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TIME SERIES MODELS AND FORECASTING

QUESTION 1.

You have been asked to analyse some data from a small convenience store. The owner wants to know if there is a pattern in the sales of bottled water. She has collected data, shown in the table below, for the past 12 weeks.

Week	Sales
1	17
2	21
3	19
4	23
5	18
6	16
7	20
8	18
9	22
10	20
11	15
12	22

Answer the following questions:

What would you do in the first instance to see if there is a pattern to the data?

_____

Using Excel plot the data.

What do you notice about the data? _____

What technical term is used to describe this pattern? _____

How could you verify statistically what the graph is telling you? _____

QUESTION 2.

In the box below explain what is meant by a 'trend pattern'.

The table below shows the yearly production of men's hats for the past 10 years from a company that is looking to raise money to expand the business. You have been asked to analyse the data and give a recommendation to a potential investor on the prospects of it being a good investment.

Year	Output (1000s)
1	21.6
2	22.9
3	25.5
4	21.9
5	23.9
6	27.5
7	31.5
8	29.7
9	28.6
10	31.4

Complete the following:

These data exhibit a _____ pattern.

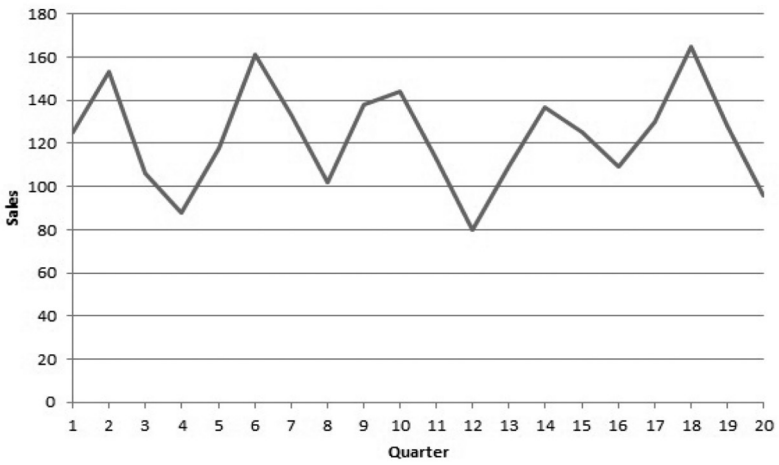
What would you do to verify the above statement about the type of pattern? _____

Based on your preliminary analysis, what would you tell the investor? _____

_____

QUESTION 3.

You have been given some data to analyse. You have put the data into Excel and plotted the result. The graphic below shows the plot produced by Excel.



Complete the following:

These data exhibit a _____ pattern.

QUESTION 4.

You have been employed by an investment bank to model metal commodity prices. The bank wants you to look specifically at copper prices. The table below shows the data for previous years.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Price	63	51	49	80	92	57	62	60	61	90
Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	
Price	98	78	67	71	62	64	62	80	119	

You decide to carry out a 3-year moving average model. The table below shows the first few years, your task is to fill in the rest of the table.

Year	Price	3-year total	3-year moving average
1990	63		
1991	51		
1992	49	63 + 51 + 49 = 163	54.3
1993	80	51 + 49 + 80 = 180	60.0

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Year	Price	3-year total	3-year moving average
1994	92	49 + 80 + 92 = 221	73.7
1995			
1996			
1997			
1998			
1999			
2000			
2001			
2002			
2003			
2004			
2005			
2006			
2007			
2008			

After completing the 3-year moving average model you decide to construct a 7-year moving average model. Complete the table below:

Year	Price	7-year total	7-year moving average
1990	63		
1991	51		
1992	49		
1993	80		
1994	92		
1995	57		
1996	62		
1997	60		
1998	61		
1999	90		
2000	98		
2001	78		
2002	67		

Year	Price	7-year total	7-year moving average
2003	71		
2004	62		
2005	64		
2006	62		
2007	80		
2008	119		

Plot the original data, the 3-year moving average model and the 7-year moving average model (use Excel) with the year on the horizontal axis and price on the vertical axis.

In the box below, comment on the plots.

QUESTION 5.

You did such a good job with developing models for copper prices, your boss at the bank wants you to look at stock performance for each decade since the 1830s. The table below shows the data you have been given (note the performance is given as a percentage).

Decade	Performance	Decade	Performance
1830s	2.8	1920s	13.3
1840s	12.8	1930s	–2.2
1850s	6.6	1940s	9.6
1860s	12.5	1950s	18.2
1870s	7.5	1960s	8.3
1880s	6.0	1970s	6.6
1890s	5.5	1980s	16.6
1900s	10.9	1990s	17.6
1910s	2.2	2000s	–0.5

What action would you take first to get an idea of how the data behaves? _____

Construct a 3-point moving average model and plot the original data and the results from your calculations.

You decide to develop an exponentially smoothed model, but you are unsure of what value to assign to the smoothing coefficient so you decide to try two values: 0.5 and 0.25.

Complete the following equations:

For the 0.5 smoothing coefficient model:

$$F_{t+1} = \_\_Y_t = (1 - \_\_)F_t$$

For the 0.25 coefficient model:

$$F_{t+1} = \_\_Y_t = (1 - \_\_)F_t$$

To test your models you decide to predict the stock performance for the 2010s.

The predicted stock performance for the 2010s using a smoothing coefficient of 0.5 is _____

The predicted stock performance for the 2010s using a smoothing coefficient of 0.25 is _____

Complete the following sentences:

The model using the 0.5 smoothing coefficient predicts a lower/higher (delete as appropriate) forecast than the model using a 0.25 smoothing coefficient.

The model using a 0.5 smoothing coefficient assigns more weight to _____ and is therefore better for _____.

The model using a 0.25 smoothing coefficient assigns more weight to _____ and is therefore better for eliminating _____.

QUESTION 6.

Your boss at the bank has asked you to develop a regression equation to predict the revenues of an international company. The table below shows the revenues (in millions of GB pounds) generated by the company since 1995.

Year	Revenue	Year	Revenue
1995	18.0	2003	21.0
1996	18.5	2004	21.9
1997	18.9	2005	23.1
1998	18.8	2006	24.1
1999	19.8	2007	28.9
2000	20.5	2008	31.9
2001	20.1	2009	31.0
2002	19.6		

Using the equation $\hat{Y}_t = b_0 + b_1 t$ construct a linear regression model and complete the following equations:

b_0 = _____ at $t = 0$ (corresponding to 1995).

$\hat{Y}_t = b_0 + b_1 t =$ _____

Enter the data into Excel and select a linear model and record the coefficients and the adjusted R^2 value:

The adjusted R^2 value = _____

The forecast revenue for 2010 is _____

Using the equation $\hat{Y}_t = b_0 + b_1 t + b_2 t^2$ construct a quadratic regression model and complete the following equations:

b_0 = _____
b_1 = _____
b_2 = _____
$\hat{Y}_t$ = _____

Use Excel again but this time select a quadratic model and, as before, record the coefficients and the adjusted R^2 value.

The adjusted R^2 value = _____.

The forecast revenue for 2010 is _____.

By comparing the _____ the conclusion is that the _____ regression model is the better model.

MINI PROJECT

In your role as an investment advisor for a multinational bank, you have been asked to analyse the sales data from a national company that manufactures motorbikes. The table below shows the yearly and quarterly sales for the past four years.

Year	QTR	Sales (1000s)
1	1	4.7
	2	4.1
	3	6.0
	4	6.5
2	1	5.8
	2	5.2
	3	6.8
	4	7.4
3	1	6.0
	2	5.6
	3	7.5
	4	7.8
4	1	6.3
	2	5.9
	3	8.0
	4	8.4

The bank has asked you to produce a report for a particular, influential investor. This investor has a reasonable knowledge of forecasting techniques and is therefore interested in how you performed the analysis. Your line manager has suggested you produce a report detailing your analysis techniques. You should include any equations, graphs and an explanation of your reasons for choosing a particular technique.

And finally...

It's time to think about emigrating - the weather in the UK is exhibiting changing seasonal patterns with an overall trend towards getting colder.