EXAMINATIONS OF THE ROYAL STATISTICAL SOCIETY

HIGHER CERTIFICATE IN STATISTICS, 2008

(Modular format)

MODULE 7 : Time series and index numbers

Time allowed: One and a half hours

Candidates should answer **THREE** *questions.*

Each question carries 20 marks.
The number of marks allotted for each part-question is shown in brackets.

Graph paper and Official tables are provided.

Candidates may use calculators in accordance with the regulations published in the Society's "Guide to Examinations" (document Ex1).

The notation log *denotes logarithm to base* ***e****.*
Logarithms to any other base are explicitly identified, e.g. $\log_{10}$.

Note also that $\binom{n}{r}$ *is the same as* ${}^nC_r$.

This examination paper consists of 5 printed pages **each printed on one side only**.
This front cover is page 1.
Question 1 starts on page 2.

There are 4 questions altogether in the paper.

1. A news article published in spring 2007 included the following extract. Note that Easter may fall either in March or in April; in 2007, it fell in April.

> "Retail sales have been volatile in recent months, rising by 1.1 per cent in December, falling by 1.5 per cent in January, rebounding by 1.6 per cent in February before March's 0.3 per cent increase. The wild swings may partly reflect problems with seasonally adjusting the data over the Christmas period as well as distortions caused by Easter. However, a slowing trend is emerging, sales rising by 0.4 per cent in the first three months of this year compared with 1.3 per cent in the previous quarter."

(i) Discuss why there could be problems with seasonally adjusting the data over the Christmas and Easter periods.

(8)

(ii) Controlling for identified effects is an important part of the seasonal adjustment process to ensure the estimation of high quality seasonal factors. Discuss how you would construct an appropriate method of correction to remove the impact of Easter.

(7)

(iii) Discuss the advantages and disadvantages of using the seasonally adjusted and trend estimates for analysis. Include reasons why you would prefer to use one estimate over the other to analyse a time series.

(5)

Turn over

2. Results from a regression analysis of a monthly economic time series are as follows, the explanatory variables being as given in the table.

Regression output for a monthly time series

Variable	Parameter Estimate	Standard Error	t value
Trading Day			
Mon	0.0365	0.02744	1.33
Tue	-0.0173	0.02750	-0.63
Wed	0.0122	0.02767	0.44
Thu	0.0203	0.02752	0.74
Fri	0.0221	0.02867	0.77
Sat	-0.0307	0.02813	-1.09
Sun (derived)	-0.0432	0.02785	-1.55
Easter	-0.1146	0.05442	-2.11
Outlier 2002.4	0.0740	0.12273	0.60
Outlier 2002.8	-0.2910	0.12487	-2.33

Chi-squared tests for groups of regressors

Regression effect	df	Chi-square	p value
Trading Day	6	11.48	0.07

(i) Prior corrections to allow for known effects are sometimes made before any further analysis of a time series is carried out. Would you use the original, seasonally adjusted, trend or irregular time series to estimate the impact of such corrections under a regression framework? Explain your answer.

(4)

(ii) Based on the model diagnostics, which variables would you keep in the model? Give reasons for your decisions.

(4)

(iii) Assume that this is a stock time series, i.e. the data values in the series have been taken as a snapshot in time. Does this have any implication for the variables identified in the table? Explain your answer.

(4)

(iv) Assume instead that this is a flow time series, i.e. the data values in the series represent a summed value over the month. What type of prior adjustment, temporary or permanent, would you use to adjust for each of the variables that are in the model above? Explain your decisions. Is the information given sufficient to support your choices of which variables to keep in the model fitted in the table above?

(8)

Turn over

3. Suppose a country's economic output can be classified into three sectors according to the following table.

Economic sector	*2004 value ($ billions)*	*2005 value ($ billions)*	*2005 Laspeyres volume index (base period 2004)*	*2006 Laspeyres volume index (base period 2005)*
Agriculture	20	21	101.2	100.7
Manufacturing	40	40	97.3	100.2
Services	70	75	103.9	105.4

(i) Calculate the Laspeyres volume index for the whole economy in 2005 using 2004 as the base period.

(4)

(ii) Calculate the Laspeyres volume index for the whole economy in 2006 using 2005 as the base period.

(4)

(iii) Link the two index numbers you have just calculated to give a chain-linked Laspeyres volume index for 2006, referenced to 2004.

(3)

A volume measure is defined as a volume index (divided by 100) multiplied by a monetary value from a reference period.

(iv) Show how the formula for the Laspeyres volume measure simplifies if the reference period is the same as the base period.

(6)

(v) Using 2004 as the reference period, calculate the Laspeyres volume measures corresponding to the indices you have calculated in parts (i), (ii) and (iii).

(3)

Turn over

4. (i) Suppose you are constructing a Laspeyres volume index and no volume data are available. Instead, you have total income from the sales of various commodity groups in the base period and in the current period.

(a) Derive the price index you would need to use as a deflator, stating the name given to the price index with such a formula.

(9)

(b) Name the price index you would use as a deflator when constructing a Paasche volume index.

(1)

(c) Name the price index you would use as a deflator when constructing a Fisher volume index.

(1)

(ii) Use data from the table below to calculate a Laspeyres volume index of the production of dairy farms in 2007, using 2006 as the base period.

(9)

Commodity group	*2006 sales (£ million)*	*2007 sales (£ million)*	*2006 volume (million litres)*	*2007 volume (million litres)*	*Deflator*
Cheeses (various)	500	520			100.4
Butters (various)	220	210			99.7
Creams (various)	120	150			98.2
Milk	690		720	750	