Forecasting

- It would be very helpful to decision-makers if they had an idea of what is likely to happen in the future.
- It is possible to forecast using historical numerical data, e.g. sales figures
- This is known as TIME-SERIES ANALYSIS

Time-Series Analysis

- There are 4 stages involved in carrying out time-series analysis:

1) Identifying the trend

- This is the most important aspect, and requires businesses to identify what has been happening.

2) Identifying variations

- Recessions and booms within the economy will affect many types of business data, and thus must be accounted for.

3) Identifying seasonal/cyclical variations

- Some businesses are seasonal in nature, ie sales are higher in summer. These must also be accounted for.

4) Accepting random variations

- "freak" events do occur, and will affect businesses. E.g. September 11th 2001.

1) Identifying The Trend

- Time-series analysis is based on **historical data**
- Managers must identify whether the data shows a generally upward, downward, or constant trend
- Raw data, though, may make this very difficult
  - e.g. can you identify the trend in the sales figures given below?

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Sales (£m)	67	70	64	61	59	66	73	69	64	63	69	75	72

- To help them to do this businesses will "smooth out" the raw data by using MOVING AVERAGES
- The moving average is usually either 3-period or 4-period, depending how often the average is taken.

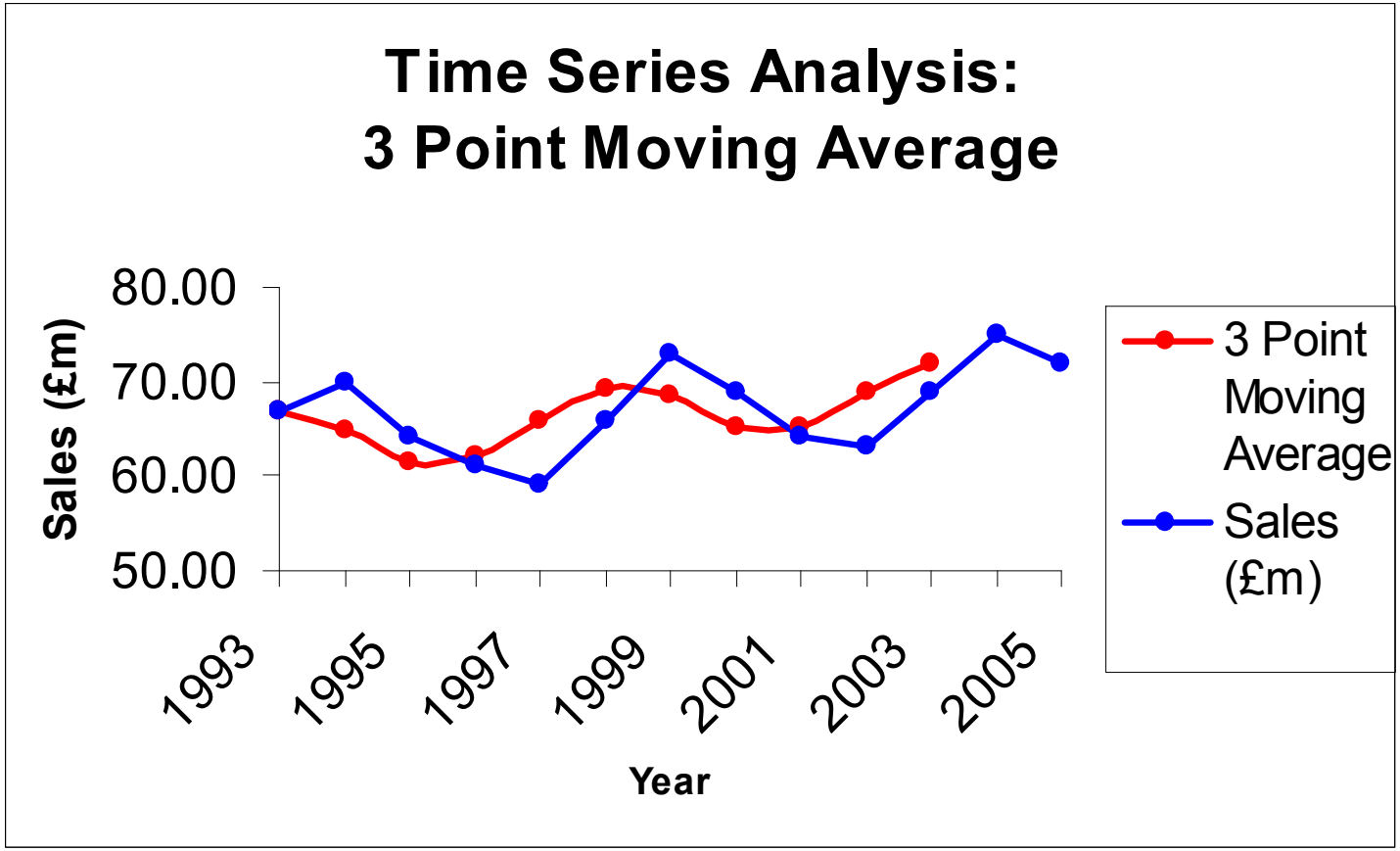
An Example 3 Period Moving Average

- The 3 period moving average is found by adding up every 3 pieces of data, and dividing by 3 to find the average.
- Using the previous data, we would calculate as follows:

Year	Sales (£m)	3 Point Total	3 Point Moving Average
1993	67		
1994	70	201	67.00
1995	64	195	65.00
1996	61	184	61.33
1997	59	186	62.00
1998	66	198	66.00
1999	73	208	69.33
2000	69	206	68.67
2001	64	196	65.33
2002	63	196	65.33
2003	69	207	69.00
2004	75	216	72.00
2005	72		

A Graphical Representation

- It is then possible to plot both the original and trend data, to see how the data has been "smoothed out":



An Example 4 Period Moving Average

- A 4 period moving average is often used because it “smoothes” the data out further
- The 4 period moving average is more complex, since no one period is the centre period.
- The solution is to use CENTRING
  - Centring requires the calculation of the 4 and 8 year moving totals in order to find a mid-point.
  - It is then necessary to find the average by dividing the totals by 8
- Using the previous data, we would calculate the 4 period moving average as follows:

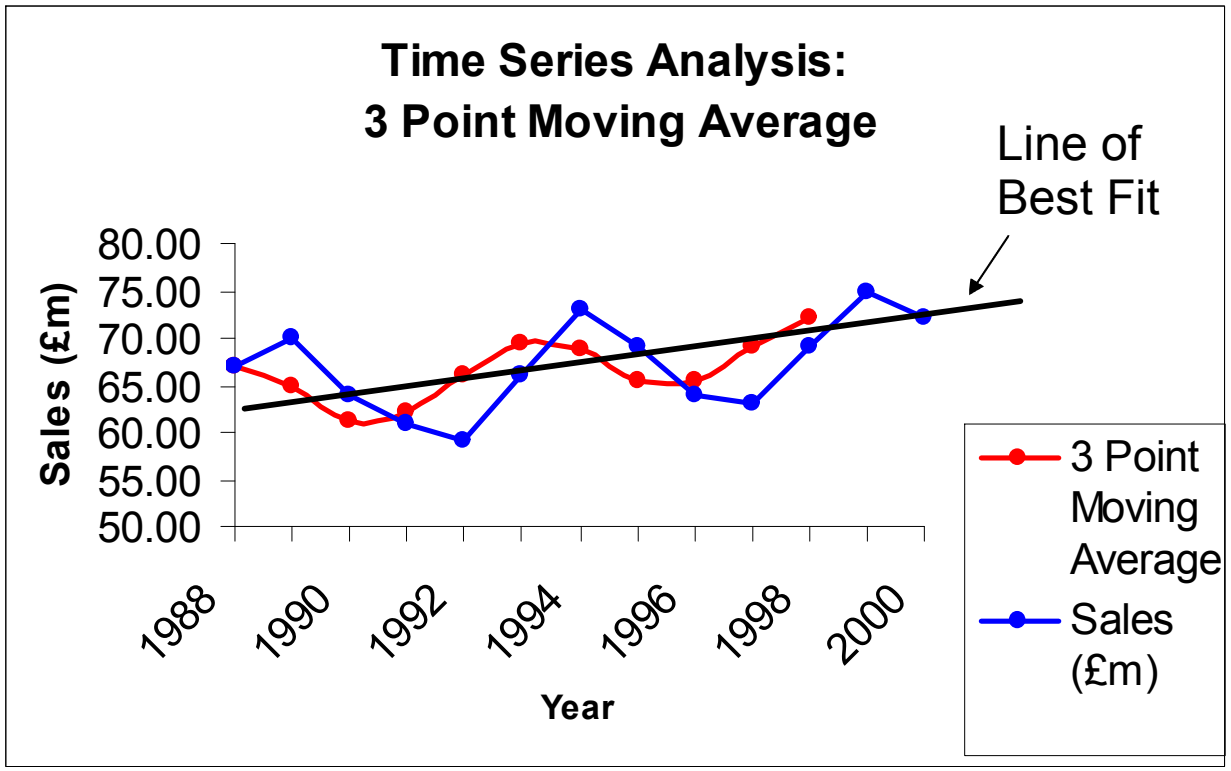
Year	Sales (£m)	4 Point Total	8 Point Total	4 Point Moving Average
1993	67			
1994	70	262		
1995	64		516	64.50
1996	61	254	504	63.00
1997	59	250	509	63.63
1998	66	259	526	65.75
1999	73	267	539	67.38
2000	69	272	541	67.63
2001	64	269	534	66.75
2002	63	265	536	67.00
2003	69	271	550	68.75
2004	75	279		
2005	72			

An Example 4 Period Moving Average

- If required this data could also be shown graphically

Forecasting From the Trend

- Having calculated the trend, and illustrated it graphically, it is a simple matter of drawing “a line of best fit”, and extending it to forecast future figures.
- Eg, using our earlier graph:



It is then a simple case of taking a reading from the line of best fit to obtain a future forecast

The Variations

- A reading from the line of best fit is unlikely to be accurate because it does not consider variations in the data, e.g. raw data is rarely plotted as a straight line!
- In order to account for these, and obtain more accurate forecasts it is necessary to calculate the variation.
- This is calculated using the formula:

Variation = Actual Data - Trend Data

Calculating The Variations

- The variations of our earlier 3 period moving average example would be:

Year	Sales (£m)	3 Point Total	3 Point Moving Average	Variation
1988	67			
1989	70	201	67.00	3.00
1990	64	195	65.00	-1.00
1991	61	184	61.33	-0.33
1992	59	186	62.00	-3.00
1993	66	198	66.00	0.00
1994	73	208	69.33	3.67
1995	69	206	68.67	0.33
1996	64	196	65.33	-1.33
1997	63	196	65.33	-2.33
1998	69	207	69.00	0.00
1999	75	216	72.00	3.00
2000	72			

The Average Variation

- Having calculated the variations it is necessary to add them together, before dividing by the number of variations.
- This will give us the average variation

Cyclical Variation
3.00
-1.00
-0.33
-3.00
0.00
3.67
0.33
-1.33
-2.33
0.00
3.00
2.00

- In our example the average variation would be:

  2.00/11 = 0.182Million

  = 182,000 units

- This means that any reading obtained from a line of best fit would have 182,000 units added.
- In theory this should yield a more accurate forecast

The Seasonal Variation

- Many businesses will sell products that sell better at some times of the year than other. ie they have seasonal products
- In this case it is often better to calculate the seasonal variation (sometimes called cyclical) rather than the variation
- Take an example of an ice-cream company, whose sales are given below
- The first step is to calculate a 4 period moving average

Year	2002				2003				2004				2005			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Sales (£000s)	120	140	190	130	130	160	220	160	130	170	240	170	160	190	250	180

Calculating The Seasonal Variation

- The trend and variation for this data would be as follows:

Year	Quarter	Sales (£000s)	4 Point Total	8 Point Total	4 Point Moving Average	Variation
2002	1	120				
	2	140	580			
	3	190	590	1170	146.25	43.75
	4	130	610	1200	150.00	-20.00
2003	1	130	640	1250	156.25	-26.25
	2	160	670	1310	163.75	-3.75
	3	220	670	1340	167.50	52.50
	4	160	680	1350	168.75	-8.75
2004	1	130	700	1380	172.50	-42.50
	2	170	710	1410	176.25	-6.25
	3	240	740	1450	181.25	58.75
	4	170	760	1500	187.50	-17.50
2005	1	160	770	1530	191.25	-31.25
	2	190	780	1550	193.75	-3.75
	3	250				
	4	180				

The average seasonal variation is then calculated by adding up the figures for corresponding quarters, and dividing by the number of pieces of data

Using The Seasonal Variation

- The seasonal variation for each quarter would be as follows:
  - **Quarter 1**

    (-26.25 + -42.5 + -31.25) / 3 = **-33.33**

    So all forecasts for quarter 1 would have £33,330 subtracted from them
  - **Quarter 2**

    (-3.75 + -6.25 + -3.75) / 3 = **- 4.58**

    So all forecasts for quarter 2 would have £4,580 subtracted from them
  - **Quarter 3**

    (43.75 + 52.5 + 58.75) / 3 = **51.67**

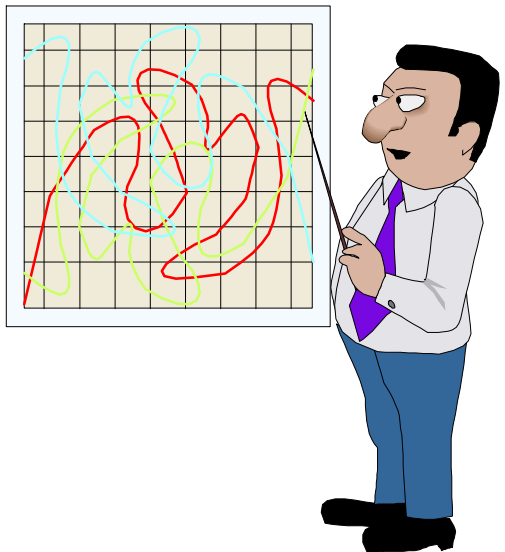
    So all forecasts for quarter 3 would have £51,670 added to them
  - **Quarter 4**

    (-20 + -8.75 + -17.5) / 3 = **- 15.42**

    So all forecasts for quarter 4 would have £15,420 subtracted from them

Advantages of Using Time Series Analysis

- It is useful for identifying seasonal variations, which can help planning at different times of the year
- It can be reasonably accurate in the short-term if the firm is in a stable environment
- The line of best fit can be drawn quite correctly in varying positions (some would say this is a disadvantage!)



Disadvantages of Using Time Series Analysis

- It is a long-winded, and complex process, particularly if 4 period moving averages are used
- Historical data is not always a good indication of what might happen in the future
- It is not very useful for long-term forecasting