Example 2

The sales figures, in thousands of dollars, for a small business over the last three years is tabled below:

Time Period	Jan-Mar 2014	Apr-Jun 2014	Jul-Sep 2014	Oct-Dec 2014	Jan-Mar 2015	Apr-Jun 2015	Jul-Sep 2015	Oct-Dec 2015
Sales($'000)	15	12	8	14	16	13	10	16

Time Period	Jan-Mar 2016	Apr-Jun 2016	Jul-Sep 2016	Oct-Dec 2016
Sales($'000)	18	14	10	15

(a) Construct a time series plot for the given sales data.
(b) Describe the time series plot in terms of its trend, seasonal, cyclic or random patterns.

SOLUTION

(a) The required time series plot is shown below.
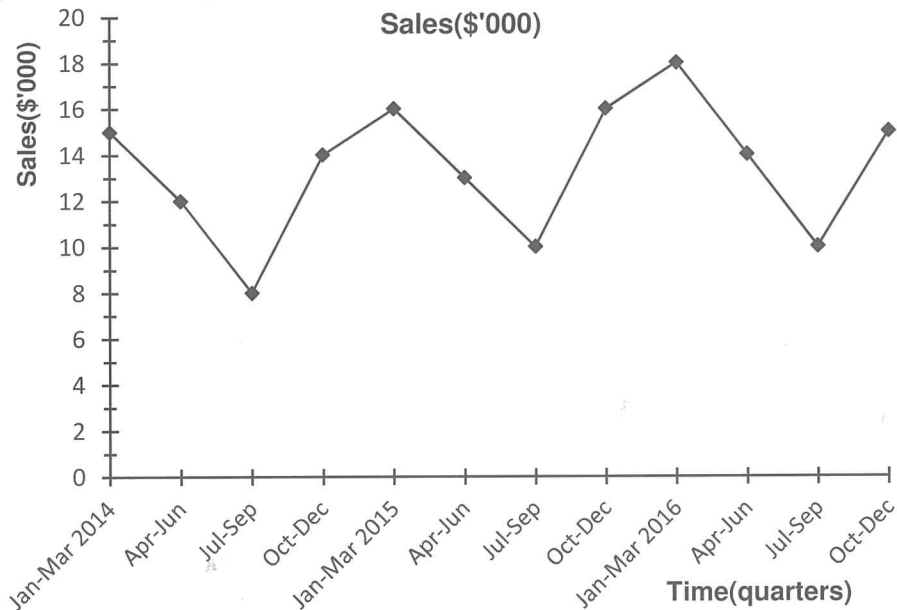
(b) The time series plot shows a slight positive trend with a seasonal pattern of period 4, peaking during the Jan-Mar quarters
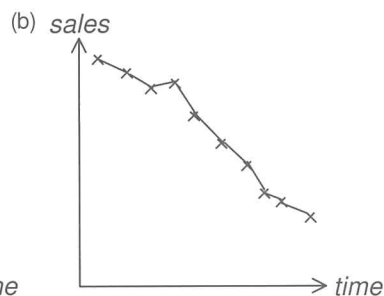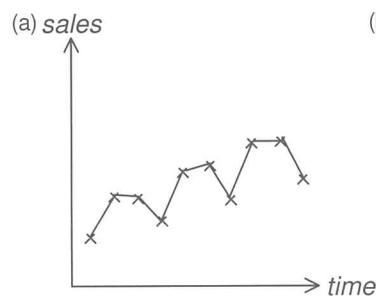
EXERCISE 1A

1.   Examine each of the following time series and match each times series graph with one of the following data patterns.

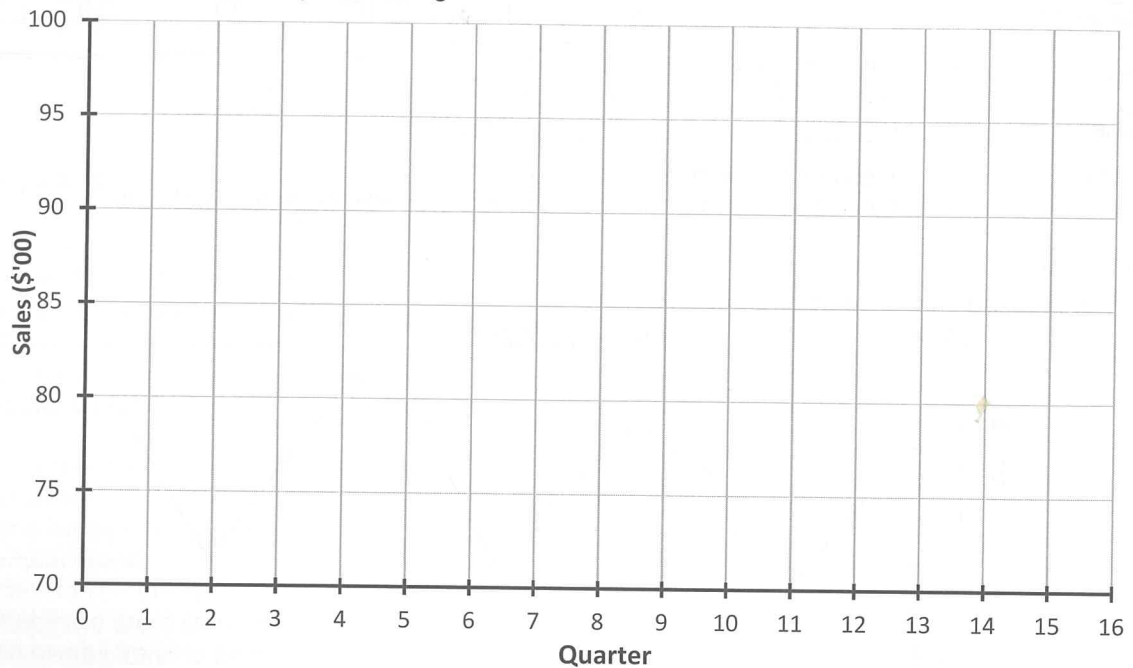Secular trend pattern,   Seasonal pattern,   Cyclic pattern,   Random pattern.

2.   The sales figures for a small business over the last three years are tabled below.

Quarter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Sales($'00)	98	84	94	97	83	92	96	82	92	95	81	91	94	80	90	94

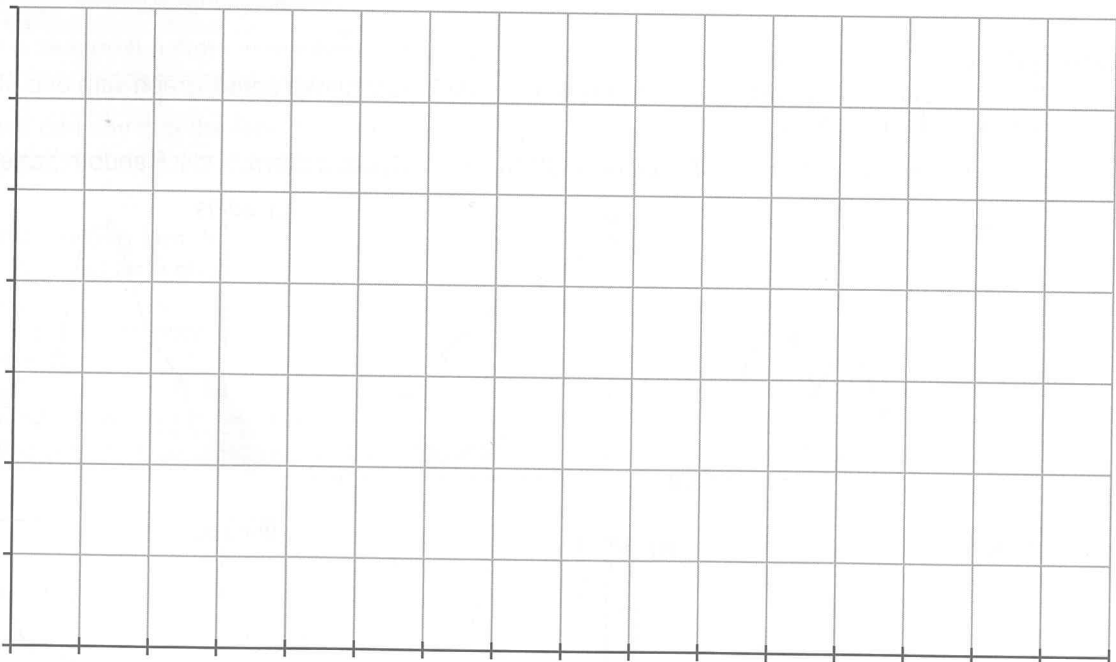(a) Construct a time series plot for the given sales data.

(b) Describe the time series plot in terms of its trend, seasonal, cyclic or random patterns.

3.   The sales figures for a small business over the last three years are tabled below.

Quarter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Sales($'00)	88	84	75	89	92	89	80	94	96	93	83	97	100	96	87	101

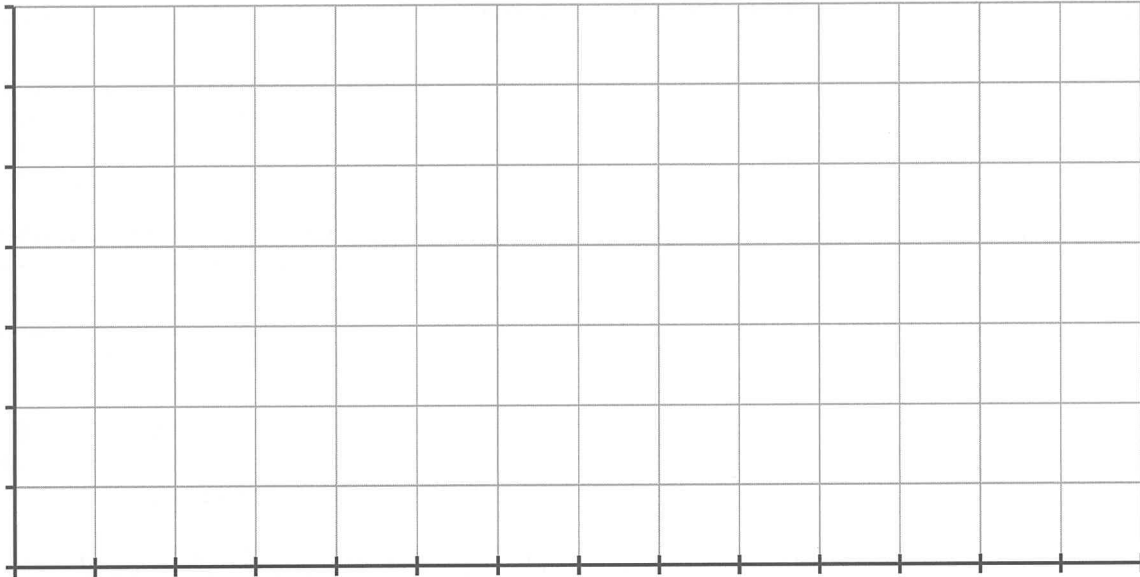(a) Construct a time series plot for the given sales data

(b) Describe the time series plot in terms of its trend, seasonal, cyclic or random patterns.

4.   The profit figures for ABC Company from 1989 to 2003 have been tabled below.

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997
Profit($'000)	48	49	49.5	49	50	49.5	50	51	50

Year	1998	1999	2000	2001	2002	2003
Profit($'000)	51.5	50.5	52	51	52	51.5

(a) Construct a time series plot for the given profit data.

(b) Describe the time series plot in terms of its trend, seasonal, cyclic or random patterns.

5.   The table gives the monthly number of motorbike accidents in a city during 2012 – 2013.

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. of accidents	18	14	6	48	43	41	9	6	5	15	20	47

2013	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. of accidents	25	30	36	28	14	10	24	58	16	26	26	15

(a) The data for the first six months of 2012 has been plotted. Complete the time series plot for 2012 – 2013.
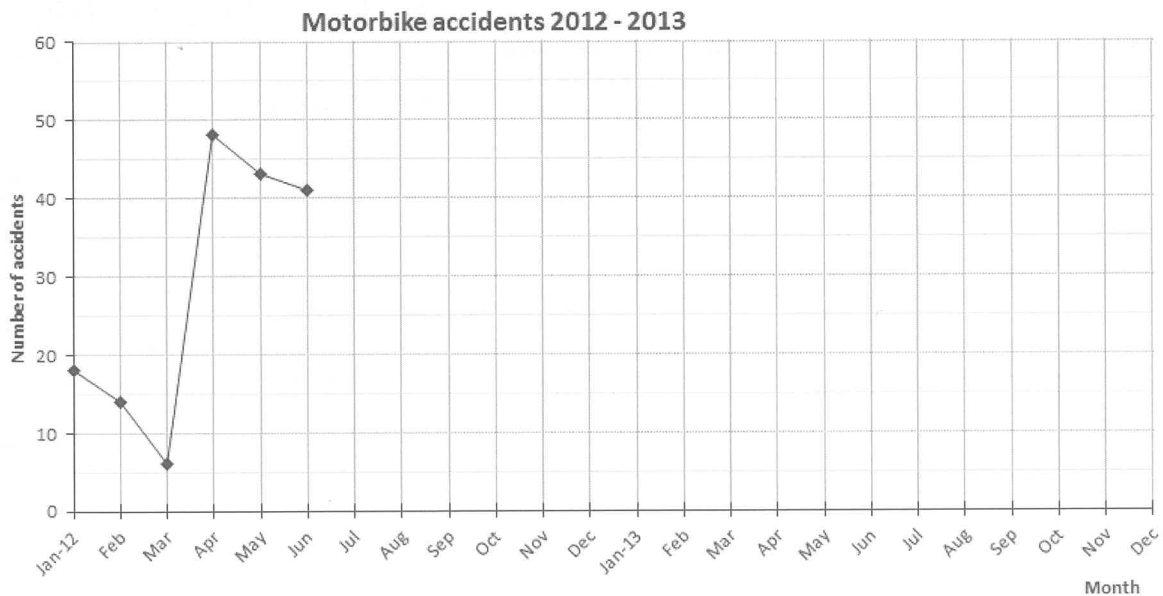
Motorbike accidents 2012 - 2013

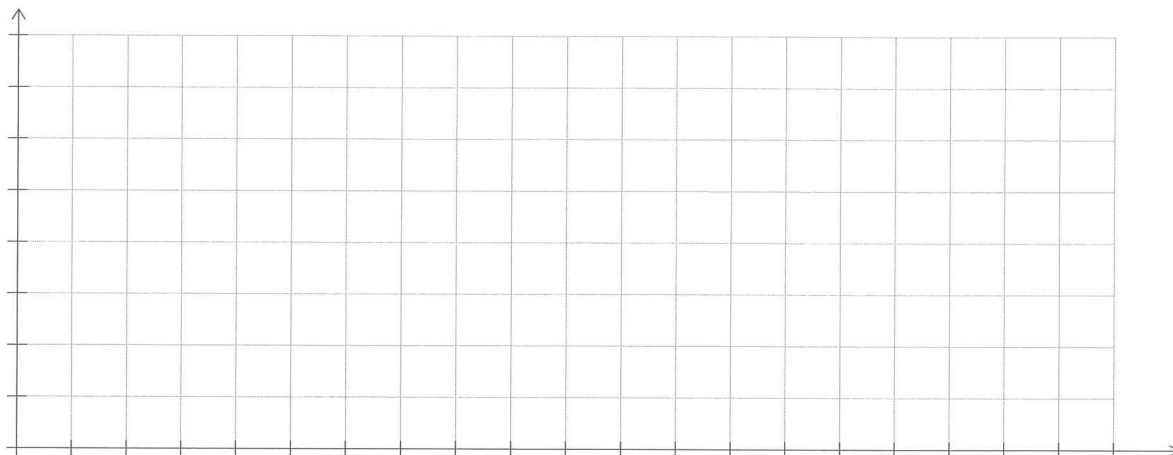(b) Does the time series plot exhibit a secular trend? If so, state the type of secular trend.

(c) Does the time series show a seasonal, cyclic or irregular pattern? Justify your response.

6.   The table shows the number (hundreds) of television sets sold by Retravision Sales from 1993
         through 2013.

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Sales ('00)	49	50	49	35	41	43	35	36	38	45	47

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Sales('00)	50	53	52	49	50	47	51	60	61	65

(a) Construct a time series plot for the given sales data.

(b) Does the time series plot exhibit a secular trend? If so, state the type of secular trend.

(c) Does the time series show a seasonal, cyclic or irregular pattern? Justify your response.

7.   The table shows the quarterly sales, reported in millions of dollars, for i-phone International for the
         years 2012 through 2015.

Year	March 2012	June 2012	September 2012	December 2012	March 2013	June 2013	September 2013	December 2013
Sales	5.7	3.8	11	12.9	5.8	5	12.4	13.8

Year	March 2014	June 2014	September 2014	December 2014	March 2015	June 2015	September 2015	December 2015
Sales	7	6	12	13.2	8	7.5	13	14.5

(a) Construct a time series plot for the given sales data.

(b) Identify any trends or patterns in your time series plot.

EXERCISE 1B

1. (a) For the time series given below, determine and enter the 5 point moving averages.

Time period (t)	Sales	ma 5
1	12	
2	9	
3	8	
4	11	
5	11	
6	10	
7	7	
8	4	
9	9	
10	9	
11	8	
12	5	
13	4	
14	7	
15	7	

(b) Using a spread sheet, either on your calculator or computer to verify your moving averages.
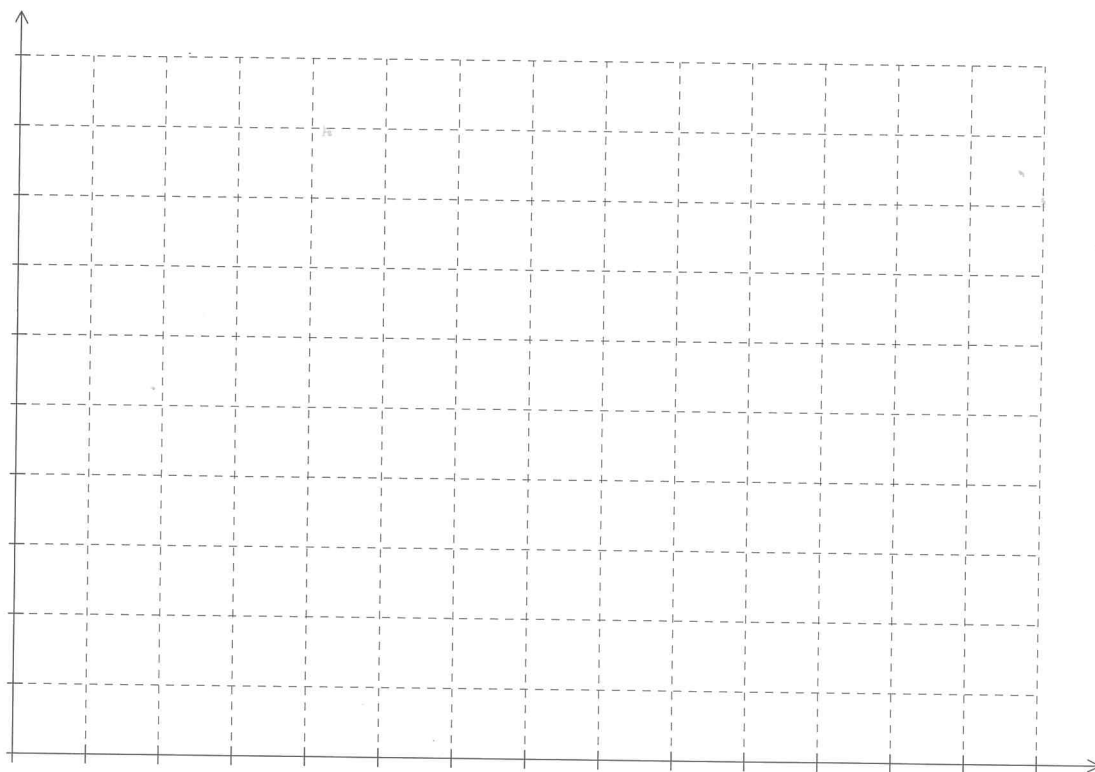(c) Graph the given data and the 5 point moving averages on the axes below.
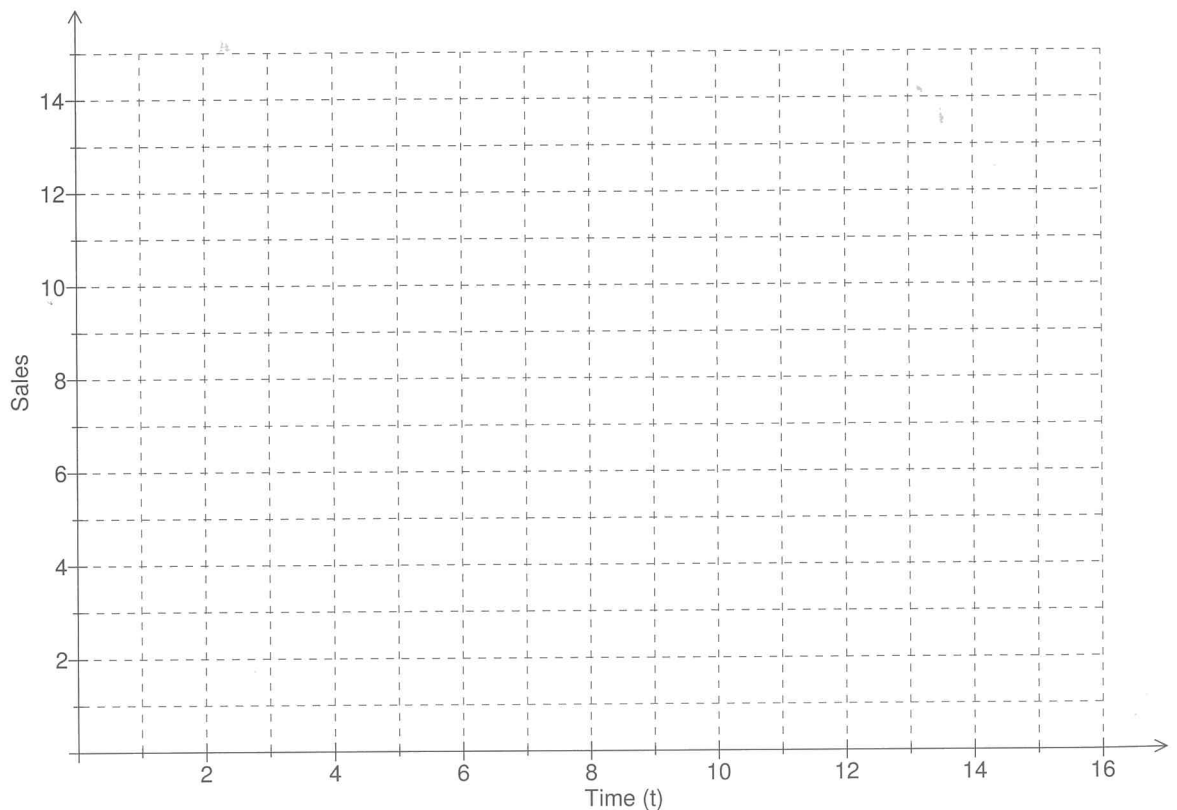
(d) State why the 5 point moving average had been used to smooth the time series.

(e) Comment on the trend of the smoothed data.

2.   For the time series shown below complete the table by calculating the 3 point moving averages.

Time period (t)	Sales	ma 3
1	39	
2	21	
3	9	
4	36	
5	18	
6	7	
7	35	
8	18	
9	6	
10	33	
11	16	
12	5	

(b) Using a spread sheet, either on your calculator or computer to verify your moving averages.
(c) Graph the given data and the 3 point moving averages on the axes below.

(d) State why the 5 point moving average had been used to smooth the time series.

(e) Comment on the trend of the smoothed data.

3.

(a) Graph the given time series data on the axes below.

(b) Examine your graph and determine the moving average that should be used to smooth the data. Justify your choice.

(c) Complete the time series table by adding the appropriate moving averages.

(d) Graph the trend line using your moving averages.

(e) Comment on the trend of the smoothed data.

Day	Sales	ma
1	63	
2	91	
3	7	
4	147	
5	203	
6	196	
7	56	
8	70	
9	98	
10	28	
11	154	
12	231	
13	217	
14	70	
15	77	
16	98	
17	35	
18	161	
19	245	
20	224	
21	56	
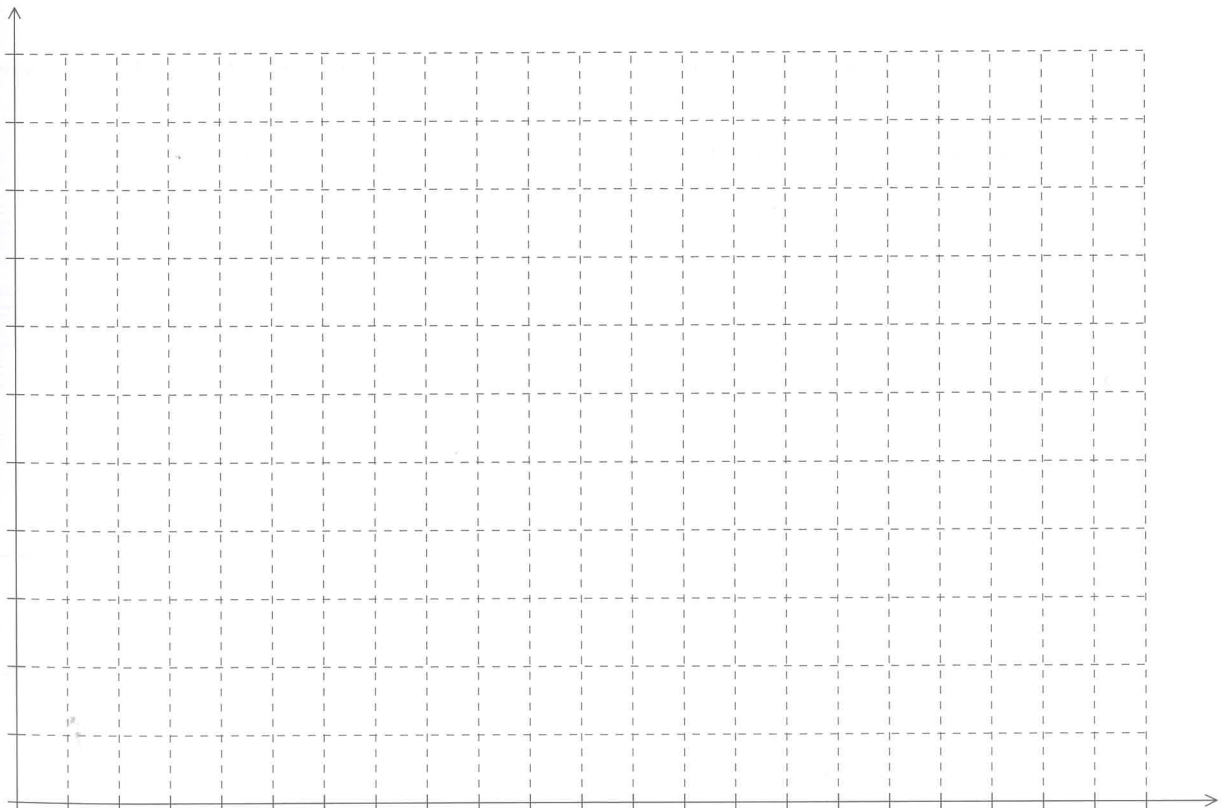
4.   Consider the following sales data.

Time (t) (Quarters)	1	2	3	4	5	6	7	8	9	10	11	12
Sales (S) ($'000)	2.6	3.6	3.4	2.9	3.7	3.6	2.9	4.0	3.9	3.2	4.6	4.2

(a) On the give axes graph the time series data.
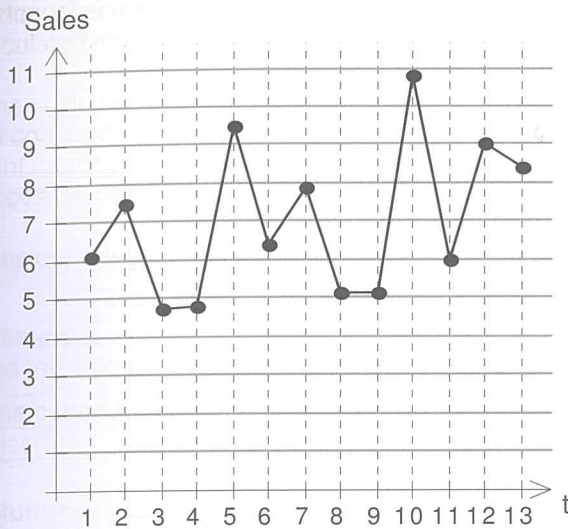
(b) What moving average should be used to smooth the data? Why?

(c) Complete the table below by determining the appropriate moving averages. Graph the moving
       averages on the observed time series graph.

Time period (t)	Sales	ma
1	39	
2	21	
3	9	
4	36	
5	18	
6	7	
7	35	
8	18	
9	6	
10	33	
11	16	
12	5	

(d) Comment on the trend revealed by the moving averages.

5.   Consider the following time series.

(a) For the graph identify the period of seasonal variation.

(b) Comment on the long term trend of the given given data.

(c) What moving average would you use to smooth this data. Give reason(s) for your choice.

6.   The following table shows the share price of a mining company over a period of 4 years.

Period		Time period (t)	Price (cents)	3 ma
2012	April	1	35	
	August	2	44	39
	December	3	38	44
2013	April	4	50	40
	August	5	32	45
	December	6	p	41
2014	April	7	q	46
	August	8	47	42
	December	9	41	43
2015	April	10	41	r
	August	11	50	43
	December	12	38	

(a) Find the values p, q and r.

(b) On the axes below plot the time series data and the moving averages.
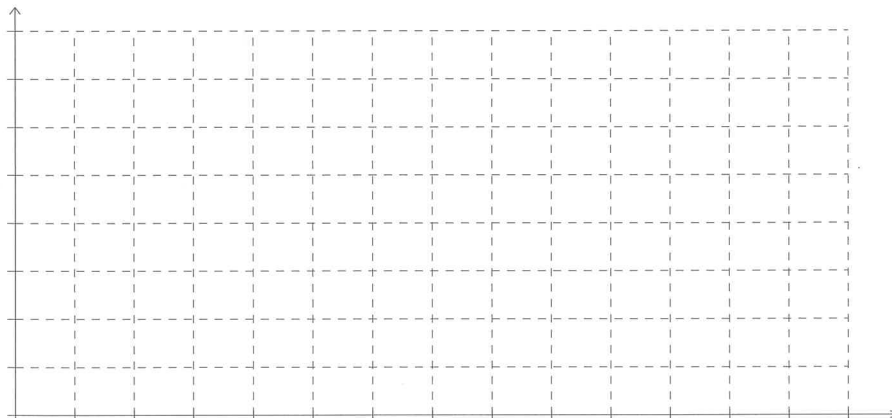
(c) The moving average smooths the time series data by removing the seasonal variation to reveal the underlying trend. Comment on how effective the 3 ma has been in smoothing the share prices.

7.   A new product is released onto the market with a big advertising campaign. The table shows the number of orders and the moving averages of this product after the advertising campaign is launched

Day (d)	Number of orders	Moving Average
1	44	
2	35	
3	40	40.0
4	41	38.0
5	40	36.2
6	34	33.8
7	26	31.8
8	28	29.6
9	31	27.0
10	29	25.0
11	21	B
12	16	20.0
13	17	17.0
14	17	15.0
15	A	
16	11	

(a) Calculate the missing values A and B

(b) On the give axes graph the time series data.

(c) Describe any pattern evident from your graph.

(d) What moving average has been used to smooth the time series data? Justify your response.

(e) Draw the trend line given by the moving averages on your graph.