**** **Year 12 Mathematics TEST 3**

**APPLICATIONS UNIT 4** TERM 3, 2023

Test Date: Thursday 27 July

***Name:*** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*All working is to be shown in the space provided. Your working should be in sufficient detail to allow your answers to be checked readily so part marks may be awarded if the answer is incorrect. For any question worth more than 2 marks valid working or justification must be shown to be awarded full marks.*

**Resource Rich** **Working Time: 50 minutes**

**Total Marks: 47**

**Question 1 (3 marks)**The seasonal indices for the sale of ice-cream for 2012-2014 first 3 quarters are:

Q1 : 115%

Q2 : 82%

Q3 : 124%

a) Determine the seasonal index Q4. (1 mark)

b) What does the seasonal index for Q2 indicate about the sales of ice-cream?

(2 marks)

**Question 2 (7 marks)**

The table below shows the nightly revenue collected over a three-week period at a seafood restaurant in Bull Creek.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| t | Week | Day | Revenue ($) | 7PMA |
| 1 | 1 | Monday | 2530 | - |
| 2 | Tuesday | 3120 | - |
| 3 | Wednesday | **A** | - |
| 4 | Thursday | 4150 | 3410 |
| 5 | Friday | 5220 | 3430 |
| 6 | Saturday | 5100 | 3440 |
| 7 | Sunday | 2280 | 3480 |
| 8 | 2 | Monday | 2670 | 3500 |
| 9 | Tuesday | 3190 | 3580 |
| 10 | Wednesday | 1750 | 3640 |
| 11 | Thursday | 4290 | 3680 |
| 12 | Friday | 5780 | **B** |
| 13 | Saturday | 5520 | 3670 |
| 14 | Sunday | 2560 | 3690 |
| 15 | 3 | Monday | 2740 | 3700 |
| 16 | Tuesday | 3050 | 3740 |
| 17 | Wednesday | 1890 | 3780 |
| 18 | Thursday | 4360 | 3730 |
| 19 | Friday | 6060 | - |
| 20 | Saturday | 5800 | - |
| 21 | Sunday | 2210 | - |

1. Determine the values of **A** and **B**. Show clear working.

(4 marks)

1. Why would it make sense to consider a seven-point moving average to smooth this data?

(2 marks)

1. Does the smoothed time-series plot indicate increasing, decreasing or steady revenue for the restaurant?

(1 mark)

**Question 3 [3 marks]**

A philanthropist is considering funding scholarships to a local college. Each student in receipt of a scholarship would receive a payment of on the yearly anniversary of the creation of the fund. Determine, to the nearest , the initial sum of money that should be deposited in an account paying interest at a rate of compounded monthly to create a perpetuity to fund all scholarships.

(3 marks)

**Question 4 (15 marks)**

A local delicatessen owner recorded the number of ice-creams sold over a three-week period.

The information collected is displayed in the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Day (d)** | **Sales** | **Weekly**  **Averages** | **Seasonal**  **Proportions** | **Deseasonalised Figures** |
| Monday | 1 | 210 | 158 | 132.9% | 162 |
| Tuesday | 2 | 230 | 145.6% | 151 |
| Wednesday | 3 | 100 | 63.3% | 160 |
| Thursday | 4 | 90 | 57.0% | **D** |
| Friday | 5 | 160 | 101.3% | 156 |
| Monday | 6 | 190 | **B** | 128.4% | 147 |
| Tuesday | 7 | 230 | 155.4% | 151 |
| Wednesday | 8 | 90 | 60.8% | 144 |
| Thursday | 9 | 80 | 54.1% | 150 |
| Friday | 10 | 150 | 101.4% | 146 |
| Monday | 11 | 180 | 142 | 126.8% | 139 |
| Tuesday | 12 | 220 | 154.9% | 145 |
| Wednesday | 13 | **A** | **C** | 144 |
| Thursday | 14 | 70 | 49.3% | 131 |
| Friday | 15 | 150 | 105.6% | 146 |

1. Determine the values of **A**, **B** and **C** (correct to 1 decimal place). Show clear working.

(6 marks)

1. Use the ‘average percentage’ method to calculate the seasonal index for **Thursdays** and explain what this index represents.

(2 marks)

1. Determine the value of **D**. Show clear working.

(2 marks)

1. The equation of the least-squares regression line used to forecast the seasonally adjusted number of ice-creams is as follows:

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With reference to this line, describe the trend in the number of ice-cream sales over time.

(2 marks)

1. If the seasonal index for Friday is, predict the **actual** number of ice-cream sales for **Friday** of **Week 4**.

Show clear working.

(3 marks)

**Question 5 (7 marks)**

An annuity compounds interest annually and its value after withdrawals can be modelled using the recurrence relation:

(a) Use the relation to state

(i) the annual percentage interest rate.

(1 mark)

(ii) the annual withdrawal from the annuity.

(1 mark)

(b) Calculate the balance of the annuity, to the nearest dollar, after withdrawals.

(1 mark)

(c) The annuity is closed after withdrawals. Calculate the total interest paid by the annuity up to this time.

(2 marks)

(d) From the outset, the annual withdrawal could have been reduced so that the annuity becomes a perpetuity. Briefly explain what a perpetuity is and determine the withdrawal required to make this occur.

(2 marks)

Question 6 (8 marks)

A customer in a store is offered a reducible interest loan that attracts interest of compounded monthly to purchase a computer and accessories. The monthly loan repayment is .

The customer set up the spreadsheet below to analyse the loan, rounding the displayed figures to the nearest cent.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Month | Balance at start of month ($) | Interest for month | Repayment | Balance at end of month ($) |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

(a) Complete row of the spreadsheet. (3 marks)

(b) Determine a simplified recurrence relation for , the loan balance at the start of month .

(2 marks)

(c) State the number of repayments required to pay off the loan. (1 mark)

(d) Determine the total amount of interest paid over the life of the loan. (2 marks)

**Question 7 (6 marks)**

An equestrian show is held in Bendigo each year over the Queen’s Birthday long weekend, starting on the Friday and finishing on the public holiday Monday.

The attendance figures for four consecutive years are shown in the following table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **t** | **Year** | **Day** | **Attendance** | **4PCMA** |
| 1 | 2014 | Friday | 9100 |  |
| 2 | Saturday | 14980 |  |
| 3 | Sunday | 16240 | 14435 |
| 4 | Monday | 16840 | 14610 |
| 5 | 2015 | Friday | 10260 | 14705 |
| 6 | Saturday | 15220 | 14970 |
| 7 | Sunday | 16760 | 15065 |
| 8 | Monday | 18440 | 14930 |
| 9 | 2016 | Friday | 9420 | 14870 |
| 10 | Saturday | 14980 | 14755 |
| 11 | Sunday | **A** | **B** |
| 12 | Monday | 17760 | 14890 |
| 13 | 2016 | Friday | 10140 | 15045 |
| 14 | Saturday | 15300 | 15270 |
| 15 | Sunday | 17440 |  |
| 16 | Monday | 18640 |  |

1. Explain why the attendance on Fridays always seems to be much lower than on other days.

(1 mark)

1. Express **A** in terms of **B.** Show clear working.

(3 marks)

1. Should the long-term trend in attendance figures be cause for concern for the organisers of the show? Justify your answer.

(2 marks)