EXERCISE 1C

1.   (a) On the axes below graph the given time series data.

(b) For the time series shown on the right, enter the missing 4 point moving averages labelled a through to f.

(c) State why 4 point moving averages have been used to smooth the time series.

(d) If possible graph the 4 point moving averages on the axes below. If not possible, explain why.

(e) What problem was encountered in graphing the ma 4? How can this problem be overcome?

Time period(t)	Profit ($'000)	ma 4	cma 4
1	19		
2	37		
		a	
3	39		p
		b	
4	23		q
		31	
5	21		r
		31.75	
6	41		31.875
		32	
7	42		32.25
		32.5	
8	24		32.875
		33.25	
9	23		s
		34	
10	44		34.375
		c	
11	45		35
		35.25	
12	27		35.75
		d	
13	25		t
		e	
14	48		u
		f	
15	50		
16	31		

(f) Enter the missing centred 4 point moving averages labelled p through to u.

(g) Graph the 4 point centred moving averages on the axes below.
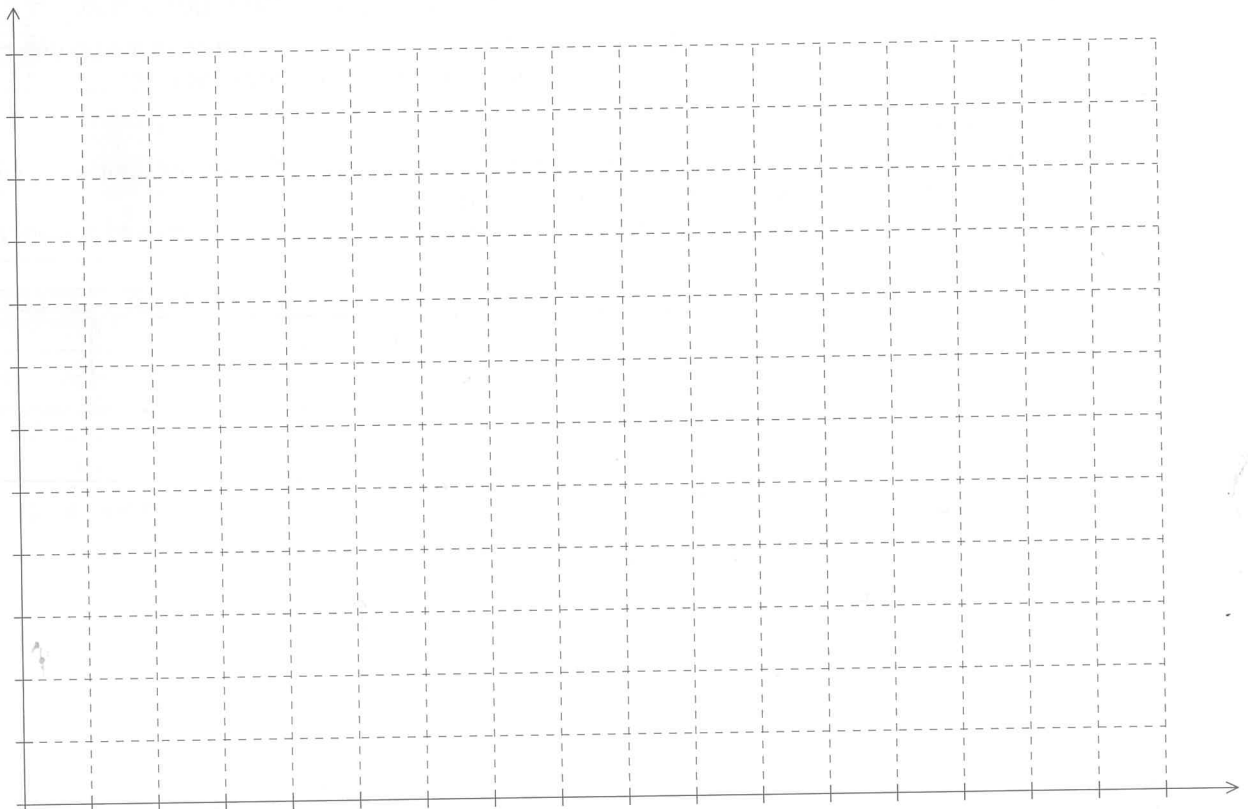
2. By carefully examining each time series shown below determine the most appropriate moving
    average which should be used to smooth the data.
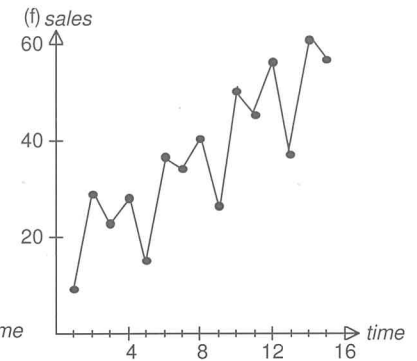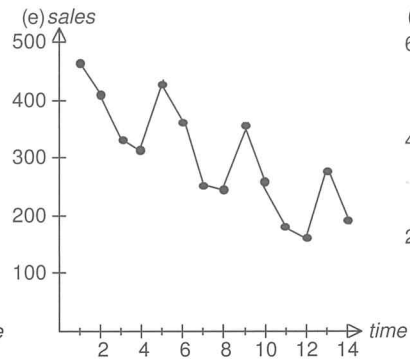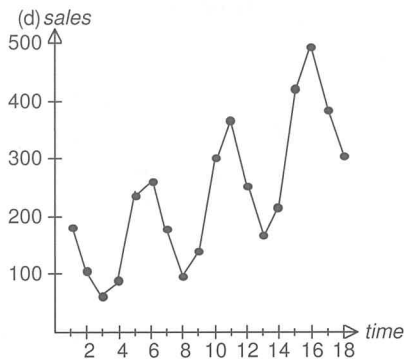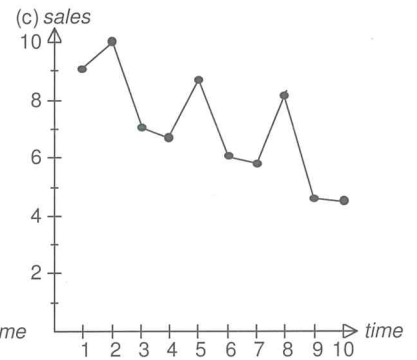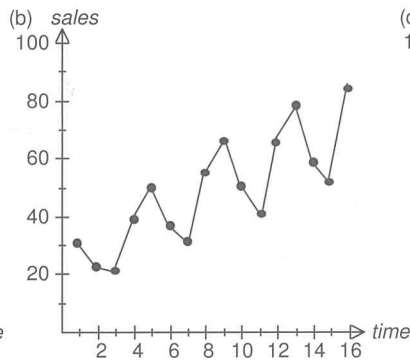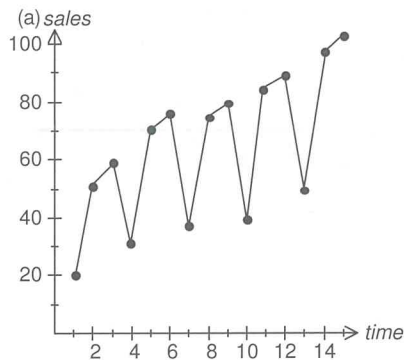
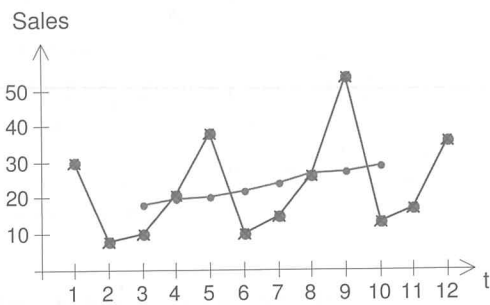(a)   (b)   (c)

(d)   (e)   (f)

3. (a) Complete the following table.

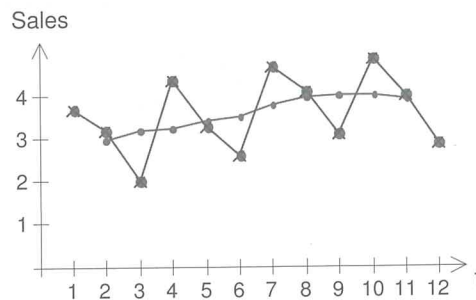| Time period	Sales($'000s)	ma 3	cma 4	ma 5	cma 6
1	36				
2	17				
3	13				
4	54				
5	26				
6	15				
7	10				
8	38				
9	21				
10	10				
11	8				
12	30				

(b) Use your calculator to graph the observed data and comment on any cycles or patterns in the
     data.

(c) As a result of your findings in (b) above, which moving average should be used to smooth the
     data?

(d) Graph the moving averages on the same set of axes as the observed data and verify your
     answer to (c) above.

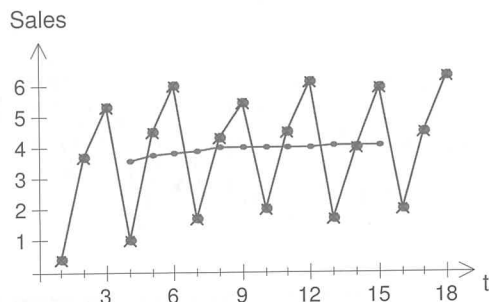4.   Each graph below shows the raw data and a moving average that has been used to smooth the raw data.
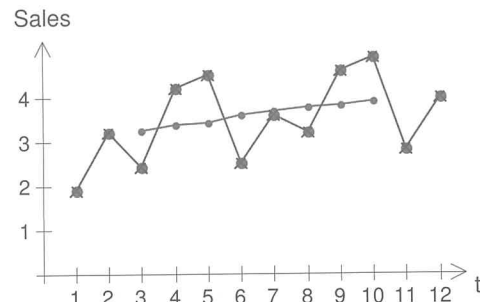
Graph A
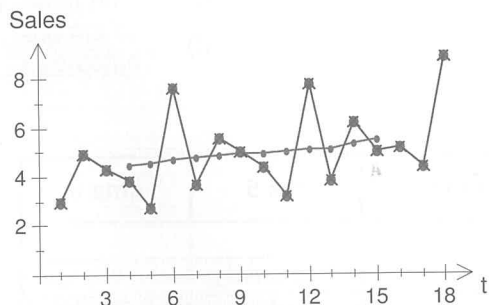
Sales

Graph B

Sales

Graph C

Sales

Graph D

Sales

Graph E

Sales

Graph F

Sales

(a) Time series data may display various patterns. The most common data patterns that have been found to occur are the secular trend pattern, seasonal pattern, cyclic pattern and the irregular or random pattern. Which pattern is demonstrated by each of the graphs A to F?

(b) Complete the table below:

	Graph A	Graph B	Graph C	Graph D	Graph E	Graph F
State the period of the time series						
Identify the moving average used						

(c) Which graphs have an inappropriate moving average? Why?

(d) For each time series describe with reasons the trend of the time series.

5.   (a) Find the values of x, y and z in the following time series.
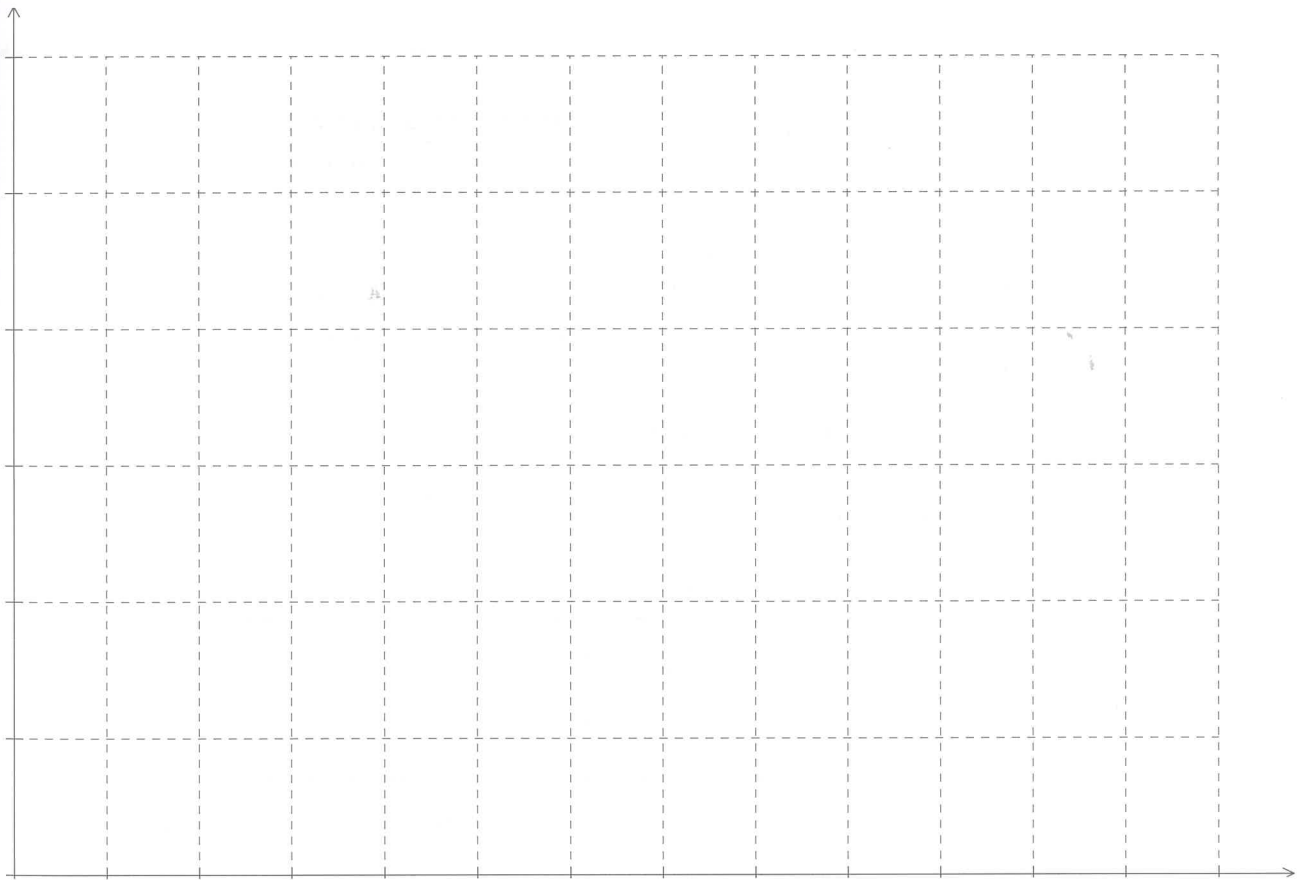
Time period	Sales	ma 3	cma 4
1	1824		
2	913	1138.6	
3	679	1431.6	1488
4	2703	1624	1427
5	1490	1650.6	1391.5
6	x	932.6	1272
7	549	y	1122.5
8	1893	1176.6	1042
9	1088	1166	z
10	517	676	936.5
11	423	827.6	
12	1543		

(b) On the axes below graph the times series data, the 3 point moving averages and the centred 4 point moving averages.

(c) Comment on the seasonality of the time series data. Justify your response.

(d) Is the underlying trend of the time series data decreasing, increasing or steady?

6.   The table below shows the quarterly sales of a particular commodity over the three year period 2015 to 2017.

	2015	2016	2017
1st Quarter	196	252	280
2nd Quarter	96	140	164
3rd Quarter	298	338	430
4th Quarter	522	594	742

(a) On the axes below graph the quarterly sale figures to identify the period of seasonal variation.
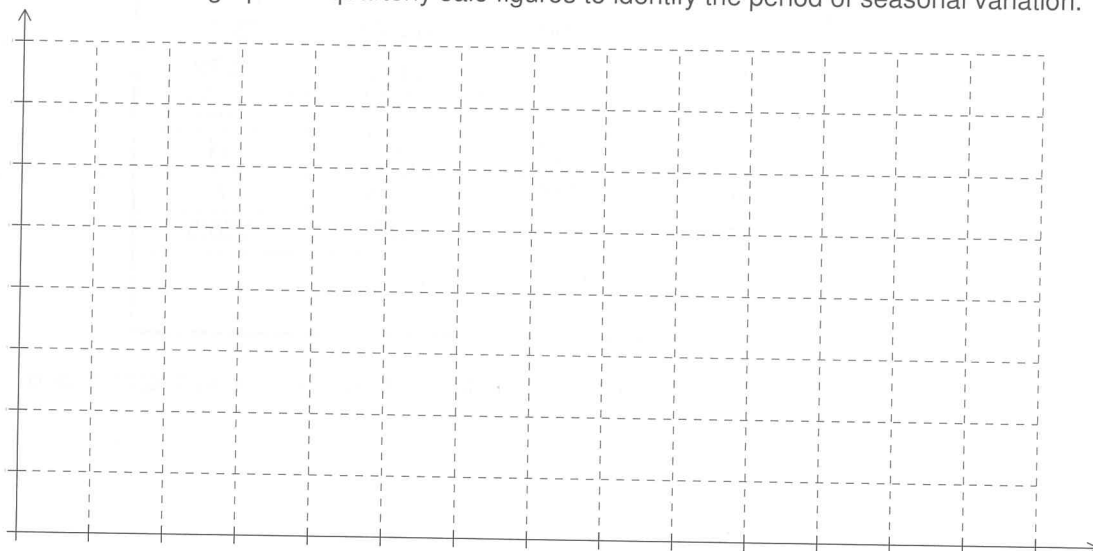
(b) Calculate the 4 point moving average and enter the moving averages in the table.

Time period (t)	Sales	ma 4	cma 4
2015 1st Q	196		
2nd Q	96		
3rd Q	298		
4th Q	522		
2016 1st Q	252		
2nd Q	140		
3rd Q	338		
4th Q	594		
2017 1st Q	280		
2nd Q	164		
3rd Q	430		
4th Q	742		

(c) Calculate the 4 point centred moving averages and graph them above in (a).
(d) Which moving average is more appropriate, ma 4 or cma 4? Why?

7. Household electrical power bills are issued every two months. The table below gives the power bills of a household for a period of 3 years.

Year	Months	Amount (dollars)	Moving average
2014	Jan - Feb	231	
	Mar - Apr	216	
	May - Jun	234	
	Jul - Aug	267	234.75
	Sep - Oct	235	237.00
	Nov - Dec	218	240.33
2015	Jan - Feb	246	243.42
	Mar - Apr	228	245.33
	May - Jun	262	q
	Jul - Aug	276	252.17
	Sep - Oct	249	253.75
	Nov - Dec	245	254.00
2016	Jan - Feb	260	255.33
	Mar - Apr	233	256.92
	May - Jun	260	257.25
	Jul - Aug	294	
	Sep - Oct	250	
	Nov - Dec	p	

(a) On the given axes graph the electrical power bills for this household.
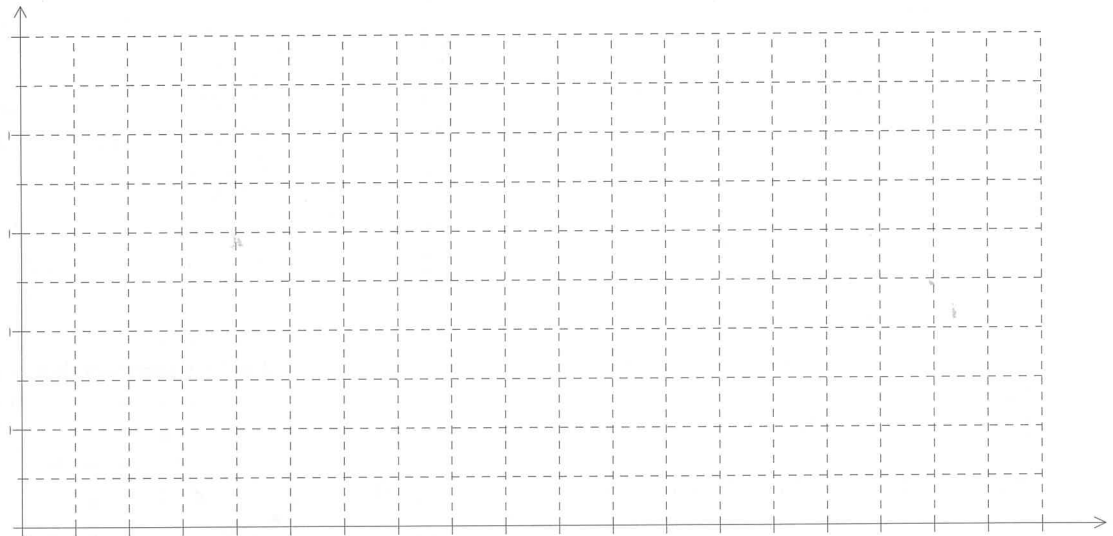
(b) Examine the data and describe any evident pattern in the power bills of this household.

(c) How many seasons does this time series have? Justify your answer.

(d) What is the period of this time series data?

(e) What moving average has been used to determine the trend of the power bills of this household?

(f) Calculate the values of the missing entries labelled p and q. Graph the moving averages on the grid above.

(g) If the power bill for Jan - Feb 2017 was $272, find the moving average figure for Jul - Aug 2016.