EXAMINATIONS OF THE ROYAL STATISTICAL SOCIETY

HIGHER CERTIFICATE IN STATISTICS, 2007

(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* ${}^{n}C_{r}$.

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. (i) Explain how seasonally adjusted and trend estimates are derived from a time series, and what each estimate represents.

(4)

(ii) State the key issues involved in seasonal adjustment and discuss any advantages and disadvantages of the seasonal adjustment process.

(5)

(iii) Discuss the key issues involved in calculating trend estimates at the end of a series, assuming a filter-based approach to trend estimation.

(5)

(iv) Discuss the advantages and disadvantages of using modelling techniques within the seasonal adjustment process, paying particular attention to the impact of modelling on time series estimates at the current end of series. Does modelling necessarily improve the quality of the seasonal adjustment?

(6)

Turn over

2. Referring to the edited output of a filter based approach to seasonal adjustment shown below, answer the following questions.

Date	Original	S×I	Seasonal factor (S)	Seas adj	Trend	Irreg (I)
DEC04	184.88	1.4507	1.4486	127.62	127.36	1.0020
JAN05	107.29	0.8439	0.8568	125.21	128.98	0.9708
FEB05	111.81	0.8789	0.8873	126.01	126.99	0.9923
MAR05	120.79	0.9458	0.9283	130.13	127.49	1.0207
APR05	122.63	0.9541	0.9589	127.89	128.38	0.9962
MAY05	124.90	0.9645	0.9621	129.82	129.48	1.0026
JUN05	128.93	0.9879	0.9828	131.18	130.63	1.0042
JUL05	130.33	0.9917	0.9896	131.70	131.66	1.0003
AUG05	128.60	0.9731	0.9499	135.39	132.47	1.0220
SEP05	124.89	0.9411	0.9429	132.45	133.01	0.9958
OCT05	131.15	0.9857	0.9756	134.43	133.27	1.0087
NOV05	149.24	1.1199	1.1219	133.02	133.32	0.9977
DEC05	195.77	1.4754	1.4521	134.82	132.59	1.0168
JAN06	113.56	0.8512	0.8548	132.86	133.15	0.9978
FEB06	116.90	0.8761	0.8826	132.44	133.06	0.9953

(i) What decomposition model (additive or multiplicative) was used for this seasonal adjustment? Give a reason for your answer.

(2)

(ii) Illustrate arithmetically that the decomposition chosen in part (i) holds, to one decimal place, by using data from November 2005 (NOV05). Discuss and give examples why the decomposition may not hold precisely in all periods.

(4)

(iii) Calculate the percentage movement between DEC04 and JAN05 for the original values, the seasonally adjusted estimates and the trend estimates. Compare the three percentages you have found, explaining what each represents and any differences between them.

(5)

(iv) DEC05 shows a record value for the original values in column 2. However, the seasonally adjusted estimate for DEC05 is only the second highest as AUG05 is higher. Explain the apparent contradiction between these two figures.

(5)

(v) What equation should the seasonal factors satisfy over what calendar period? Demonstrate this using the output above.

(4)

3. The Laspeyres price index at time t, with base period 0, can be expressed as

$$P_L(0,t) = \frac{\sum_{i=1}^{N} p_{ti} q_{0i}}{\sum_{i=1}^{N} p_{0i} q_{0i}} ,$$

where p_{ui} is the price of commodity i at time u, q_{ui} is the quantity of commodity i at time u, and N is the number of commodities.

The corresponding expression for the Paasche price index is

$$P_P(0,t) = \frac{\sum_{i=1}^{N} p_{ti} q_{ti}}{\sum_{i=1}^{N} p_{0i} q_{ti}} .$$

(i) Starting from these formulae and recalling that value is the product of price and quantity, derive expressions for the Laspeyres and Paasche price indices in terms of values and price relatives.

(7)

(ii) State why a Laspeyres price index is typically more convenient to calculate than its corresponding Paasche price index.

(2)

(iii) Calculate Laspeyres and Paasche price indices using the data in the following table.

(7)

Commodity	*Value in base period 0*	*Value in current period t*	*Price relative*
Knives	€20	€25	1.10
Forks	€20	€20	1.15
Tablespoons	€20	€15	1.24
Teaspoons	€15	€10	1.07

(iv) Explain why Laspeyres price index numbers are usually greater than their Paasche equivalents.

(4)

Turn over

4. (a) Prove that the ratio of the Paasche price index to the Laspeyres price index is equal to the ratio of the Paasche volume index to the Laspeyres volume index when these indices are calculated from the same data.

(6)

(b) Suppose that a country is divided into a number of administrative provinces. Using data from the table below,

(i) calculate the Laspeyres, Paasche and Fisher price indices for South province, using Central province as a base province,

(7)

(ii) calculate the Laspeyres, Paasche and Fisher volume indices for South province, using Central province as a base province.

(7)

Commodity	**Central province**		**South province**	
	Price	*Quantity*	*Price*	*Quantity*
Plain chocolate	70c	100 million	55c	20 million
Milk chocolate	40c	100 million	30c	40 million
White chocolate	45c	50 million	38c	10 million