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# Foundation Mathematics

*Topic 6 – Lecture 2: Presentation of Data*

*Forms of Data Presentation*

*Construction of Frequency Diagrams*

# Scope and Coverage

*This topic will cover:*

- Presentation of data using different formats including histograms, pie charts and bar charts
- Presentation of data as histograms, cumulative frequency graphs (ogives) and time series graphs

# Learning Outcomes

*By the end of this topic students will be able to:*

- Present data using tables, pie charts and bar charts
- Construct frequency distributions
- Present data as histograms, cumulative frequency graphs (ogives) and time series graphs

# The Presentation of Data

- A table.

- Definition
  - A table is a matrix of data arranged in rows and columns with each row and column having titles.

# The Presentation of Data - Tables

- For example, a table may show the relationship between a car model and cost of component manufacture.
- Comparison of component manufacture in various car models

| Car Model | Cost of Component Manufacture $ | | | |
|---|---|---|---|---|
| | Clutch | Gasket | Head | Radiator |
| BMW | 400 | 700 | 1000 | 150 |
| Mercedes | 600 | 900 | 1200 | 190 |
| Ford | 250 | 400 | 800 | 110 |
| Rover | 220 | 500 | 900 | 200 |
| Jaguar | 350 | 550 | 1450 | 240 |
| Lexus | 670 | 890 | 1500 | 450 |

# Formatting of Tables - 1

- Each table must have a clear heading describing what it is telling us:
- Each column must have a clear heading indicating the class of data.
- Each row must also have a clear heading also indicating the class of data.
- In the case where data is numerical the numbers should be lined up.

# Formatting of Tables - 2

- Simplify the data by placing the zeros in the column heading:
- Comparison of driving activity and car type (P/A – Per Annum)

| Car Type | Miles Driven P/A* | Hours driven P/A |
|---|---|---|
| Saloon | 140000 | 160000 |
| Coupe | 240000 | 150000 |
| Estate | 260000 | 130000 |

- This is a complex table as there are too many 0s included in each row, a better presentation is therefore

| Car Type | Miles Driven P/A (000s) | Hours driven P/A (000s) |
|---|---|---|
| Saloon | 140 | 160 |
| Coupe | 240 | 150 |
| Estate | 260 | 130 |

The table now gives miles and hours in units of 1000

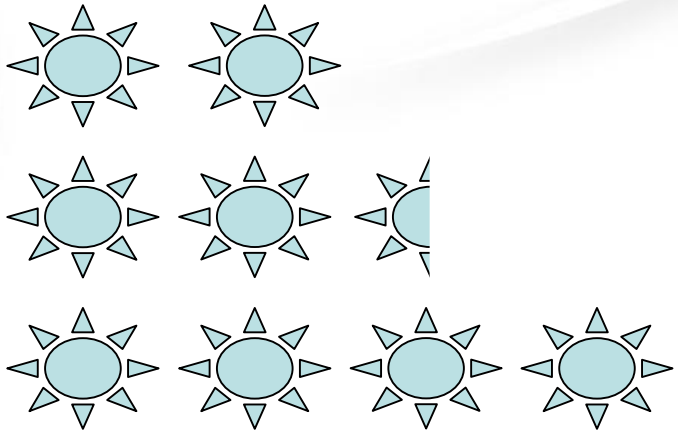
# Visual Representation of Data

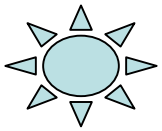
- Although tables present valuable information to the reader they might not always be considered as ‘eye catching’.
- To draw attention to the data being presented a number of diagrammatic representations may be used.
- The simplest form of which is the pictogram.
- Pictograms are often used by newspapers or TV to try and convey as much information as possible in an eye catching and understandable way.

# Visual Data - Pictograms

- Simple pictograms can convey messages in easy to understand ways for example:
- Summary of sunshine in York during the first week of June.

- Fri
- Sat
- Sun





Key
= 2 hours
of sunshine

- Whilst not very scientific, it does convey the message to the reader as to the relative amount of sunshine each day.
- To make sense a pictogram always needs a key.

# Pie Charts - 1

- Pie charts use different-sized sectors of a circle to represent data.
- Example
  - Frequency of the mode of travel of students to a university campus

| Mode of Travel | Frequency |
|---|---|
| Car | 9 |
| Bus | 4 |
| Cycle | 3 |
| Walk | 2 |
| Train | 2 |
| | |
| Total | 20 |

# Pie Charts - 2

- Identify the frequency of each mode of travel in relation to the total frequency.
- Identify what percentage or proportion of the total is represented
- Our table becomes:

  Relative frequency of the mode of travel of students to a university campus.

| Mode of Travel | Frequency | Relative Frequency % |
|---|---|---|
| Car | 9 | 45 |
| Bus | 4 | 20 |
| Cycle | 3 | 15 |
| Walk | 2 | 10 |
| Train | 2 | 10 |
| Total | 20 | 100 |

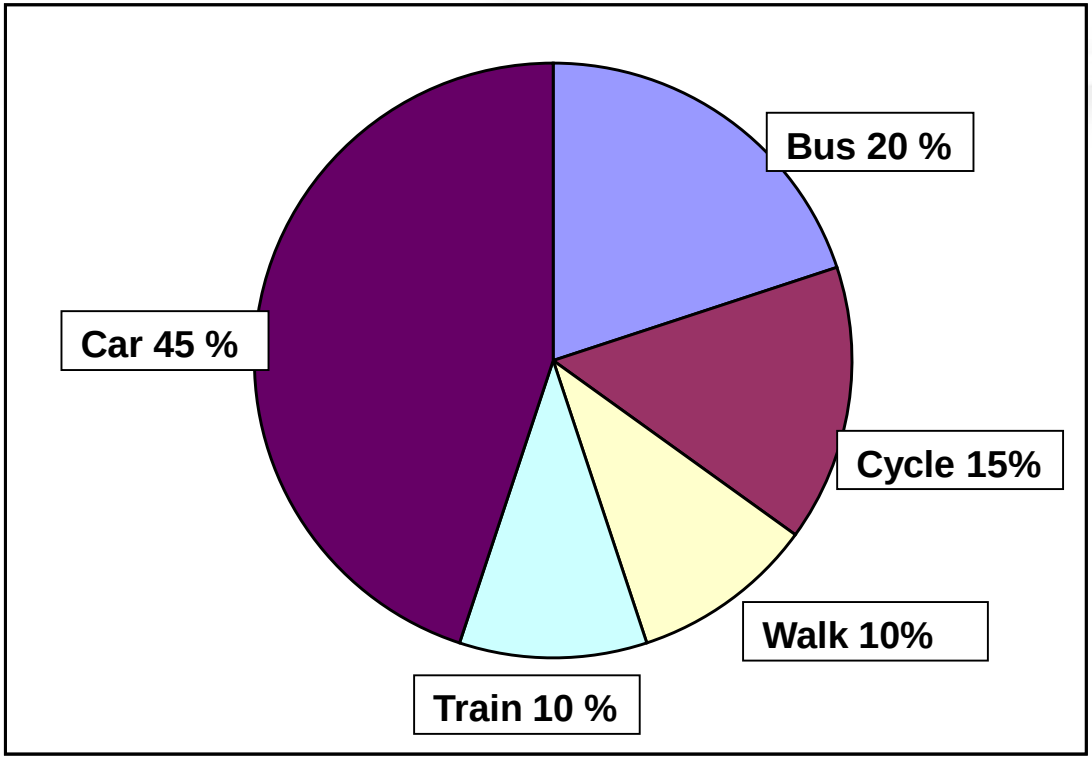
# Pie Charts - 3

- It is necessary to show each of the frequencies as percentages of 360° (the total number of degrees in a circle)
- Our table becomes:
  - Relative frequency of the mode of travel of students to a university campus

| Mode of Travel | Frequency | Relative Frequency % | Angle |
|---|---|---|---|
| Car | 9 | 45 | 162º |
| Bus | 4 | 20 | 72º |
| Cycle | 3 | 15 | 54º |
| Walk | 2 | 10 | 36º |
| Train | 2 | 10 | 36º |
| Total | 20 | 100 | 360º |

# Pie Charts - 4

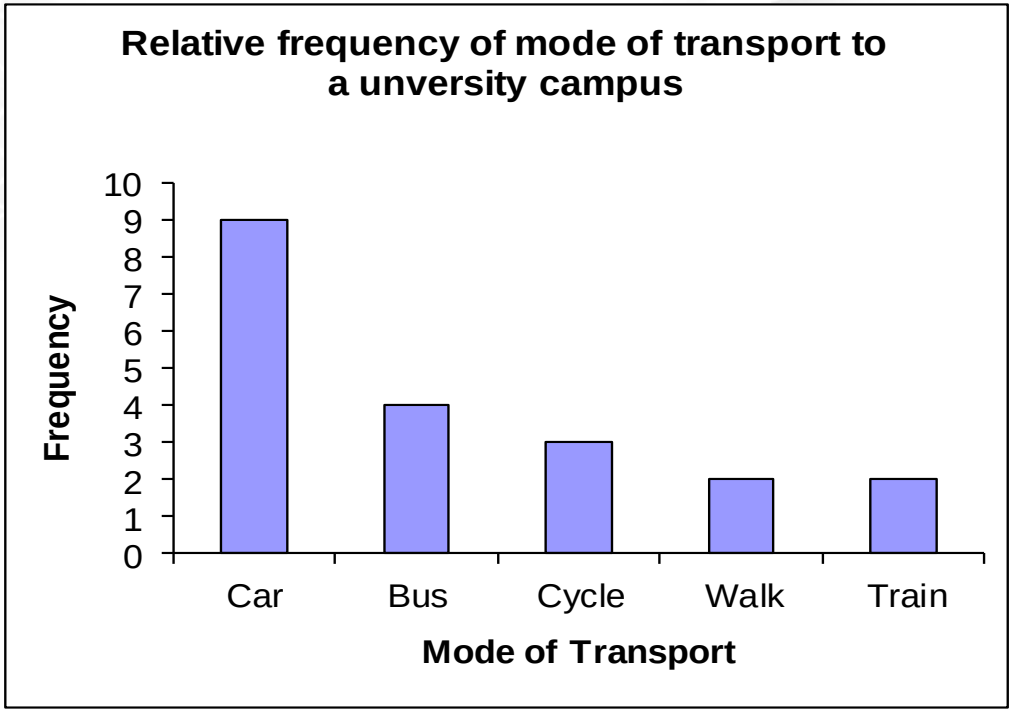
- Plotting this as a pie chart - Relative frequency of the mode of travel of students to a university campus




- Advantages of a pie chart include:
  - They give a simple pictorial display of the relative sizes of elements making up the total.
  - They show clearly when one element is bigger than another.
  - They can sometimes clearly show the differences in the elements of two different totals.

# Bar Charts

- Using the previous example we can plot our data as a bar chart in which for each category a vertical bar is drawn, the height of the bar being proportional to the frequency.



# Frequency Distributions

- A frequency distribution (or frequency table) records the number of times each value occurs (i.e. the frequency of the value).
- For example the output of workers in a given week.

| Output (number of units) | Number of employees (frequency) |
|---|---|
| 65 | 1 |
| 66 | 0 |
| 67 | 2 |
| 68 | 2 |
| 69 | 4 |
| 70 | 5 |
| 71 | 3 |
| 72 | 1 |
| 73 | 1 |
| 74 | 1 |
| Total | 20 |

When the data is arranged like this it is obvious that 69 and 70 are the most frequent outputs per employee per week.

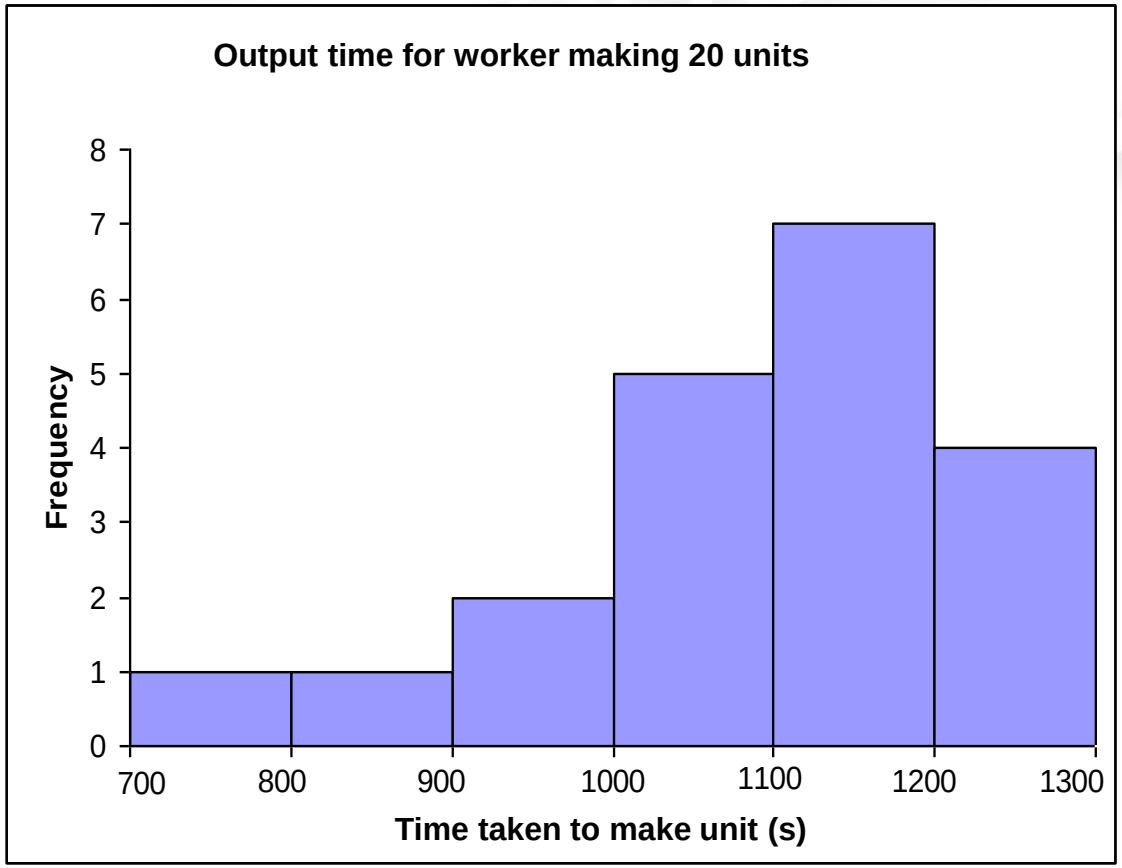
# Histograms - 1

- A histogram is a frequency diagram drawn to show grouped continuous data.
- The area of a bar on a histogram represents the frequency. If all the groups are of equal width, the height also represents the frequency as with a bar chart.
- On a histogram there are no gaps between the bars.
- Consider the following data for output time for a factory worker making 20 units.

| Time taken to make unit (s) | Frequency |
|---|---|
| 700-799 | 1 |
| 800-899 | 1 |
| 900-999 | 2 |
| 1000-1099 | 5 |
| 1100-1199 | 7 |
| 1200-1299 | 4 |

# Histograms - 2

- As a histogram this data would appear as:




In this distribution the class interval is equal for all data i.e. the output class interval is 100 in all cases.

The x-axis is labelled as a continuous scale.

# Histograms – Unequal Class Intervals

- It is possible to have histograms with unequal class intervals
- ***Example*** - The weekly wages for Reckit and Scarper building contractors are as follows:

| Wages per employee (£) | Number of employees |
|---|---|
| $40 < w \leq 60$ | 40 |
| $60 < w \leq 80$ | 60 |
| $80 < w \leq 90$ | 60 |
| $90 < w \leq 120$ | 60 |
| $120 < w \leq 150$ | 30 |

- $>$ is the same as saying greater than
- $<$ is the same as saying less than
- $\geq$ is the same as saying greater or equal to
- $\leq$ is the same as saying less than or equal to.

# Histograms – Example continued

- As can be seen in this example there are a number of class widths within the data.
- Sometimes frequency distributions have groups of different sizes. A histogram uses frequency density so that the area of the bar represents the frequency no matter how wide it is.
- The **area** of each bar is proportional to the frequency of the class it represents.

$$\text{Frequency density} = \frac{\text{frequency}}{\text{class width}}$$

- The frequency density is calculated for each class and gives the **height** of each bar.
- The vertical axis of the histogram is labelled “frequency density”

# Histograms – Example continued

- This gives the following table

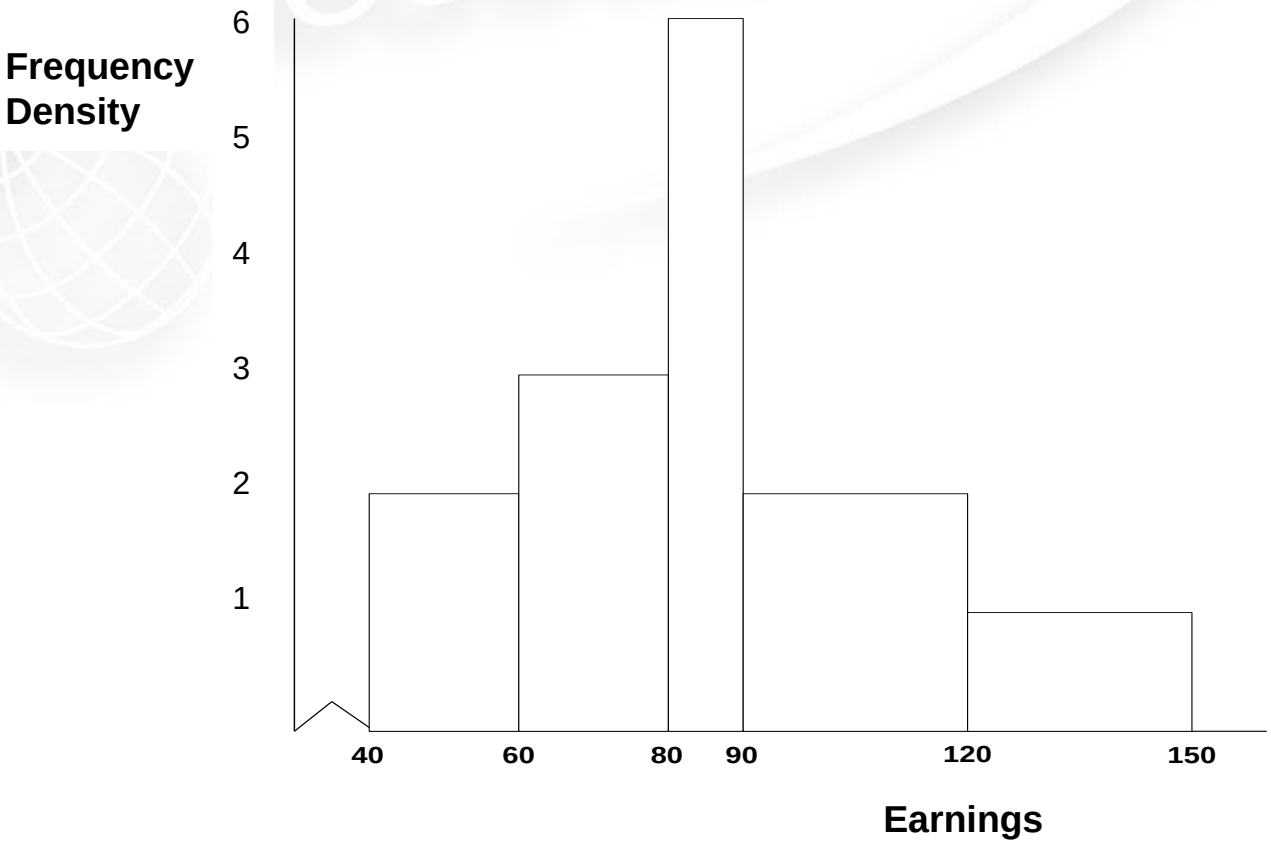
| Wages per employee (£) | Size of class Interval | Number of employees (frequency) | Frequency density | Height of bar |
|---|---|---|---|---|
| $40 < w \leq 60$ | 20 | 40 | 40÷20=2 | 2 |
| $60 < w \leq 80$ | 20 | 60 | 60÷20=3 | 3 |
| $80 < w \leq 90$ | 10 | 60 | 60÷10=6 | 6 |
| $90 < w \leq 120$ | 30 | 60 | 60÷30=2 | 2 |
| $120 < w \leq 150$ | 30 | 30 | 30÷30=1 | 1 |

# Histograms – Example continued

- The first of the bars will be of normal height.
- The third bar will be twice as high as the class frequency would suggest, this is to compensate for the fact that the class interval is only half the standard size.
- The fourth and fifth bars will be two thirds as high as the class frequencies would suggest to compensate for the fact that the class interval £30 is 150% of the standard size.
- In this case the height of the bar corresponds to frequency
- Density and the y axis is labelled as such.

# Histograms – Example continued

- Our histogram therefore looks like this.



# Ogives - 1

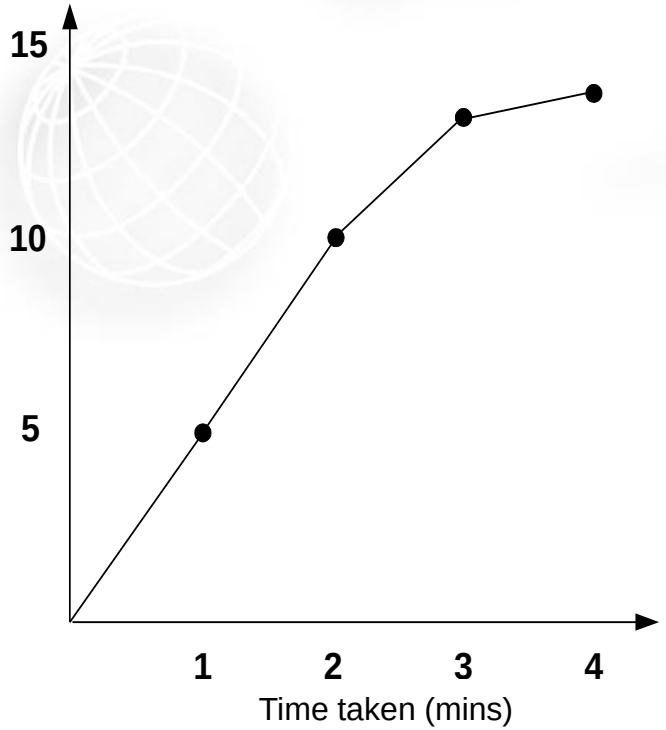
- Cumulative frequency is a running total of all the data up to a certain point.
- When the data in a frequency distribution is continuous, a cumulative frequency diagram or graph (also known as an ogive) can be drawn.
- Consider the following data from a factory:

Time taken to quality check a unit made

| Time taken (mins) | Frequency | Cumulative Frequency |
|---|---|---|
| $0<t\leq 1$ | 5 | 5 |
| $1<t\leq 2$ | 5 | 10 |
| $2<t\leq 3$ | 3 | 13 |
| $3<t\leq 4$ | 1 | 14 |

# Ogives - 2

- The cumulative frequency graph (ogive) of this distribution would be represented thus:




- The ogive is drawn by plotting the cumulative frequencies on the graph and joining them with straight lines.
- Ogives are more accurately produced by a curved line.
- The cumulative frequencies are plotted against the upper limits of the class.

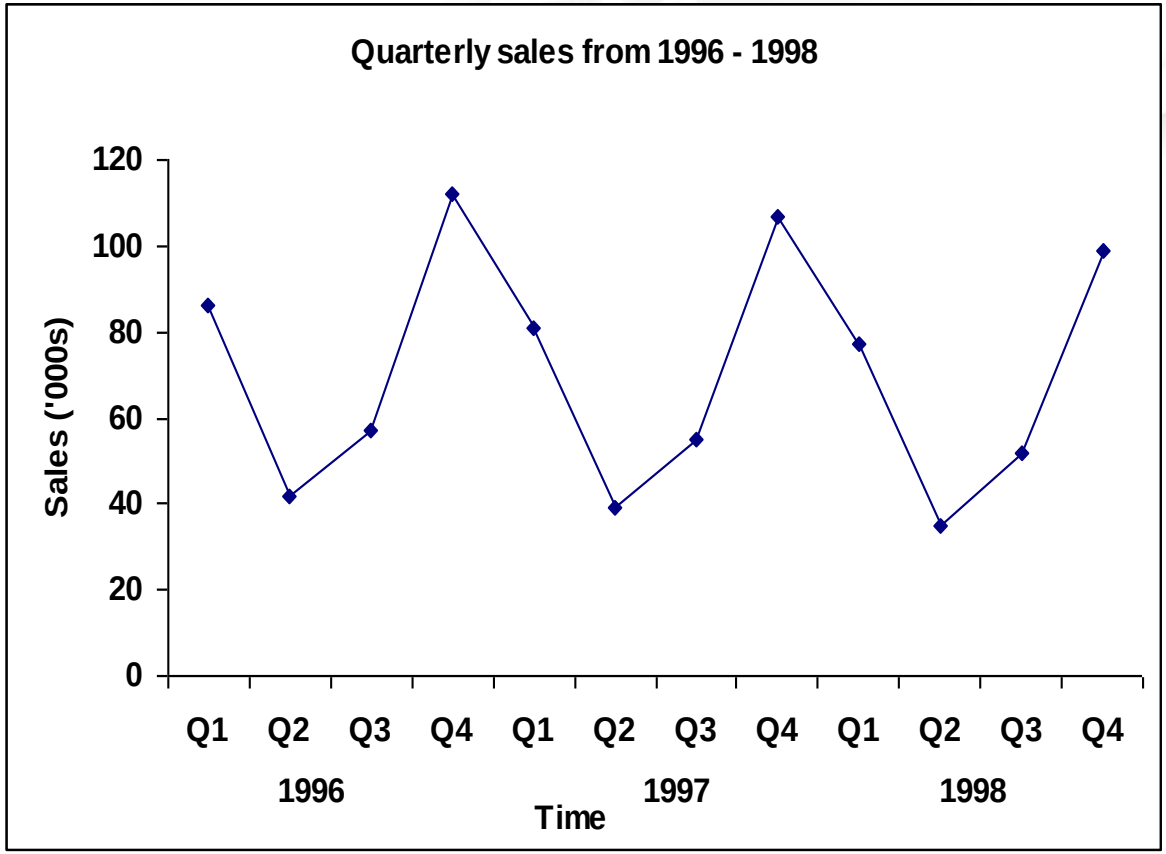
# Time Series Graphs - 1

- A time series is a series of figures or values recorded over time.
- An example of such a graph is commonly used in the representation of sales figures over a particular time period.
- Quarterly sales figures of trainers in the period 1996-1998

| Year | Quarter 1 Sales '000s | Quarter 2 Sales '000s | Quarter 3 Sales '000s | Quarter 4 Sales '000s |
|---|---|---|---|---|
| 1996 | 86 | 42 | 57 | 112 |
| 1997 | 81 | 39 | 55 | 107 |
| 1998 | 77 | 35 | 52 | 99 |

# Time Series Graphs - 2

- The time series graph for this would appear as:




- This type of graph can easily be used to identify changes in the relationship between one variable over a defined time period.
- This can help in forecasting demand and also recruitment patterns

# Topic 6 – Presentation of Data 2

*Any Questions?*

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