## 1.Introduction to Line Charts

Welcome to the series of E-learning session on Line Charts. Having understood the need and importance of graphically representing data let us now understand the various diagrams and charts that we can use to graphically represent data.

At the end of this session, you will be able to:

- Define Line Charts
- Identify the practical uses of Line Charts
- Explain the steps involved in constructing Line Charts
- Understand the advantages & limitations of Line Charts

Charts or diagrams can be of 4 types-

One dimensional- such as line charts and bar charts

Two dimensional- such as rectangles, squares and circles

Three dimensional-such as cubes, cylinders and spheres

Pictograms and Cartograms

Under one dimensional chart we have Line and Bar charts. In this session let us learn something more about Line charts.

A line chart is a type of chart that displays information as a series of data points connected by straight line segments. Each data point represents an individual measurement or value. If you look at the example it depicts the speeds of a body in miles per second at certain points in time- over a period of 6 seconds.

If we read the line chart we see that in the first column Elapsed Time-Seconds

In the second column we have Speed which is in miles per second

So at time zero or in zero seconds speed is zero miles per second.

When time of one second we have 3 miles per second, at 2 seconds we have 7 miles per second, at 3 seconds it goes upto 12 miles per second, when we finish 4 seconds we go up to 20 miles per second, at the 5<sup>th</sup> second we touch

30 miles per second. And finally after 6 seconds we touch a speed of 45 miles per second.

This is graphically depicted via a line chart taking each and every point of speed with relation to time.

Elapsed Time- Seconds	Speed- miles per second
0	0
1	3
2	7
3	12
4	20
5	30
6	45

A line chart is often used to visualize trends in data over a period of time.

Hence, this chart is often drawn chronologically.

For example if we want to draw a line chart to represent the average price of petrol per litre in India over the last few years- our data will be-2008- Rs 45, 2009- Rs 50, 2010- Rs 55 & 2011-Rs 70. Our line chart graphically depicts how petrol has been getting more and more costly in the last few years in our country.



In line diagrams only the length dimension is important. In these diagrams data is graphically represented by the length of lines drawn. The length of the line is proportional to the data it represents. Hence if the line drawn in a line chart is to represent a larger number then it will be longer than a line drawn to represent a smaller number.

To understand this lets take an example of data containing the weight of 5 individuals who weigh- 62,67,75,82 & 86 kilograms respectively. If a line diagram is drawn to represent this data then the shortest line will be for the individual weighing 62 kilograms and the longest line for the individual weighing 86 kilograms. These lines maybe drawn either vertically or horizontally. In our example we have drawn these lines vertically.



Line charts are mostly used to plot changes of data over time such as monthly temperatures or daily stock prices.

## 2.Practical uses of Line charts

One of the most popular uses of the Line chart is to depict the ups and downs of the stock market. In India, we commonly see Line charts in newspapers and on News channels showing us the daily movement of the Bombay Stock Exchange's (BSE) Sensitivity Index (commonly called the Sensex) or the National Stock Exchange's index which is called Nifty.

Line charts are also used by businesses to show operational trends graphically, be it to represent monthly or yearly profits, monthly or yearly sales in terms of volume ie. units sold or in terms of cash. We also can represent things like input costs and other such numerical data that changes over a period of time.

Another example for practical example of line chart is in limited overs Cricket matches. Here Line charts are used to graphically present the scoring pattern of the team batting first, over the course of 50 overs. A second line chart is also drawn to show the scoring pattern of the team batting second. The difference between the 2 line charts gives the viewer an understanding of how a team is faring at a particular point in the match. These line charts are popularly referred to as 'worms' by Cricket commentators.

Line charts are also used by the Government and media to represent various macro-economic data like Inflation, Gross domestic product (GDP), Bank rates etc.

Line charts are the most basic type of chart used in finance and they are generally created by connecting a series of past prices together with a line.

Market trends, budgets & forecasts are other practical applications of line charts. Time series data is usually presented in a line chart as the movement of a variable (price, cost, sales etc.) can be graphically represented chronologically.

## 3. Construction of a Line chart

How to construct a line chart-

A line chart is constructed using the X & Y axis of a graph sheet.

Line charts are normally constructed using the first quadrant because the values to be plotted are usually positive.

On the baseline of the X axis the independent variable is marked out. This means the data decided by the person drawing the graph, for example- ta ime period or the type of data we are representing, other examples could be people, products, etc. It is essential to keep an equal distance between each consecutive entry for this data on the baseline of the X axis. The total number of markings will be dependent on the number of observations. For example If we are studying the yearly changes in petrol prices over the last 5 years, the X axis will have 5 markings one for each of the last 5 years under observation. In case we are representing the weight of 5 individuals then on the X axis we will have markings for each of the individuals these are Individual- 1,2,3,4 & 5. Each of these markings will be equidistant from the next. Depending on the total space available and the number of independent variables to be marked we decide on the distance between each of them.

On the Y axis the values for the dependent variable are marked. This data is dependent on or corresponds to the data entered on the X axis hence it is called the dependent variable. In case the range of our independent variable is very large then we need to have a scale for our notations to ensure that the entire range of dependent variables is covered. For example- 1 cm= 10 kgs in our previous example

If we were to construct a line chart for our past example to represent the trend of Petrol prices over the past few years- Then our independent variable would be the last few years (2011, 2010 etc.) which we would plot on the baseline of the X axis and the price would be our dependent variable which we would plot on the Y axis. (Eg- Rs 70, Rs 55 etc.). Our range of variables would thus be from Rs 0- Rs 70 hence we should be able to cover this range on the Y axis by using a scale. Let us take a scale on the Y axis to be 1cm =Rs 10.To summarize our X axis baseline would have notations for years and our Y axis would contain data for Price in Rupees.

Let us also practice by drawing a line chart for our other example- 5 individual's weight these individuals had weights of- 62,67,75,82 & 86 kgs

respectively. Here the independent variables whose data will be marked on the X axis are the 5 individuals. Let's say individual 1,2,3,4 & 5. The dependent variable which we will mark on the Y axis and plot corresponding to our entries on the X axis will be weights of these 5 individuals. Let's take a scale of 1cm = 10kgs. Hence for individual 1 we will need to draw a line up to 62 kgs, for the entry on the X axis, for individual 2 we will need to draw a line to 67 kgs and so on for the other 3 entries.

For data that is chronological or trend related we plot the dependent variables in the form of data points corresponding to the independent variable. We then join consecutive plotted points with straight lines. In our example such a chart can be constructed for the petrol prices over the last few years.

For data that is independent in nature we can plot the values of the dependent variables in the form of data points corresponding to their respective independent variable. These data points are then joined to the base of the X or Y axis to which they correspond with straight lines. If the Lines are drawn joining the point to the X axis then we will have a Vertical line chart and if they are drawn to connect the data points to the Y axis we will have a horizontal line chart. We can refer to our example on weights of 5 individuals and construct such a chart.

An important rule in the construction of line graphs is that the scale of the Yaxis should begin from zero even when the lowest figure in the Y-series of data happens to be far above zero. This may prove difficult when we have to map data of very high value along with some data which is of lower value and closer to zero. It may be difficult to accommodate the entire scale beginning from zero, as the space may not be sufficient. In such cases a false baseline can be adopted. Take the example presented -

Year	Population in lakhs
1951	45
1961	53
1971	60
1981	73
1991	91
2001	115

Growth in population of a city, and we have the 'Years' in one column and the population in the other. So if we look at this cities population in year 1951 it was 45 lakhs, in the year 1961 it went upto 53 lakhs. Ten years later in 1971 it went upto 60 lakhs. In 1981 it further went upto 73 lakhs. In 1991 it went upto 91 lakhs and in 2001 it touched 115 lakhs or 1.15 crores.

It is very difficult to show the population of 1991 and 2001 on a line chart hence we have adopted a false baseline at 40. The use of false baseline should be resorted to when it is absolutely necessary due to non-availability of sufficient space.

#### 4. Presentation of Line charts

Presenting a line chart-

When we present a line chart it is important for us to include all the data i,e presented in this chart. For example

Heading- The Heading is the substance of the subject matter and this must be made clear under a broad heading which properly conveys the purpose of the chart.

Another thing that must be mentioned in the chart

Scale- The scale must be presented along side the diagram. In some cases the scale is presented either above or below the diagram. The details for the scale used for both the X- and Y axis must be mentioned.

Labelling- The data on the X and Y axis must be labelled to help the viewer understand the nature of data presented.

Line charts can also be used to depict multiple series of data. When depicting data from more than one series in a Line chart, we will have different trend lines for different series of data. These lines must be plotted over the same area using the a common, uniform scale. The different series of data will normally have a common theme. Examples for mutiple series of data could be sales of different products of an organization, sales of a single product across various geographic locations or financial data plotted over mutliple time periods. The advantage of using line charts to represent multiple sets of data is that it is easy to compare mutilple trends when they're plotted or represented on the same graph. An example for different products represented in a line chart could be if we want to compare monthwise sales of Cola beverages in India for 2011- We could use one line to depict the sales of Coke, another for pepsi and a third for thumbs up. Another example could be if Pepsico wanted to do a comparitive analysis of monthwise sales for the year 2011 of Pepsi cola in India and the USA, we could have one line representing the sales for India and another for US sales.

When multiple trends are shown in a line chart, different colours are used to represent different sets of data. This is done to help the viewer easily distinguish between multiple sets of data. The colours used to represent different data are specified in the notes on the chart. This is to assist the viewer in recognizing which data is represented by which colour. In our

previous example the color blue could be used to represent Pepsi, red for coke and black for thumbs up.

When representing data from multiple series we have to ensure that we consider the range of all the different sets of data and use the same scale to depict them or else our comparison will not be uniform.

In our previous example of practical applications of line charts we had mentioned scoring patterns a cricket match- here the multiple series line chart can be used. In this chart one line represents the runs scored by one team and another line can represent the other teams scores.

The comparitive line chart has multiple uses in the business arena- It can be used to compare sales or profits of multiple products of a single organization over a time period it can also be used to compare competing product's sales and profits like we did for rival cola brands or financial data of multiple years. For example last years month wise profits vs this years for a company.

This type of data helps desicion makers in business to understand trends and take approporate action. It helps senior managers see the big picture in simple graphic form

The comparitive line chart is also very useful in stock market analysis. Here the price of a single stock or the net asset values of a mutual fund can be compared to that of a benchmark index like the sennsex or the nifty. Through a comparitive line chart a viewer can easily understand whether a stock or mutual fund has perfomed better or worse than the benchmark indices over a period of time and also at particular points of time.

# Advantages and limitations of Line charts

Now that we have learnt the practical applications of line charts and how to construct them let us take a look at the advantages of line charts-

• They are very easy to construct-

the simple principles of plotting data on graph sheets are used to construct line charts, this makes it very simple for people to draw line charts

• The reader can understand information easily from line charts-

This is because line charts are very simple to read

• They are useful for representing comparative data and for making comparisons-

Let us say when data has to be compared over a similar time period for different data this can be easily depicted in a line chart

• Their suitability for presenting trends-

Trends are easily identifiable in a line chart. This is one of the biggest

advantages that makes it highly suited for showing data that changes over a period of time

• They are useful for a quick analysis of data-

For many managers and other decision makers, line charts provide a basis for quick analysis of numerical data which would otherwise need a lot more time if only the numerical values were presented to them.

• They show the range and also maximum and minimum very easily-

Readers of line charts can easily understand the range of data presented. Readers can also point out minimum and maximum values easily as these are identifiable in a line chart

• Exact values are retained in these graphs

Values are not changed when plotting them in a line chart. Hence absolute values are available to the reader and not in percentage terms.

Let us also look at the limitations of line charts-

• They are not as visually appealing as other graphs

Since line charts are one dimensional in nature they do not have the pictorial appeal of other types of graphs

• They are best suited under 50 data values

If more data values are presented in a line chart the ease of understanding and simplicity is lost. Hence they are only suited for a limited amount of data

• They need a small range of data

If there is a large range of data a false base line may need to be used. Sometimes if the range is too large it may not be possible to represent the data in a line chart because of space constraints.

Here's a summary of our learning in this session:

- We first learnt the definition of Line charts
- We now know some of the practical uses of Line charts
- We have gone through the steps involved in constructing Line charts
- We have also seen the advantages and limitations of Line charts