**Pearson Edexcel Level 3 Certificate in Mathematics in Context**

**PRACTICE TASK: WINTER OLYMPICS**

**Data source A**

The 2014 Winter Olympics took place in Sochi, Russia. As expected, the nations which tended to do well were those either with large populations or with snow‑covered mountainous terrain. The exception to this was The Netherlands – a country with no mountains and not much snow, but still a top nation as far as the Games were concerned.

**Table 1: Excel spreadsheet for Winter Olympics 2014 Medal Table. All countries that won a medal are included. (Two entries have been omitted.)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | A | B | C | D | E | F | G | H |
| 1 |  | **Gold** | **Silver** | **Bronze** |  | **Medal rank** | **Population rank** | *d*2 |
| 2 | Russia | 13 | 11 | 9 | 33 | 1 | 3 |  |
| 3 | USA | 9 | 7 | 12 | 28 | 2 | 2 | 0 |
| 4 | Norway | 11 | 5 | 10 | 26 | 3 | 23 | 400 |
| 5 | Canada | 10 | 10 | 5 | 25 | 4 | 12 | 64 |
| 6 | Netherlands | 8 | 7 | 9 | 24 | 5 | 15 | 100 |
| 7 | Germany | 8 | 6 | 5 | 19 | 6 | 5 | 1 |
| 8 | Austria | 4 | 8 | 5 | 17 | 7 | 19 | 144 |
| 9 | Sweden | 2 | 7 | 6 | 15 | 8.5 | 18 | 90.25 |
| 10 | France | 4 | 4 | 7 | 15 | 8.5 | 6 | 6.25 |
| 11 | Switzerland | 6 | 3 | 2 | 11 | 10 | 20 | 100 |
| 12 | China | 3 | 4 | 2 | 9 | 11 | 1 | 100 |
| 13 | Korea | 3 | 3 | 2 | 8 | 14 | 9 | 25 |
| 14 | Japan | 1 | 4 | 3 | 8 | 14 | 4 | 100 |
| 15 | Slovenia | 2 | 2 | 4 | 8 | 14 | 26 | 144 |
| 16 | Italy | 0 | 2 | 6 | 8 | 14 | 8 | 36 |
| 17 | Czech Rep | 2 | 4 | 2 | 8 | 14 | 16 | 4 |
| 18 | Poland | 4 | 1 | 1 | 6 | 17.5 | 11 | 42.25 |
| 19 | Belarus | 5 | 0 | 1 | 6 | 17.5 | 17 | 0.25 |
| 20 | Finland | 1 | 3 | 1 | 5 | 19 | 22 | 9 |
| 21 | Britain | 1 | 1 | 2 | 4 | 20.5 | 7 | 182.25 |
| 22 | Latvia | 0 | 2 | 2 | 4 | 20.5 | 25 | 20.25 |
| 23 | Australia | 0 | 2 | 1 | 3 | 22 | 13 | 81 |
| 24 | Ukraine | 1 | 0 | 1 | 2 | 23 | 10 | 169 |
| 25 | Slovakia | 1 | 0 | 0 | 1 | 25 | 21 | 16 |
| 26 | Croatia | 0 | 1 | 0 | 1 | 25 | 24 | 1 |
| 27 | Kazakhstan | 0 | 0 | 1 | 1 | 25 | 26 | 1 |
| 28 | **Totals** | 99 | 97 | 99 |  |  |  | 1840.5 |

*d* is the difference between the medal rank and the population rank

Another possible factor why a country may be more successful could be its wealth as a nation. Wealthy countries may be able to supply money for training facilities and for financial support. One measure of wealth is the Gross Domestic Product (GDP). This is the value of all the goods and services produced in a country in a year.

**Table 2: Excel spreadsheet for Winter Olympics 2014 Medal Table with GDP rankings.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | A | B | C | D | E | F | G | H |
| 1 |  | **Gold** | **Silver** | **Bronze** |  | **Medal Rank** | **GDP Rank** | *d*2 |
| 2 | Russia | 13 | 11 | 9 | 33 | 1 | 8 |  |
| 3 | United States | 9 | 7 | 12 | 28 | 2 | 1 |  |
| 4 | Norway | 11 | 5 | 10 | 26 | 3 | 16 |  |
| 5 | Canada | 10 | 10 | 5 | 25 | 4 | 9 |  |
| 6 | Netherlands | 8 | 7 | 9 | 24 | 5 | 12 |  |
| 7 | Germany | 8 | 6 | 5 | 19 | 6 | 4 |  |
| 8 | Austria | 4 | 8 | 5 | 17 | 7 | 17 |  |
| 9 | Sweden | 4 | 4 | 7 | 15 | 8.5 | 14 |  |
| 10 | France | 2 | 7 | 6 | 15 | 8.5 | 6 |  |
| 11 | Switzerland | 6 | 3 | 2 | 11 | 10 | 13 |  |
| 12 | China | 3 | 4 | 2 | 9 | 11 | 2 |  |
| 13 | Korea | 1 | 4 | 3 | 8 | 14 | 11 |  |
| 14 | Japan | 0 | 2 | 6 | 8 | 14 | 3 |  |
| 15 | Slovenia | 3 | 3 | 2 | 8 | 14 | 25 |  |
| 16 | Italy | 2 | 4 | 2 | 8 | 14 | 7 |  |
| 17 | Czech Rep | 2 | 2 | 4 | 8 | 14 | 20 |  |
| 18 | Poland | 4 | 1 | 1 | 6 | 17.5 | 15 |  |
| 19 | Belarus | 5 | 0 | 1 | 6 | 17.5 | 23 |  |
| 20 | Finland | 1 | 3 | 1 | 5 | 19 | 18 |  |
| 21 | Britain | 1 | 1 | 2 | 4 | 20.5 | 5 |  |
| 22 | Latvia | 0 | 2 | 2 | 4 | 20.5 | 26 |  |
| 23 | Australia | 0 | 2 | 1 | 3 | 22 | 10 |  |
| 24 | Ukraine | 1 | 0 | 1 | 2 | 23 | 21 |  |
| 25 | Slovakia | 0 | 0 | 1 | 1 | 25 | 22 |  |
| 26 | Croatia | 1 | 0 | 0 | 1 | 25 | 24 |  |
| 27 | Kazakhstan | 0 | 1 | 0 | 1 | 25 | 19 |  |
| 28 | **Totals** | 99 | 97 | 99 | 295 |  |  |  |

*d* is the difference in the medal rank and the GDP rank.

A related possible factor is the standard of living of a country – roughly the GDP divided by the population giving the average income of a person living in the country.

This pattern of success for some nations can be seen by a brief examination of the 2010 medal list where the USA, Canada and Norway feature at the top of both the 2010 and 2014 lists.

**Table 3: Medals for the 2010 Winter Olympics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rank** |  | **Gold** | **Silver** | **Bronze** | **Total** |
| 1 | USA | 9 | 15 | 13 | 37 |
| 2 | Germany | 10 | 13 | 7 | 30 |
| 3 | Canada | 14 | 7 | 5 | 26 |
| 4 | Norway | 9 | 8 | 6 | 23 |
| 5 | Austria | 4 | 6 | 6 | 16 |
| 6 | Russia | 3 | 5 | 7 | 15 |
| 7 | S Korea | 6 | 6 | 2 | 14 |
| 8 | France | 2 | 3 | 6 | 11 |
| 9 | China | 5 | 2 | 4 | 11 |
| 10 | Sweden | 5 | 2 | 4 | 11 |
| 11 | Switzerland | 6 | 0 | 3 | 9 |
| 12 | Netherlands | 4 | 1 | 3 | 8 |
| 13 | Czech Rep | 2 | 0 | 4 | 6 |
| 14 | Poland | 1 | 3 | 2 | 6 |
| 15 | Finland | 0 | 1 | 4 | 5 |
| 16 | Italy | 1 | 1 | 3 | 5 |
| 17 | Japan | 0 | 3 | 2 | 5 |
| 18 | Belarus | 1 | 1 | 1 | 3 |
| 19 | Slovakia | 1 | 1 | 1 | 3 |
| 20 | Croatia | 0 | 2 | 1 | 3 |
| 21 | Slovenia | 0 | 2 | 1 | 3 |
| 22 | Australia | 2 | 1 | 0 | 3 |
| 23 | Latvia | 0 | 2 | 0 | 2 |
| 24 | Great Britain | 1 | 0 | 0 | 1 |
| 25 | Estonia | 0 | 1 | 0 | 1 |
| 26 | Kazakhstan | 0 | 1 | 0 | 1 |
|  |  |  |  |  |  |
|  | **Total** | **86** | **87** | **85** | **258** |

**Data source B**

In February 2014, Sochi experienced higher than average temperatures for the time of year and plans were put in place to take measures to ensure there was enough snow for the Games to go on.

In 2018, the Winter Olympics are scheduled to take place in February and March in Pyeongchang, South Korea. Extensive research has already gone on to investigate the distribution of temperatures at the relevant time of year.

**Table 4b**

**Highest daytime temperature at Pyeongchang for 20 successive days taken at 24 hour intervals.**

**Each temperature was measured the day following the corresponding night-time temperature.**

|  |  |
| --- | --- |
| **Temp oC** | **Frequency** |
| –1 | 1 |
| 0 | 2 |
| 1 | 1 |
| 2 | 3 |
| 3 | 4 |
| 4 | 4 |
| 5 | 0 |
| 6 | 2 |
| 7 | 1 |
| 8 | 1 |
| 9 | 1 |

**Table 4a**

**Lowest night-time temperature   
at Pyeongchang for 20 successive**

**nights taken at 24 hour intervals.**

|  |  |
| --- | --- |
| **Temp oC** | **Frequency** |
| –14 | 1 |
| –10 | 1 |
| –8 | 1 |
| –7 | 3 |
| –6 | 4 |
| –5 | 2 |
| –4 | 0 |
| –3 | 3 |
| –2 | 2 |
| –1 | 2 |
| 1 | 1 |

**1 Refer to data source A**

(a)Write down the Excel formula to find the entry in **Table 1.**

(i) for cell E28

(ii) for cell H2

**(2)**

(b)(i) Draw box plots for the for total number of medals won in 2014 and for the total number of medals won in 2010.

Mark any outliers with a cross (×).

Use Q1 − 1.5 × IQR and Q3 + 1.5 × IQR as the lower and upper limits for non‑outliers.

**(6)**

(ii) Compare the distributions of the number of medals gained in 2010 and 2014.

**(2)**

A total of 88 nations competed in the 2014 Winter Olympics.  
   
(c) Comment briefly on how this would affect the values you found in part (b)(i).

**(2)**

**2 Refer to data source A**

(a)Find the Spearman rank correlation coefficient for each of the following pairs of ranks in 2014.

(i) Number of medals and population. (**Use Table 1)**

(ii) Number of medals and GDP. (**Use Table 2)**

(iii) Number of medals and standard of living.

(For medal rank and standard of living rank the value of Σ*d*2 is 1184)

**(5)**

(b) Comment on the values that you have calculated.

**(2)**

**3 Refer to data source B**

(a) Calculate the mean and the standard deviation of the lowest night-time temperatures.

**Use a copy of Table 4a:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Temp oC** | **Frequency** |  |  |  |  |
| –14 | 1 |  |  |  |  |
| –10 | 1 |  |  |  |  |
| –8 | 1 |  |  |  |  |
| –7 | 3 |  |  |  |  |
| –6 | 4 |  |  |  |  |
| –5 | 2 |  |  |  |  |
| –4 | 0 |  |  |  |  |
| –3 | 3 |  |  |  |  |
| –2 | 2 |  |  |  |  |
| –1 | 2 |  |  |  |  |
| 1 | 1 |  |  |  |  |

**(4)**

The mean of the highest daytime temperatures is 3.2 °C.  
The standard deviation of the highest daytime temperatures is 2.52 °C.

(b) Compare the lowest night-time temperatures with the highest daytime temperatures.

**(2)**

In all, with training and the paralympics games following afterwards, the 2018 Winter Olympic games will need at least 35 days of cold weather.

(c) Using **Table 4b,** work out an estimate of the number of times the lowest daytime temperature will be 0 °C or below in 35 days.

Make a comment about any assumptions you use.

**(3)**

The product moment correlation coefficient between the lowest night-time temperatures and the following daytime highest temperatures obtained from the temperatures in °C in **Table 4a** and **Table 4b** is 0.482.

(d)Interpret in context what this value means.

**(1)**

(e) If instead of measuring temperatures in °C, they had been measured in °F, describe briefly what would have been the effect on the value of the correlation coefficient.

**(1)**

**Total 30 marks**