1. **Introduction**

Welcome to the e-learning module of Bar chart.

At the end of this chapter, we will learn

- What is a bar chart or a bar diagram? How to construct a bar chart?
- Various types of bar charts
- Vertical versus Horizontal bar charts
- Multiple bar charts
- Sub-divided Bar diagrams (or Component bar diagram)
- Deviation bar diagram and Duo-directional bar diagram
- Other types of bar charts and diagrams

We have understood the need and importance of graphically representing data. Let us now understand, how we can diagrammatically represent data.

In the previous discussion, we learnt about ‘line charts’, a one dimensional diagrammatic representation of data. Continuing, in today’s discussions, we will focus on another one dimensional diagrammatic representation of data, the ‘bar charts or bar diagrams’.

A ‘bar chart’ is a chart with rectangular bars, with their lengths proportional to the values that they represent. The bars can be plotted vertically or horizontally.

Bar charts can be leveraged to represent and understand information or data. They can be used for:

- Recording information or data in a diagrammatic format to be easily understood
- To represent and compare data of one dimension, at different intervals of time

Bar charts or diagrams also look a lot like a histogram. At times, they are mistaken for each other!

There are several scenarios in our day to day life where bar charts find their leverage and relevance. To share a few examples…

- Bar charts can be used to represent and compare performance of students in a college, over different years
- Bar charts or diagrams can be used to represent and compare performance of students in different colleges over different years
- To present population of a country by geography, across age groups, and across genders

A ‘bar chart’ is a chart with rectangular bars with lengths proportional to the values that they represent. Let us look an example to understand the bar charts:
The table shows information about factories and their production capacity of ‘output in tonnes’. The table shows:

- 3 factories in the first column – the values of factory number 1, 2 and 3
- The second column shows the corresponding ‘output in tonnes’ produced in each of

the 3 factories – the values of 1200, 1560 and 900 respectively

Figure 1

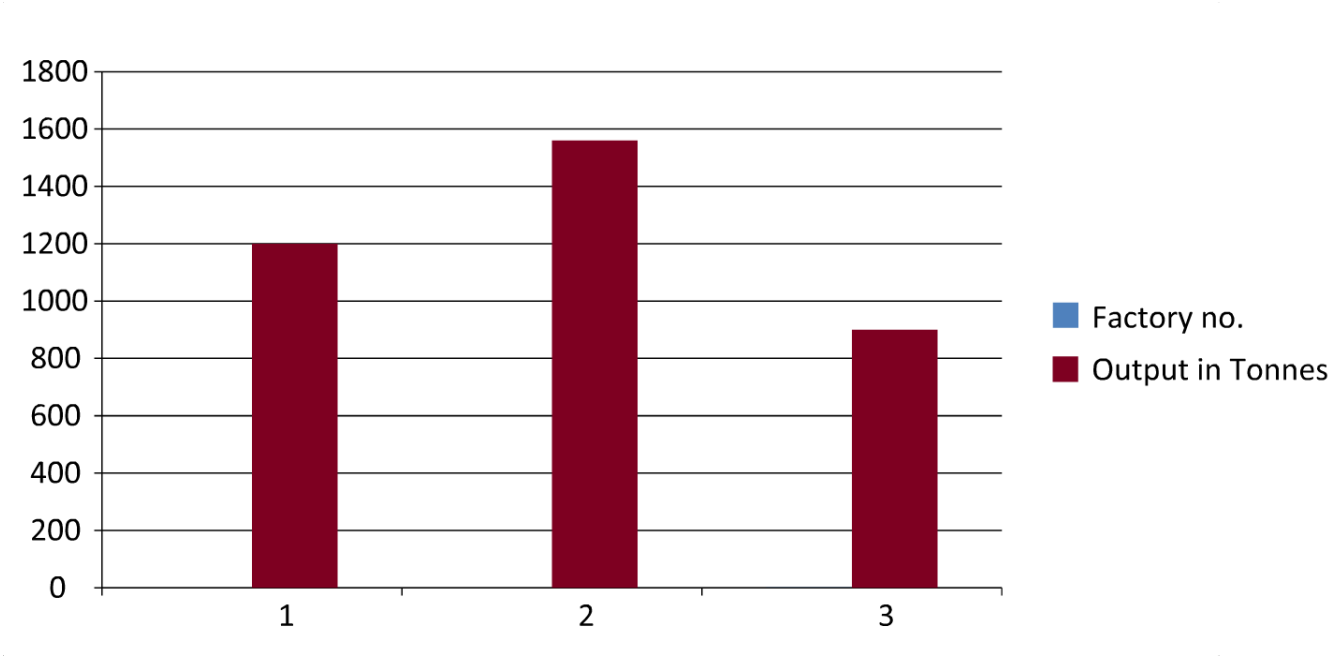
Factory no.	Output in Tonnes
1	1200
2	1560
3	900

This table of information can be represented in a bar chart as shown in this picture…
This chart which has vertical columns is called a ‘bar chart’ or a ‘column chart’. If you notice in this diagram, the x-axis represents the “factories” and the y-axis represents the “output in tonnes”.

- The 3 factories from the table, are represented as 3 columns on the x-axis or the factory-axis, with equal width
- The production output from each of the 3 factories in tonnes, is shown as the height of each of the column, represented on the y-axis, in line with the data shown in the table. The unequal length of the bar indicates the magnitude of the produced output from the factory, i.e. factory 1 produced 1200 tonnes, factory 2 produced 1560 tonnes, factory 3 produced 900 tonnes.

The diagrammatic representation in this manner is referred to as a ‘bar chart’. In this particular example it can be noticed that the different outputs from each of the factory visually provides a picture about the various production levels of each of the factory.

Figure 2



The simplicity and the ease of drawing the bar chart, makes it a very popular chart in practice. However such a diagram, suffers from a major limitation of representing only one category of data.

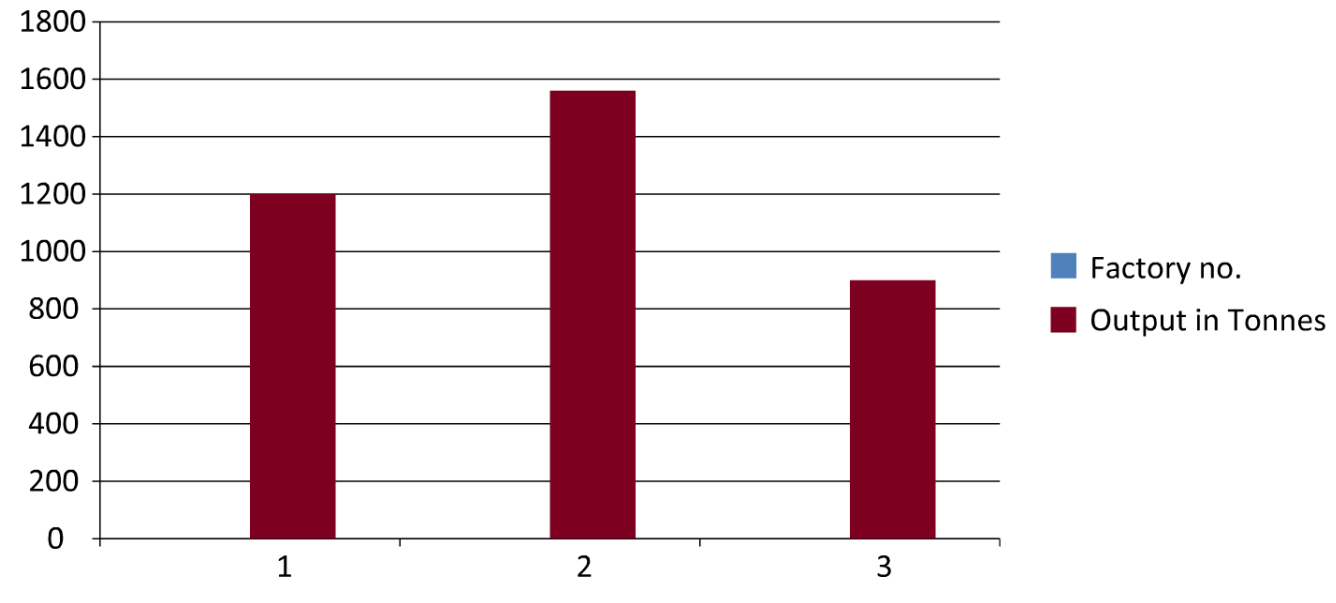
2. Horizontal and Vertical bar charts

We have understood the need and importance of graphically representing data, let us now understand the how we can diagrammatically represent data.
The bar chart shown in the previous example is typically called as a bar chart or a vertical bar chart. The simple bars shown in this diagram are drawn vertically.

Figure 3

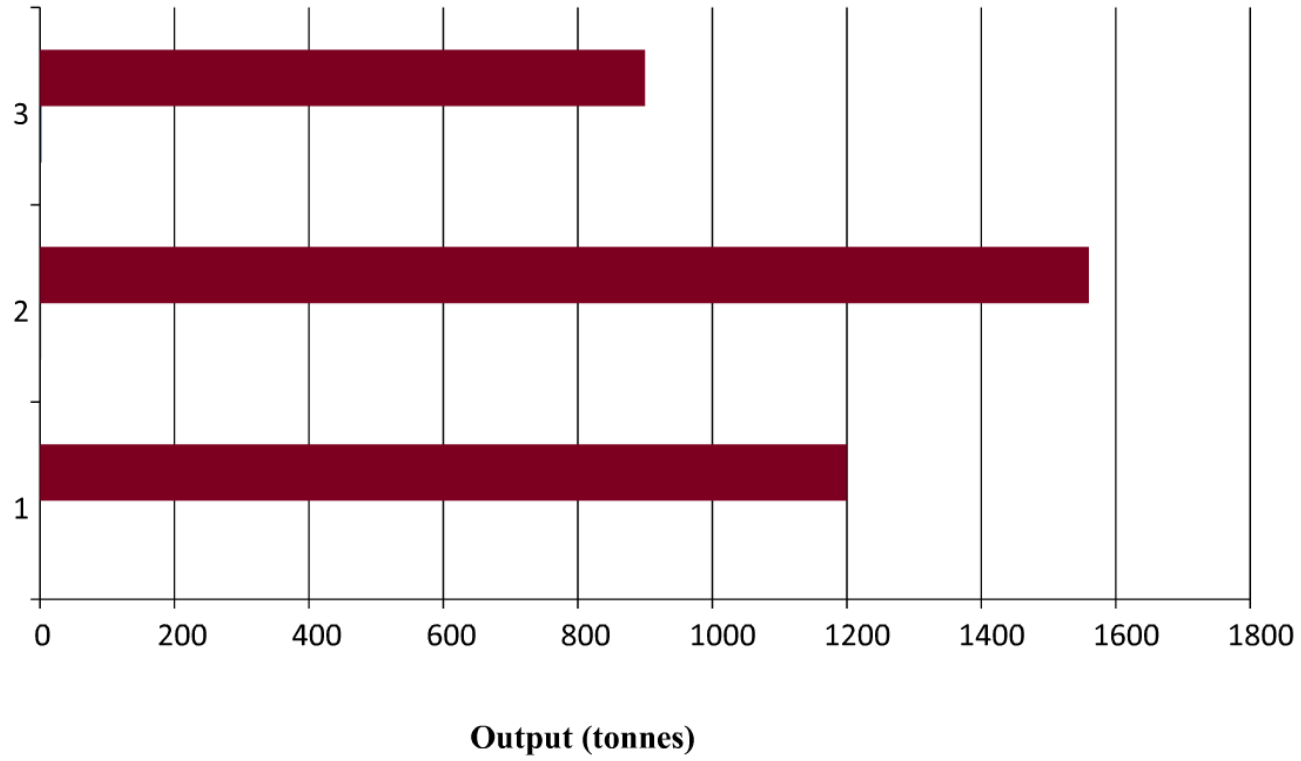
Factory no.	Output in Tonnes
1	1200
2	1560
3	900

Figure 4



The same data can also be represented as a bar chart in a horizontal fashion, also called as the horizontal bar chart. If you notice in this diagram, the y-axis represents the factories and the x-axis represents the outputs from the factories in tonnes.

Figure 5



We have seen how to represent data in a ‘bar chart’ format representing one category of data. We also discussed that is one of the limitations of a bar chart.

However, when two or more interrelated series of data are depicted by a bar chart, such a diagram is known as a ‘multiple bar diagram’.

Let us look into an example to understand a ‘multiple bar diagram’.

• An Engineering college in Bangalore has 4 year degree program. The number of students in the college is represented by the table below:

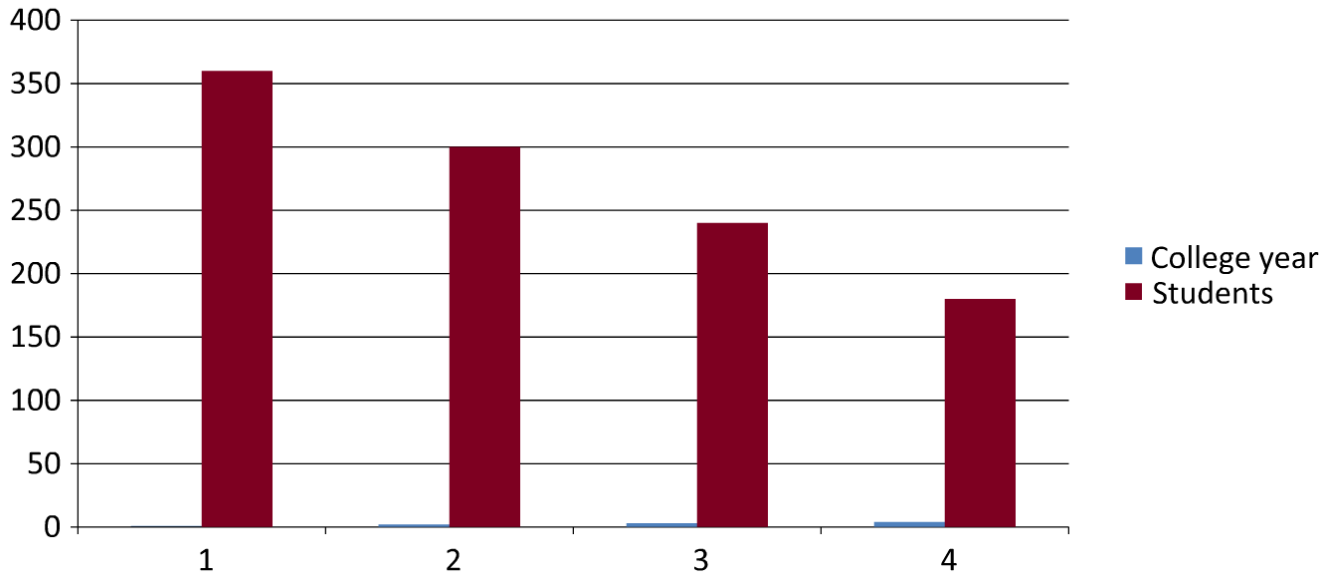
Figure 6

College year	Students
1	360
2	300
3	240
4	180

• As you can notice, over the years, the number of students in the college has grown. The Year 4 or the final year has 180 students whereas the Year 1 or the first year that has just started has 360 students.

Based on our learning from the earlier sections, we can represent this data in the form of a bar chart and you can see the same now:

Figure 7



• The college year is represented as follows – 4 is the final year and 1 is the first year. This college year data is represented on the x-axis as a vertical bar of equal width.

• On the y-axis the number of students data is represented in units of 50 to go up to 400, to be able to represent the highest number in the table which is 360.

Now, let us understand the constituents of the student population, that is how many boy students and girl students are there in each year.

The number of boys and girls in each college year is shown in the table. We can notice that there is a steady increase in both the boys and girls students population from the Year 4 or Final year to the most current Year 1 or First year.

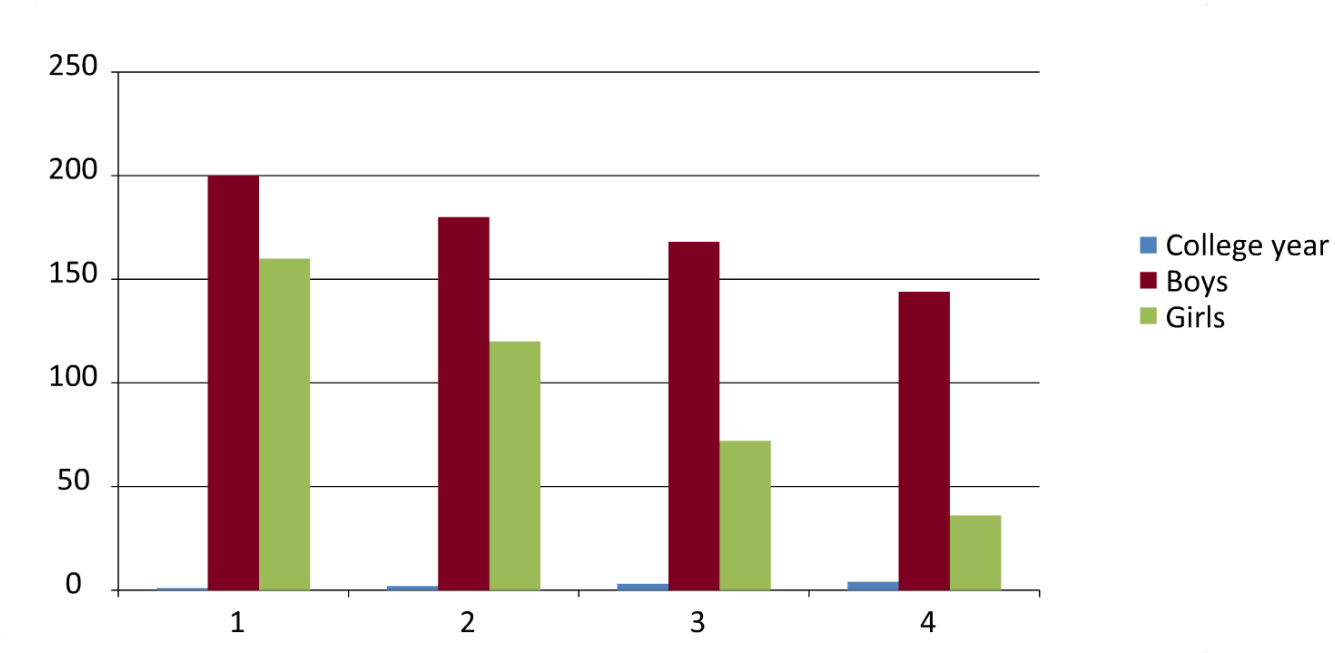
Figure 8

College year	Boys	Girls
1	200	160
2	180	120
3	168	72
4	144	36

While we can notice the increase in student numbers both boys and girls, let us see how this data can be represented in a different bar chart type.

Since the data category is the same – which is the number of students, there should be a way to represent the number of girl students and the number of boy students in the same diagram.

Figure 9



As you can see in the diagram, the x-axis continues to show the college year and the y-axis represents data of number of students.

However we can notice the following changes:

- There are multiple bars for each college year, there is a green bar which represents number of girl students and there is a brown/maroon bar which represents number of boy students. For every college year you can see two bars.

- As you can notice for the Year 4 or the final year, the number of boy students are much larger that the number of girl students, a shown by the green and the brown bars for year 4.

- However, let us draw our attention to the data being represented for boy and girl students for the year 1 or the 1st year. Here, we notice that the difference between the number of boy students and the number girls students is much smaller, in comparison to the difference in the Year 4 between boy and girl students.

- This bar chart clearly depicts that, while the total number of students have increased over the years, the total number of boy students and girls students have increased over the years, the difference between the number of boy and girl students every year has reduced.

- This type of a chart is referred to as Multiple Bar chart OR Multiple bar diagram. Multiple bar charts provide a great opportunity to compare two different entities, like the boy students and girl students in the example, however against the same category which is number of students, as represented on y-axis in the example.

3. Sub-divided or Component Bar Diagram

Now, let us look into another interesting and informative bar diagram, termed as Sub-divided bar diagram, also called Component bar diagram. As the name implies, this diagram will show subdivisions or components in a single bar.

Let us review the same example from the earlier section – the college students, boys and girls. The data in the table shows the number of boys, girls and the total number of students, every year for the 4 years in the college.

Figure 10

College year	Boys	Girls
1	200	160
2	180	120
3	168	72
4	144	36

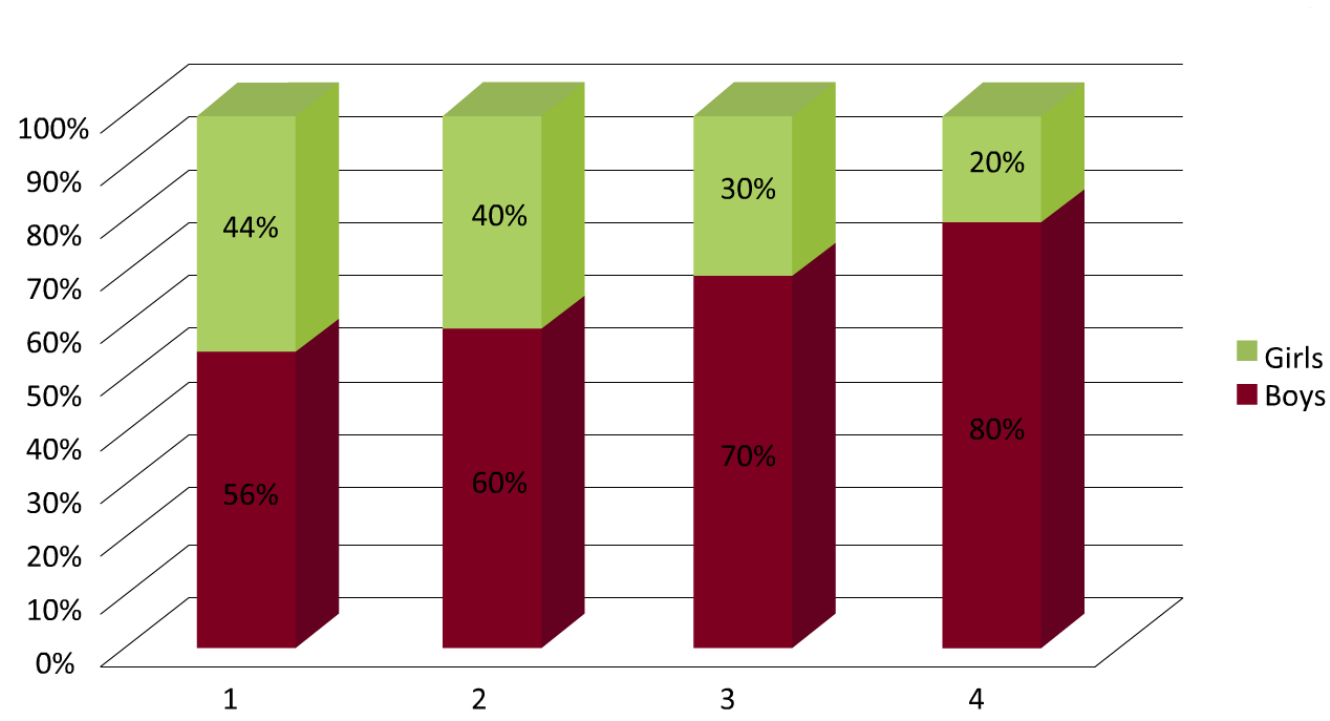
If we do a simple mathematics to calculate the percentage of boys and girls in the table, we will be able to generate the following table which shows the percentage of boys and percentage of girls every year.

Figure 11

College year	Boys	Girls	Total %
1	56%	44%	100%
2	60%	40%	100%
3	70%	30%	100%
4	80%	20%	100%

This data which has two sub-divisions of girls and boys, in the category of students, can be represented in a diagrammatic way, using the subdivided or component bar diagram as shown in the diagram:

Figure 12



Let us observe the key factors in a subdivided bar diagram:

- Each bar for every year, has two components represented within. The green bar represents the percentage of girl students AND the red bar represents the percentage of boy students.
- Each of the bar in the diagram for every year, is represented in terms of percentages.

The length of each bar is the same, indicating that the total of the sub-division components in each bar, total to 100 percent.

- In order to distinguish the different components, different colours or shades should be used. This should be accompanied by a legend or key for identifying these components.
-

The subdivided bar diagrams should not be used when there are too many components or subdivisions – for two reasons:

- First, it may be very difficult to provide so many subdivisions particularly when their magnitudes are small
- Second, it may be difficult to understand and interpret such a diagram

Sub-divided or Component bars are very suitable for representing enrolment of students into different types of courses. Let us look into a quick example:

Figure 13

Degree	2009	2010	2011
Mechanical	60	60	60
Electronics	30	60	90
Civil	60	60	60
Computer Science	30	60	90
	180	240	300

In the data table, we see the number of students who joined in the year 2009 total to 180. The break-up of these students by the engineering discipline, like Mechanical, Electronics, Civil and Computer Science is also provided.

Similarly data of the break-up of students by engineering disciplines, is provided for year 2010 and 2011.

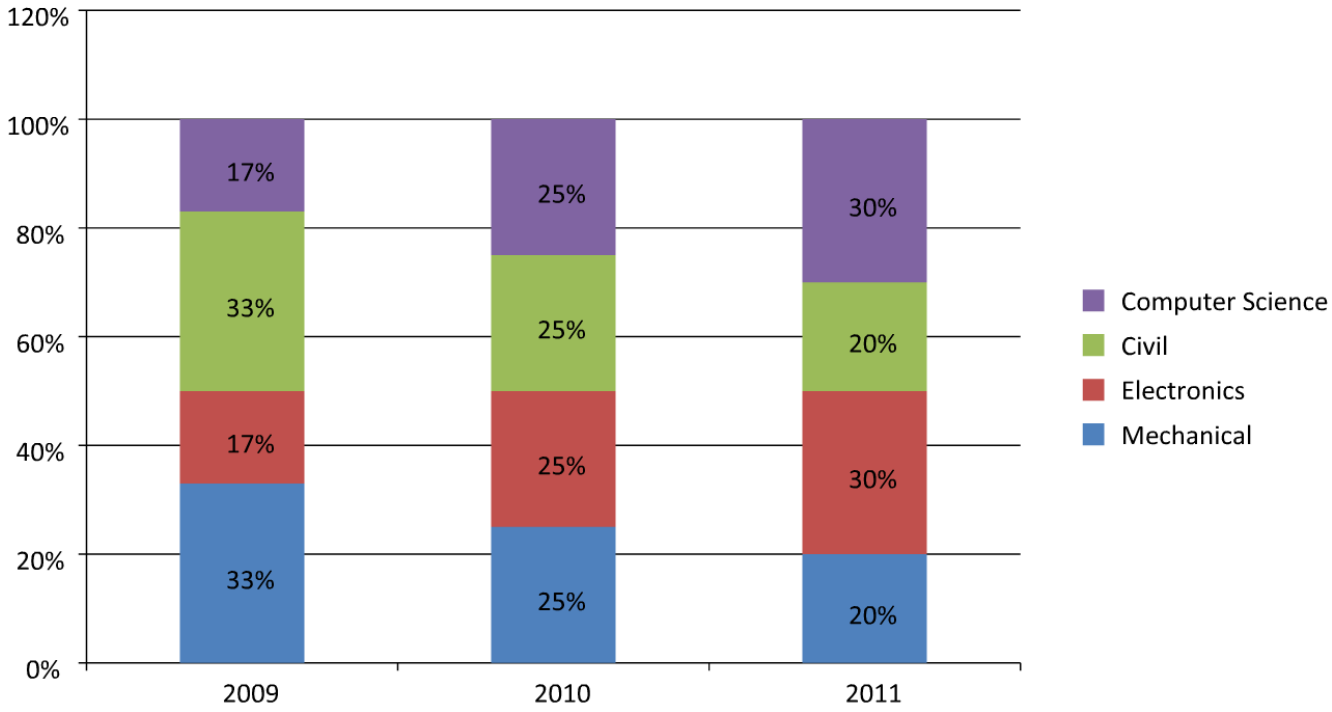
Let us look into how this data is translated into a percentage table as shown:

Figure 14

Degree	2009	2010	2011
Mechanical	33%	25%	20%
Electronics	17%	25%	30%
Civil	33%	25%	20%
Computer Science	17%	25%	30%
TOTAL %	100%	100%	100%

As you can see, each row represents data of percentage of students in each of the engineering discipline, totalling to 100% for the year.

Figure 15



The percentage of students across engineering disciplines every year, has been diagrammatically represented in this sub-divided or component bar diagram. The diagram

helps us to:

- visually see the percentages of students in different engineering disciplines in a column bar, totalling to 100%. The different engineering disciplines are represented by different colours.

- To visually see the relative changes in percentages every year for each of the engineering discipline. For example :
    - the Mechanical branch student percentages in the college has decreased from 33% in 2009, to 20% in 2011
    - whereas, the computer science student percentages in the college has increased from 17% in 2009, to 30% in 2011

4. Types of Bar Diagrams

We will have a quick look into a few other important types of bar diagrams.

a. Deviation bar diagrams

Deviation bars are used to show both positive and negative values. For instance, let us consider the net profit data for a company over several years. It is possible that in some years the company, instead of earning a net profit, might have sustained net loss. In such cases, the data on net profit will be displayed above the x-axis or the base line, and the net loss will be displayed below the x-axis of the base line.

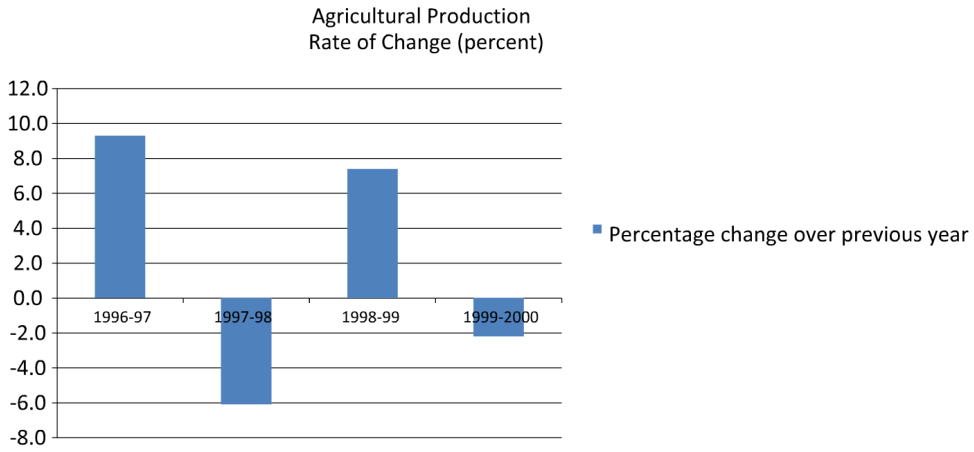
Let us look at an example of agricultural production. The data table shows, the data related to the rates of change (percent) in agricultural production for a few years. As you can see, 'rate of change' in agricultural production in Year 1996-97 and 1998-99 were positive. Whereas, the 'rate of change' is negative in the year 1997-98 and 1999-2000.

Figure 16

	Percentage change over previous year
1996-97	9.3
1997-98	-6.1
1998-99	7.4
1999-2000	-2.2

This data can be represented in the form of a deviation bar diagram. This bar diagram shows the positive and the negative values of the 'rate of change' in agricultural production in percent over the previous year. The negative values are shown below the x-axis or the base line as can be seen for Year 1997-98 and Year 1999-2000.

Figure 17



b. Duo-direction bar diagrams

As the name indicates a duo direction bar diagram, is a diagram on both sides of the x-axis. The diagram will show one component of the data above the x-axis and the other component below the x-axis. The two components taken together, give the total value of the item displayed.

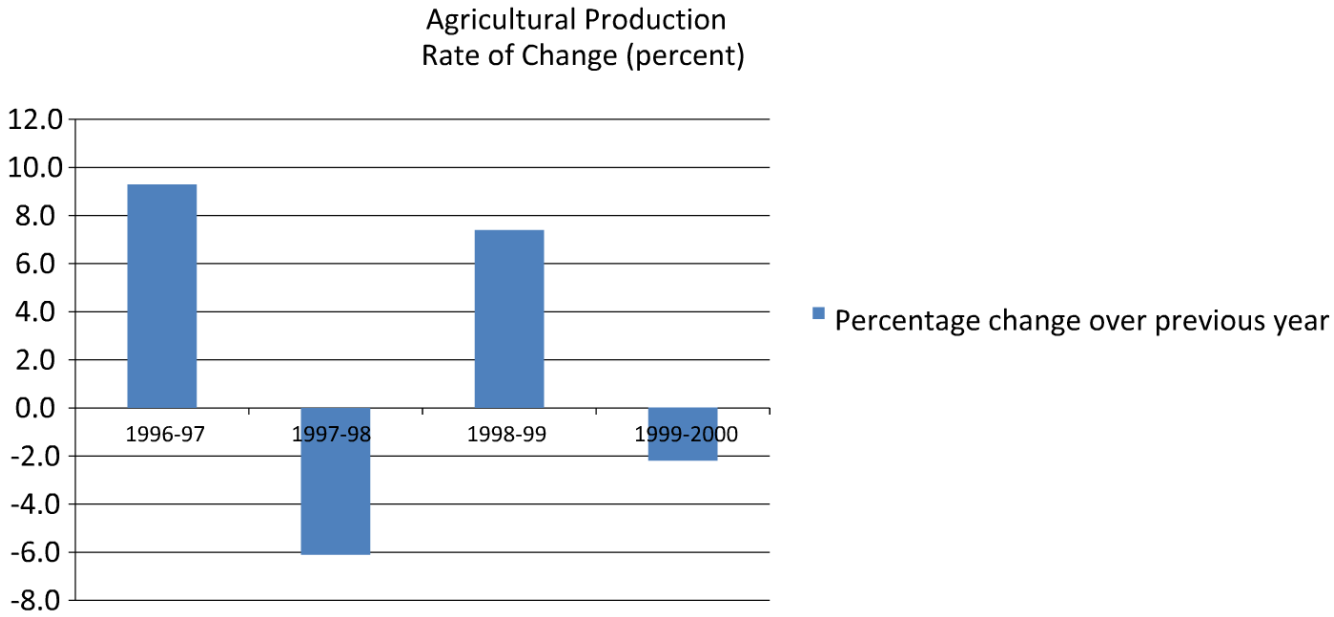
Let us look into this data table…

Figure 18

Items	1998-99 ('000 Rs)	1999-2000 ('000 Rs)
Total earnings from production	100	80
Cost of production (all expenses)	60	55
Net Income	40	25

The table shows the total earnings of a company for years 1998-99 and 1999-2000. The break-up of the total earnings, in terms of the cost of production and the net income is also shown in the row 2 and row 3 of the data table for both the years.

Figure 19



This can be aptly represented in a duo-directional bar diagram as shown. The cost of

production data is shown above the x-axis and the net income is shown below the x-axis on the same bar diagram for the corresponding year. The total of the two components on each bar diagram in this picture, which includes the ‘cost of production’ and ‘net income’, is the total earnings from production.

A few other types of bar diagrams which are also in use are:

- Broken bar diagram – these are used in cases where there are wide variations in values and need to be represented in the same diagram
- Sliding bar diagram – this is similar to a duo-directional bar diagram, the only difference being that the duo-direction bar diagram is based on absolute values, whereas the sliding bar diagram is based on percentages.
- Pyramid diagram – shows a number of horizontal bars, arranged in such a manner as to give an appearance of a pyramid. Typically, such diagrams are suitable to present data on population, occupation, education and so forth.

5. Combination of Bar Charts

Let us look into another example of a Bar chart which is a combination of bar charts or diagrams.
Let us consider this example of income details from a ‘cookie shop’ from year 2003 to year 2005. The ‘cookie shop’ income table shows the following information….Total revenues, Total Expenses and Profit or Loss for the years 2003, 2004 and 2005.

Figure 20

The Cookie Shop income – 2003 to 2005			
	2003	2004	2005
Total Revenues	82,837	87,671	69,888
Total Expenses	57,190	69,872	72,000
Profit/Loss	25,647	17,799	2,112

All the amounts are mentioned in US dollars. Let us now understand the data in detail.
In 2003 the cookie shop:

- registered total revenues of – eighty two thousand eight hundred and thirty seven dollars
- total expenses of – fifty seven thousand one hundred and ninety dollars
- and the associated profit of – twenty five thousand six hundred and forty seven dollars

Similarly, we see the data in 2004 and 2005. However, in 2005 we notice that the Total

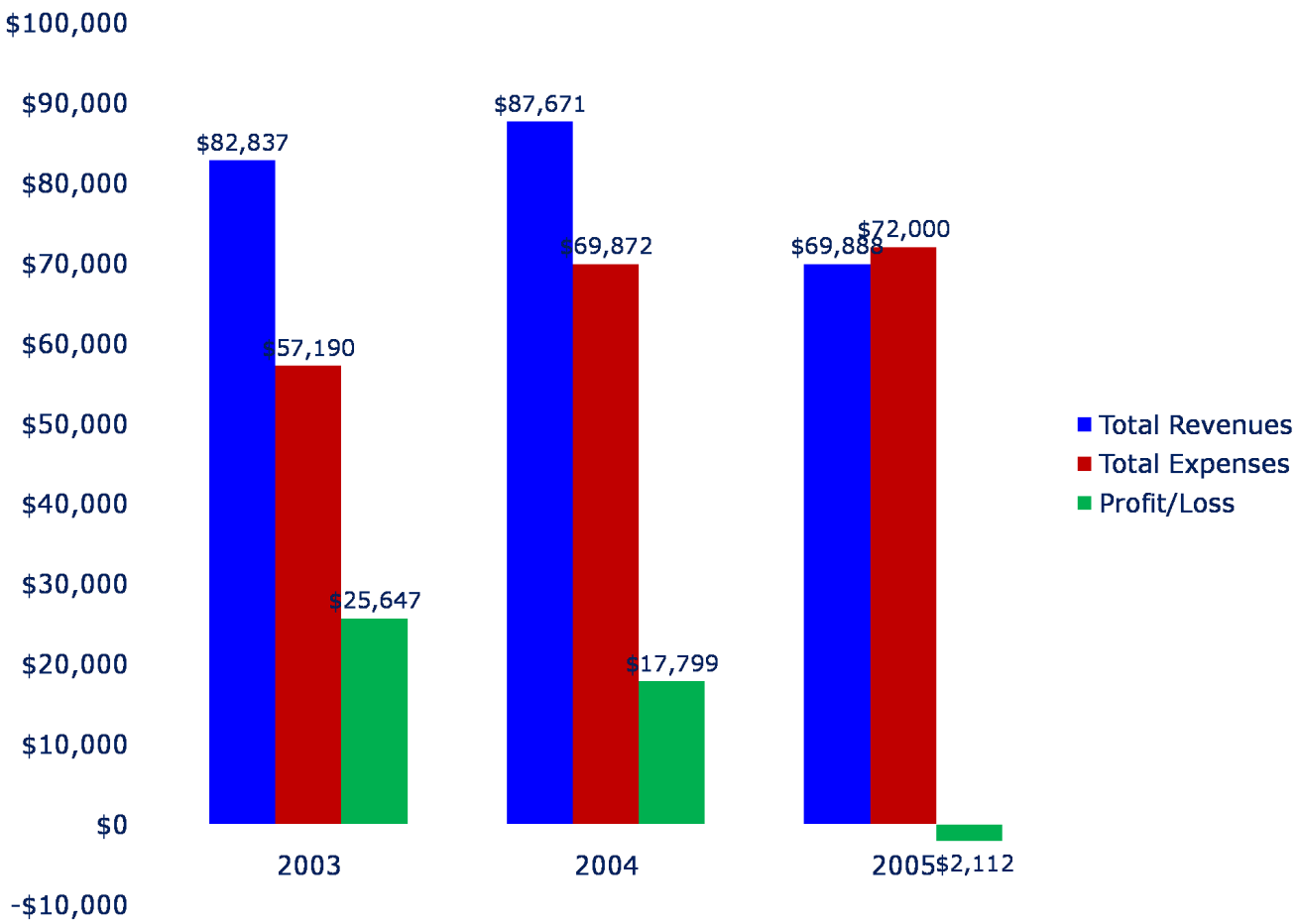
revenues are lesser than the total expenses for the year. With this situation, the ‘cookie shop’ has registered a LOSS in that year of – two thousand one hundred and twelve dollars, as shown in the table.

Now, how do we show the overall income details of the ‘cookie shop’ in one single bar chart? Leveraging a combination of bar charts – like the multiple bar chart, the deviation bar diagrams and duo-directional bar diagrams, we will be able to diagrammatically represent the ‘cookie shop’ income data.

The chart shows the following:

- for every year of the ‘cookie shop’ income, there are 3 bars, representing – total revenues in blue, total expenses in red and Profit or loss in green
- the x-axis has 3 such groups of bars, to show the income of the ‘cookie shop’ for the years 2003, 2004 and 2005.
- the y-axis represents the income numbers in dollars, from minus ten thousand to plus one hundred thousand, in units of ten thousand
- as you can see the y-axis has both positive and negative values on its axis, all the positive income values are above the x-axis and the negative income values are below the x-axis
- the height of the bar represents the value in dollars
- we can also see from the bar diagrams that..
    - the total revenue and total expense bars, the blues and the red bars, are above the x-axis for all the years. This indicates that the revenue and the expense values are positive.
    - However, we notice that in 2003 and 2004 the Profit or Loss bar, the green bar, is above the x-axis depicting a PROFIT for the ‘cookie shop’. Whereas, in 2005 the Profit or Loss bar is below the x-axis, depicting a LOSS for the ‘cookie shop’.
    - The profits in 2003 and 2004 are because of the revenues being higher than the expenses of the cookie shop, whereas the loss in 2005 is because of the expenses being higher than the revenues

Figure 21



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

In this session, we have covered the following topics

- An overview of Bar chart and the why it is important
- How to construct a bar chart
- Various types of bar charts like the Horizontal and Vertical Bar chart diagrams, Multiple Bar Diagrams, Subdivided or Component Bar Diagram and others

We have also looked into various real life examples of where Bar Charts are important and useful as well.