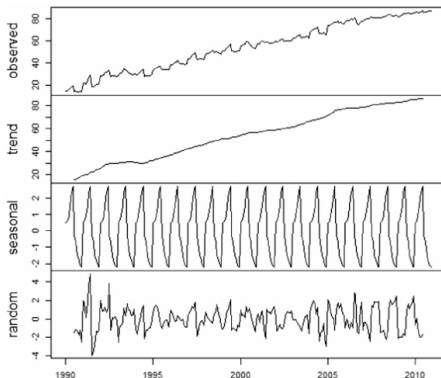

Quantitative sales forecasting

2017-18

CALCULATING TIME SERIES DATA

4 main components that a business wants to identify in time series:

- ▶ *trend*
- ▶ *seasonal fluctuations*
- ▶ *cyclical fluctuations*
- ▶ *random fluctuations*



IDENTIFYING THE TREND

- ▶ Trend helps to *predict* future values
- ▶ Calculation of trend using *moving average* method

Table 2 Yearly sales of a garden furniture manufacturer

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Sales (£ 000)	125	130	130	150	140	155	180	190	210	230

- ▶ First *three-year average* of sales:

$$\frac{125 + 130 + 130}{3} = \frac{385}{3} = 128.3$$

- ▶ Next *three-year average* of sales:

$$\frac{130 + 130 + 150}{3} = \frac{410}{3} = 136.7$$

- ▶ Continue this process by moving the *window* step-by-step to the right end

Table 3 Three-year moving average for sales of a garden furniture manufacturer

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Sales (£000)	125	130	130	150	140	155	180	190	210	230
		128.3	136.7	140	148.3	158.3	175	193.3	210	

Table 4 Centring

Year	2006	2007	2008	2009	2010
Sales (£ 000)	125	130	130	150	140

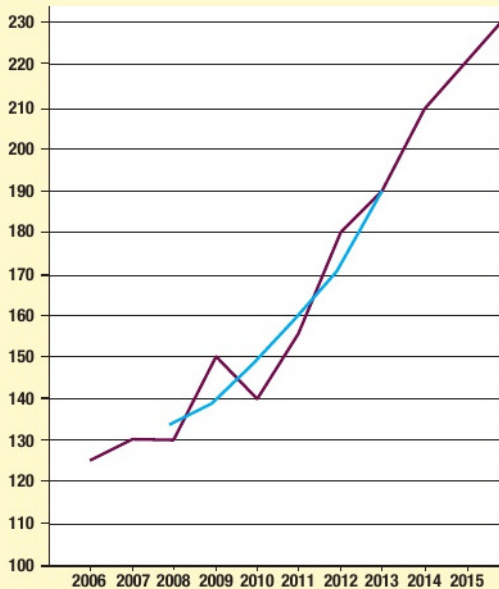
$535 + 550 = 1085$
(Four-year moving totals) (Eight-year moving total)

Table 5 Calculating a four-year moving average for a garden furniture manufacturer

Year	Sales	Four-year moving total	Eight-year moving total	Trend (Four-year centred moving average = Eight-year moving total / 8)
2006	125			
2007	130			
2008	130	535	1,085	135.63
2009	150		1,125	140.63
2010	140	550	1,200	150
2011	155	575	1,290	161.25
2012	180	625	1,400	175
2013	190	665	1,535	193.13
2014	210	735		
2015	230	810		

Annual sales of a garden furniture manufacturer

Sales
(£000)



PREDICTING THE LINE OF BEST FIT FROM THE TREND

- ▶ Assumptions made by business before constructing the forecast:
 1. No other *factors* are likely to have changed to affect the trend
 2. Sales figures are predicted by *drawing a line (line of best fit)* through the trend figures
- ▶ The *fitted line* should pass through the coordinates (X, Y) , where X is the average of the years and Y is the average sales:

$$\begin{aligned}\bar{X} &= \frac{\sum X(\text{the total years})}{N(\text{the number of years})} \\ &= \frac{2008 + 2009 + 2010 + 2011 + 2012 + 2013}{6} \\ &= \frac{12063}{6} = 2010.5\end{aligned}$$

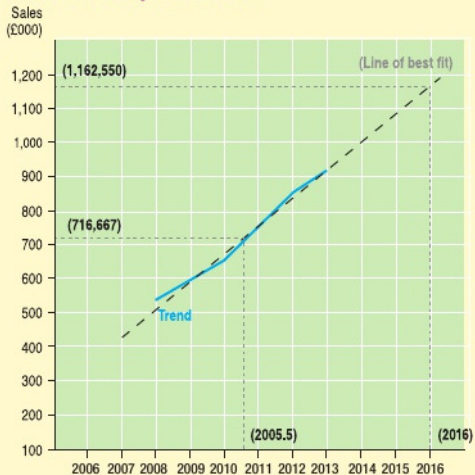
PREDICTING THE LINE OF BEST FIT FROM THE TREND

$$\begin{aligned}\bar{Y} &= \frac{\sum Y(\text{the total sales in the trend})}{N(\text{the number of years})} \\ &= \frac{525000 + 593750 + 656250 + 756250 + 850000 + 918750}{6} \\ &= \frac{4300000}{6} = 716667\end{aligned}$$

Table 7 Four-year moving average and trend for a toy manufacturer

Year	Sales	Four-year moving total	Eight-year moving total	Trend (Four-year centred moving average = Eight-year-moving total / 8)
2006	300			
2007	500			
2008	600	1,950	4,200	525.00
2009	550	2,250	4,750	593.75
2010	600	2,500	5,250	656.25
2011	750	2,750	6,050	756.25
2012	850	3,300	6,800	850
2013	1,100	3,500	7,350	918.75
2014	800	3,850		
2015	1,100			

Annual sales of a toy manufacturer



VARIATIONS FROM THE TREND

Table 8 Cyclical variations

			(£000)
Year	Sales	Trend (four-year centred moving average)	Variation in each year
2006	300		
2007	500		
2008	600	525.00	+75.00
2009	550	593.75	-43.75
2010	600	656.25	-56.25
2011	750	756.25	-6.25
2012	850	850.00	+/- 0
2013	1,100	918.75	+181.25
2014	800		
2015	1,100		

SEASONAL VARIATIONS

Table 9 Seasonal variations

				(£000)
Year	Quarter	Sales	Four-quarter moving average	Variation
2012	3	460		
	4	218		
2013	1	205	328.5	-123.5
	2	388	346.0	+42.0
	3	546	358.25	-187.75
	4	272	369.125	-97.125
2014	1	249	383.625	-134.625
	2	431	396.625	+34.375
	3	619	404.0	+215.0
	4	303	420.5	-117.5
2015	1	277		
	2	535		

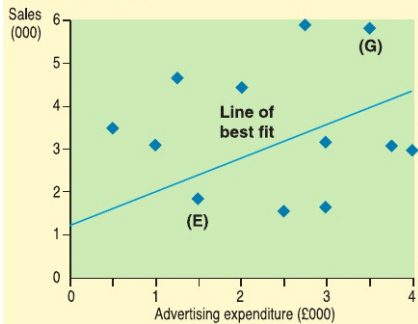
THE LIMITATIONS OF QUANTITATIVE SALES FORECASTS

CAUSAL MODELLING AND LINE OF BEST FIT

Table 11 Advertising and sales data

Period	Advertising expenditure (£000)	Sales (000)	(£million)	(million)	(£million)
	X	Y	X^2	Y^2	XY
A	1.0	3.2	1.0	10.24	3.2
B	2.0	4.5	4.0	20.25	9.0
C	3.0	1.8	9.0	3.24	5.4
D	4.0	3.0	16	9.0	12.0
E	1.5	1.8	2.25	3.24	2.7
F	2.5	1.6	6.25	2.56	4.0
G	3.5	5.8	12.25	33.64	20.3
H	1.2	4.7	1.44	22.09	5.64
I	2.7	5.9	7.29	34.81	15.93
J	3.0	3.5	9.0	12.25	10.5
K	3.6	3.1	12.96	9.61	11.16
L	7.0	3.5	0.49	12.25	2.45
			$\Sigma X^2 = 81.93$	$\Sigma Y^2 = 173.18$	$\Sigma XY = 102.28$

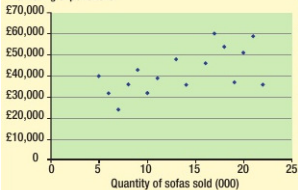
Advertising and sales data



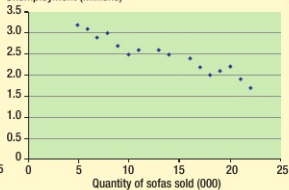
QUALITATIVE FORECASTING

A weak positive correlation, a strong negative correlation and little or no correlation

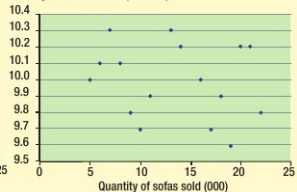
Marketing expenditure



Unemployment (Millions)



Quantity of baked beans (Millions)



KEY TERMS

- ▶ **Centring:** a method used in the calculation of a moving average where the average is plotted or calculated in relation to the central figure
- ▶ **Correlation:** the relationship between two sets of variables
- ▶ **Correlation coefficient:** a measure of the extent of the relationship between two sets of variables
- ▶ **Moving average:** a succession of averages derived from successive segments (typically of constant size and overlapping) of a series of values
- ▶ **Scatter graph:** a graph showing the performance of one variable against another independent variable on a variety of occasions. It is used to show whether a correlation exists between the variables.
- ▶ **Time series analysis:** a method that allows a business to predict future levels from past figures

KEY TERMS

REVISION OF CHAPTER 15

- ▶ **Curriculum vitae:** A document that lists personal details, qualifications, work experience, referees and other information about the jobseeker
- ▶ **External recruitment:** Appointing workers from outside the business
- ▶ **Induction training:** Training given to new employees when they first start a job
- ▶ **Internal recruitment:** Appointing workers from inside the business
- ▶ **Job description:** A document that shows clearly the tasks, duties and responsibilities expected of a worker for a particular job

KEY TERMS

REVISION OF CHAPTER 15

- ▶ **Off-the-job training:** Training that takes place away from the work area
- ▶ **On-the-job training:** Training that takes place while doing the job
- ▶ **Person specification:** A personal profile of the type of person needed to do a particular job
- ▶ **Training:** A process that involves increasing the knowledge and skills of a worker to enable them to do their jobs more effectively

KEY TERMS

REVISION OF CHAPTER 16

- ▶ **Authority:** The right to command and make decisions
- ▶ **Centralisation:** A type of business organisation where major decisions are made at the center or core of the organisation and then passed down the chain of command
- ▶ **Chain of command:** The way authority and power is organised in an organisation
- ▶ **Decentralisation:** A type of business organisation where decision making is pushed down the chain of command and away from the center of the organisation
- ▶ **Delayering:** Removing layers of management from the hierarchy of an organisation

KEY TERMS

REVISION OF CHAPTER 16

- ▶ **Delegation:** Authority to pass down from superior to subordinate
- ▶ **Formal organisation:** The internal structure of a business as shown by an organisational chart
- ▶ **Hierarchy:** The order or levels of responsibility in an organisation, from the lowest to the highest
- ▶ **Organisational chart:** A diagram that shows the different job roles in a business and how they relate to each other
- ▶ **Responsibility:** The duty to complete a task
- ▶ **Span of control:** The number of people a person is directly responsible for in a business
- ▶ **Subordinates:** People in the hierarchy who work under the control of a senior worker