**Data smoothing**

**In-class investigation**

**Solutions and marking key**

**Question 1**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Solution | Mathematical behaviours | Marks |
| (a) | circle around 500 in the second graph | * selects correct data point | 1 |
| (b) | April 2012 | * interprets scatter graph | 1 |
| (c) | triangles around 1000 on the first graph and 240 on the second graph | * selects correct data points | 2 |
| (d) | There may have been other costs included in the account. OR  The charge per unit may have differed | * provides mathematical argument for the difference | 1 |
| (e) | 3 | * interprets time series | 1 |
| (f) | (i) April  (ii) Consumption is always higher in this household in the period before that account is sent out.  (It is the end of summer so maybe using a pool filter or an air-conditioner) | * interprets scatter graph * justifies maximum cost for that time of year – relates to consumption | 1  1 |
| (g) | The consumption rises and falls in a regular pattern  Appears to be decreasing overall  Always much higher in April  Similar consumption in August and December | identifies three of the following points   * increase and decrease * pattern of changes * apparent downward trend * maximum in April * similarity at other times | 1  1  1 |
| (h) | Period before August 2014 because consumption was the lowest overall (fell significantly) OR  Period before April 2015 – the 2015 April reading was the lowest of all the April readings | * identifies time * justifies decision | 1  1 |
| (i) | The consumption and the cost rise and fall at the same time. OR  When the consumption is high, the cost is high. When the consumption is low, the cost is low | * describes both variables rising at the same time * describes both variables falling at the same time | 1  1 |

**Question 2(a)**

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| --- | --- |
| Solution | |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Time** | **Cost** | **Data point** | **Moving average calculations** | **Moving average** | | Apr-12 | 500 | 1 |  |  | | Aug-12 | 280 | 2 | (500 + 280 + 320) ÷ 3 | $367 | | Dec-12 | 320 | 3 | (280 + 320 + 440) ÷ 3 | C **$347** | | Apr-13 | 440 | 4 | (320 + 440 + 310) ÷ 3 | $357 | | Aug-13 | 310 | 5 | A **(440 + 310 + 305) ÷ 3** | $352 | | Dec-13 | 305 | 6 | B **(310 + 305 + 410) ÷ 3** | D **$342** | | Apr-14 | 410 | 7 |  | $322 | | Aug-14 | 250 | 8 |  | $300 | | Dec-14 | 240 | 9 |  | $267 | | Apr-15 | 310 | 10 |  |  | | |
| Mathematical behaviours | Marks |
| * determines a value for A * determines a value for B * determines a value for C * determines a value for D | 1  1  1  1 |

**Question 2(b,c,d)**

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| Solution |
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**Question 2(b,c,d) (cont’d)**

|  |  |
| --- | --- |
| Mathematical behaviours | Marks |
| * plots costs for two given data points * plots costs in correct time positions for given data points * plots costs for 7 other values in table * plots costs for D * joins data points for reported costs * joins data points for moving average * draws a trend line for moving averages | 1  1  1  1  1  1  1 |

**Question 2(e)**

|  |  |
| --- | --- |
| Solution | |
| Downward  Linear  (As times passes the consumption decreases linearly) | |
| Mathematical behaviours | Marks |
| * describes direction of trend * describes nature of trend | 1  1 |

**Question 2(f)**

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| --- | --- |
| Solution | |
| Less fluctuation in the cost for data in the moving averages graph | |
| Mathematical behaviours | Marks |
| * identifies one difference between graphs for reported data and moving average | 1 |

**Question 3**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Solution | Mathematical behaviours | Marks |
| (a) | t = 10  MA = 388 – 12.5 x 10  MA = $263 | * identifies value for t * substitutes into equation provided * determines moving average | 1  1  1 |
| (b) | Not very reliable  Extrapolated beyond data  Usual April peak not considered | * describes reliability * gives one reason for conclusion * gives second reason for conclusion | 1  1  1 |
| (c) | 263 = (240 + 310 + Aug) ÷ 3  Aug = $239 | * selects correct data for calculation * establishes expression to calculate answer * determines value for August | 1  1  1 |

**Question 4**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Solution | Mathematical behaviours | Marks |
| (a) | Units used  It varies according to time | * identifies response variable * justifies decision | 1  1 |
| (b) | (i)  The line has a negative slope  (ii)  The electricity consumption will continue to decrease if the trend continues OR  The trend is unlikely to continue so one expects the consumption to stabilise | * explains negative trend * determines long-term outcome * relates conclusion about outcome to the trend in consumption | 1  1  1 |
| (c) | Both trends indicate the consumption is about 1100 units | * uses the graphs to determine estimates in both sets of data * determines estimates | 1  2 |
| (d) | Neither are reliable  Both extrapolated  First graph – low correlation and data vary widely  Second graph better correlation but data not original | * describes reliability * recognises extrapolation * identifies widely fluctuating data in the first graph * identifies prediction is not based on original data | 1  1  1  1 |