaining to any kind of situation can be generally represented in the form of a table. It is one of the easiest and the most accurate way of presenting data in a non-graphical manner. It correlates or measures two things at a time. The difficulty associated with this type of data representation is that it requires much closer reading as compared to other forms of data representation like bar graphs and pie charts and hence it is comparatively complicated and time consuming to interpret. The calculations which are done on the basis of a numerical table to draw inferences are easy in terms of formulae but they are lengthy and take lots of time.
The following illustration will explain the way of representing data in numerical table form and how various useful inferences can be drawn from this table.
Example: The following table shows the time table of a train.

Railway Time Table-Gitanjali Express

City	Arrival time (hr)	Departure time (hr)	Cumulative mileage (km)
Mumbai	—	09:00	0
Igatpuri	11:00	11:02	80
Nasik	14:50	14:55	281
Bhusaval	17:10	17:12	391
Akola	22:40	22:45	730
Nagpur	00:05	00:15	800
Durg	01:00	01:02	845
Jamshedpur	04:15	04:28	995
Kolkata	06:25	–	1100

The above is also a type of data representation but is in the timetable form. However, very interesting information can be interpreted from the above table. One can obtain:

- The average speed between the stations.
  The average speed of the train between the stations = $\frac{\text{distance covered}}{\text{time taken in hr}}$

  Similarly the average speed between the other stations, for parts of the journey as well as the complete journey can be calculated.

  The average speed of the train between Mumbai and Igatpuri = $\frac{80 - 0}{11:00 - 09:00} \approx \frac{80\text{km}}{2\text{hr}}$ = 40 km/hr.
- The relative distance between the stations and the relative waiting time.
- The portion of waiting time in the total travel time.

Solved Example

Directions for questions: Refer to the table below and answer the questions that follow.

Energy (in kwh) generated for one KW of Installed Capacity

Year	Thermal	Hydel
1991	4000	4240
1992	4200	4010
1993	4020	4160
1994	4050	3700
1995	4040	3930

Q : For which sector and when was the greatest percentage increase over the previous year recorded in power

A : A visual inspection of the energy table shows that the largest difference in power generation in the current year over the previous year is shown by the Hydel between 94-95 followed by Thermal between 91-92.

Hydel 94-95 = 230 kwh

Therefore % increase = $\frac{230}{3700} \times 100 = 6.21\%$

Thermal 91-92 = 200 kwh

Therefore % increase = $\frac{200}{4000} \times 100 = 5\%$

Note: This question is based on observation and calculation skills

Q : The approximate average Kwh generated per Kw of installed capacity for Hydel power station for the above period:

A : Required average = $\frac{4240 + 4010 + 4160 + 3700 + 3930}{5}$ = 4008.

Q : If the total installed capacity in the Thermal Sector in 1992 was 8900000 KW, how many Kwh of energy was generated?

A : In 1992, for Thermal Sector, 4200 KWH were generated for 1 KW of installed capacity. Hence, if the installed capacity is 8900000 KW, i.e., 89×10^5 KW, total KWH generated is: $89 \times 10^5 \times 4200 = 3.74 \times 10^{10}$ KWH.

Note: These questions are based on calculation skills

Cartesian (line) Graphs

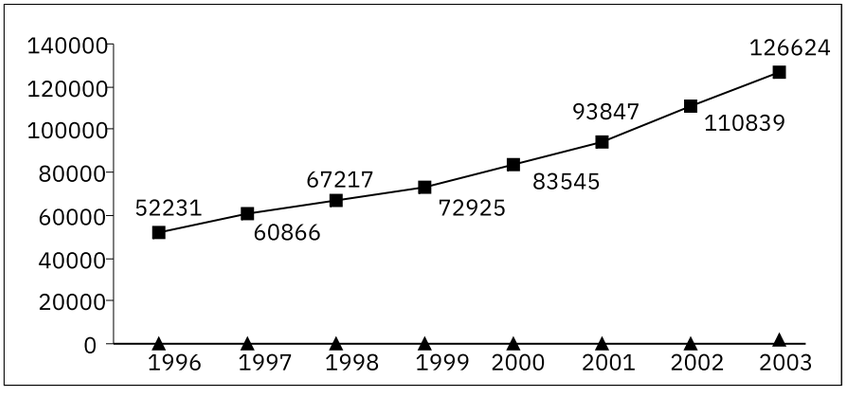
The Cartesian or Line Graph indicates the variation of a parameter with respect to another. The parameters are calibrated on X and Y axes.
For example, with the 'years' plotted on the X axis, variation of 'imports', 'exports', 'shipments' etc. as the other parameter can be plotted on the Y axis.
The line graph simplifies the data interpretation, as it is a pictorial presentation of data and is therefore very useful for determining trends and rate of change. The slope of the line graph helps in comparing the magnitude of change between any two consecutive points on the graph. Steeper the slope, greater is the change in magnitude between the two consecutive points.

Note: The slope of the graph indicates the absolute growth and not the percentage growth.

Simple Average Growth is found out by Simple Interest method. Cumulative means the increase or growth by accumulation or successive addition of parts or elements.
Cumulative Average Growth Rate (CAGR) is different from simple average growth in the sense that, simple average growth is the growth between two points of measurement or time.
Cumulative Average Growth Rate is found by Compound Interest Method. Hence, increase in each period is accounted while calculating the increase in the next period.

Example: The following graph represents the growth of Exports (figures are in Rs. crore)

Growth of Exports in India (Rs.Crore)

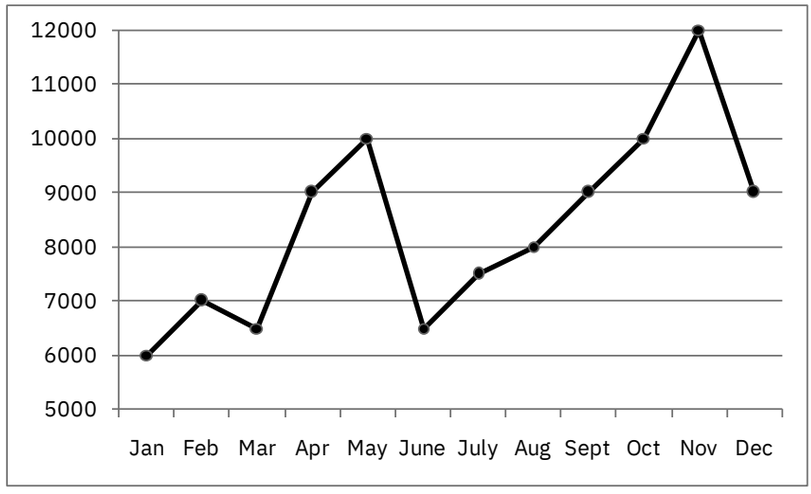


In the above graph, years are plotted on the x-axis and the Exports for the years 1996 to 2003 in crores of rupees are plotted on the y-axis.

The graph represents the variation in the Exports over a time period between 1996-2003, from which one can ascertain trends as well as the growth rates of the Exports. For instance, it can be noted that the Exports has been continuously increasing over the years.
If the graph had been fluctuating, then questions on average exports in the period and peak exports or lowest exports and their relation (like ratio) may also be asked.

Solved Example

Directions for questions: Following line graph depicts the monthly sales of Reliance Industries for the year 2018. (All figures are in Rs. crores)



Q : The maximum sales of Rs._____ was in _____.

A : Maximum sales was Rs.12000 crores in November.

Note: This question is based on observation skills

Q : For how many months, were the sales higher than the average sales?

A : Average sales = Rs.8375 crores. Hence, the sales were more than the average sales for 6 months.

Q : If the company sells only 2 products A and B and product A has a fixed sales of Rs.6000 crores per month then the % increase in the sales of product B from September to October was:

A : Sales of product B in September 2018 = 9000 – 6000 = Rs.3000 crores

Sales of product B in October 2018 = 10000 – 6000 = Rs.4000 crores

% increase in sales of product B from September to October = $\frac{4000 - 3000}{3000}$ = 33%.

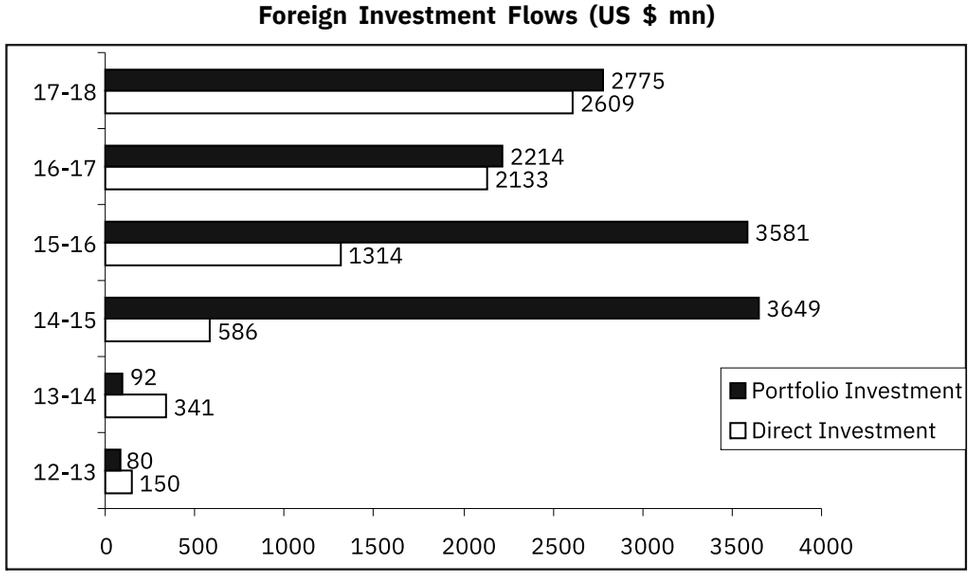
Note: This question is based on deduction and calculation skills

Bar Charts

- In this method of data representation, the data is plotted as bars.
- This method of data interpretation is more or less similar to the one in Cartesian Graphs except that the data plotted on Cartesian Graphs is continuous whereas in Bar Chart the data is discrete. Also, a single point denoted in the line graph is represented by an entire bar in the bar graph.
- They have one advantage over line graphs that is they are much more accurate since they do not involve any interpolation or extrapolation between two points & data measurement.
- Presentation of data in this format makes comparitive evaluation of parameters very easy.

There are three main types of Bar Charts to represent data. Illustrations given below show three main types of Bar Charts.
In the given illustrations, the same data is used. The bar chart give a brakeup of foreign investment flows in India for the years 2012-13 to 2017-18. Foreign Investments are made up of only two types of investments i.e., Direct Investments and Portfolio Investments.

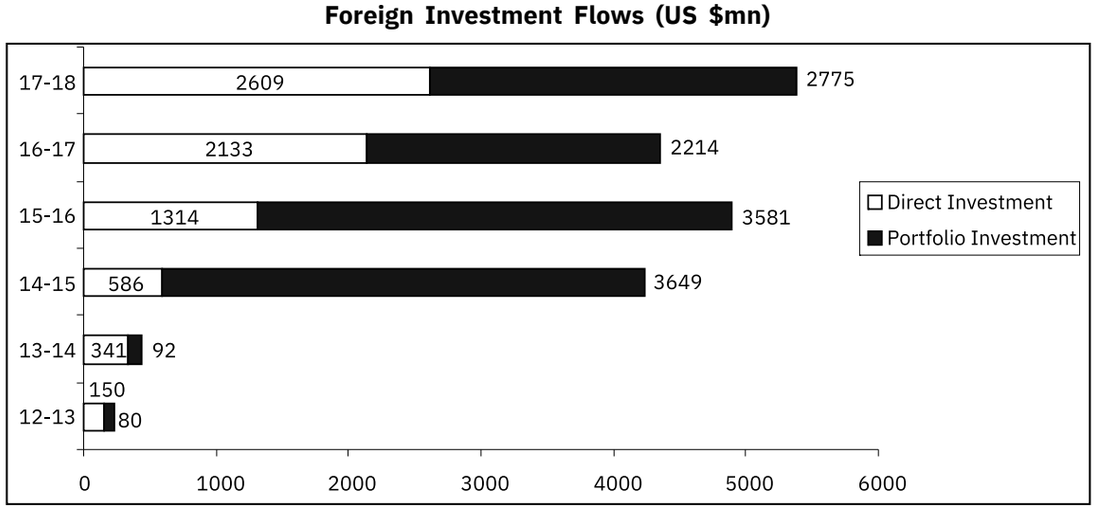
Clustered Bar Chart



This is the simplest type of Bar Chart. It compares values across categories. Thus, from the above figure, one can see that the values of the Portfolio Investment and Direct Investment have been compared for specific years. From this, one can easily arrive at the following:

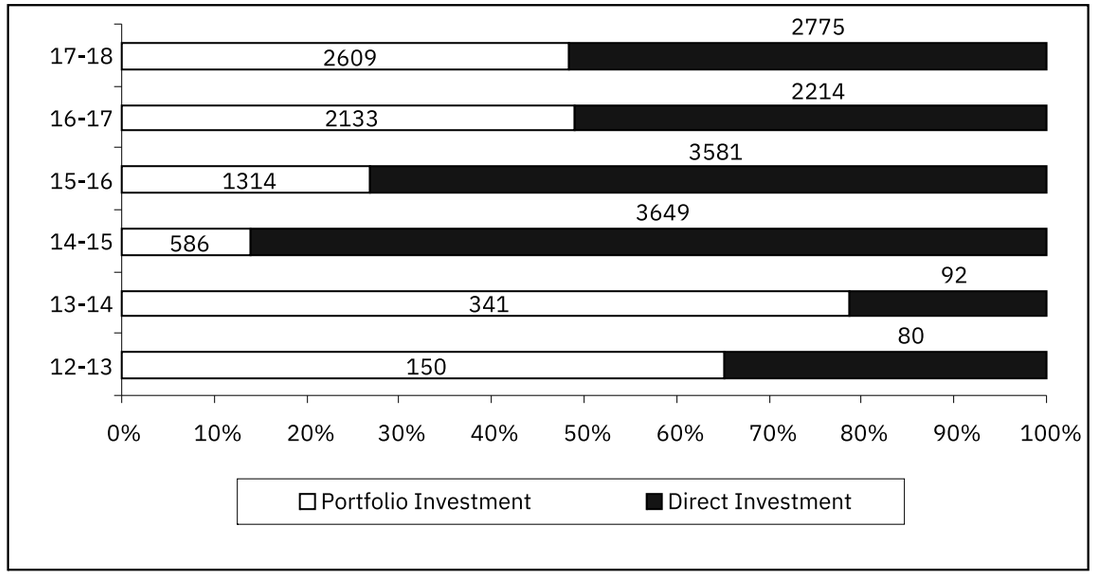
- The increase or decrease in the Foreign Investment over the period with the rate of total increase or decrease (as well as for each category).
- The highest and the lowest values of the foreign investment flows by category and year.
- Contribution of each category of investment in the total foreign investment flows for the years.
- The Foreign Investment trend (total & for each category) over the years.

Stacked Bar Chart



This compares the contribution of each value to the total, across categories. In this, one can get the total of the categories as well as the individual figures. In this kind, both parameters are represented along a single bar. From this kind of representation, the same kind of conclusions can be arrived at as in Clustered Bar Chart. Also, they will give value of any one parameter and value of total. For example, for 2017-2018, only direct investment, $2609 mn, and total investment, $5384 mn, is given. We can calculate portfolio investments = 5384 – 2609 = $2775 mn.

100% Stacked Bar



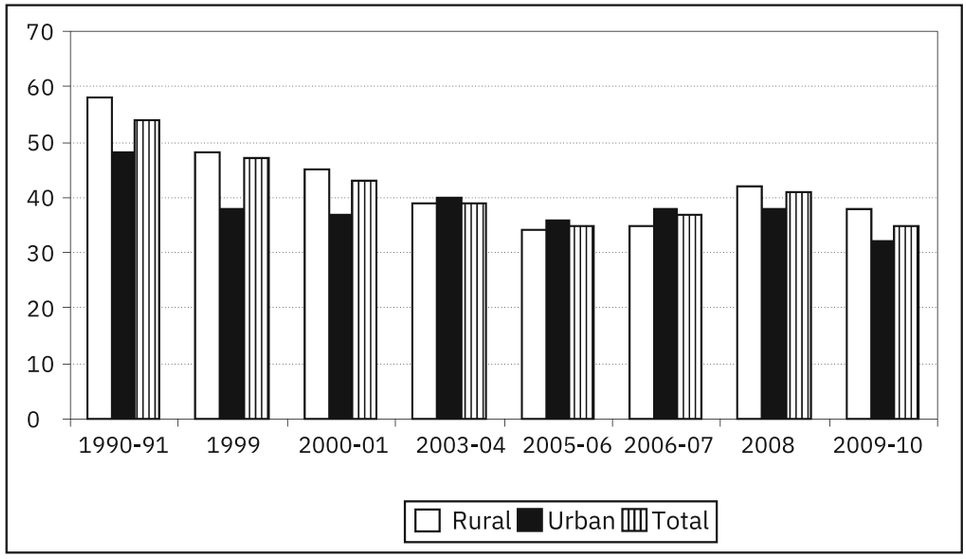
This compares values of different categories of data by the percentage contribution to the total. The percentages are given clearly, hence it is easy to derive the contribution of each category. In the figure, the amount of investment is clearly indicated. In the absence of this, given the

total investment flow figures for the years, it would be easy to estimate the amount of foreign investment flows by each category.

Solved Example

Directions for questions: Refer to the graph below and answer the questions that follow.

Percentage of People below Poverty Line



Q : Overall, the total percentage of people below the poverty line between 1990-91 to 2009-10 decreased (in percentage points) by

A : From the bar chart the following can be observed:

- Total Percentage of people below poverty line in 1990-91 = 54%
- Total Percentage of people below poverty line in 2009-10 = 35%

Therefore, there was an overall decline of 19% in the percentage of people below the poverty line.

Q : If the rural population in 1990-91 was 30 crore and urban population was 20 crore, then find the total population (in crores) below the poverty line.

A : Rural population below the poverty line = 0.58 × 30 = 17.4 crore

Urban population below the poverty line = 0.48 × 20 = 9.6 crore

$\therefore$ Total population below the poverty line = 17.4 + 9.6 = 27 crore.

Q : If the total population below the poverty line was 20 crore in 1990-91, then what was the population in rural areas that was below the poverty line?

A : Total population = $\frac{20}{0.54}$ = 37 crore.

Let rural population = x crore. Then, urban population = 37 – x crore.

Rural population below poverty line = 0.58x and urban population below poverty line = 0.48(37 – x) crore. $\therefore$ 20 = 0.58x + 0.48(37 – x) $\therefore$ x = 22.4 crore.

Rural population below poverty line = 0.58 × 22.4 $\approx$ 13 cr.

Pie Charts

Graphic Representation in a Circle or Pie

In this method, the total quantity in question is distributed over a total angle of 360°, which is one complete circle or a pie. Unlike, the bar charts where the variable can be plotted on two co-ordinates X and Y, here the data can be plotted with respect to only one parameter. It is best used when data pertaining to shares of various parts of a particular quantity are to be shown. This method is also useful for representing proportions or percentages of various elements with respect to the total quantity.

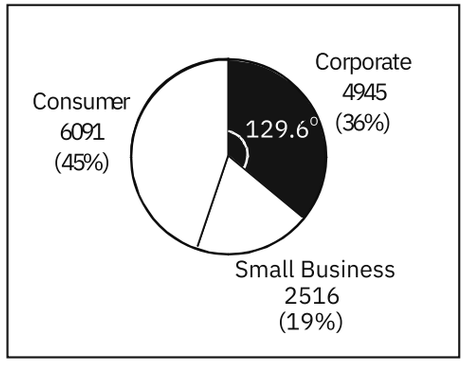
Any angle which has its vertex at the centre of the circle is called a central angle. The shaded region shown in the pie-chart in Illustration (1) is called a sector.

Example: Let's take a look at revenue breakup of the Internet Services Providers (ISP) in the US. The following table gives an overview of the same, for the year 2018. There are 3 types of clients

(i) Corporate
(ii) SBE's i.e., Small Business Enterprises
(iii) Consumers i.e., individuals

Market Segment	ISP Revenues in US $ million	Percentage of Total	Central Angle
Corporate	4945	36%	$\frac{36}{100}$ × 360 = 129.6°
Small Business	2516	19%	$\frac{19}{100}$ × 360 = 68.4°
Consumer	6091	45%	$\frac{45}{100}$ × 360 = 162°
Total	**13552**	**100%**	**360**

The above data can be easily plotted on the pie chart as given below and can be subjected to interpretation.

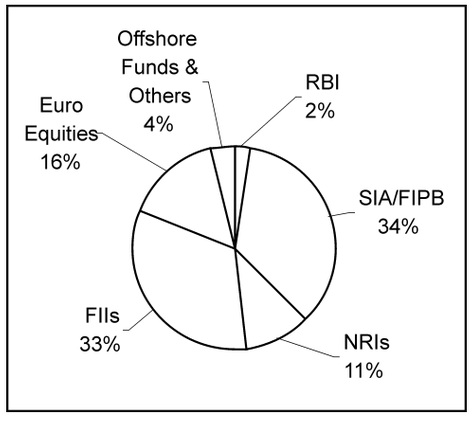


In the pie chart above, it can be seen that the data can be plotted easily representing values as well as in terms of percentage of the total value.
By visual observation itself, one can conclude that in the US market for the year 2018, the revenue from the Consumer market was the largest and constitutes 45% of the total revenue generated. Similarly, revenue from the Small Business market formed the smallest of the revenue generated and was 19% of the Total.
Since the data in a pie chart is spread over 360 degrees, the data can be subjected to geometrical calculations in a circle.
A central angle of the sector is equal to the arc it intercepts in measure. The central angle for the components can be easily calculated since 100% of the quantity is spread over 360 degrees of the pie and thus 1% = 3.6 degrees. In the above example, the central angle for the sector of consumer market will be equal to 3.6 × 45 = 162 degrees.
An arc can be measured in degrees. The entire circle is 360 degrees and thus an arc of 120 degrees would be 1/3rd of the circle.
The total area of the circle is represented by 360 degrees and thus the sector area can be calculated with respect to the corresponding central angle of the sector.

Solved Example

Directions for questions: Refer to the pie chart below and answer the questions that follow.

Foreign Investment flows by different categories in 2016-17
Total Investment Flows = US $ 5706 Million



Q : What is approximately the ratio of investment flows through FIIs to NRIs?

A : When the total investment inflows are proportional to the percentage of the pie covered, the ratio of investment through FIIs to that of NRIs will be the ratio of the corresponding percentages of the pie covered.

$\therefore \frac{\text{FII Investments}}{\text{NRIs Investments}} = \frac{33}{11} = 3 : 1.$

Q : What was the value of total investment flows through Euro Equities?

A : The value of the total investment flows is US $ 5706 million and Euro Equities contribute to 16% of the total, hence the value of investment through Euro Equities is 16% of 5706 = US$ 913 million.

Q : If the Total Investment Flow were to be doubled and FIIs were to be halved in the next year, what would be the proportion of FIIs in the total investment flows?

A : Total investment next year = 2 × 5706 = 11412 million

FIIs next year = $\frac{0.33 \times 5706}{2} \approx 942$ million.

$\therefore$ Proportion of FIIs in total investment flow = $\frac{942}{11412}$ = 8.25%.

Caselet Form

In this form of data representation, the data is given in a case (paragraph) form. It is for the reader to read the given case or paragraph and cull out the requisite data and arrange it in a suitable form so as to interpret it meaningfully.
Example: The following is an extract from a report on the ISP (Internet Service Providers) business.

"Not surprisingly, the growth of the ISP industry is driven by the increase in the number of people accessing the Web and the increase in per person use of the Web. In 2018, there were 275 million Web users in the United States, or about 80% of the population, and they generated over $43 billion in ISP revenues. Industry revenues should expand from $43 billion to almost $52 billion by 2022, while the number of users should grow to over 325 million or to about more than 90% of US population in the same period."

From the above extract, one can see that most of the paragraph is packed with data related to the ISP industry in the United States.

The above paragraph talks about the revenues from the ISP in the year 2018 and also the estimated increase in revenues by 2022. At the same time, the population figures, both in 2018 and the estimation for 2022, are also given.

Thus, from the above caselet, one can deduce the population of US, the growth in the US population as well as growth in the users and ISP revenues and so on.

Solved Example

Directions for questions: Refer to the caselet below and answer the questions that follow.

"The Indian IT training market is dominated by two large players with a regional presence. NIIT and Aptech have more than 75% of the total computer education and training market. SSI is also strongly emerging as a force to be reckoned with on a national level, especially at the higher end of the training market. NIIT and Aptech – because of their long standing in business, have an alumni base of more than 700,000 each and approximately 1000 centres across the country. NIIT and Aptech brands easily enjoy the "top of the mind recall" among the IT training sector in India. Companies are leveraging their presence in IT training to venture into software exports and TBT products – upgrading their growth orbit. NIIT is already the country's fourth largest software exporter, Aptech which initiated its software thrust in early 1998 is making strong presence in software exports (growth of more than 90% in first quarter of '99). SSI is contemplating putting up a separate division to foray into offshore development. Thus, software which is a high growth

area (average revenue growth expected for the next 3-5 years is 50%) relative to training (average revenue growth expected 30%) is emerging as a key growth driver among the major players in the industry. This is changing the traditional growth rates of these companies from around 30-35% to 40-50% in general."

Q : Traditionally what has been the growth rate of IT training companies?

A : The answer is 30-35% which is traditional growth rate of the IT training companies. However, one has to be careful while reading the paragraph as growth rates pertaining to many of the segments of business are mentioned which could be misleading.

Q : What is the combined revenue of Aptech and NIIT together in the training segment if the total training market is US $ 320 million?

A : As given in the paragraph, Aptech and NIIT jointly have more than 75% of the training market. Thus, if the total training market is US $ 320 million in India, 75% of the market is 75% × 320 = 240.

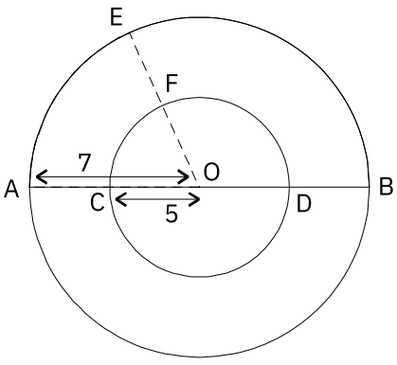
Q : The number of students per centre for NIIT and Aptech for the current year will be:

A : This is a misleading question. The data given is on the number of alumni for NIIT and Aptech together which is 700000 alumni for 1000 centres approximately. From this data, number of current students per centre cannot be calculated.

Geometrical Diagrams

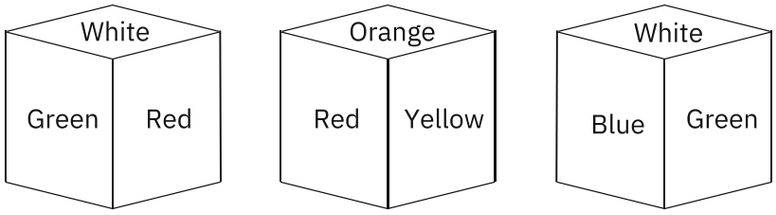
Data can be represented using a combination of various geometrical shapes such as squares, circles, rectangles, trapeziums, cubes, triangles etc. The interpretation and the analysis of such data requires an understanding of the basic concepts of geometry.
Given below are a few examples of this method.

Example 1



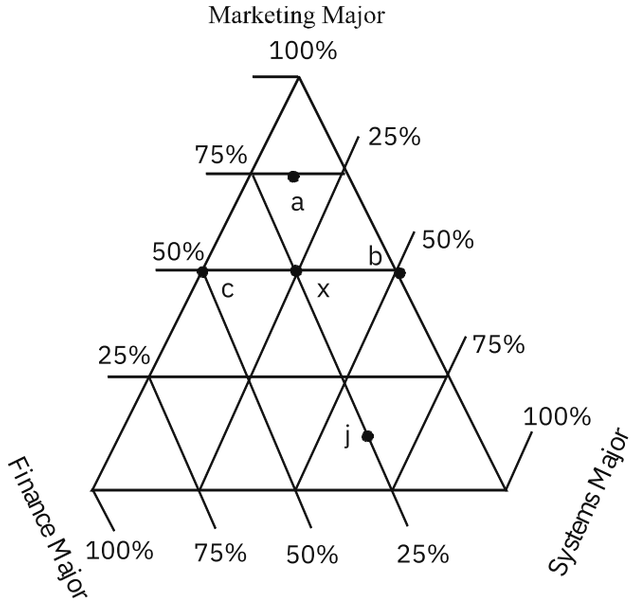
This circular diagram might be the presentation of a ring-route road map of a city. By using simple geometrical rules, one can find the linear distance as well as the angular distance between the points A, C, O, D, B, E and F.

Example 2



In this example, one's ability to imagine a multicoloured cube in various positions is tested. By carefully observing the 3 given positions one can ascertain the 4 different colours adjacent to say yellow or orange. Also, one can identify the colour of the side opposite to a particular side. In this example, you can deduce that yellow is opposite green, red is opposite blue and white is opposite orange.

Example 3

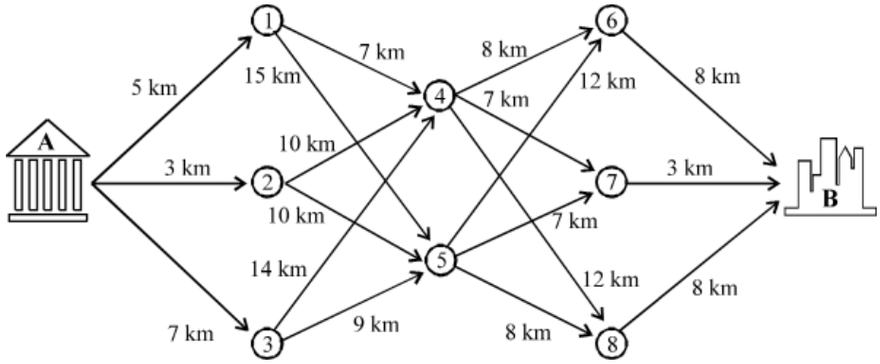


Data can be presented on a triangular plane with each vertex of the triangle acting as a different dimension.

Marketing, Systems and Finance are the three streams of MBA schools. a, x, b, c and j are Business Schools. From the given figure, it can be interpreted that 75% of the students in school 'a' major in Marketing, 12.5% in Systems and 12.5% in Finance. 50% of the students in the school 'b' major in Marketing, 50% in Systems and 0% in Finance. Similarly, in school 'c', 50% major in Finance and 50% in Marketing. In school 'x', 25% major in Systems, 25% in Finance and 50% in Marketing. In school 'j', 25% in finance, 12.5% in Marketing and 62.5% in Systems.

Solved Example (1)

Directions for questions: Refer to the diagram below and answer the questions that follow.



Given above is a route from A to B via 8 cities.

Q : What is the number of routes from A to B?

A : There are 3 routes from A to cities 1, 2 and 3. Further, there are 2 routes each from cities 1, 2 and 3 to cities 4 and 5. Therefore, there are 3 × 2 = 6 routes so far. Further, from cities 4 and 5, there are 3 routes each to cities 6, 7 and 8. So, there are 6 × 3 = 18 routes so far. Now, from cities 6, 7 and 8, there is only route each to city B. Therefore, the number of routes from city A to city B are 18 × 1 = 18.

Q : Find the shortest and longest route from A to B.

A : A146B 5 + 7 + 8 + 8 = 28 km.

A147B 5 + 7 + 7 + 3 = 22 km.

A247B 3 + 10 + 7 + 3 = 23 km.

A357B 7 + 9 + 7 + 3 = 26 km.

A346B 7 + 14 + 8 + 8 = 37 km.

A356B 7 + 9 + 12 + 8 = 36 km.

A248B 3 + 10 + 12 + 8 = 33 km.

A156B 5 + 15 + 12 + 8 = 40 km.

A348B 7 + 14 + 12 + 8 = 41 km.

Hence, A348B is the longest route and A147B is the shortest route.

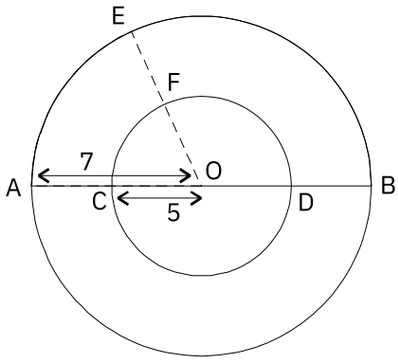
Q : A person starts from A to reach B with the speed of 5 kmph with the condition that he must touch 7. Also, he must increase his speed by 2 kmph every time he touches any junction, what is the longest time duration required to reach B?

A : A147B = 22 km, A157B = 30 km, A247B = 23 km, A257B = 23 km, A347B = 31 km, A357B = 26 km. Hence, the longest route is A347B.

Thus, the time required would be = $\frac{7}{5}+\frac{14}{7}+\frac{7}{9}+\frac{3}{11}$ = 4 hours and 30 minutes. (approx.)

Solved Example (2)

Directions for questions: Refer to the diagram below and answer the questions that follow.



Q : What is the ratio of the circumference of the inner circle to that of the outer circle?

A : Ratio of the circumference = Ratio of the Radius = 5 : 7

Q : If a road is required to be built on the ring route (between the outer and the inner circle), what would be the area of the road?

A : Area of the ring = (Area of the outer circle) – (Area of the inner circle) = $\frac{22}{7} \times (7)^2 - \frac{22}{7} \times (5)^2 = \frac{22}{7} \times (49 - 25) = \frac{22}{7} \times 24 \approx 75$ square units.

Q : If the speed of a person travelling from A to B is as follows; towards the centre: 2 units per minute, away from the centre: 6 units per minute and along the circumference of the circle: 0.5 units per minute, the least time required to reach B from A if the straight line journey from C to D is prohibited would be:

A : The time taken will be least if the person travels along AC (straight), arc CD and then DB (straight). The time required will be $\frac{2}{2} + \frac{16}{0.5} + \frac{2}{6} \approx 33$ minutes.

CLASS EXERCISE

Directions for questions 1 to 6: Refer to the table below and answer the questions that follow.

The table given below provides information about the number of people joining five clubs namely ASC Club, SSC Club, MSC Club, RSC Club and TSC Club over the period 2014-2018.

	ASC Club	SSC Club	MSC Club	RSC Club	TSC Club
2014	300	330	300	360	360
2015	260	150	120	120	160
2016	240	160	250	100	140
2017	220	120	270	80	340
2018	180	230	320	60	200

1. What is the difference between the sum of the number of people who joined the ASC Club in 2014 & 2015 and the sum of the number of people who joined the SSC Club in 2016, 2017 & 2018?

   1) 35 2) 38 3) 48 4) 50

2. What is the ratio of the sum of the number of people who joined MSC Club & RSC Club in 2018 to the sum of the number of people who joined ASC club & TSC Club in 2016?

   1) 5 : 6 2) 3 : 4 3) 2 : 3 4) 1 : 1

3. Which of the following clubs had maximum number of people joining over 2014 to 2018 period?

   1) ASC Club 2) SSC Club 3) MSC Club 4) RSC Club

4. By what percent is the sum of the number of people who joined the given five clubs in 2016 and 2017 more than that in 2015 and 2018?

   1) 5% 2) 6.67% 3) 10% 4) 12%

5. Each member of every club has to pay Rs. 30,000 as non refundable one-time joining fees and Rs. 60,000 annual membership fees. The number of people who left the RSC Club in 2015, 2016, 2017 and 2018 was 60, 50, 40 and 30 respectively. What is the total revenue earned by the RSC Club in 2018? (All the clubs started their operations in the year 2014.)

   1) Rs. 3.42 crore 2) Rs. 3.68 crore 3) Rs. 3.78 crore 4) Rs. 3.88 crore

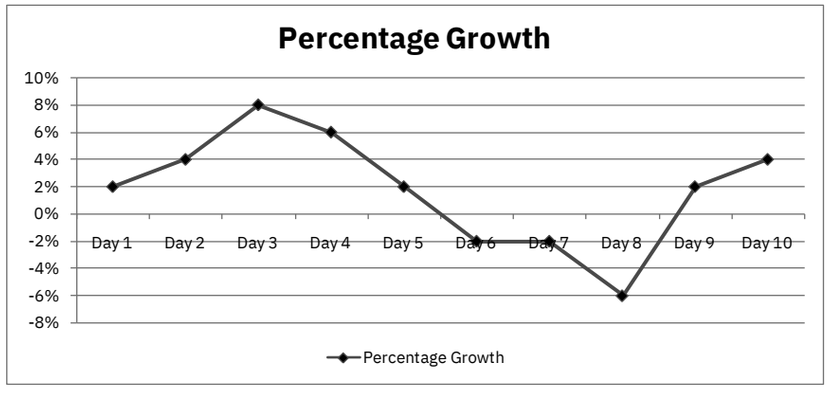
6. In the year 2014, the ratio of the number of male members to female members in the five clubs is given below :

	Male: Female
ASC Club	2:3
SSC Club	5:6
MSC Club	7:8
RSC Club	5:4
TSC Club	8:1

What is the average number of male members who joined the five clubs in 2014?

1) 166 2) 176 3) 186 4) 196

Directions for questions 7 to 12: Refer to the graph below and answer the questions that follow.



The graph given above represents the percentage growth in the price of Gold over the price on the previous day. The price of Gold on day 0 (i.e. previous day of day 1) was Rs. 3,000 per gram.

7. On how many days from day 1 to day 10, did the price of Gold increase as compared to the previous day?

1) 4 2) 6 3) 7 4)Cannot be determined

8. On how many days from day 1 to day 10 did the price of Gold decrease as compared to the previous day?

1) 2 2) 3 3) 4 4) Cannot be determined

9. Pushpa bought 20 grams of Gold on day 0. She earned the maximum profit by selling it on one of the given days. On which day did she sell the Gold?

1) Day 3 2) Day 5 3) Day 10 4) Cannot be determined

10. Both Kavya and Sheetal bought 10 grams of Gold on day 2 and day 3 respectively and sold on day 3 and day 4 respectively. What is the difference between the profits earned by them?

1) 384 2) 424 3) 484 4) 524

11. What can be said about the price of Gold on day 3 and day 10?

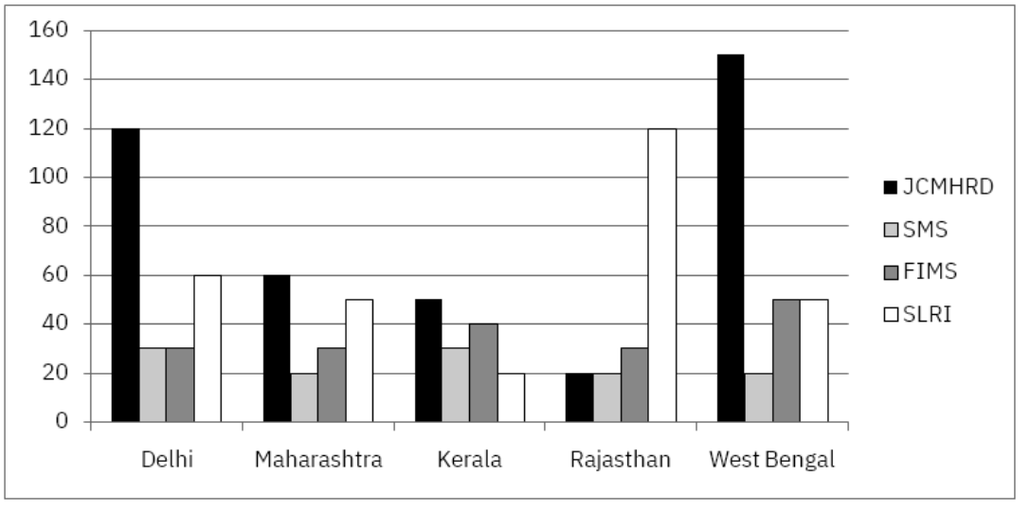
1) The price of Gold was higher on day 3 compared to day 10.
2) The price of Gold was higher on day 10 compared to day 3.
3) The price of Gold was equal on both the days.
4) No relation between the two prices can be established.

12. Mr. Ranjan purchased 10 grams of Gold everyday from day 1 to day 9 and sold it on the next day. (i.e., he bought 10 grams of Gold on day 1, which he sold on day 2. He bought 10 grams of Gold on day 2, which he sold on day 3 and so on). What is his cumulative profit till the tenth day?

1) Rs. 4890 2) Rs. 4940 3) Rs. 4950 4) Rs. 4990

Directions for questions 13 to 18: Refer to the graph below and answer the questions that follow.

The following Bar Graph provides information about the number of students admitted for the class of 2019-2021 in 4 MBA institutes namely, JCMHRD, SMS, FIMS and SLRI from five different states of India. The tuition fees for the two years MBA programs of JCMHRD, SMS, FIMS,and SLRI is Rs. 1.8 million, Rs.1 million, Rs. 0.6 million, and Rs. 2.2 million respectively. All the students of these Institutes are only from the given five states. (Note: 1 million = 10 lakhs)



13. Which of the following MBA Institutes has the highest number of students admitted to the class of 2019-2021?

1) JCMHRD 2) SMS 3) FIMS 4) SLRI

14. What is the total number of students admitted to SMS in the class of 2019-2021?

1) 110 2) 120 3) 125 4) 130

15. What is the difference between the number of students admitted in the given four MBA Institutes from the states of Delhi & Maharashtra combined and the states of Rajasthan & West Bengal combined?

1) 40 2) 50 3) 60 4) 80

16. Which of the following Institutes earned the highest revenue from the tuition fees of class 2019-2021?

1) JCMHRD 2) SMS 3) FIMS 4) SLRI

17. If 10%, 20%, 25%, 40% and 50 % of all MBA applicants from Rajasthan, Kerala, Maharashtra, Delhi,and West Bengal respectively got admitted in the given four MBA Institutes, then what is the ratio of the total number of MBA applicants from Rajasthan & West Bengal combined and the total number of MBA applicants from Delhi, Maharashtra & Kerala combined?

1) 87 : 112 2) 97 : 122 3) 112 : 87 4) 122 : 97

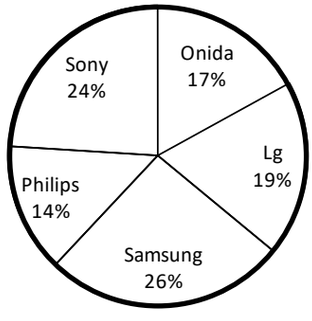
18. The ratio of male to female students is 7 : 5 in FIMS and 5 : 1 in SMS and the female students get a concession of 10% in the tuition fees in both the institutes. What is the difference between the amount earned from tuition fees from the class of 2019-21 by these institutes?

1) Rs. 14.5 million 2) Rs. 16 million 3) Rs. 15 million 4) 10 million

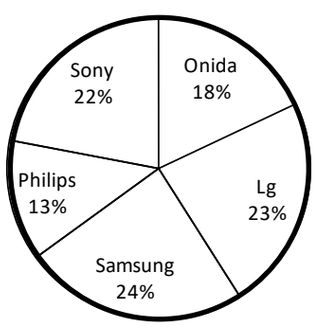
Directions for questions 19 to 24: Refer to the data below and answer the questions that follow.

Given below are pie charts showing the sales of different TV brands for the years 2012 and 2013. Assume that these are the only brands existing in the market.

Total sales in 2012 = Rs. 1400 lakhs



Total Sales in 2013 = Rs. 1750 lakhs



19. For how many brands there has been an increase in sales of more than 25%?
1) 0 2) 1 3) 2 4) 3

20. What is the percentage growth in the sales of Lg from 2012 to 2013?
1) 51% 2) 54% 3) 47% 4) 58%

21. In 2014, the sales of Onida is expected to grow by one-third over 2013, and experts predict a 25% market capture due to the same. What will be the sales(in lakhs) of Philips in 2014, if it is expected to have the same market share as on 2012?
1) Rs.246.3 2) Rs. 235.2 3) Rs. 242.2 4) Rs. 248.4

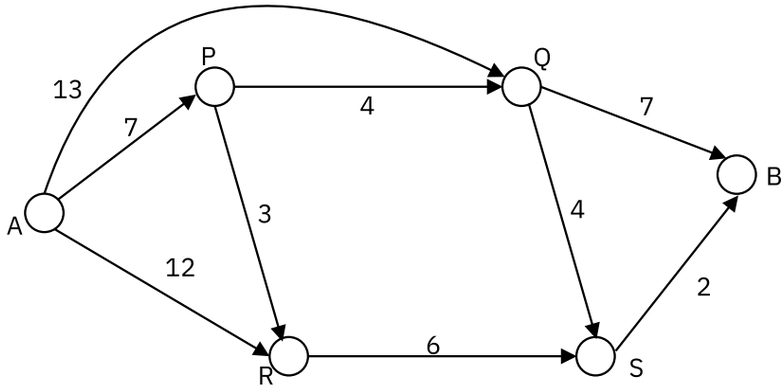
22. Which brand had the highest increase in sales from 2012 to 2013?
1) Sony 2) Philips 3) Samsung 4) None of these

23. What is the percentage increase in total sales in 2013 over 2012?
1) 20% 2) 25% 3) 30% 4) 35%

24. What is the percentage growth in the sales of Sony and Samsung combined from 2012 to 2013?
1) +10% 2) – 10% 3) +15% 4) – 15%

Challengers

In Venice, there is a network of canals used for transportation, and one can hire boats to travel along them. In particular, the highly popular route from A to B comprises the set of canals shown below, with arrows indicating the permitted direction of travel. The numbers on each route indicate the fare that one has to pay a boatman to traverse that route. In addition, the government of Venice may choose to charge a levy at any of the junction points P, Q, R or S along the way for purposes of traffic regulation.



Tourists generally follow the route where the total cost is minimum. If the total cost along two or more routes is equal, then the tourist traffic is split equally between these routes.

1. If the Government of Venice decides to impose a levy of 3 units at each junction point (P, Q, R and S) then the minimum cost of travel from A to B will be:

   1) 21 units 2) 22 units 3) 23 units 4) 24 units

2. If the Government of Venice wants to ensure that there is no traffic on the canal QS, while equal traffic passes along the canals PQ and PR, then a feasible set of levies at P, Q, R and S in order could be:

   1) 1, 5, 3, 2 2) 2, 5, 3, 1 3) 2, 5, 3, 4 4) 2, 4, 2, 1

3. If the Government of Venice wishes to ensure equal traffic along all possible routes, then a feasible set of levies at P, Q, R and S in order could be:

   1) 1, 3, 2, 4 2) 2, 5, 3, 1 3) 2, 5, 4, 1 4) 2, 3, 2, 2

4. If the route from PR suffers a temporary blockage and the Government of Venice wants to ensure equal traffic through each of the tollbooths P, Q, R and S, then a feasible set of levies at P, Q, R and S in order could be:

   1) 4, 1, 1, 2 2) 2, 3, 1, 1 3) 4, 2, 2, 1 4) 1, 4, 1, 2

5. If the Government of Venice wishes to keep the cost to tourists as low as possible, and yet ensure that all possible routes get equal traffic, then what is the cost a tourist would incur on each of these routes?

   1) 21 units 2) 22 units 3) 23 units 4) 24 units

PRACTICE EXERCISE-1

DIRECTIONS for questions 1 to 4: Refer to the data and answer the questions that follow.

Four friends – A, B, C and D – play a game which involves money. They all start with different amounts, and at the end of 4 rounds, they end up with Rs. 1024 each. The results of each round are as given below:

	Position			
Round	I	II	III	IV
1	A	D	C	B
2	B	A	D	C
3	C	B	A	D
4	D	C	B	A

In each round, the amount with the person who is ranked I becomes 4 times its value, the amount with the person who is ranked II becomes twice its value, the amount with the person who is ranked III remains the same, and the person who is ranked IV loses the amount that were gained by ranks I and II (such that the sum total of the amounts with the four of them remains constant in each round).

1. Who had the least amount before the game started?
   1) A 2) B 3) C 4) D

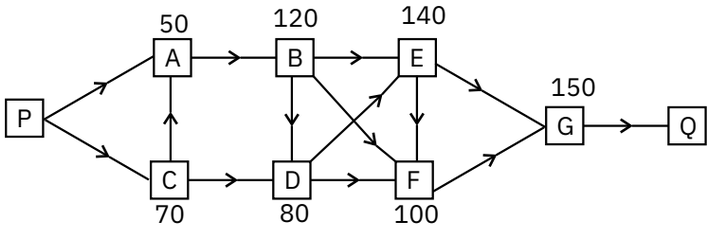
2. At the end of which round did C have the least amount among all four?
   1) Round 1 2) Round 2 3) Round 3 4) Round 4

3. What is the maximum amount that anyone had in any of the four rounds?
   1) Rs. 2304 2) Rs. 1152 3) Rs. 1728 4) Rs. 2048

4. Who had the least amount at the end of round 3?
   1) A 2) B 3) C 4) D

DIRECTIONS for questions 5 to 8: Refer to the data and answer the questions that follow.

In a workshop, certain machine components are stored in 7 locations named A, B, C, D, E, F and G (called storage locations). These components are to be carried to location Q for further processing using a robot. Various paths connecting different locations as well as the number of machine components stored at different storage locations are as shown in the diagram below. The robot can take only one of the paths given in the diagram and can travel only along the direction of the arrow. For example, the robot can travel from E to F but not from F to E.

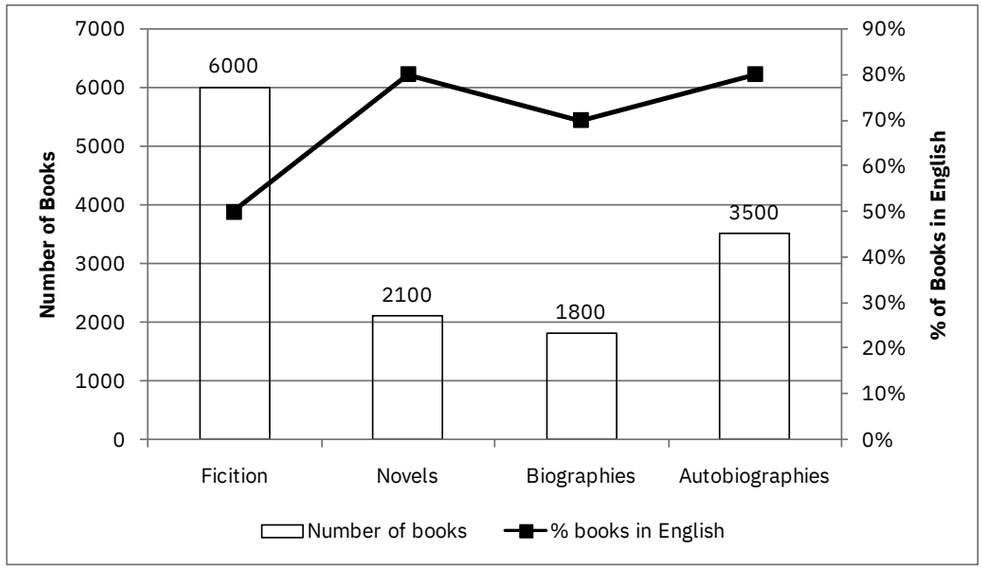


The robot starts with a drum from location P, follows one of the possible routes, visits all the storage locations along that route, puts all the machine components at that location in the drum and finally drops all the machine components at location Q.

5. How many routes can the robot take from P to Q such that it carries at most 550 machine components?
6. What is the maximum difference between the number of machine components carried by the robot along a route that visits maximum storage locations and that of a route that visits minimum storage locations between P and Q?
7. What is the number of possible paths taken by the robot between P and Q such that the number of machine components carried by it is equal to 540?
8. If, due to an oil spill between B and D, the robot cannot travel along the path joining B and D, what will be the maximum number of components carried by the robot?

DIRECTIONS for questions 9 to 12: Refer to the data and answer the questions that follow.

A library contains books on seven genres in English and Marathi languages: Fiction, Novels, Biographies, Autobiographies, Dramatics, Poetry and Philosophy. The following graph gives the distribution of books in English and Marathi languages on four out of the seven genres. There is at least one book in each language on each genre.



The number of books on different genres are to be read on the left hand side axis whereas the number of books in English language as % of total books in that genre is to be read on the right hand side axis.

In addition to this, the following facts are known.

1] The total number of books in Marathi is greater than the total number of books on Fiction.

2] The number of Marathi books on Philosophy is ten times the number of Marathi books on Poetry.

3] The total number of books on Autobiographies is half the total number of books on Biographies, Poetry and Philosophy taken together.

4] The total number of books on Dramatics is greater than the total number of books on any other genre but Fiction.

5] For both Biographies and Philosophy, the ratio of the number of books in English to the total number of books is the same.

6] Only 10% of the books on Poetry are in Marathi.

7] At least 50% books of any genre are in English.

9. Which of the following is the total number of books on Philosophy?

1) 1000 2) 1200 3) 3600 4) None of these

10. The number of Marathi books on Dramatics is certainly not greater than ____ .

1) 2000 2) 3000 3) 1200 4) 2500

11. Which of the following statements is certainly true?

Statement I: The number of English books on Autobiographies is same as the number of English books on Philosophy.

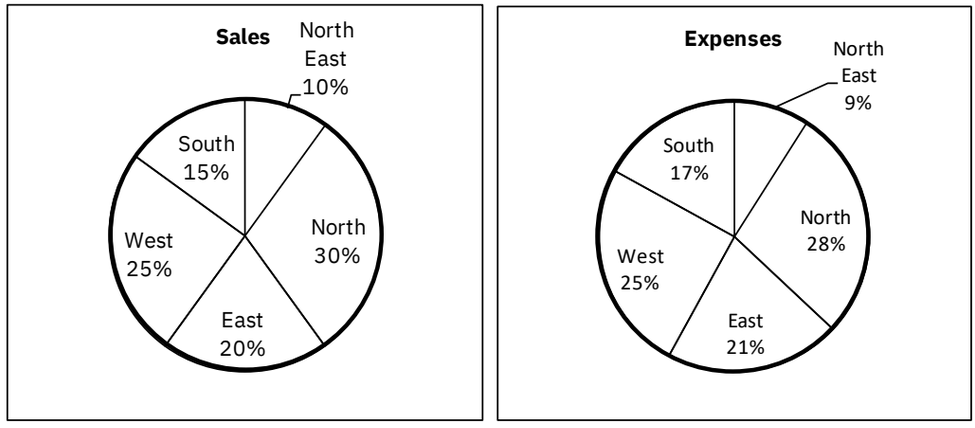
Statement II: The number of Marathi books on Dramatics is greater than 20.

1) Only Statement I 2) Only Statement II
3) Both I and II 4) Neither I nor II

12. Let x : y be the ratio of the total number of books on Dramatics to the total number of books in the library. Then which of the following is certainly true?

1) $\frac{1}{6} < \frac{x}{y} < \frac{1}{5}$ 2) $\frac{1}{4} < \frac{x}{y}$ 3) $\frac{1}{4} > \frac{x}{y}$ 4) $\frac{x}{y} < \frac{1}{5}$

DIRECTIONS for questions 13 to 16: Refer to the data and answer the questions that follow.
2017 was a particularly bad year for Python Enterprises, a Delhi based company that operates in the North, East, West, South and North-East regions of India. The company ended up making losses in all the five regions of India in the year 2017.



Pie chart-1 shows the break-up of the sales of the company in different regions in 2017. Similarly Pie chart-2 shows the break-up of the expenses of the company in different regions in 2017.

Note:

Profit = Sales – Expenses (If Sales > Expenses)

Loss = Expenses – Sales (If Expenses > Sales)

$\%\ \text{Profit Margin} = \frac{\text{Profit}}{\text{Sales}} \times 100$

$\%\ \text{Loss Margin} = \frac{\text{Loss}}{\text{Sales}} \times 100$

"Both Profit/Loss and % Profit margin/% Loss margin of the company can also be calculated at the country level by aggregating the expenses and the sales of the company from all the five regions."

13. Which of the following cannot be the total percent loss margin suffered by the company in India in 2017?

1) 15% 2) 10% 3) 20% 4) 25%

14. In which region did the company suffer minimum percent loss margin in 2017?

1) East
2) South
3) North-East
4) More information is required to answer this question

Additional information for Q.15 and Q.16: In 2017, the company suffered a total loss margin of 50% in the five regions of India combined.

15. Which of the following is not the percent loss margin suffered by the company in one of the five regions in 2017?

1) 37.50% 2) 57.50% 3) 40% 4) 70%

16. The company improved its sales in the year 2018. The total expenses of the company in the year 2018 were same as that in 2017. However, exactly one region registered a break-even (the situation of zero profit/zero loss) while the other regions still registered a loss. What was the percent increase of the sales of the company in 2018 over the sales in 2017? (Assume that percent increase in sales in 2018 over 2017 was uniform across all the five regions.)

1) 25% 2) 35% 3) 40% 4) 50%

PRACTICE EXERCISE-2

DIRECTIONS for questions 1 to 4: Refer to the data given below and answer the questions that follow:

Five fruits—Apple, Mango, Pineapple, Guava and Strawberry—saw an increase in their price per kg from 2011 to 2014.

The price per kg of Apple in 2011 was 66.66% that of Pineapple. The price per kg of Guava in 2011 was 64% that of Strawberry. The price per kg of Mango in 2011 was 33.33% more than that of Pineapple. The price per kg of Strawberry in 2011 was 66.66% more that of Apple. The price per kg of Mango in 2011 was 87.5% more than that of Guava.

The percentage increase in the price of Apple over the previous year in 2012, 2013 and 2014 were 20%, 25% and 11.11% respectively. The percentage increase in the price of Mango over the previous year in 2012, 2013 and 2014 were 15%, 33.33% and 25% respectively. The percentage increase in the price of Pineapple over the previous year in 2012, 2013 and 2014 were 20%, 16.66% and 11.11% respectively. The percentage increase in the price of Guava over the previous year in 2012, 2013 and 2014 were 25%, 5% and 14.28% respectively. The percentage increase in the price of Strawberry over the previous year in 2012, 2013 and 2014 were 10%, 20% and 4.5454% respectively.
It is known that the price per kg of Pineapple in 2014 was Rs. 70.

1. What was the average price per kg of Guava between 2011 and 2014?
   1) Rs. 40 2) Rs. 40.5 3) Rs. 42.5 4) Rs. 44

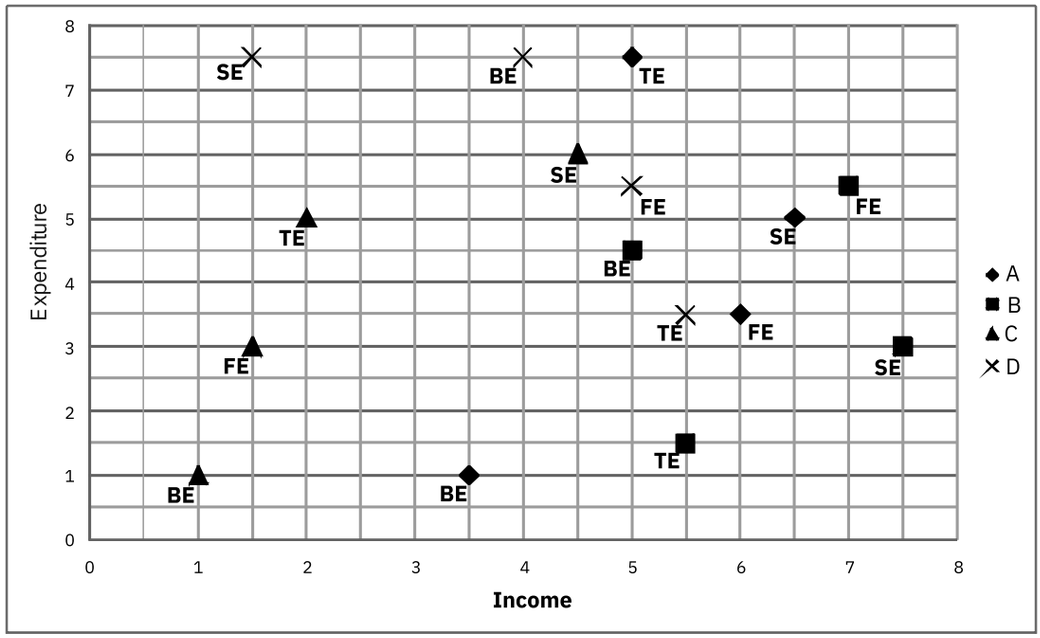
2. What percentage of the price per kg of Apple in 2014 was its price in 2012?
   1) 60% 2) 64% 3) 72% 4) 80%

3. What was the maximum increase in the price per kg of Strawberry in a year over the previous year?
   1) Rs. 11 2) Rs. 8 3) Rs. 5 4) Rs. 3

4. Which fruit recorded the maximum percent increase in price per kg in 2014 over 2011?
   1) Apple 2) Strawberry 3) Pineapple 4) Mango

DIRECTIONS for questions 5 to 8: Refer to the data and answer the following questions.

A, B, C and D are four engineering coaching classes in the city that offer coaching for the four years of engineering, named as FE (First year), SE (Second year), TE (Third year) and BE (Fourth year). The following graph shows the incomes (collected through fees from students) and expenditures (mainly on room rent, electricity bills and faculty payments) of the four classes on each of the four years of engineering:



The numbers in the graph are all in Rs. Lakhs.
Profit = Income – Expenditure (if Income > Expenditure)
Loss = Expenditure – Income (if Income < Expenditure)

% Profit margin = $\frac{\text{Profit}}{\text{Income}} \times 100$; % Loss margin = $\frac{\text{Loss}}{\text{Income}} \times 100$

% Profit margin and % Loss margin can be calculated at the level of individual year of Engineering or at the level of the class by aggregating the income and expenditure on all the four years.

5. How many classes suffer more than 50% loss margin (for all the four years combined)?
   1) 0 2) 1 3) 2 4) 3

6. The total expenditure on the four years of engineering for which of the following classes is the highest?
   1) Class A 2) Class B 3) Class C 4) Class D

7. For which year is the average income of the four classes the lowest?
   1) FE 2) SE 3) TE 4) BE

8. In how many years (i.e. FE, SE, TE and BE) is the sum total of the income of the four classes more than the sum total of the expenditure of the four classes?
   1) 0 2) 1 3) 2 4) 3

DIRECTIONS for questions 9 to 15 : Refer to the data and answer the following questions.

The table below shows the batting performances of 8 top teams in cricket in the 2000s. Average indicates the average runs scored per dismissal by the batsmen of that team during that year. RPO indicates the average runs scored per over during that year by that team.

Team	Year→	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
England	Ave	27.91	27.81	37.59	34.89	43.62	35.52	34.13	35.73	33.96	42.32
	RPO	2.56	2.9	3.37	3.03	3.49	3.62	3.16	3.39	3.02	3.56
Australia	Ave	39.02	44.43	45.5	54.25	38.43	40.47	48.58	64.1	37.38	41.73
	RPO	3.42	3.77	3.99	4.08	3.55	3.71	3.64	3.9	3.31	3.5
India	Ave	35.45	31.72	34.74	43.27	40.74	39.67	35.6	42.4	37.21	58.9
	RPO	3.12	2.87	3.02	3.1	3.38	3.43	3.34	3.46	3.44	3.65
Sri Lanka	Ave	28.44	38.31	37.71	37.69	35.6	31.21	33.3	48.04	39.4	44.51
	RPO	2.91	3.28	3.32	2.98	3.28	3.38	3.29	3.46	3.41	3.69
Pakistan	Ave	32.44	36.38	32.84	35.34	27.78	37.91	43.65	30.97	NA	32.24
	RPO	2.77	3.39	3.34	2.99	3.11	3.55	3.6	3.13	NA	3.07
South Africa	Ave	32.29	37.4	37.18	47.42	39.91	42.77	29.62	35.48	45.13	33.3
	RPO	2.74	2.83	3.29	3.54	3.06	3.17	3.21	3.12	3.26	2.94
West Indies	Ave	22.17	30.23	31.53	32.71	34.21	29.07	30.47	28.72	30.69	31.12
	RPO	2.62	2.68	2.92	3.28	3.51	3.08	3.14	3.34	3.09	3.25
New Zealand	Ave	29.45	42.26	26.19	38.41	35.13	36.22	28.1	16.59	29.22	31.38
	RPO	2.66	3.27	2.78	2.74	3.11	3.4	3.38	3.34	3.23	3.15

Note: Pakistan did not play any tests during 2009 and hence may be excluded for that year

9. How many teams have never managed an RPO of over 3.5 during the given period?
   1) 0 2) 3 3) 4 4) 1

10. In how many of the given years did Australia have the highest Average among the given teams?
   1) 2 2) 4 3) 6 4) 7

11. Which of the following teams has managed to get a higher RPO than Australia's in a particular year?
   1) Pakistan 2) South Africa 3) India 4) West Indies

12. How many combinations of (year, country) have recorded an average over 40 in the given period?
   1) 16 2) 18 3) 20 4) Cannot be determined

13. How many combinations of (year, country) have recorded an RPO below 3.0 in the given period?
   1) 16 2) 18 3) 20 w4) Cannot be determined

14. Which team had the lowest average for the maximum number of years during the given period?
   1) West Indies 2) England 3) New Zealand 4) Both (1) and (3)

15. In 2002, how many teams averaged more than India?
   1) 3 2) 4 3) 5 4) 6

Directions for questions 16 to 19: Answer the questions based on the table given below:

The following table describes sales of the twenty most popular patterns of T-shirts manufactured by the new company CuTees, sorted into 12 "varieties" by type and colour. There are 3 "types": Men, Women and Children. Each type is available in 4 "colours": W – White, B – Black, G – Green and R - Red.

	Number of T-shirts											
	Men				Women				Children			
Pattern Code	**W**	**B**	**G**	**R**	**W**	**B**	**G**	**R**	**W**	**B**	**G**	**R**
a	8	11	24	0	6	2	0	0	3	12	0	0
b	21	7	9	3	8	15	3	12	21	14	13	0
c	3	12	15	1	13	3	3	0	2	14	1	0
d	13	18	4	9	16	9	4	8	18	23	17	5
e	20	20	8	4	5	17	0	5	1	3	22	6
f	8	1	3	3	4	8	2	3	6	0	4	0
g	0	0	0	0	0	0	0	0	0	0	0	0
h	9	9	5	4	4	9	0	4	7	6	8	6
i	4	2	3	6	0	0	0	0	2	7	3	0
j	9	8	6	7	2	4	1	8	6	7	4	3
k	7	2	6	2	6	3	0	3	6	9	9	3
l	0	9	5	7	1	2	4	1	5	4	4	4
m	0	0	0	0	0	0	0	0	0	0	0	0
n	9	1	0	9	2	4	8	3	5	4	7	6
o	2	5	8	5	3	3	0	9	8	8	2	9
p	1	1	4	3	4	0	1	3	3	0	3	3
q	2	3	2	0	0	0	2	0	2	4	4	0
r	2	3	4	4	3	2	0	2	2	1	3	0
s	4	0	0	0	4	0	0	1	0	0	0	4
t	3	0	4	1	2	2	2	1	0	1	4	3
Production	125	112	110	68	83	83	30	63	97	117	108	52
Order	123	112	110	66	83	83	30	62	97	116	105	52

16. How many patterns were produced in red?
    1) 14 2) 15 3) 16 4) 17

17. How many patterns were produced for women in colours other than Black and White?
    1) 15 2) 16 3) 17 4) 18

18. Which of the 12 varieties was produced in the maximum number of different patterns?
    1) Men, White 2) Women, White 3) Children, Green 4) Men, Black

19. In how many varieties of T-shirts was there excess production?
    1) 6 2) 4 3) 3 4) 5

DI-1.2 | CALCULATION BASED DI

THEORY

Concept of Approximation

Often it is not necessary or feasible to solve a question in the exact way it is supposed to be done; often the best techniques are those which are shortest and simplistic, though they may not be the first ones thought of.

Let us first look at some shortcuts in calculations.

For example, one would normally come across computing values like $\frac{1617}{1760}$. Here one should definitely think of approximation, wherein one can reduce the numerator to 1600 and increase the denominator to 1800 and hence the approximate value would be $\frac{1600}{1800}$ which is equal to $\frac{8}{9}$ thus the value being equal to 88.88%. Now if we have two close answers like 89% and 92% we cannot definitely come to a conclusion. Hence, we need to fine-tune our approximation.

The fine tuning can be done in the following way:

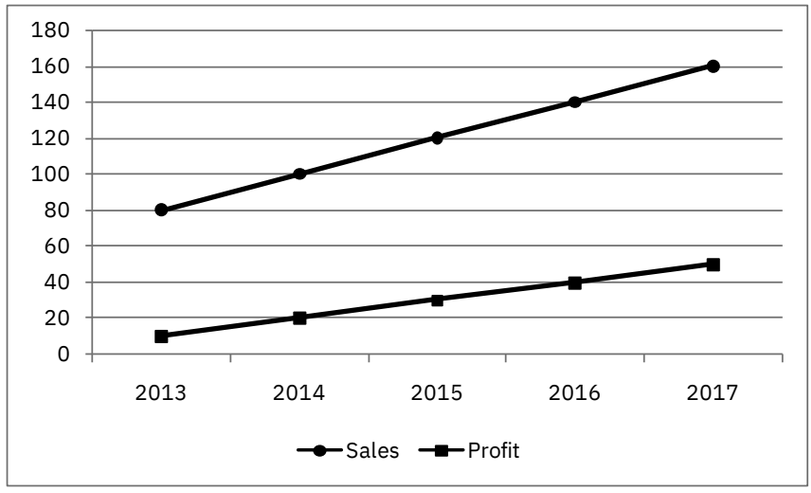
- If one changes the value of the numerator (increase or decrease), then an opposite change has to be incorporated in the final value. In our example we have reduced the numerator by 17 (i.e., from 1617 to 1600). The answer obtained when we take smaller numerator will be lower than the actual answer i.e., if we perform operation $\frac{1600}{x}$, the answer obtained will be lower than the answer for $\frac{1617}{x}$. Hence, we have to increase the final value and the extent of increase in value is computed by $\frac{17}{1617}$, which is approximately 1%.

- If one changes the value of the denominator (increase or decrease), then a similar change has to be incorporated in the final value. In our example, we have increased the denominator by 40 (i.e., from 1760 to 1800). The answer obtained when we take larger denominator will be lower than the actual answer i.e., if we perform operation $\frac{x}{1800}$, the answer obtained will be lower than the answer for $\frac{x}{1760}$. Hence, we have to increase the final value and the extent of increase in value is computed by $\frac{40}{1760}$, which are approximately 2.5%.

- Hence the final value has to be adjusted by 3.5% which in our case would then turn out to be (approximately) 92%.

Concept of Percentage

A good weightage of the DI questions asks you to find the percentage change in one quantity with respect to another.



What is the sales growth from 2015 to 2016?

Sales growth from 2015 to 2016 would be from 120 crore to 140 crore
$\therefore$ Absolute growth = 140 – 120 = Rs.20 cr.

$$\text{Percentage growth} = \frac{140-120}{120}\times 100 = \frac{20}{120}\times 100 \cong 17\%$$

This explains the difference between absolute growth and percentage growth.

Now, if we observe the sales figure from the year 2013 to 2017, we can infer that every year, the sales have increased by the same quantity i.e. Rs.20 crore. But if we consider the percentage change, then the values are different. In year 2014, sales have increased to Rs.100 crore from Rs.80 crore in the year 2013. But 100 is 20 more than 80 and 20 is one fourth of 80, i.e., 25%. Thus, 100 is 25% more than 80. Also, 20 is 20% of 100. Thus, 80 is 20% lower than 100.

Note: While calculating percentage, take the figure with which you are comparing the other figure as the base.

Now, consider the sales figures for the year 2013 and the year 2015. Sales have increased from Rs.80 crore to Rs.120 crore. Here the absolute increase is Rs.40 crore and percentage increase would be $\frac{40}{80}$ × 100 i.e. 50%.

The percentage change can also be found by taking the ratio of final value to initial value. If the ratio is more than 1, then there is percentage increase and if the ratio is less than 1, there is a decrease.

To find the percentage increase, subtract 1 from the ratio and multiply it by 100.
To find the percentage decrease, subtract the ratio from 1 and multiply it by 100.

In the above example, from 2013 to 2016, the sales ratio = $\frac{140}{80} = \frac{7}{4}$ = 1.75
$\therefore$ The percentage increase is (1.75 – 1) × 100 = 75%.
Thus, sales in 2016 is 75% higher or 1.75 times as compared to the year 2013.

Now, if we observe the figures for profits, absolute increase is the same for all the years, i.e. Rs.10 cr. But the percentage increase is varying.

Year 2014 $\frac{20-10}{10} \times 100 = 100\%$

Year 2015 0.5 × 100 = 50%
Year 2016 0.33 × 100 = 33%
Year 2017 0.25 × 100 = 25%

Suppose in the above graph, a note was given as Costs = Sales – Profits, then, costs figures for various years, and absolute and percentage change in the costs can be found out. We cannot always take costs = sales – profits, since the costs as well as the sales may be broken into other categories like operational costs, profit before interest, etc. At times, you need to add other heads to profit or cost to find total of the figures i.e. Do not assume things on your own!!

To find the percentage increase in costs from 2013 to 2017:
Costs in 2013 = 80 – 10 = Rs.70 cr.
Costs in 2017 = 160 – 50 = Rs.110 cr.
$\therefore$ Absolute increase = 110 – 70 = Rs.40 cr.
Percentage increase = $\frac{40}{71}$ × 100 $\cong 57.14\%$

Now, this problem can also be solved using fractions.
$\frac{4}{7} > \frac{4}{8} = \frac{1}{2}$ $\therefore$ The given ratio would be more than 50%.

Also, 50% of 70 is 35 and 40 is 5 more than 35 and 5 is approximately 7% of 70.
Thus, the required answer is 50 + 7 = 57%.
Now, suppose we need to compare the growth rate of sales in the year 2014 and 2015. In 2014, the growth in sales was 25%, and in 2015, the sales grew by 20%. Hence, growth rate of sales in the year 2000 is $\frac{20}{25}$ × 100 = 80% of the growth rate of sales in 2014.

Now consider the following data,

Year	2017	2018
India	80	100
Gujarat	20	28

(All figures are in million tonnes)

The above table gives the quantity of rice produced in two consecutive years all over India and one of its states – Gujarat.
In 2017, the share of Gujarat in total rice production is $\frac{20}{80} \times 100 = 25\%$. In 2018, this figure is $\frac{28}{100} \times 100 = 28\%$. Hence, we can say that the share of Gujarat in the total rice production in India increased by (28 – 25) = 3% percentage points.

Conversion between Percentages and Degrees in a Pie-chart.

In pie graphs, the entire quantity is represented on the sectors of a circle or a pie. The circle or the pie is taken as 1 or as a whole. This circle is either divided in percentage terms or in degrees. Thus, a circle has 100% or 360°.
$\therefore$ 100% of the circle = 360°
$\therefore$ 1% = 3.6°
Thus, the sector representing 20% will have $20 \times 3.6 = 72°$ as its central angle.
And if a sector has 90° in its central angle, then it will represent $\frac{90}{3.6} = 25\%$ of the circle.

Percentages and Fractions

To convert fractions into percentages, multiply the fraction by 100.
Thus, $\frac{1}{2} \equiv \frac{1}{2} \times 100 = 50\%$

To convert percentages to fractions, divide the percent term by 100.
Thus, $25\% \equiv \frac{25}{100} = \frac{1}{4}$

Memorise the following:

$\frac{1}{2} = 50\%$	$\frac{1}{3} = 33.33\%$	$\frac{1}{4} = 25\%$
$\frac{1}{5} = 20\%$	$\frac{1}{6} = 16.67\%$	$\frac{1}{7} = 14.29\%$
$\frac{1}{8} = 12.5\%$	$\frac{1}{9} = 11.11\%$	$\frac{1}{10} = 10\%$
$\frac{1}{11} = 9.09\%$	$\frac{1}{12} = 8.33\%$	$\frac{1}{13} = 7.7\%$
$\frac{1}{14} = 7.14\%$	$\frac{1}{15} = 6.67\%$	

Concept of Average

This is also an important concept in Data Interpretation. More often than not, while solving a DI set you will come across questions that will require you to calculate averages of different quantities.

In the first example:

Average sales over the five year period = $\frac{80+100+120+140+160}{5}$ = Rs.120 crore

Average profit = $\frac{10+20+30+40+50}{5}$ = Rs.30 crore

Average sales from 2013 to 2015 = $\frac{80+100+120}{3}$ = Rs.100 crore

Average sales from 2016 to 2017 = $\frac{140+160}{2}$ = Rs.150 crore

Thus, average sales for year 2016 and 2017 is greater than average sales in the period 2013 to 2015 by Rs.50 crore or by 50%.

Concept of Growth Rate

To find the growth rate over a period, find the percentage growth rate.

i.e. From year 2013 to 2017: Growth rate in sales = $\frac{160-80}{80} \times 100 = 100\%$

AAGR

To find Annual Average Growth Rate, find total growth over the period and divide the same by number of periods.

In the above example: Average Annual Growth Rate of sales = $\frac{100}{4}$ = 25%

CAGR

To find Compounded Annual Growth Rate over the period, use the concept of compound interest. i.e., if r is the CAGR and n is the number of periods, then:

Final value = Initial value $\left(1+\frac{r}{100}\right)^n$

Thus, in the above case $160 = 80\left(1+\frac{r}{100}\right)^4 \therefore \frac{160}{80} = \left(1+\frac{r}{100}\right)^4 \therefore \left(1+\frac{r}{100}\right)^4 = 2$

Thus, $\left(1+\frac{r}{100}\right) = \sqrt[4]{2}$

Now, we know that $\sqrt{2} = 1.414 \quad \therefore \sqrt[4]{2} = \sqrt{\sqrt{2}} = \sqrt{1.414}$

Now, $1.1^2 = 1.21$

$1.2^2 = 1.44$

$1.3^2 = 1.69$

$\therefore \sqrt{1.414} \cong 1.2 \quad \therefore \left(1+\frac{r}{100}\right) = 1.2 \quad \therefore r = 20\%$

To find the CAGR it is advisable to learn the squares upto 50 and cubes upto 15.

Note: The CAGR will always be lesser than the Average Annual Growth Rate as it is a compounded growth rate.

Commonly Used Conversions

Length

10 millimetre	= 1 centimetre	10 centimetre	= 1 decimetre
10 decimetre	= 1 metre	10 metre	= 1 decametre
10 decametre	= 1 hectometre	10 hectometre	= 1 kilometre
12 inches	= 1 foot	3 feet	= 1 yard
1 mile	= 1760 yards = 5280 feet	1 metre	= 100 cm

Weight

10 milligram	= 1 centigram (cg)	10 centigram	= 1 decigram
10 decigram	= 1 gram (g)	10 gram	= 1 decagram
10 decagram	= 1 hectogram (hg)	10 hectogram	= 1 kilogram (kg)
100 kilogram	= 1 quintal	1000 kilogram	= 1 metric ton

Volume

10 millilitre	= 1 centilitre (cl)	10 centilitres	= 1 decilitre
10 decilitre	= 1 litre	10 litres	= 1 decalitre
10 decalitre	= 1 hectolitre (hl)	10 hectolitres	= 1 kilolitre (kl)
1 m^3	= 1000 litre	1 litre	= 1000 cubic cm (cc)

1. Area is written in sq. (square) units and volume in cu. (cubic) units. Some conversions in square units are:

   100 mm^2 = 1 cm^2; 100 cm^2 = 1 dm^2; 100 dm^2 = 1 m^2

2. A few equivalent

   1 inch $\approx$ 2.54 cm; 8 kilometre $\approx$ 5 miles; 1 metre $\approx$ 39.37 inches; 1 kilogram $\approx$ 2.2 pound

3. 1 kilo = 1000 1 lakh = 10^5

   1 million = 10^6 1 billion = 10^9

Approximate Conversions

1 mile = $\frac{8}{5}$ km; 1 gallon = $\frac{9}{2}$ litre; 1 pound = $\frac{9}{20}$ kg.

$1\frac{m}{s} = \frac{18}{5}$ km/hr or $1\frac{km}{hr} = \frac{5}{18}$ m/s.

Formulae

Some data sets define some terms and give formula for them, pertaining to the data given in the table/graph/chart. Mostly, they appear as footnotes. If the formula is defined in the data common to all the questions in the set, it can be used in all the questions of that set, but if it is defined in any specific question, we cannot use it in other questions (unless otherwise stated). In the chart/table where large amount of data is given under various heads, students must be very careful about picking-up the correct data.

Solved Example (1)

Directions for questions: Refer to the table below and answer the questions that follow.

AVAILABILITY AND DEMAND FOR STEEL
(For the period 2004-2005 and 2009-2010)

('000 tonnes)

Sr. No.	Category	2004-2005		2009-2010	
		Demand	Availability	Demand	Availability
1	Shapes	6960	5725	9745	9360
2	Flats	4360	5020	6300	6600
3	Railway Material	400	550	450	560

Q : In 2004-2005, approximately, what percent of the total demand for steel, is the demand for Flats?

A : In 2004-2005, demand for Flats = 4360. Total demand = 6960 + 4360 + 400 = 11720

Therefore, required % = $\frac{4360}{11720} \times 100 = 37.2\%$ approx.

Q : The percentage growth in the demand for Railway Material over the five year period from 2004-2005 to 2009-2010 is:

A : Percentage growth in demand

$$= \frac{(\text{Demand in } 2009 - 2010) - (\text{Demand in } 2004 - 2005)}{(\text{Demand in } 2004 - 2005)} \times 100 = \frac{450 - 400}{400} \times 100 = 12.5\%.$$

Q : Which of the following statements is necessarily true?

1) The demand for Shapes as a percentage of the total demand for Steel was almost the same for 2004-2005 and 2009-2010.
2) The shortage of Shapes is only due to excess availability of Flats and Railway Materials.
3) The rate of growth in demand for Shapes is greater than the rate of growth in supply of Shapes. (Assume all the available material is supplied).
4) The total demand as a percentage of total availability of steel (all categories) in 2009-2010 is expected to be 125%.

A : Statement [1]

For 2009-2010, required ratio for Shapes = $\frac{9745}{(9745+6300+450)} \times 100\% = \frac{9745}{16495} \times 100\%$ = 59%

For 2004-2005, required ratio for shapes = $\frac{6960}{6960+4360+400} \times 100\% = \frac{6960}{11720} \times 100\%$ = 59%.

Hence, the statement [1] is correct statement.

Statement [2]

There is no information available on the reason for shortage of Shapes and one cannot deduce statement 2. Hence, incorrect.

Statement [3]

Growth rate of demand for Shapes = $\frac{9745 - 6960}{6960} \times 100 = 40\%$

Growth rate of supply for Shapes = $\frac{9360 - 5725}{5725} \times 100 = 63.5\%$. Hence, incorrect.

Statement [4]

In 2009-2010, Total demand = 9745 + 6300 + 450 = 16495

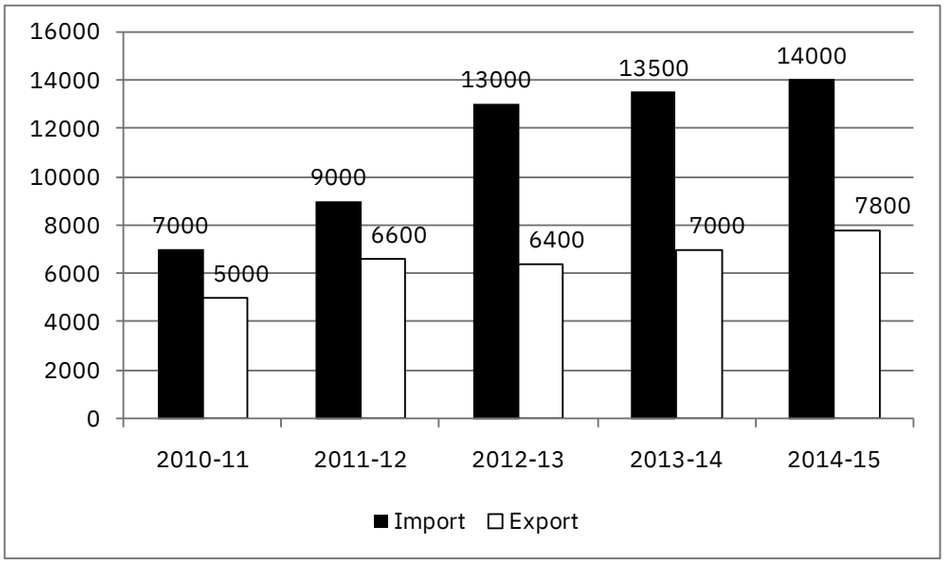
Total availability = 9360 + 6600 + 560 = 16520

$\therefore$ Total demand as a percentage of total availability = $\frac{16495}{16520} \times 100 = 99.8\%$. Hence, incorrect.

Solved Example (2)

Directions for questions: Refer to the graph below and answer the questions that follow.

India's Foreign Trade in Rs. Crore.



Q : The percentage increase in imports between 2010-11 and 2014-15 was:

A : Imports in 2010-11 = 7000 crore rupees
Imports in 2014-15 = 14000 crore rupees

Percentage increase in imports = $\frac{(\text{Import in } 2014 - 15) - (\text{Imports in } 2010 - 11)}{\text{Imports in } 2010 - 11} \times 100$

Therefore, increase in imports = $\frac{14000 - 7000}{7000} \times 100 = \frac{7000}{7000} = 100\%$.

Alternately, imports have doubled in size from 2010-11 to 2014-15. Hence there is a 100% increase.

Q : Approximately, what was the percentage change in trade gap (imports – exports) between 2013-14 and 2014-15?

A : There has been a decrease in trade gap between 2013-14 and 2014-15.
Trade gap in 2013-14 = 13,500 – 7000 = 6,500
Trade gap in 2014-15 = 14,000 – 7,800 = 6,200

Percentage decrease = $\frac{6500 - 6200}{6500} = 4.6\%$.

Q : The percentage increase in trade gap between 2011-12 and 2012-13 was approximately...

A : Trade gap in 2011-12 = 9000 – 6600 = 2400.
Trade gap in 2012-13 = 13000 – 6400 = 6600
Percentage increase in trade gap
$= \frac{(\text{Trade gap in } 2012 - 13) - (\text{Trade gap in } 2011 - 12)}{\text{Trade gap in } 2011 - 12} \times 100 = \frac{6600 - 2400}{2400} \times 100 = \frac{4200}{2400} =$ 175%

Q : If oil imports constituted 20% of the total imports in 2012-13, then what percent of the trade gap was due to oil (assuming that no oil is exported)?

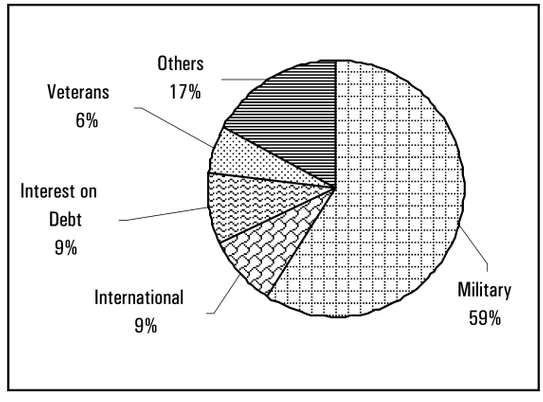
A : Oil imports in 2012-13 = $\frac{20}{100} \times 13000$ = Rs.2600 crore.

Trade gap in 2012-13 = 6600
Hence, percentage of trade gap due to oil = $\frac{2600}{6600} \times 100 = 39.39\% \approx 40\%$. (approximately)

Solved Example (3)

Directions for questions: Refer to the pie chart below and answer the questions that follow.

National Budget Expenditure (Percentage allocation) year 2018



Q : Approximately how many degrees should there be in the central angle of the sector for military expenditure?

A : In a pie-chart where 100% of any quantity are spread over 360 degrees, 1% = 3.6 degrees. Military expenditure = 59% which is equivalent to 3.6 × 59 = 212.4 degrees.

Q : What is the ratio of military expenditure to veterans expenditure approximately?

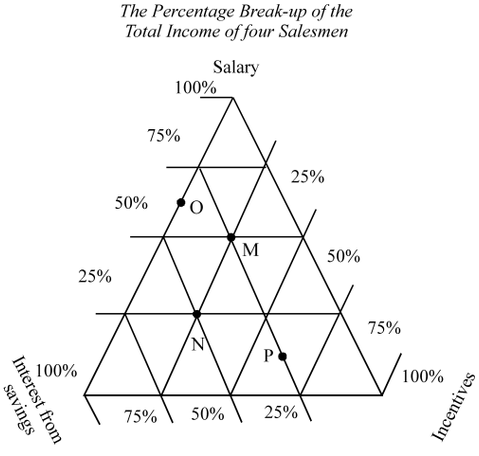
A : Since the budget expenditure is proportional to the percentage of the pie covered, ratio of military expenditure to veterans expenditure would be the ratio of corresponding percentage allocations.
Therefore, $\frac{\text{Military Expenditure}}{\text{Veterans Expenditure}} = \frac{59}{6} \approx \frac{10}{1}$.

Q : If 9 billion rupees were spent in 2018 for veterans, what would have been the total expenditure for that year in billions?

A : 9 billion Rupees were spent for veterans
This represents 6.0% of the total expenditure for 2018
i.e., $6 = \frac{\text{Amount spent on veterans}}{\text{Total Expenditure}} \times 100$
$6 = \frac{9}{\text{Total Expenditure}}$
Therefore, total expenditure = $\frac{9}{6} \times 100 = 150$ billion rupees.

Solved Example (4)

Directions for questions: Refer to the diagram below and answer the questions that follow.



Q : If the total income of O is Rs.6000 and of N is Rs.7,000, then find the difference in their salaries.

1] Rs.1500 2] Rs.1750
3] Rs.2000 4] Rs.2250

A : Salary of O is 62.5% of his total income.

$\therefore$ Salary of O = $\frac{62.5}{100} \times 6000 = 3750$

Salary of N is 25% of his total income

$\therefore$ Salary of N = $\frac{25}{100} \times 7000 = 1750$

$\therefore$ Difference in their income = 3750 – 1750 = Rs.2000. Hence, [3].

Q : If the total income of P is Rs.8000, find the interest he earns from his savings.

1] Rs.2500 2] Rs.1000 3] Rs.1500 4] Rs.2000

A : The interest from his savings form 25% of P's total income.

$\therefore$ Interest from his savings = $\frac{25}{100} \times 8000$ = Rs.2000. Hence, [4].

Q : If the incentives of N amount to Rs.2000, find his monthly salary.

1] Rs.8000 2] Rs.4000 3] Rs.6000 4] Rs.2000

A : Incentives of N are 25% of his total income and so is his salary.
$\therefore$ Salary of N is also Rs.2000. Hence, [4].

Q : If the incentives of M are Rs.3000, his salary is ____ of his total income.

1] $\frac{1}{4}$ 2] $\frac{1}{2}$ 3] $\frac{2}{3}$ 4] $\frac{3}{4}$

A : Salary of M is 50% of his total income, hence, his salary will be 1/2 of his total income. Hence, [2].

Note: The actual amount does not matter as figures in percentage can be directly considered for the fractional part.

CLASS EXERCISE

Approximation

1. Find approximately:
   a) 12.4 × 5.01 b) 53.6 × 49.9 c) 0.11 × 56
   d) 33.2 × 18 e) 5632 × 11

2. Find the approximate value of:
   a) $\frac{14}{55}$ b) $\frac{273}{89}$ c) $\frac{128}{99}$ d) $\frac{157}{503}$ e) $\frac{125}{351}$

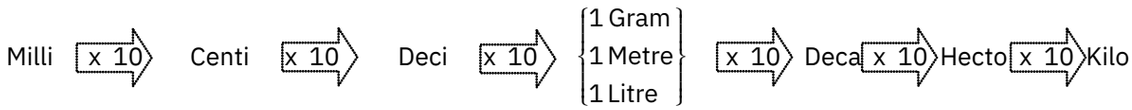
3. Approximately evaluate:
   a) $(1.03)^5$ b) $(1.07)^3$ c) $(10.1)^4$ d) $(100.4)^3$ e) $(0.1005)^4$

A number of the form $(1 + k)^n$, where $k << 1$, can be approximated via binomial expansion as:
$(1 + k)^n \approx 1 + nk + {}^nc_2\ k^2$

4. For the number x = 3227.345, find approximately:
   a) 10 % of x b) 5 % of x c) 21 % of x
   d) 33 % of x e) 50.5 % of x

5. Convert the following:
   a) 30 gm = _____kg? b) 7 kg = _____ lb?
   c) 25 feet = ____ metres? d) 18 km = _____ miles?
   e) 3.6 lb = _____ gm f) 17 yards = _____ cm?
   g) 7.4 inches = ____ metres? h) 2854 litres = _____ m3?

Some useful conversions



Weight:	1 kg = 1000 gm	1 Pound (lb) ≈ 0.45 kg	1 kg ≈ 2.2 lb
Distance:	1 inch ≈ 2.54 cm	1 foot = 12 inches ≈ 30 cm	1 yard = 3 feet ≈ 0.9 m
	1 mile = 1760 yards	1 mile ≈ 1.6 km	1 km ≈ 0.625 mile
Volume:	1 gallon = 3.78 litres	1 litre = 1000 cubic cm (cc)	1 m^3 = 1000 litres
Speed:	1 kmph = 5/18 m/s	1 m/s = 18/5 kmph	

6. * Calculate roughly:

a) 16.65 x 42 b) 252 x 314 c) 1.75 x 44 d) $(100.3)^3$
e) 21 % of 53290 f) 49 % of 8648 g) $(2.01)^4$ h) 0.011 x 456
i) $\frac{852}{1197}$ j) $\frac{1321}{549}$ k) $\frac{361}{333}$ l) $\frac{18.9}{2.51}$

Percentages

7. Calculate the equivalent percentages for the following fractions

a) $\frac{1}{5}$ b) $\frac{2}{7}$ c) $\frac{5}{8}$
d) $\frac{4}{11}$ e) $\frac{14}{9}$ f) $\frac{32}{44}$

8. Find the percentage change when a value changes from

a) 50 to 80 b) 80 to 50 c) 27 to 51
d) 120 to 100 e) 56 to 77 f) 154 to 143

Data for questions 9 – 15: Cattel is a toy company which makes a variety of different toys. The following table gives the sales of Cattel's five most popular toy series, in thousands of units:

	1997	1998	1999	2000	2001	2002	2003	2004	2005
P I Joe	6850	7200	7850	7700	8150	9000	8500	9250	9700
Bhabhi	3350	3400	4100	4250	4500	4350	4600	5100	5100
Jokemon	2800	3200	3600	3900	3650	4100	3800	4000	4200
Haute Wheels	2100	2250	2300	2450	2350	2500	2700	2800	3000
Catman	1700	1650	1800	2100	2050	2250	2200	2100	2450

9. By what percentage did the sales of P. I. Joe increase between 1998 and 2002?

10. What was the highest percentage growth in sales shown by any toy over the given time period?

11. In which year did the total sales fall as compared to the previous year? By roughly what percent?

12. Which toy showed the greatest growth in sales in a single year? In which year?

To convert a fraction to a percentage, multiply by 100. To convert a percentage to a fraction, divide by 100

$$\text{Percentage change} = \frac{(\text{Final Value} - \text{Initial Value})}{\text{Initial Value}} \times 100$$

13. * Which toy showed the sharpest decrease in sales in any given year? In which year?

14. * Supposing Cattel had planned that in any given year they would produce 5% more "Catman" toys than the previous year's actual sales, in how many years would production have failed to meet demand?

15. * For how many year/toy combinations was an increase of over 10% observed during the given period?

Averages

16. Find the average of the following sets of numbers:
    a) 3.5, 2.3, 4.7, 8.2, 1.8
    b) 123, 127, 129, 118, 117
    c) 81.3, 76.4, 89.2, 82.7, 90.1

17. If the average of 25, 18, 27, 32 and x is 26, find x

Data for questions 18 – 22: The table below gives the marks (out of 100) in 5 subjects obtained by 7 students, and their average score. Certain values in the table are missing.

	Language 1	Language 2	Science	Maths	Social Science	Average
Radhika	75	67	93	88	78	
Umesh	81		86	89	71	79.8
Tarak	72	69		93	81	82
Viraj	67	71	79	85		73.4
Sanjay		74	83	78	78	80.8
Wyomkesh	78	81	69		75	
Younus		67	84	81	69	76.6

18. Which of the given students topped in Language 1?

19. What was the difference between Umesh's score in language 2 and Tarak's score in Science?

20. If Wyomkesh ended up with the lowest average among the given students, what is the maximum he could have scored in Maths?

21. Umesh gives his Social Science paper for revaluation, and as a result ends up with the highest average in the class. What could be the minimum marks he must have scored in Social Science after revaluation?

22. How many marks would Wyomkesh need in Maths to achieve the highest average in the group?

Challengers

The proportion of male students and the proportion of engineers in the batch of 2015 in the business school ZIM is given below. ZIM has 600 students in three departments, out of whom 60% are in Human Resources while the remaining are equally split between the departments of Social Work and Hospital Management.

	Male (M)	Engineers (E)
Human Resource	0.65	
Social Work	0.45	
Hospital Management		0.1
Total		

In addition is in known that:

- The fraction of engineers in Social Work is the same as the fraction of males in Human Resource.
- The number of non-engineers in Human Resource and Hospital Management is the same.

1. What is the percentage of Engineers in Human Resource?

   1) 10% 2) 55% 3) 70% 4) Cannot be determined

2. What is the total number of Engineers?

   1) 288 2) 342 3) 328 4) Cannot be determined

3. What is the total number of females?

   1) 252 2) 288 3) 312 4) Cannot be determined

4. If it is known that the overall number of females is not more than that of the males, then what is the maximum percentage of females in Hospital management?

   1) 90.0% 2) 78.2% 3) 49.9% 4) Cannot be determined

5. If the number of male non-engineers is 6 more than the number of female engineers, then what percentage of Hospital Management students are female?

   1) 50.0% 2) 66.6% 3) 75.0% 4) Cannot be determined

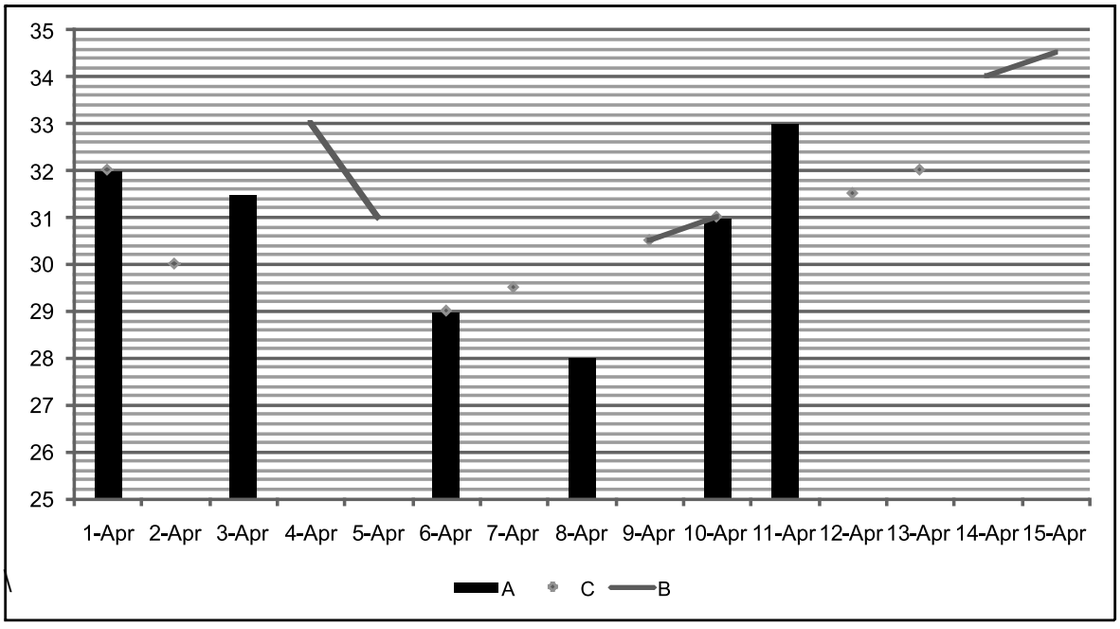
6. If in the Hospital Management department, the number of females is 5 times the number of engineers, what percentage of the total females are in Human Resource?

   1) 54.0% 2) 50.0% 3) 66.3% 4) Cannot be determined

PRACTICE EXERCISE

DIRECTIONS for questions 1 to 4: Refer to the data and answer the questions that follow.

Three friends—A, B and C—recorded the maximum temperatures (in °C) for the first half of the month of April. However, each one of them couldn't measure the temperature on all days, but at least one of them was eventually able to record the temperature for each day. The recordings are represented in the graph below.



1. What was the average of the daily maximum temperature (in °C) during the given period?

   1) 30.45 2) 31.37 3) 32.45 4) 32.21

2. What is the maximum number of days for which the maximum temperature recorded (in °C) has consecutively increased?

   1) 2 2) 3 3) 4 4) 5

3. If the 15 days are divided into 5 periods of 3 consecutive days each, then which period recorded the lowest average maximum temperature (in °C)?

   1) Period 1 2) Period 2 3) Period 3 4) Period 4

4. Which day saw the sharpest increase in the maximum temperature (in °C) recorded that day over the previous day?

   1) 4-Apr 2) 11-Apr 3) 13-Apr 4) 9-Apr

DIRECTIONS for questions 5 to 9: Refer to the data and answer the following questions.

The following table shows the summary of the batting career of a well-known cricketer, who made his debut in 1989.

Year	Matches	Innings	Not out	Runs scored	Average	Balls Faced	Strike Rate	Fours hit	Sixes hit
1989	1	1	0	0	0	2	0	0	0
1990	12	11	0	239	21.73	244	97.95	21	6
1991	26	25	2	656	28.52	804	81.59	54	9
1992	47	45	4	1360	33.17	1823	74.6	104	10
1993	65	62	8	1679	31.09	2259	74.32	126	13
1994	90	87	10	2768	35.95	3488	79.36	256	24
1995	102	99	11	3212	36.5	3926	81.81	318	28
1996	134	131	13	4823	40.87	5880	82.02	481	45
1997	173	167	16	5834	38.64	7070	82.52	582	57
1998	207	200	20	7728	42.93	8924	86.6	770	97
1999	229	222	22	8571	42.86	9875	86.79	854	111
2000	263	256	22	9899	42.3	11499	86.09	997	124
2001	280	272	25	10803	43.74	12489	86.5	1113	127

The entries in the table except for average and strike rate are cumulative. That means he played 65 matches till 1993, he scored 9899 runs till 2000 etc.

We define the following:

Average = $\frac{\text{Runs scored}}{\text{Innings - Not out}}$; Strike Rate = $\frac{\text{Runs scored}}{\text{Balls faced}} \times 100$

One over consists of 6 balls. Overs faced = $\frac{\text{Balls faced}}{6}$

RPO = $\frac{\text{Runs scored}}{\text{Over faced}}$

Each four gets the batsman 4 runs while each six gets him 6 runs. In addition to fours and sixes, the batsman scored runs only in the form of singles (one run at a time) and doubles (two runs at a time). The balls faced by the batsman in which he did not score a single run are called 'dot balls'.

5. What can be the maximum number of dot balls faced by the batsman in 1999?

6. Between 1993 and 1999 (both years included), in which two-year span (1993-1994, 1994-1995, ... , 1998-1999) in the given period was the average of the batsman the highest? (For this answer, write the answer as the beginning year of the two-year period. That means if your answer is 2003-2004, enter your response as 2003).

7. Between 1991 and 2001 (both years included), for which year was the strike rate of the batsman the maximum?

8. In how many years in the given period was the RPO of the batsman greater than 5.4?

9. In which year did the batsman score maximum runs in the form of 4s and 6s?

DIRECTIONS for questions 10 to 13: Refer to the data and answer the following questions.

A, B, C, D, E, F, G, H, I and J are the ten developing countries in Sub-Saharan Africa. Following are the values of their imports and exports (both in million dollars) over four years: 2012, 2013, 2014 and 2015.

	A		B		C		D		E		F		G		H		I		J	
Year	I	E	I	E	I	E	I	E	I	E	I	E	I	E	I	E	I	E	I	E
2012	60	20	30	50	10	70	80	45	70	25	70	25	10	10	15	35	70	70	25	35
2013	25	45	50	75	25	20	80	75	50	25	30	60	10	45	65	10	10	15	40	60
2014	80	50	80	45	45	30	50	30	20	55	75	25	65	30	15	40	65	80	15	20
2015	25	10	35	35	80	70	70	70	80	40	50	60	20	10	70	45	15	45	75	40

I : Imports
E : Exports

For a country, following three parameters are defined.
Trade surplus = Exports – Imports (if exports > imports)
Trade deficit = Imports – Exports (if imports > exports)
Total international trade = Imports + Exports
These three parameters can be defined for a particular year or over a multiple years' period.

10. What was the percent increase in the sum of the total international trade of these 10 countries between 2012 and 2014?

1) 14.55% 2) 10.91% 3) 12.27% 4) 15.95%

11. What was the increase in total imports from these 10 countries between 2014 and 2015?

1) 10 million dollars
2) 20 million dollars
3) 30 million dollars
4) There was a decrease in total imports between 2014 and 2015

12. How many countries registered consistent increase in exports in 2013, 2014 and 2015 over the previous year?

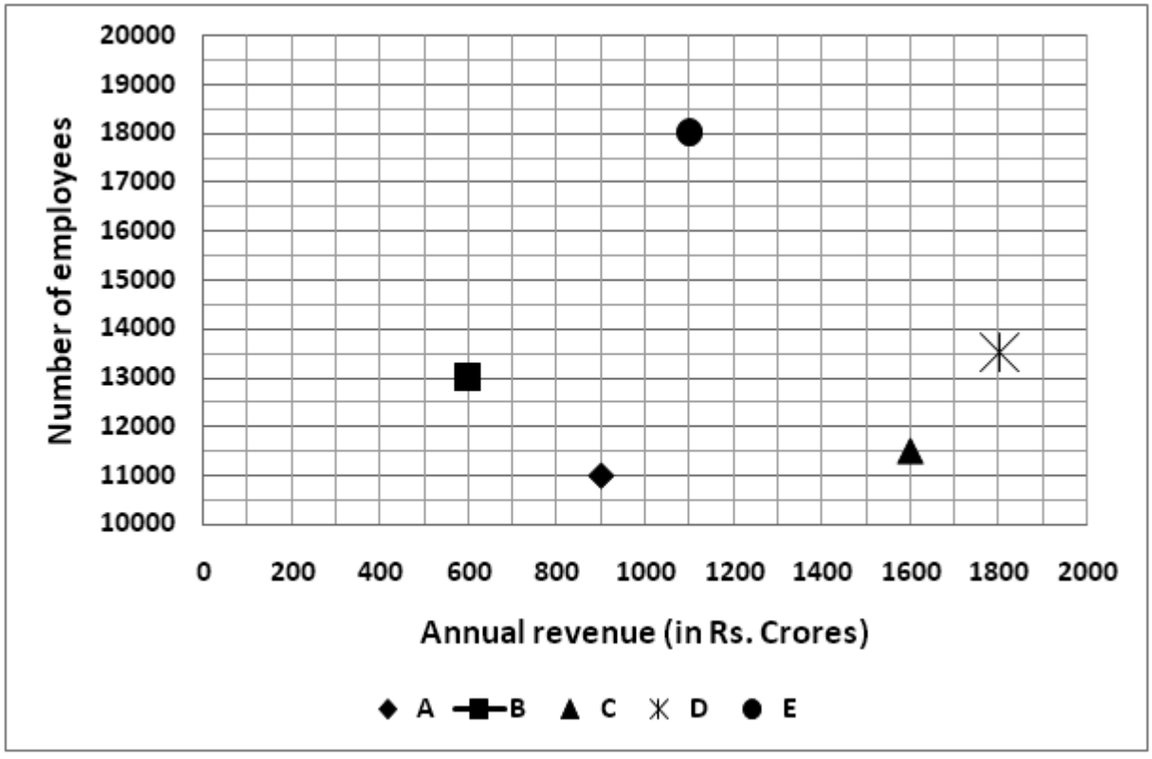
1) 0 2) 1 3) 2 4) More than 2

13. How many countries exhibited a positive trade surplus in all the four years?

1) 0 2) 1 3) 2 4) More than 2

DIRECTIONS for questions 14 to 17: Refer to the data and answer the following questions.

The following graph shows the information on the number of employees and the annual revenue of five different companies, namely A, B, C, D and E in the year 2015-16.



The maximum working hours per year per employee are 2000. We define efficiency ratio for the companies as the ratio of the actual number of working hours in the year of all employees to the maximum working hours in the year of all employees.

In the year 2015-16, the average efficiency ratios of the five companies were as follows:

Company	Efficiency ratio
A	94.50%
B	90.90%
C	94.40%
D	92.80%
E	97.60%

1 Crore = 100 Lakhs; 1 Lakh = 100,000

14. Which of the following is closest to the average revenue generated by company B in 2015-16 per hour per employee (in Rs)?

1) 225 2) 250 3) 275 4) 300

15. If the average revenue generated per employee of the five companies is arranged in the ascending order, which of the following will be the correct order?

1) B-A-E-C-D 2) B-E-A-C-D 3) B-E-A-D-C 4) B-A-E-D-C

16. Which of the following is closest to the ratio of the total number of working hours of all employees of company C to the total number of working hours of all employees of company D (in the year 2015-16)?

1) 1566:1357 2) 1593:1334 3) 1334:1593 4) 1357:1566

17. If the values of average revenue generated by companies A, C, D and E in 2015 per hour per employee are arranged in the descending order, which of the following will be the correct order?

1) C-D-E-A 2) C-D-A-E 3) C-E-A-D 4) C-E-D-A

LR-1.1 | TYPES OF ARRANGEMENTS THEORY

Introduction

Questions based on Simple Arrangements can be further divided into 2 types; one involving Linear Arrangements i.e., arrangements in a line or scheduling of objects in a particular order and the second involving Circular arrangements i.e., arrangements of objects in a Circular manner. Taking care of all the constraints you have to find the proper or probable arrangement.

Linear Arrangement

Questions based on Linear Arrangements can be classified into 2 types.

Type I: Arranging objects or elements in a line (i.e., row or column)

These problems involve arranging objects in a line based on their ranking. The rank would be due to any attribute such as weight, height, time, distance, marks etc. Necessary information like comparison of objects would be provided e.g., A is taller than B or A comes after B and so on. Other examples include arrangement of families on different floors of a building. e.g. Marwari family lives 2 floors above Gujarati family & Bengali family lives 1 floor below Marwari family.

Type II: Scheduling objects or elements in a particular order.
Some examples of these are:

a] Programs in a week
These type of problems generally include scheduling lectures, subjects to be studied, activities to be done or flights of an airline etc., in a week.

b] Drama / movies to be played / screened
These problems include certain number of dramas/movies or dance programs which are to be scheduled in different time slots in a day or on particular days of the week during a drama/movie festival.

Symbolic Notations

1. There can be conditions for the positions that A can take.
   a] A does not live next to anybody. × A ×
   b] A cannot occupy position 3. ~A

	1	2	3	4	5
c] A is always at position 4				(A)	

Note: The symbol '~' denotes 'not'.

2. We can also consider the various positions that a person A can take with respect to another person B.

a] A and B are adjacent to each other or A and B are always together.	AB or BA
b] A and B are not adjacent to each other.	AB^x or BA^x
c] There is a vacant place between A and B.	A ___ B
d] There is a vacant place between A and B which cannot be occupied.	A × B
e] A must precede B.	A.....B
f] A is older than B or A is taller than B.	A > B.

3. a] If A is at position 1 then B must be at position 3. A1→ B3
   b] If A is not at position 2 then B must be at position 3. A ~2 → B3
   c] Position 1 is empty. 1 2 3 4 5 6 ?
   d] Position 1 could be empty / occupied. 1 2 3 4 5 6 ?

Scheduling Objects

Solved Example

Directions for questions 1 to 3: Refer to the information below and answer the questions that follow.

Mumbai Airport has only one flight departing at every 1.5 hours each day. The last flight is for Singapore at 7.30 p.m. Flight for Japan is exactly at 12.00 hours and it is the third flight. The maximum time gap between two consecutive flights is between that for Singapore and Pakistan. Flight for France is the fifth flight and is followed by Canada. Time gap between the flights for France and Nepal is the same as that between the flights for Australia and Korea.

Q1. First flight of the day is for:
1) Australia 2) Pakistan 3) Nepal 4) Korea

Q2. If the second-last flight is for Nepal, then the flight for Australia is the ... flight.
1) second 2) fourth 3) second or fourth 4) Cannot be determined

Q3. If the flight for Nepal is at 10.30 a.m., then the flight for Korea could be at:
1) 9 a.m. 2) 1.30 p.m. 3) 4.30 p.m 4) 3.00 p.m.

Soln

Step I: Identify the elements:
Australia (A) Korea (K)
Singapore (S) Canada (C)
Pakistan (P) Nepal (N)
Japan (J)

Step II: Identify the positions

Since there is a flight every one and a half hours and the third flight is 12 noon, so the 1st flight has to be at 9.00 a.m. Also, it is given that the last flight is at 7.30 p.m. So, flights will be scheduled at following times

9.00 am	10.30 am	12 noon	1.30 pm	3.00 pm	4.30 pm	6.00 pm	7.30 pm
1	2	3	4	5	6	7	8

Step III: Conditions

a] Last flight is for Singapore

1	2	3	4	5	6	7	8
						S	

b] Flight for Japan is at 12.00 noon

1	2	3	4	5	6	7	8
	J					S	

c] Maximum time gap between 2 consecutive flights will be the time gap between the last flight on one day and the first flight on the next day. So, the first flight for the day will be for Pakistan

1	2	3	4	5	6	7	8
P	J					S	

d] Flight for France is the 5th flight of the day

1	2	3	4	5	6	7	8
P	J		F			S	

e] Flight for France is followed by the flight for Canada

1	2	3	4	5	6	7	8
P		J		F	C		S

f] Time gap between the flights for Australia & Korea and that of France & Nepal is the same. Combining data from all the conditions, we get:

1	2	3	4	5	6	7	8
9.00	10.30	12.00	1.30	3.00	4.30	6.00	7.30
Pakistan		Japan		France	Canada		Singapore

Now we can answer the questions:

A1. First flight is for Pakistan. Hence, [2].

A2. If second-last flight is for Nepal, then flight for Australia could be the second or fourth. Hence, [3].

A3. If flight for Nepal is at 10.30 a.m., then flight for Korea would be at 1.30 p.m. or 6.00 p.m. Hence, [2].

Arrangement Of Objects

Solved Example

Directions for questions 1 to 4: Refer to the information below and answer the questions that follow.

Six friends went on a vacation to a hill station. They are to be accommodated in a row of nine cottages, each one in a different cottage. Mohan, Tanya and Roma do not want to live in a cottage at either end of the row. Babu and Mohan must not have anybody adjacent to their cottages. There is exactly one empty cottage between Mohan and Roma. Chander is adjacent to both Jayanthi and Roma. Tanya is next to the cottage at the extreme left end of the row.

Q1. Who has empty cottages on both sides?
1) Roma 2) Babu 3) Mohan 4) Tanya

Q2. Who is in the third cottage from the extreme left end?
1) Jayanthi 2) Chander 3) Nobody 4) Roma

Q3. Which cottages are empty from the extreme left end?
1) 1, 6, 8 2) 1, 5, 8 3) 4, 5, 6 4) 5, 6, 8

Q4. What is the maximum number of consecutive cottages that are occupied?
1) 2 2) 3 3) 1 4) 4

Soln

Step I

Identify the elements: Mohan (M) Tanya (T)
Babu (B) Roma (R)
Chander (C) Jayanthi (J)

Step II

Identify the positions: These 6 friends have to occupy 6 out of 9 cottages. 1 2 3 4 5 6 7 8 9

Step III

Using the conditions:

a] M, T and R do not want to live in a cottage at either end of the row

1	2	3	4	5	6	7	8	9
~R								~R
~T								~T
~M								~M

b] B and M must not have anybody adjacent to their cottages: × B × and × M ×

c] There is 1 empty cottage between M and R (If the cottage is empty then nobody occupies it): M × R or R × M

d] C is adjacent to both J and R: J C R or R C J

e] T is next to the cottage at the extreme left end

1	2	3	4	5	6	7	8	9
(T)								

We need to confirm to all the conditions to arrive at the answer. Look out for the person or element which is common to 2 or more conditions. We find R common to conditions (c) and (d). We form a chain J C R × M **OR** M × R C J

Also, since there must not be anybody adjacent to M (condition (b)) we have J C R × M × **OR** × M × R C J the following possible relative arrangements for J, C, R & M
The other conditions are × B × and T at position 2
Looking at conditions [a], [b] & [d], the only possibility for position 1 is that it is an empty cottage. C, M and B cannot be at position 3 (condition (b) and (d)). Thus, either R or J can occupy position 3.
If R occupies position 3 then condition [c] is not satisfied i.e., M × R or R × M. Hence, J must be at position 3. Thus, C will be at position 4 and R at position 5 followed by an empty cottage at position 6. Therefore, M is at position 7 followed by an empty cottage and B is at position 9. Therefore, the final arrangement will look like:

1	2	3	4	5	6	7	8	9
×	T	J	C	R	×	M	×	B

A1. Only Mohan has empty cottages on both the sides. Hence, [3].

A2. Jayanthi is in the third cottage. Hence, [1].

A3. The first, sixth and eighth cottages are empty. Hence, [1].

A4. Maximum four consecutive cottages are occupied. Hence, [4].

Circular Arrangement

One more type of arrangement is circular arrangement. In this type, objects or people are arranged around a circle as per the conditions given. It may be a circular table, a rectangular table, etc. It can be illustrated taking up a sample question as follows:

Solved Example (1)

Directions for questions 1 and 2: Refer to the information below and answer the questions that follow.

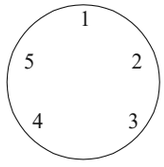
There are 5 executives in a business conference seated around the circular table. 2 males Jim and Tim and 3 females Dolly, Charlotte and Brenda. Following are some of the conditions.
i. No males sit adjacent to each other.
ii. Brenda sits to the left of Jim such that 2 people are seated in between them.
iii. Tim sits immediately to the right of Brenda and is one place away from Dolly.

Q1. Who sits to the left of Jim?

Q2. Who sits in between Brenda and Charlotte?

Soln
Step I: Identify the members i.e., Jim (J), Dolly (D), Tim (T), Brenda (B). Charlotte (C)
Identify the number of people, their sitting positions and their sex.
2 males - J, T
3 females - D, C, B.

Step II: ***Representation:*** Number of positions 1 to 5 as below:



Step III: Follow the conditions one by one.

Condition 1

No males sit adjacent to each other.

J __ T or J __ __ T.

Condition 2

B sits to the left of J such that there are two people in between them.

B __ __ J.

With this condition we cannot identify their exact position.

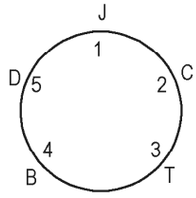
Condition 3

T sits immediately to the right of B.

B T

Combining this with condition (2) B T __ J. Now T is also one place away from D. However looking at the above arrangement. J is one place away from T on the right side. So D cannot occupy that position. So D has to be one place away from T on the left side i.e., D B T __ J. The only remaining place has to be occupied by C.

Final Representation: Fixing the position of J at 1 and moving in a clockwise order we get the final arrangement as JCTBD.



Now, all the questions can be answered

A1. Charlotte sits to the left of Jim

A2. Tim sits in between Brenda and Charlotte.

Solved Example (2)

Directions for questions 1 to 5: Refer to the data below and answer the questions that follow.

Six friends are sitting around a circular table at equal distance from each other. Sita is sitting two places right of Gita who is sitting exactly opposite to Nita. Nita is on the immediate left of Lata, who is sitting exactly opposite to Rita. Mita is also sitting at the table.

Q1. Who is the only person sitting between Gita and Sita?

1) Rita 2) Mita 3) Lata 4) Nita

Q2. Sita is not sitting at equal distance from:

1) Rita and Nita 2) Lata and Gita 3) Mita and Lata 4) All of these

Q3. Gita is sitting to the:

1) left of Mita 2) right of Rita 3) left of Rita 4) right of Nita

Q4. The angle subtended by Mita and Nita at the centre of the table is:

1) 60° 2) 120° 3) 90° 4) 180°

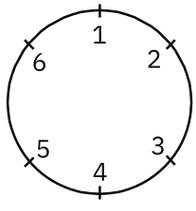
Q5. Which of the following statement is not correct?

1) Mita and Sita are sitting exactly opposite to each other.
2) Rita and Mita are sitting at an equal distance from Gita.
3) Angle subtended by Rita and Mita is same as the angle subtended by Sita and Lata at the centre of the table.
4) Mita is on the immediate left of Lata.

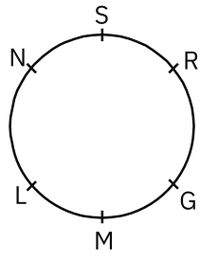
Soln

Step I: Identify the members Sita (S) Lata (L)
Gita (G) Rita (R)
Nita (N) Mita (M)

Step II: Representation: Number the positions 1 to 6 in the clockwise direction such that 1 is opposite 4, 2 is opposite 5 and 3 is opposite 6.



Step III: Following the conditions one by one, the final representation is:



Now answer the questions:

A1. Rita is between Gita and Sita. Hence, [1].

A2. Sita is not sitting at an equal distance from Mita and Lata. Hence, [3].

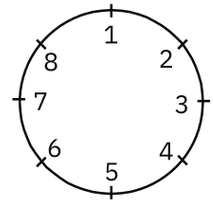
A3. Gita is sitting to the left of Rita. Hence, [3].

A4. Angle between Mita and Nita is 120° . Hence, [2].

Note: In a circular arrangement of 6 people equidistant from each other, angle subtended by adjacent people at the center = $\frac{360}{6}$ = 60°. So for individuals that are 2 places away from each other angle subtended at the center = 2 × 60° = 120°. In general, for a circular arrangement of n objects angle subtended by adjacent objects at the center = $\frac{360}{n}$. Largest angle subtended at the center by 2 objects will be for objects opposite each other i.e., at a angle of 180° from each other.

A5. Statement [4] is not correct as Mita is to the immediate right of Lata. Hence, [4].

Note: In a circular arrangements of 8 objects number the positions 1 to 8 such that 1 is opposite 5, 2 is opposite 6, 3 is opposite 7 and 4 is opposite 8. Diagramatically it can be represented as below:



Matrix Arrangements

Matrix Arrangements involve fixing of 2 or more attributes to any object. The most important point of concern in matrix arrangements is to understand the problem and draw a matrix illustrating all the given points of the basic structure of the argument. In this chapter, we will discuss the various methods to draw a matrix.

Method I

In this method, we fix any given parameter, called as reference parameter, in a column and place the parameters in row getting a matrix. Ideally, the parameter about which maximum information is given should be used as the reference parameter.

Solved Example

Directions for questions 1 to 3: Refer to the data below and answer the questions that follow.

There are 5 people, each of whom likes exactly one of the five different brands of beverages.
5 people -- Altaf, Bheem, Charlie, Dan and Eeshwar.
5 beverages -- Pepsi, Sprite, Nescafe, Appy and Energee.
They have following preferences.

- Altaf does not like Sprite or Energee.
- Dan prefers Nescafe or Sprite.
- Charlie prefers Pepsi.
- Bheem does not prefer Appy, Nescafe or Energee.

Q1. Who prefers Energee?

Q2. Who drinks Appy?

Q3. What does Dan drink?

Soln

Step I: Identify the number of people and the number of beverages. There are 5 beverages and 5 people, and all have only one choice.
People -- Altaf (A), Bheem (B), Charlie (C), Dan (D) and Eeshwar (E).
Beverages - Pepsi (P), Sprite (S), Nescafe (N), Appy (Ap) and Energee (En).
Codes should be given to make representation easy.

Step II: Draw the matrix. Since there are 5 beverages and 5 people, draw a 5 × 5 matrix, with 5 beverages on x-axis and 5 people on the y-axis as follows:

	(P)	(S)	(N)	(Ap)	(En)
A		✗			✗
B			✗	✗	✗
C	✓				
D		✓	✗		
E					

OR

	(P)	(S)	(N)	(Ap)	(En)
A		✗			✗
B			✗	✗	✗
C	✓				
D		✗	✓		
E					

Step III: Follow the given conditions.
Condition 1: A does not like Sprite or Energee.
Condition 2: D prefers Nescafe or Sprite.
Condition 3: C prefers Pepsi.
Condition 4: B does not prefer Appy, Nescafe and Energee. Since Pepsi is preferred by C, the only option for B is Sprite. Since B prefers Sprite, D will prefer Nescafe (condition 2). Only beverages left are Appy and Energee. A does not prefer Energee (condition 1) and therefore prefers Appy. Therefore, by default E prefers Energee.

Final Representation

	(P)	(S)	(N)	(Ap)	(En)
A				✓	
B		✓			
C	✓				
D			✓		
E					✓

Now, all the questions can be answered.

A1. Eeshwar prefers Energee.

A2. Altaf drinks Appy.

A3. Dan drinks Nescafe.

Method II
This technique is more compact than the previous one and takes less working space. **It is advisable for the students to adapt themselves with this method.**

Solved Example (1)

Directions for questions 1 to 3: Refer to the data given below and answer the questions that follow.

4 people Ashraf, Bharat, Carlos and Dhiraj stay on 4 different floors of a building and each one of them prefers a particular brand of car from the following

- Omni, Toyota, Honda and Cielo
- Ashraf takes either the 4^{th} or 3^{rd} floor and prefers Toyota.
- Bharat stays just above the person who likes Cielo.
- Person who likes Honda stays on the 4^{th} floor.
- Dhiraj stays on a higher floor than Carlos.

Q1. Who stays on the first floor?

Q2. Who prefers Cielo?

Q3. Who stays between Carlos and Dhiraj?

Soln

Step I: Identify the number of people Ashraf (A), Bharat (B), Carlos (C), Dhiraj (D) and number of floor 1, 2, 3, 4 and cars of preferences - Omni (O), Toyota (T), Honda (H) and Cielo (Ci).

Step II: This particular problem can be solved by making an array as follows.

Name Floor Car

A

B

C

D

Step III: Following the conditions one by one.

Condition 1: A takes either the 3rd or the 4th floor and prefers Toyota.

Condition 2: B stays just above the person who likes Cielo. This means that B is not on the 1st floor and also that Cielo is not prefered by B.

Condition 3: The person who likes Honda stays on the 4th floor. This means that A stays on third floor. Therefore B cannot occupy 4th floor as he stays above the person who prefers Cielo. Therefore he does not prefer Honda. Therefore B prefers Omni and also stays on the second floor.

Final Representation:

Name	Floor	Car
A	3	Toyota
B	2	Omni
C	1	Cielo
D	4	Honda

Now all the questions can be answered.

A1. Carlos stays on the first floor.

A2. Cielo is prefered by Carlos.

A3. Ashraf and Bharat stay between Carlos and Dhiraj.

There are alternate methods of solving a matrix arrangement. For the same let us look at the illustration below:

Solved Example (2)

Directions for questions 1 to 5: Refer to the data given below and answer the questions that follow.

There are 6 male players who play 6 different sports - Cricket, Football, Hockey, Tennis, Badminton and Athletics. They are married to 2 Engineers, Doctor, CA, Professor and Housewife not necessarily in the same order. The couples stay in 6 different cities - Ahmedabad, Bangalore, Kolkata, Delhi, Ernakulam and Indore. Following information is given:

1. The Football player is married to an Engineer, but does not belong to either Kolkata or Delhi.
2. The Doctor and the Athlete do not stay in Indore and Ernakulam respectively.
3. The Hockey player is not married to either Doctor or CA, but his wife is not a housewife either.

4. One of the Engineer stays in Delhi.
5. The Hockey player, the Tennis player and the Cricketer stay in Kolkata, Indore and Bangalore respectively.
6. The lady who stays in Ernakulam is a Housewife.

Q1. Who is married to the Hockey player?

Q2. In which city does the Doctor stay?

Q3. Who is married to the Athlete?

Q4. In which city does the Badminton player stay?

Q5. In which city does the Football player stay?

Soln

The given problem can be classified as a three parameter problem in which 2 attributes are assigned to a given parameter. Here we are required to match correctly the male players with the female professionals living in different cities. Our objective should be very clear.
For e.g., here our objective can be represented as,
Male player $\rightarrow$ Profession of wife $\rightarrow$ City
Draw a Matrix as below:

Male players	Profession of Wife	Cities

The blocks in the matrix are filled with the respective parameters following the given conditions. Here also we fix a parameter taking it as a reference.
Using conditions (1), (2), (3) and (5) we get,

Male	Profession of Wife	Cities	
Football	Eng.		~Kolkata, ~Delhi
Cricket		Bang.	
Hockey		Kolkata	~Doc, ~CA, ~HW
Tennis		Ind.	~Doc
Bad.			
Athlete			~Ern

On the right hand side of the matrix, the negation symbol means that the particular object cannot be associated with the reference parameter.
Using conditions (4) and (6), the only possibility for placing Housewife + Ernakulam and Engineer + Delhi is with the Badminton player or the Athlete. But the Athlete does not live in Ernakulam.

Thus he should be associated with the Engineer who lives in Delhi while the Badminton player with the Housewife. Hence we get,

Male	Profession of Wife	Cities	
Football	Eng.		~Kolkata, ~Delhi
Cricket		Bang.	
Hockey		Kolkata	~Doc, ~CA, ~HW
Tennis		Ind.	~Doc
Bad.	HW	Ern.	
Athlete	Eng.	Delhi	~Ern

Now, the Hockey and Tennis players cannot be married to the Doctor. Thus, the only option left with Doctor is the Cricketer. Also, the Hockey player cannot be married to the CA. Hence, the Tennis player must be married to the CA and the Hockey player with the Professor. Hence, we get the final matrix as,

Male	Profession of Wife	Cities	
Football	Eng.	Ahm.	~Kolkata, ~Delhi
Cricket	Doctor	Bang.	
Hockey	Prof.	Kolkata	~Doc, ~CA, ~HW
Tennis	CA	Ind.	~Doc
Bad.	HW	Ern.	
Athlete	Eng.	Delhi	~Ern

Method III

Another way in which the matrix for the above illustration can be made is described as follows: For the question given, we take the 6 male players as the fixed parameter, in 6 columns. Then, we put the remaining parameters in two rows. The rows are further divided into 2 rows. We put a cross and tick in both the splitted rows (as shown).

		Footballer	Tennis	Badminton	Athlete	Hockey	Cricketer
Wives	×						
	✓						
Cities	×						
	✓						

The whole idea is to fit the given information into this matrix, so that we can find the unknown elements in the remaining cells. Whatever combinations are not possible, we put them in the crossed rows, and whatever combinations are possible are put in ticked row.

Statement 1: Footballer is married to an Engineer but does not belong to either Kolkata or Delhi.

Application for matrix formation – Engineer into ticked row corresponding to wives, and 'K' and 'D' in the crossed row of cities. As soon as we know an element in any cell in ticked rows, we totally cross the corresponding crossed cell.

Statement 2: Doctor does not stay in Indore, Athlete does not stay in Ernakulam.

Application – This information cannot be put into matrix at this stage, hence we will put it separately.

Statement 3: Hockey player is not married to any one of Doctor, CA or Housewife.
Application – We will put D, CA and HW in the crossed sub row under the wives row, in Hockey player's column.
Statement 4: One of the Engineers stay in Delhi.
Application – Again this information cannot be put directly in the matrix, but we know from the matrix, that this Engineer is not married to the Footballer because Footballer cannot stay in Delhi, hence this Engineer is married to someone else.
Statement 5: Hockey player, Tennis player and Cricketer stay in Kolkata, Indore and Bangalore respectively.
Application – We put K, I and B in the ticked sub row under the cities row of Hockey player, Tennis player and Cricketer column respectively.
Statement 6: Lady who stays in Ernakulam is a Housewife. Now as Athlete cannot stay in Ernakulam (St.2), he must stay in Delhi and thus is married to the Engineer. Badminton player must stay in the only remaining city i.e., Ernakulam and his wife is a housewife. The Football player stays in Ahmedabad.
Application – Hence we end up with the matrix, by looking at which we can easily answer all the questions.

		Footballer	Tennis	Badminton	Athlete	Hockey	Cricketer
Wives	×					D, CA, HW	
	✓	Eng		(HW)	(Eng)		
Cities	×	K and D					
	✓	(A)	I	(E)	(D)	K	B

Now we can answer the questions:

A1. Professor is married to the Hockey player.

A2. Doctor stays in Bangalore.

A3. Engineer from Delhi is married to the Athelete.

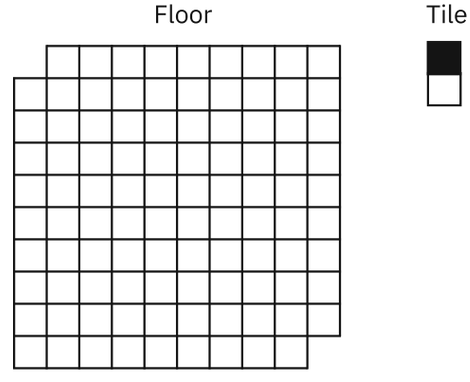
A4. The Badminton player stays in Ernakulam.

A5. The Football player stays in Ahmedabad.

CLASS EXERCISE

Teaser

Consider a square room of 10 ft x 10 ft, whose floor is to be tiled in a chess-board pattern with alternate black and white. In two opposite corners of the room, there are two pillars each of cross-section 1 ft x 1 ft. The resultant area which needs to be tiled appears as shown below. We have a supply of tiles from 'Domino' company, each of size 2 ft x 1 ft, half black and half white (as shown alongside the floor below). Is it possible to tile the floor using such tiles?



DIRECTIONS for questions 1 to 5: Refer to the data below and answer the questions that follow.

7 solo artistes – Joshi, Kalia, Lajwanti, Mohandas, Narad, Oorvashi and Parmesh – are scheduled to perform at a day-long classical music extravaganza. Out of them, three will perform in the pre-lunch session while the remaining four will perform in the post-lunch session. Joshi must perform immediately before Parmesh, in the same session. Lajwanti and Oorvashi insist on performing in different sessions. Kalia must perfom immediately after lunch.

1. If Mohandas is the first performer, which of the following could not be the last performer?
   1) Lajwanti 2) Narad 3) Oorvashi 4) Parmesh

2. If Lajwanti is the sixth performer, who among the following could be the third performer?
   1) Mohandas 2) Narad 3) Oorvashi 4) None of these

3. If Mohandas performs before Parmesh but after Oorvashi, then in which position could Narad be?
   1) Second 2) Fifth 3) Seventh 4) None of these

4. If Narad is the second performer, then which of the following best describes the sixth performance?
   1) Parmesh 2) Oorvashi 3) Lajwanti 4) Cannot be determined

5. If Lajwanti is the second performer, then in how many ways can the day's schedule be prepared?
   1) 2 2) 4 3) 6 4) 12

DIRECTIONS for questions 6 to 8: Refer to the data below and answer the questions that follow.

Six boys A, B, C, D, E and F, and six girls P, Q, R, S, T and U are going to see a play. There are 6 consecutive seats each in the first and second row of the audience. They have twelve tickets, 6 each in the first and second rows of the audience. It is also known that:
A does not wish to sit next to any of the girls.
Q and R are best friends and insist on sitting together.
S and C sit together in the first row. B and Q also sit together.
A and F sit in different rows and neither sits in a corner seat.
There are an equal numbers of boys and girls in each row.

6. If F sits in the second row, then which of the following must be true?
   1) B sits next to A 2) R sits next to A
   3) C sits next to A 4) S sits next to A

7. Which of the following can be true?
   1) B sits next to C
   2) A sits next to B
   3) R sits next to S
   4) Q sits next to D

8. If R, U and B sit directly behind C, S and F respectively, which of the following cannot be true?
   1) D sits in a first row corner
   2) P sits in a first row corner
   3) D sits in a second row corner
   4) P sits in a second row corner

DIRECTIONS for questions 9 to 11: Refer to the data below and answer the questions that follow.

Four married couples are sitting around a round table such that neither any couple nor two men are sitting together.
A is a male sitting opposite to G.
E is sitting between F and G.
To the immediate right of B is H.
C and H are of same sex and are not sitting opposite to each other.
Only two persons are sitting between C and B who are married to each other.

9. Who is married to D?
   1) A
   2) B
   3) F
   4) G

10. Which of following cannot be the married couple according to given conditions?
   1) G and H
   2) E and A
   3) G and E
   4) None of these

11. Who is married to the male sitting between H and C?
   1) C
   2) H
   3) D
   4) E

DIRECTIONS for questions 12 to 15: Refer to the data below and answer the questions that follow.

Mr. Joshi, Mr. Deshmukh, Mr. Patil, Mr. Kale, Mr. Pandey and Mr. Chaudhary are the managers from the Product, Sales, Marketing, Personnel, Logistics and Systems departments (not necessarily in the same order) in company ABC Ltd. They were chosen for giving a presentation on the progress of their respective departments. The presentations were scheduled from Monday to Friday. We also know the following:

- Mr. Joshi wants to be the first to make the presentation and Mr. Deshmukh wants to be the last to make the presentation.
- Except on Friday, there is only one presentation everyday.
- Mr. Patil, the Logistics manager does not have any preference for the day of presentation.
- The Product department presentation should be immediately followed by Marketing department presentation.
- Mr. Chaudhary a Personnel manager is having a presentation on Thursday.
- Mr. Pandey is neither the Product nor the Sales manager, but he presents his report on Friday.

12. Which of the following managers presented their report on Wednesday?
1) Mr. Patil 2) Mr. Pandey 3) Mr. Kale 4) Cannot be determined

13. Who is the Marketing Manager of company ABC Ltd.?
1) Mr. Kale 2) Mr. Pandey 3) Mr. Patil 4) Mr. Deshmukh

14. Which department manager is definitely the last one to present his report?
1) Marketing manager 2) Product manager
3) Sales manager 4) Logistics manager

15. Which department manager presented his report on Monday?
1) Logistics Manager 2) Sales Manager
3) Product Manager 4) Marketing Manager

DIRECTIONS for questions 16 to 19: Refer to the data below and answer the questions that follow.

Five people A, B, C, D and E live in houses of different colours (Green, Blue, Yellow, Pink and White) and follow different professions (Teacher, Chemist, Lawyer, Banker and Artist). Furthermore it is known that:

- The chemist lives in the green house
- A, who is not the teacher, lives in a blue house
- B recently painted his house white
- D is not the lawyer
- E lives in the pink house

16. If C is the lawyer, then D could be described by
1) Teacher 2) Chemist 3) Yellow house
4) Banker 5) None of the above

17. If C is the lawyer, then the teacher must be
1) A 2) B 3) E
4) either (1) or (2) 5) either (2) or (3)

18. If E is the artist and B is the banker, then the teacher must stay in a
1) Yellow house 2) Green house 3) Blue house
4) Blue or Yellow house 5) Any of the above

19. If C is the lawyer and E is the artist, then the banker
1) must be B 2) must be A 3) must be D
4) must be A or B 5) has a white house

Challengers

DIRECTIONS for questions 1 to 4: Refer to the data below and answer the questions that follow.

The panel at Perfect Institution of Managers plans to interview 8 candidates – A, B, C, D, E, F, G and H – which include four engineers, two commerce graduates, one arts graduate and a doctor. Each candidate has scored a different percentile in the P.A.T. and will be called at 40 minute intervals starting from 1:40 pm. It is also known that:

- Neither the first nor the last interviewee is an engineer
- The doctor, C, cannot come before 5 pm
- The engineer with a 98.35 comes at 3 pm
- B comes at 3:40 and has a 98.87
- F is an engineer who has scored 99.43
- H is an arts graduate with a score of 99.97
- A is a commerce graduate who comes at 5 pm

1. If D is a commerce graduate who comes at 5:40 pm, which of the following need not be true?

   1) C comes at 6:20 pm
   2) F comes at 4:20 pm
   3) H comes at 1:40 pm
   4) G comes before A does

2. If G, a commerce grad with 99.87, comes at 2.20 pm, then which of the following must be true?

   1) C comes at 5:40 pm
   2) H comes at 4:20 pm
   3) B is an engineer
   4) F comes at 5:40 pm

3. If G is an engineer who is immediately followed by E, then which of the following must be true?

   1) F comes at 4:20 pm
   2) There are at least three people who have scored above E in the PAT
   3) C is the last person to be interviewed
   4) His the first person to be interviewed

4. If E comes at 4:20 and G at 5:40, then which of the following need not be true?

   1) D scored a 98.35
   2) B is an engineer
   3) C comes more than 4 hours after H
   4) F comes at 2:20 pm

PRACTICE EXERCISE-1

DIRECTIONS for questions 1 to 4: Refer to the data below and answer the questions that follow.

Six participants Barrack, Vladimir, Hillary, Donald, David and Benjamin have participated in racing. No two of them completed race at the same time. Barrack and Vladimir have completed the race before Benjamin. David was last one to complete the race. Hillary completed race before Donald and Donald completed race just before Barrack.

1. Who completed the race just before David?
   1) Benjamin 2) Barrack 3) Vladimir 4) Cannot be determined

2. If Donald stood third, then how many possibilities still exist in order to determine the sequence in which the participants completed the race?
   1) 3 2) 2 3) 1 4) None of these

3. How many participants can complete the race before Donald?
   1) 1 2) 2 3) 1 or 2 4) More than 2

4. Who stood first in the race?
   1) Hillary 2) Donald 3) Barrack 4) Cannot be determined

DIRECTIONS for questions 5 to 8: Refer to the data and answer the following questions.

Five books containing 300 pages, 400 pages, 500 pages, 600 pages and 700 pages are stacked one above the other. The books have violet, indigo, green, yellow and red covers (not necessarily in that order) and they belong to Ashish, Bhushan, Chandrakant, Dattu and Eknath (not necessarily in that order)

The following points are known:

1] The bottom-most book contains 400 pages.

2] There is at least one book on top of and underneath Bhushan's book.

3] Dattu's book contains 500 pages.

4] The violet-covered book has 300 pages.

5] Chandrakant's book has indigo-coloured cover and contains 600 pages.

6] Eknath's book does not have a red cover and only one person has a book with fewer pages than Eknath's book.

7] The topmost book has green cover and the maximum number of pages.

5. Who has the book with the yellow cover?
   1) Dattu 2) Ashish 3) Bhushan 4) Eknath

6. Who has the book containing 700 pages?
   1) Dattu 2) Ashish 3) Bhushan 4) Eknath

7. What is the colour of the cover of Bhushan's book?
   1) Indigo 2) Yellow 3) Violet 4) Red

8. If both the indigo- and violet-covered books had at least two books underneath them, then which of the following must be true?
   1) Bhushan's book is second from the top.
   2) The red-covered book is fourth from the top.
   3) The book with 600 pages is the middle one.
   4) Dattu's book is second from the top.

DIRECTIONS for questions 9 to 11: Refer to the data and answer the following questions.

6 horses, A, B, C, D, E and F, took part in a race. Each of them wore trappings of a different colour. The following information is known:

- B was in blue and came second to a horse in grey.
- A was in gold while C was in purple. The horse in fourth place wore white.
- 3 horses finished between F and D.
- The horse wearing yellow finished just ahead of C and just behind E.

9. Which of the following could be a possible finishing order?
   1) DBAFEC 2) FBCDEA 3) DBCEFA 4) FBAEDC

10. If D was in yellow, who won the race?
    1) A 2) F 3) D 4) C

11. Which three horses finished between F and D?
    1) A, C, E 2) A, B, C 3) A, B, E 4) B, C, E

DIRECTIONS for questions 12 to 15: Refer to the data and answer the following questions.

Five friends, named Ajay, Bhushan, Chandru, Dinesh and Eknath, each belonging to a different profession, play Cricket, Tennis, Hockey, Polo and Squash, not necessarily in the same order. We know that:

1. Ajay plays Tennis and he is not a Professor.
2. Dinesh is not a Doctor.
3. The Writer plays Squash and the Doctor plays Cricket
4. Bhushan does not play Squash.
5. Eknath is the Manager and does not play Polo.
6. The 5th person is an Architect.

12. If Dinesh plays Polo, who plays Cricket?
    1) Bhushan 2) Chandru 3) Ajay 4) Eknath

13. What is the profession of the person who plays Polo?
    1) Architect 2) Professor 3) Doctor 4) Cannot be determined

14. Who of the following is the Architect?
    1) Ajay 2) Bhushan 3) Chandru 4) Eknath

15. Which game is played by the Manager?
    1) Squash 2) Tennis 3) Hockey 4) Cannot be determined

PRACTICE EXERCISE-2

DIRECTIONS for questions 1 and 2: Refer to the data and answer the following questions.

A round-table conference on global warming is being conducted at the UN headquarters. In all, six delegates named A, B, C, D, E and F participate in the conference. They are from America, Australia, Britain, France, Germany and Spain (not necessarily in that order). All the delegates are sitting facing inwards on chairs such that the distance between any two adjacent chairs is equal.

The following points are known:

1] Three of the six delegates are men and the remaining are women. No male delegate is sitting next to another male delegate. Similarly, no female delegate is sitting next to another female delegate.

2] The delegate from Australia is sitting two places to the left of the delegate from Britain, who in turn is sitting two places to the left of the delegate from Germany.

3] D is sitting two places to the left of B, who in turn is sitting two places to the left of A.

4] C is sitting three places to the left of the delegate from Spain.

5] The delegate from France and F are facing each other.

6] A is sitting two places to the right of the delegate from Spain and two places to the left of the delegate from America.

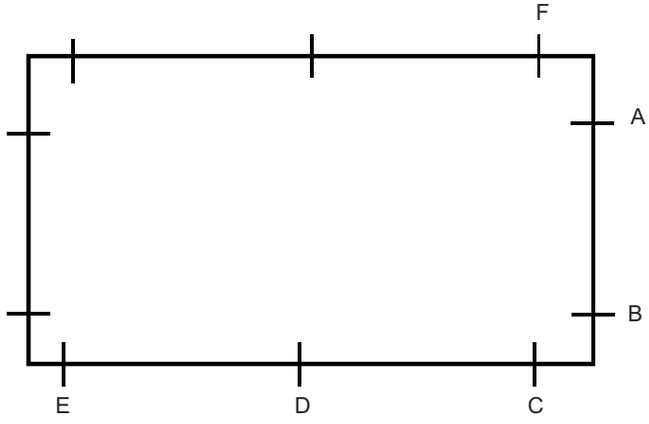
7] The delegate from Britain is a woman.

1. The nationalities of how many of the six delegates can be uniquely determined?

2. The genders of how many of the six delegates can be uniquely determined?

DIRECTIONS for questions 3 to 6: Refer to the data and answer the following questions.

Four Indians - Hritik, Ranveer, Kareena and Alia, three Americans - Alfred, Heather and Janet, two British - Boris and Margaret and one Chinese - Yuang, are seated along a rectangular table (all facing inwards). The table has a total of 10 seats with three seats along each of the longer sides and two seats along each of the shorter sides, as shown below:



Persons can be seated next to each other along the same side of the table or along the adjacent sides. For example, A and B are seated next to each other along the same side of the table. So are C and D and D and E. On the other hand, A and F are seated next to each other along the adjacent sides of the table. So are B and C. Similarly C, D and E are said to be seated along the same side of the table.

The following points are known:

1] Kareena, Alia, Heather, Janet and Margaret are women while all others are men.
2] No two persons of the same nationality are seated next to each other either along the same side of the table or along the adjacent sides.
3] No two men or no two women are seated next to each other, either along the same side of the table or along the adjacent sides.
4] No two Indians are seated facing each other.
5] No Indian is seated facing a British.
6] Yuang is seated along the smaller side of the table with only two seats.

3. Who among the following cannot be seated facing Alia?

1) Janet 2) Alfred 3) Yuang 4) Heather

4. Who is seated farthest to Yuang?

1) Janet 2) Heather 3) Kareena 4) Cannot be determined

5. Who is seated facing Boris?
   1) Margaret
   2) Either Heather or Janet
   3) Either Kareena or Alia
   4) Yuang

6. If Ranveer is seated facing Janet, who among the following is seated facing Hritik?
   1) Heather 2) Yuang 3) Margaret 4) Boris

DIRECTIONS for questions 7 to 10: Refer to the data and answer the following questions.

BATA Crucible is a prestigious quiz contest organized for B-school students from India. Six students from National Institute of Management-Lucknow participated in the contest. They were Mandar, Bhanu, Chandrashekhar, Amarendra, Tushar and Jayant. They were from six different states of India, namely Rajasthan, Gujarat, Orissa, Assam, Kerala and Maharashtra in no particular order. They specialized in six different fields, namely Finance, Marketing, Operations, Human Resources, Systems and General Management in no particular order. Three of them are less than 25 years old and the rest are more than 25 years old. Each of them got a unique rank (between 1st and 6th – both inclusive) in the contest.

The following information is available.
1] The student from Rajasthan specialized in Marketing and is the oldest of all.
2] Jayant, who is not from Gujarat, specialized in Systems and finished fourth.
3] The student who specialized in Finance is more than 25 years old and is from Orissa.
4] Bhanu was ranked higher than at least 3 students.
5] Tushar, who is the youngest student, specialized in Operations.
6] The student who specialized in General Management was ranked second, while the student from Assam was ranked first.
7] The rank of Mandar in the contest was immediately after the rank of Amarendra.
8] Chandrashekhar is from Maharashtra.
9] Incidentally, all the students were ranked in the contest in the ascending order of their ages.

7. To which state does Jayant belong?
   1) Kerala 2) Orissa 3) Rajasthan 4) Assam

8. In which field did Amarendra specialize?
   1) Human Resources
   2) General Management
   3) Finance
   4) Marketing

9. Which of the following statements is definitely false?
   1) The second oldest student is from Orissa
   2) Bhanu specialized in Human Resources
   3) Amarendra is less than 25 years old
   4) Chandrashekhar specialized in General Management

10. If Bhanu was ranked third in the contest, which field did he specialize in?
    1) Marketing
    2) General Management
    3) Operations
    4) Human Resources

DIRECTIONS for questions 11 to 14: Refer to the data and answer the following questions.

The year is 2030. Four friends from IMS Catapult coaching for CAT-2016 had graduated from the four best B-schools in India, named NIM-Ahmedabad, NIM- Bangalore, NIM-Calcutta and NIM-Lucknow in 2019. All of them were meeting together for the first time with their families. All of them have one daughter each. The daughters of two of them are named Gayatri.

Additionally, the following points are known:

1] Neha's father is an alumnus of NIM-Ahmedabad.
2] Prakash is a successful businessman.
3] Rajesh is not an alumnus of NIM-Lucknow and his daughter's name is not Shweta.
4] Sameer is an alumnus of NIM-Calcutta and is not a Banker.
5] The father of one girl named Gayatri is a consultant.
6] Shweta's father is not a Marketing Professional and is not an alumnus of NIM-Lucknow.
7] Tushar is not an alumnus of NIM-Bangalore and is not a Banker.

11. Who are the fathers of the two girls named Gayatri?
    1) Rajesh and Sameer
    2) Sameer and Tushar
    3) Prakash and Tushar
    4) Cannot be determined

12. What is the name of the daughter of the alumnus of NIM-Bangalore?
    1) Neha
    2) Shweta
    3) Gayatri
    4) Cannot be determined

13. Rajesh's daughter is _____.
    1) Gayatri
    2) Shweta
    3) Neha
    4) Cannot be determined

14. Which of the following combinations is definitely correct?
    1) Rajesh – Neha – Marketing Professional
    2) Sameer – Shweta – Consultant
    3) Tushar – Shweta – NIM Bangalore
    4) None of the above

LR-1.2 | CONDITIONALITIES & GROUPING THEORY

Introduction

In the formation of groups, or for an event to occur or for a particular arrangement, certain conditions are imposed. These conditions have to be taken into account during the formation of the groups or for the particular event to occur. Translated into Mathematics, we need to understand the conditional statements in Logic. In conditionality, on the basis of the occurrence of an event, the occurrence of another event depends. This chapter introduces you to such logical conditional statements and shows how they are applied to segregate objects into groups.

Types of Conditional Statements

Conditional statements can be classified into four groups:

a) If A occurs then B will also occur.
$A \rightarrow B$
The reverse implication of this statement is, that, if B has not occurred A will also not occur.
The not statement is denoted by the symbol '~', i.e., not B is denoted as ~B.
$\sim B \rightarrow \sim A$
It is not necessary that $B \rightarrow A$.

b) If A occurs then B will not occur.
$A \rightarrow \sim B$
The reverse implication is
$B \rightarrow \sim A$
It is not necessary that $\sim B \rightarrow A$

c) If A has not occurred then B will occur.
$\sim A \rightarrow B$
The reverse implication is
$\sim B \rightarrow A$
It is not necessary that $B \rightarrow \sim A$

d) If A has not occurred then B will also not occur.
$\sim A \rightarrow \sim B$
The reverse implication is
$B \rightarrow A$
It is not necessary that $\sim B \rightarrow \sim A$.

Few more examples of conditional statements are as given below:

a] Symptoms of disease A are fever and headache but not rash or sore throat.
b] E occurs only if C occurs. A causes B or C, but not both.
c] There are 3 strains of bacteria which can be positive or negative. Antibiotic G is the only drug that kills bacteria of class negative, but it does not kill bacteria of class positive.

Notations

The various notations used in conditionalities and group formations are:

1.	A belongs to B	$A \in B$ or $A \subset B$
2.	A does not belong to B	$A \notin B$ or $A \not\subset B$
3.	If A belongs to Group I then B belongs to Group II	$A \in I \Rightarrow B \in I$
4.	A and B do not belong to the same group.	AB^x
5.	A and B belong to the same group.	AB

Grouping

Directions for questions 1 to 5: Refer to the data below and answer the questions that follow.

From a group of six boys A, B, C, D, E and F and five girls L, M, N, O and P, a volleyball team of six members is chosen under the following conditions:

i. O and P have to be together.
ii. C cannot go with O.
iii. A and D have to be together.
iv. D cannot go with L.
v. C and M have to be together.
vi. B and N have to be together.
vii. B and E cannot be teamed together.

Q1. If the team consists of four girls, then the members of the team are:

1) BELNOP 2) EFLNOP 3) BFLNOP 4) BCLNOP

Q2. If the team consists of five boys and there is only one girl, then the girl would be:

1) L 2) M 3) N 4) O

Q3. If the team consists of four boys including E, then the other members of the team are:

1) ADFOP 2) ABDOP 3) ACDLM 4) ABDNM

Q4. If the team consists of three girls including L, then the other members of the team possibly are:

1) ABDNO 2) BCFNO 3) ADEOP 4) BCFMN

Q5. If the team including C consists of four boys, then the other members of the team are:

1) ADEOP 2) ABDMN 3) ABDLM 4) ABDLN

Soln: **Step I:** Identify the elements & groups
Boys: A, B, C, D, E & F
Girls: L, M, N, O & P
Step II: Follow the conditions.
i) OP
ii) CO^x
iii) AD
iv) DL^x
v) CM
vi) BN
vii) BE^x

A1. Option [1] i.e., BELNOP is not possible as it violates condition (vii) i.e., BE^x. Option [2] i.e., EFLNOP is not possible as it violates condition (vi) i.e., BN. In this case only N is present in the group. Option [4] i.e., BCLNOP is not possible as it violates condition (v) i.e., CM. Option [3] satisfies all the conditions. Looking at option [3], firstly O and P have to be together. Therefore, C won't be there, according to (ii) and hence M won't be there according to (v). So, the four girls would be L, N, O and P. Hence, D and A won't be there according to (iv) and (iii). Hence, one of either B and E will be there according to (vii). Since B and N have to be together, the members of the team would be BFLNOP. Hence, [3].

> **Note:** In conditionalities if we can logically eliminate 3 out of the 4 options, we need not logically deduct the right answer option. The logical working is shown for conceptual understanding.

A2. Amongst the boys, BE^x i.e., [condition (ii)]. So, if the team consists of 5 boys & 1 girl, 2 possible combinations of 5 boys are ABCDF and ACDEF. If we choose ABCDF then it is not possible to fulfill both conditions (v) and (vi) i.e., CM and BN, as then 2 girls will have to be selected. Now, if we select ACDEF from the boys, we cannot select L from option [1] as it would violate condition (iv) i.e., DL^x. According to condition (v) M can be that girl. Looking at option [3] N cannot be the girl as it would violate condition (vi) i.e., BN. Also O cannot be the girl as it would violate condition (ii) i.e., CO^x. Hence, [2].

A3. Condition (vii) BEx: So this eliminates option [2] and [4].
Condition (iv) DLx: This eliminates option [3].
The girls in the team consists of O & P. Also, C will not be a part of the team. The team will be adfop, as it satisfies all the conditions. Hence, [1].

A4. According to condition (i) OP. So we can eliminate options [1] & [2]. Also according to condition (iv) DLx: This eliminates option [3]. The 4th option bcfmn satisfies all the conditions. Hence, [4].

A5. According to condition (ii) COx. This eliminates option [1]. According to condition (iv) DLx. This eliminates option [3] and [4]. Option [2] i.e., abdmn satisfies all the conditions. Hence, [2].

Conditionalities

Directions for questions 1 to 5: Refer to the data below and answer the questions that follow.

There are five events A, B, C, D and E that can happen. The occurrence of every event is governed by a few rules, which are:
- If A occurs then either of B or C or both must occur.
- If B occurs then D cannot occur.
- If C occurs then E must occur.
- If D occurs then C must occur.
- If E occurs then A must occur and B cannot occur.
- If D has not occured then A will also not occur.

Q1. If C has occured, then which event definitely occurs?

1) A 2) B 3) D 4) A and D

Q2. If E has not occured, then which of the following statements must be true?

I. C has not occured. II. B has occured.
III. D has not occured. IV. A has not occured.

1) I and II 2) III and IV 3) I, III and IV 4) I and IV

Q3. If B has occured, then which of the following statements will definitely be false?

1) D has not occured 2) C has not occured
3) E has not occured 4) A must occur

Q4. If A has occured, then which event(s) will definitely occur?

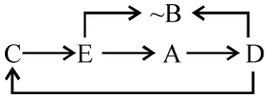
1) B 2) C and D 3) B and E 4) C, D and E

Q5. If D occurs, then any of the events can occur except:

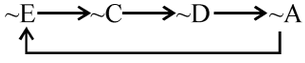
1) A 2) B 3) A and E 4) Cannot say

Soln: **Step I:** Identify the elements A, B, C, D and E
Step II: Follow the conditions
Let us symbolise the given conditions and interpret their reverse implications.
$A \rightarrow B$ or C or both
If both B and C have not occured then A will not occur but it is not true for the condition that any of B or C has not occured.
$B \rightarrow \sim D \Rightarrow D \rightarrow \sim B$
$C \rightarrow E \Rightarrow \sim E \rightarrow \sim C$
$D \rightarrow C \Rightarrow \sim C \rightarrow \sim D$
$E \rightarrow A \Rightarrow \sim A \rightarrow \sim E$
$E \rightarrow \sim B \Rightarrow B \rightarrow \sim E$

A1.



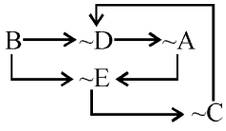
If C has occured, then A and D must also have occured. Hence, [4].

A2. 

I. True. II. We cannot say. III. True. IV. True.

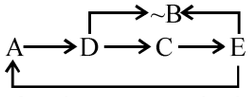
If E does not occur, then C, D & A all do not occur. Statement I, III and IV are true. Hence, [3].

A3.



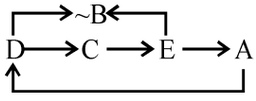
If B has occured, then E, D, A & C all have not occured. So, option 4 i.e., A must have occured is false. Hence, [4].

A4.



If A has occured, then C, D & E must have also occured. Hence, [4].

A5.



If D occurs then C, E & A also occur. Only B will not occur. Hence, [2].

Grouping Using Conditional statements

Directions for questions 1 to 5: Refer to the data below and answer the questions that follow.

2 collectors, Ajay and Puneet, are each selecting a group of three wildlife prints from 7 prints T, U, V, W, X, Y and Z. No print can be in both groups. The selections made by Ajay and Puneet are subject to the following restrictions.

1. If U is in Ajay's group, W must be in Puneet's group.
2. If X is in Ajay's group, Z must be in Puneet's group.
3. T and Z cannot be in the same group.
4. W and Y cannot be in the same group.

Q1. If X is in Ajay's group, any one of the following could be in Puneet's group except:

1) T 2) U 3) V 4) W

Q2. Which of the following pairs of groups selected by Ajay and Puneet confirm to the restriction?

	AJAY	PUNEET
1)	T, U, V	W, X, Y
2)	T, U, Z	V, W, X
3)	U, X, Z	T, W, Y
4)	V, W, X	U, Y, Z

Q3. If U is in Ajay's group, then which of the following is true?

1) T must be in Ajay's group.
2) Y must be in Ajay's group.
3) V must be in Puneet's group.
4) Y cannot be in Puneet's group.

Q4. If U and X are in Ajay's group, Puneet's group must consist of:

1) T, W and Y
2) T, Y and Z
3) V, W and Z
4) V, Y and Z

Q5. If T is in Puneet's group, which of the following is true?

1) U cannot be in Ajay's group.
2) X cannot be in Ajay's group.
3) Y cannot be in Puneet's group.
4) Z must be in Puneet's group.

Soln

Step 1
Identify the elements. Seven prints - T, U, V, W, X, Y and Z.

Step 2
Identify the groups. Ajay (A) and Puneet (P).

Conditions:
1. If U is in Ajay's group, W must be in Puneet's group. i.e., $U \subset A \rightarrow W \subset P$.
2. If X is in Ajay's group, Z must be in Puneet's group. i.e., $X \subset A \rightarrow Z \subset P$.
3. T and Z cannot be in the same group i.e., TZ^x.
4. W and Y cannot be in the same group i.e., WY^x.

A1. From condition (2), $X \subset A \rightarrow Z \subset P$, Z must be in Puneet's group. Since TZ^x from (3), T cannot be in Puneet's group. Hence, [1].

A2. Choices [1] and [3] are ruled out since condition (4) is violated. Choice [2] is ruled out since condition (3) is violated. Hence, [4].

A3. Since $U \subset A \rightarrow W \subset P$ and since WY^x, Y is not in Puneet's group, but at the same time it is not necessary that Y should be in Ajay's group. Hence, [4].

A4. $U \subset A \rightarrow W \subset P$ and $Y \not\subset P$
$X \subset A \rightarrow Z \subset P$ and $T \not\subset P$
Choice [3] satisfy these two conditions. Hence, [3].

A5. If T is in Puneet's group, then Z cannot be in Puneet's group - TZ^x . This means that X cannot be in Ajay's group because $X \subset A \rightarrow Z \subset P$. Hence, [2].

CLASS EXERCISE

Teaser

Some miscreant has stolen a cookie from Zeenat's cookie jar. She realises that there are only five people who could possibly have done it, and catches them. Under strict questioning, each of them makes two statements, as follows:

Anand: It wasn't Eeshaan
It was Bittu

Bittu: It wasn't Chandni
It wasn't Eeshaan

Chandni: It was Eeshaan
It wasn't Anand

Divya: It was Chandni
It was Bittu

Eeshaan: It was Divya
It wasn't Anand

It was known that each person told exactly one lie. Who stole the cookie from the cookie jar?

DIRECTIONS for questions 1 to 4: Refer to the data below and answer the questions that follow.

In a five-member team to go to a science fair, three scientists and two students are to be selected. A, B, C, D and E are scientists and P, Q, R and S are students.

i. A will not go if C goes.
ii. P will go only if Q goes.
iii. Q will not go if R goes.
iv. B will go only if E goes.
v. D will not go if S goes.
vi. E will not go with P.
vii. B will not go with R.

1. What is the largest number of students and scientists combination possible?
   1) 1 2) 2 3) 3 4) 4

2. If B is selected, then which other scientists may be selected?
   (i). A, E (ii). D, E (iii). C, E
   1) (i) only 2) (i) and (iii) 3) (i) or (ii) 4) (ii) only

3. If Q is selected, then which other students must be selected?
   1) P 2) R 3) S 4) R or S

4. Who of the following is not necessarily selected?
   1) Q 2) A 3) E 4) S

DIRECTIONS for questions 5 to 8: Refer to the data and answer the following questions.

A combination of three students is being selected for a quiz competition. The students must be chosen from a group of seven students – Farid, Gaurav, Harish, Jayant, Kiran, Laxman and Mahesh – according to the following conditions:

1. If anyone of Farid or Gaurav is chosen, then the other must also be chosen.
2. Harish and Jayant cannot be chosen together.
3. Both or any one of either Harish or Farid must be chosen.

5. Which of the following combination of students conforms to the given conditions?
   1) Harish, Kiran, Mahesh 2) Farid, Kiran, Laxman
   3) Gaurav, Harish, Mahesh 4) Harish, Jayant, Laxman

6. If Jayant is chosen, then which of the following pairs of students must also be chosen?
   1) Farid and Gaurav 2) Farid and Mahesh
   3) Gaurav and Kiran 4) Laxman and Kiran

7. If Kiran is chosen, then which of the following pairs of students could also be chosen?
   1) Farid and Harish
   2) Farid and Laxman
   3) Gaurav and Harish
   4) Harish and Laxman

8. If Harish and Mahesh are chosen, then how many of the remaining students could possibly be chosen as the third student?
   1) 1 2) 2 3) 3 4) 4

DIRECTIONS for questions 9 to 13: Refer to the data below and answer the questions that follow.

Seven programmers (T, U, V, W, X, Y and Z) must be assigned to two projects, 4 to project 1 and 3 to project 2, subject to the following conditions:

- U and V must be in different projects
- If Z is assigned to project 2, W also must be assigned to project 2
- If T is assigned to project 2, U must be assigned to project 1
- Y has to be assigned to project 1

9. Which of the following could be an acceptable team assigned to project 1?
   1) T, X, Y, Z 2) T, V, W, Y 3) T, V, Y, Z 4) V, W, Y, Z

10. If W and X are assigned to the same project, then which of the following must be true?
   1) V is in Project 2
   2) Z is in Project 2
   3) T is in Project 1
   4) X is in Project 1

11. If U and X are assigned to the project 1, then which of the following pairs must be together?
   1) Z and W 2) Z and T 3) V and W 4) T and U

12. If V is assigned to project 1, which of the following must be a correct assignation?
   1) T – 1, W - 2
   2) Z – 1, X - 2
   3) U – 1, W – 2
   4) X – 1, T – 2

13. If Z is assigned to project 2, then which of the following must be true?
   1) V is in Project 2
   2) U is in Project 2
   3) U is in Project 1
   4) X is in Project 1

DIRECTIONS for questions 14 to 18: Refer to the data below and answer the questions that follow.

Company XYZ has a eight member HR team consisting of Shivani, Stella, Rhea, Karan, Rahul, Ravi, Rina and Amit. At the start of a two month campus recruitment drive, Company XYZ divides its eight member HR team into two groups: Group A and Group B each consisting of four members. After conducting campus recruitment drives at different colleges and cities for one month, the groups will meet and the team will again divide into: Group A and Group B of four members each, which will again conduct campus recruitment drives at different colleges and cities for a month. The groups must be formed with the following restrictions:

- For the first month, Rina cannot be in the same group as Amit.
- For the second month, both Rina and Amit must be in the Group A.
- For each of the two months, if Shivani is in the Group B, Karan must also be in the Group B.
- For each of the two months, Rhea must be in the same group as Rahul.

14. Which of the following could be the members of the Group A for the first month?
    1) Shivani, Stella, Karan and Amit
    2) Shivani, Karan, Rahul and Ravi
    3) Stella, Rhea, Ravi and Rina
    4) Stella, Karan, Rina and Amit

15. If Rahul is in the Group A for the second month, which of the following must be the members of the Group B for that month?
    1) Shivani, Stella, Rhea and Ravi
    2) Shivani, Stella, Karan and Ravi
    3) Stella, Rhea, Karan and Ravi
    4) Stella, Rhea, Ravi and Amit

16. If, for each month, Ravi is in a different group from Rina, Ravi must be in a group with which of the following for exactly one month?
    1) Shivani
    2) Stella
    3) Karan
    4) Amit

17. If Rhea is in the Group B for the first month, which of the following must be in the Group A for that month?
    1) Shivani
    2) Stella
    3) Karan
    4) Amit

18. If exactly two person change groups at the end of the first month, those two persons could be which of the following?
    1) Stella and Karan
    2) Stella and Ravi
    3) Rina and Amit
    4) Karan and Amit

DIRECTIONS for questions 19 to 21: Refer to the data below and answer the questions that follow.

10 members of a family are going on a picnic. Albert, Claire, Effie, Francis, Irwin and Josh are adults while Beth, Darren, George and Hammie are children. They have two vehicles, a jeep which can hold 6 people and a car which can hold 4 people.
There have to be at least 2 adults in each vehicle, at least one of whom has a driving license.
Darren must be with Albert.
Hammie wants to be with at least one out of Francis or Claire
Albert, Effie and Josh have driving licenses.

19. If Darren and Effie are in the jeep, while Claire and Francis are in the car, then in how many ways can the ten people be split among the two vehicles?

    1) No arrangement possible
    2) 1 way
    3) 2 ways
    4) More than 2 ways

20. If Darren and Beth are the only children in the jeep, then which of the following pairs could be together?

    1) Hammie and Albert
    2) Francis and Claire
    3) George and Irwin
    4) Irwin and Francis

21. If Claire, Francis and George are travelling together, in how many ways can the ten people be split among the two vehicles?

    1) 5
    2) 6
    3) 7
    4) 8

Challengers

DIRECTIONS for questions 1 to 5: Refer to the data below and answer the questions that follow.

Ten students A, B, C, D, E, F, G, H, I, J went for a camp. Three groups Satyam, Shivam and Sundaram were formed out of these students such that there were at least three students in a group. B, F, H and I are girls. A, C, E, F, J and H can cook and B, C, D, G, H and I can put up a tent. Each group contained at least one girl, two students who could cook and two students who could put up a tent. F is the only girl in Satyam group. A and E were in the Sundaram group.

1. Which group has four students in it?
   1) Satyam
   2) Sundaram
   3) Shivam
   4) Cannot be determined

2. Which one of the following students is definitely in the Shivam group?
   1) C
   2) D
   3) J
   4) G

3. If J and B were not in the same group, then which of the following students is definitely in the Sundaram group?
   1) G
   2) J
   3) I
   4) None of these

4. If there are two girls in the Sundaram group, then which of the following students can be in the Shivam group?
   1) C, G, D
   2) H, J, G
   3) H, G, C
   4) C, B, I

5. Which of the following two students were definitely not in the same group?
   1) B and D
   2) H and G
   3) F and D
   4) C and I

PRACTICE EXERCISE

DIRECTIONS for questions 1 to 4: Refer to the data and answer the questions that follow.

In Imperial College of Engineering, Delhi, a committee of 6 professors is to be formed to design the syllabus of Non-Engineering subjects. The requirement is that exactly two professors each from Physics, Chemistry and Mathematics departments must be the members of the committee. Following is the list of professors who are eligible to be selected to the committee:

Department	Professor
Physics	A, B, C, D
Chemistry	L, M, N, O
Mathematics	P, Q, R, S

The committee is to be formed subject to the following conditions:

1) If A is selected, S must be selected and vice-versa.
2) Both C and P must not be selected simultaneously
3) Exactly two of B, N and R must be selected.
4) If D is selected, Q must be selected.
5] If A is not selected, O must be selected.

1. If both B and C are selected, in how many different ways can the other members of the committee be selected?

2. If both N and O are selected, in how many different ways can the other members of the committee be selected?

3. If both P and R are selected, in how many different ways can the other members of the committee be selected?

4. If both A and L are selected, in how many different ways can the other members of the committee be selected?

DIRECTIONS for questions 5 to 8: Refer to the data and answer the following questions.

A delegation of six people comprising of 4 men and 2 women is to be selected subject to the following conditions.

1) Anna and Paul are always together.
2) Shawn does not go if both Roger and Heather are in the delegation.
3) John and Terry are never part of the delegation at the same time.
4) If Roger and John both are in the delegation then Cheryl is not in the delegation.
5) If both Anna and Albert are part of the delegation, John has to be with them.
6) If Dana is in the delegation then Brenda is not in it.

Also, it is known that Anna, Brenda, Cheryl, Dana and Heather are women whereas Paul, John, Roger, Shawn, Terry and Albert are men.

5. Which of the following group of delegates is possible?

1) Anna, Shawn, Roger, John, Heather, Paul
2) Anna, John, Albert, Cheryl, Terry, Paul
3) Paul, John, Albert, Cheryl, Roger, Anna
4) Shawn, Heather, Anna, Paul, John, Albert

6. If the delegation is selected irrespective of the gender of the person, then which of the following is/are the possible group/s?

I. Anna, Paul, Brenda, Cheryl, Heather, Terry
II. Albert, Paul, Roger, John, Anna, Heather
III.Shawn, Heather, Dana, Cheryl, Terry, Albert

1) II and III 2) I and III 3) I and II 4) All of the above

7. How many groups including Paul are possible that include Roger and Cheryl but does not include Terry?

1) 0 2) 1 3) 2 4) 3

8. How many groups including both Anna and Albert are possible that do not include Shawn?

1) 2 2) 3 3) 4 4) 5

DIRECTIONS for questions 9 to 12: Refer to the data and answer the following questions.

Three women – Janet, Mary and Kathy, and four men – Chris, John, Bill and Steve, are eligible to serve on a 3-member committee. No other people are eligible.

– Mary and John are the only people in the group who are related to each other.
– People who are related to each other cannot serve together.
– Steve cannot serve with any of the women.

9. If Mary has been selected, among how many people must the other two members be selected?

   1) 2 2) 3 3) 4 4) 5

10. If Janet and Kathy have been selected, which of the following is a comprehensive and accurate list of those people who could possibly be selected as the third member?

   1) Mary, John, Chris, Bill, Steve
   2) Mary, Chris, Bill
   3) Chris, John, Bill
   4) Mary, John, Chris, Bill

11. If both Chris and Bill refuse to serve, in how many ways can the committee of three be selected?

   1) 1 2) 2 3) 3 4) 4

12. If there is an additional condition that the committee members cannot all be of the same gender, and if John has been selected, what is the total number of people from which the other two members must be selected?

   1) 4 2) 3 3) 2 4) 5

DIRECTIONS for questions 13 to 16: Refer to the data and answer the following questions.

Mr. Vishal Sharma and his wife Vineeta Sharma have settled in Atlanta, USA. Varun, Vikram and Vijay are their three sons. The Sharmas have their neighbours, Mr. Bill Hamilton and Mrs. Peggy Hamilton as their family friends. Mrs. and Mr. Hamilton have two daughters named Chelsea and Barbara. On a long weekend, all the members of the Sharma and Hamilton families visited Smoky Hills.

They rented three compact cars, with three persons in each car. Since all the children are minors, they do not have a licence to drive and as a result, each car must be driven by one of the four parents. At least one person from each family must be in each car.

13. If Bill and Vishal ride together in the same car, and the three brothers each ride in different cars, which of the following must be true?

1) Each car has both males and females in it.
2) One of the cars has only females in it.
3) One of the cars has only males in it.
4) The sisters ride in the same car.

14. If Peggy and Chelsea are together in one of the cars, which of the following could be the list of people together in another car?

1) Vikram, Bill, Barbara
2) Vikram, Bill, Vijay
3) Vikram, Barbara, Varun
4) Bill, Barbara, Vineeta

15. If Bill and Vineeta are together in one of the cars, each of the following could be the list of people together in another car except:

1) Vikram, Peggy, Barbara
2) Peggy, Vishal, Varun
3) Peggy, Barbara, Vijay
4) Peggy, Varun, Vijay

16. If the three Sharma children ride in different cars, then which of the following must be true?

I. The Hamilton parents do not ride together in the same car.
II. The Sharma parents do not ride together in the same car.

1) I only
2) II only
3) Both I and II
4) Neither I nor II