

Topics from GCE AS and A Level Mathematics covered in Sections 5:

- Interpret histograms and other diagrams for single-variable data
- Select or critique data presentation techniques in the context of a statistical problem
- Be able to clean data (including dealing with missing data, errors and outliers).

The problem

How do you measure a team's performance in the Olympics?

If you were to just consider the number of medals won, certain countries always come out on top: the Olympic 'superpowers' consisting of the USA, China, Russia, UK, Australia and Germany.

But suppose the total number of medals took account of factors that are likely to have an influence, such as the size of a country's population or its economic power, or the size of the Olympic team relative to these factors.

One way to measure the success of the teams is to give each type of medal a weighting. In this investigation a gold medal will be given a weighting of three, a silver medal a weighting of two and a bronze medal a weighting of one.

To investigate the success of New Zealand in the 2012 Summer Olympic Games:

- a) Find the ranking of New Zealand for the number of gold medals won.
- b) Find the ranking of New Zealand for the total number of medals won.
- c) Display the ranking of New Zealand for the weighted total number of medals won.
- d) Display the ranking of New Zealand for the weighted total number of medals won per million of population.

Data collection

Open the Excel workbook '**2012OlympicSwimmers.xlsx**' and select the worksheet '**OlympicMedals**'.

The number of medals each country won in the Olympic Games has been taken from 2012 Olympic medal data (<https://goo.gl/K1G7cA>)

1. Why may some of the numbers of medals won per country in 2012 have changed from those recorded at the Olympic Games in 2012?

Some medals have been taken away due to cheating.

2. State reasons why the population data may not be accurate.

The population of countries varies by the second due to migration, immigration, births and deaths.

3. What does '#N/A' mean in these data?

The country won no medals.

4. The populations for each country were taken from the Public domain data from the *CIA World Factbook*. These populations had to be pasted into the worksheet '*OlympicMedals*' and matched to the countries that took part in the 2012 Summer Olympics.

Country from CIA World Factbook	Country from Olympics.org
China	People's Republic of China
South Korea	Republic of Korea
Moldova	Republic of Moldova
Russian Federation	Russia
United Kingdom	Great Britain
Falkland Islands	

The table above shows an extract from this worksheet. What are the difficulties when trying to match the countries from the CIA World Factbook with those in the '*OlympicMedals*' worksheet?

The country names are different so when the data is sorted they may be missed.

Some of the countries did not take part in the 2012 Summer Olympics.

5. What type of data has been collected for this investigation?

Secondary data, as they have been collected by someone else.

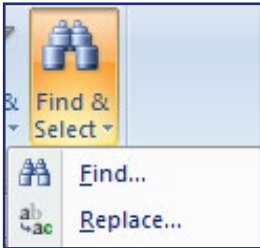
6. What type of variable is 'Total number of medals'?

The variable is quantitative and discrete.

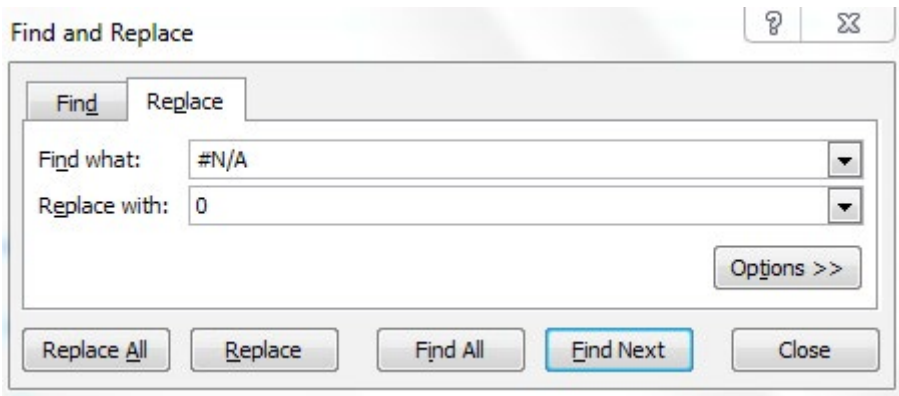
Process

In the worksheet '*OlympicMedals*' clean the data by replacing #N/A with 0. This will make sorting the data easier.

To replace #N/A with 0

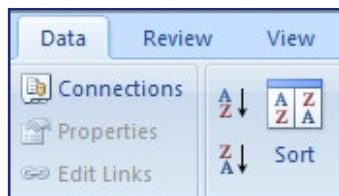


- Select columns **C** to **F**
- In the **Home** tab, select **Find & Select**, then **Replace**
- Type **#N/A** in **Find what**
- Type **0** in **Replace with**
- **Replace All**
- **Close.**
- **Save your work**



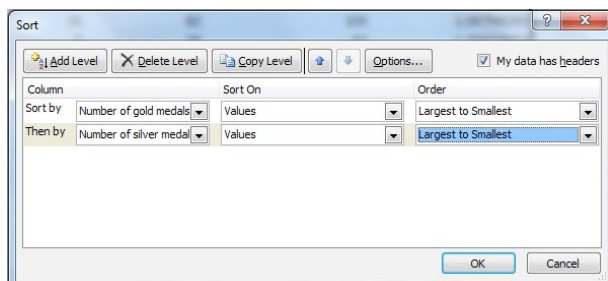
- a) Find the ranking of New Zealand for the number of gold medals won at the 2012 Summer Olympics.

To sort in Excel



- Sort the data according to '**The number of gold medals**'
- Select columns **A to H**
- In the **Data** tab, select **Sort**.

More than one country may have the same number of gold medals, so it may be necessary to add a second level to the sort.



- **Sort by *Number of gold medals***
- Click **Add Level**
- **Then by *Number of silver medals***
- **Order *Largest to Smallest*** for both
- **OK.**

New Zealand is ranked 16 for the number of gold medals won at the 2012 Summer Olympics.

- b) Find the ranking of New Zealand for the total number of medals won at the 2012 Summer Olympics.

New Zealand is ranked 19 for the number of gold medals won at the 2012 Summer Olympics.

- c) Display the ranking of New Zealand for the weighted total number of medals won at the 2012 Summer Olympics.

To work out the weighted total number of medals won at the 2012 Summer Olympics

- Select **G2** and type in the formula below to calculate the total weighting:
- $=3*C2+2*D2+E2$
- Select **G2** and hover the cursor over the bottom right hand corner of the cell until a small black cross appears and double click.
- This will copy the formula into every cell in the **G** column where there is an entry in the **F** column.
- **Save your work**

Sort the countries according to the '**Weighted total number of medals**' to find New Zealand's ranking. If two countries have the same rank, add a second sort level, '**Number of gold medals**'.

New Zealand is ranked 18 for the weighted total number of medals won at the 2012 Summer Olympics.

Next, display the weighted total number of medals won for the top 18 countries. The variable '**Weighted total number or medals**' is a discrete variable so it is appropriate to plot a bar chart.

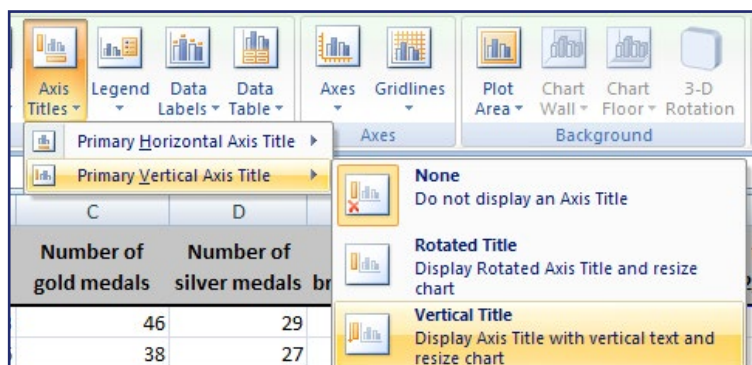
To plot a bar chart for the weighted total number of medals for the top 18 countries

	A	B	E	F	G
	Country	Population	Number of gold medals	Total number of medals	Weighted total (Gold=3, Silver=2, Bronze=1)
1					
2	United States of America	31888	29	104	225
3	People's Republic of China	135566	22	87	190
4	Russian Federation	1424	38	62	155
5	Great Britain	6274	19	68	140
6	Germany	8099	14	44	85
7	France	6621	12	34	67
8	Japan	12711	17	38	66
9	Australia	2256	12	35	65
10	Republic of Korea	4961	7	28	62
11	Italy	6161	11	28	53
12	Netherlands	1681	8	20	38
13	Ukraine	4421	9	20	37
14	Hungary	991	5	17	37
15	Spain	4771	4	17	33
16	Kazakhstan	1791	5	13	28
17	Brazil	202656788	3	9	17
18	Cuba	11047251	5	3	14
19	New Zealand	4401916	5	3	13
20	Islamic Republic of Iran	80840713	4	3	12

- Select **G1** to **G19**, to include New Zealand
- Hold down the **Ctrl** key and select **A1** to **A19**
- In the **Insert** tab select **Column**, then **Clustered Column**.

Delete the legend:

- Click on the **legend** then **delete**.



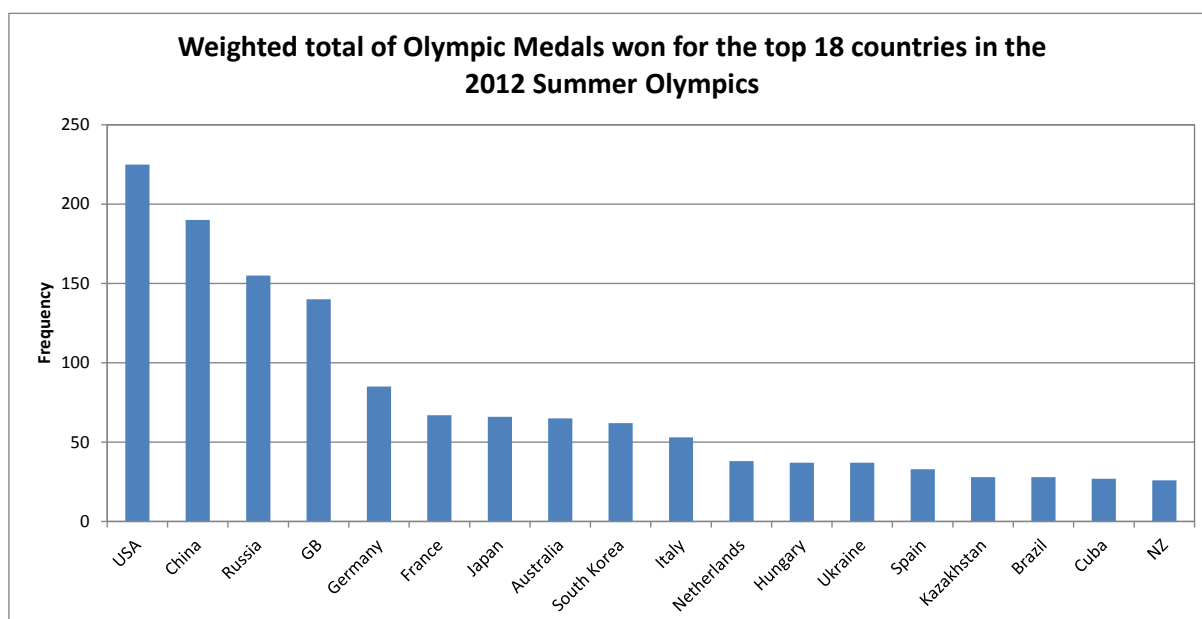
Edit the title:

- Click into the **title** and type **Weighted total of Olympic Medals won for the top 18 countries in the 2012 Olympics**
- **Enter.**

Format the bar chart: add a border to the plot area:

- Right click on the chart
- Select **Format Plot Area**
- Select **Border Color** then **Solid Line** and choose **Black**
- Abbreviate the countries' names in column A
- Add the title **Frequency** to the vertical axis
- In the **Layout** tab select **Axis Titles** then **Primary Vertical Axis Title** then **Vertical Title**
- Type **Frequency**
- **Enter**
- **Save your work**

Some of the names of the countries have been abbreviated in the bar chart below.



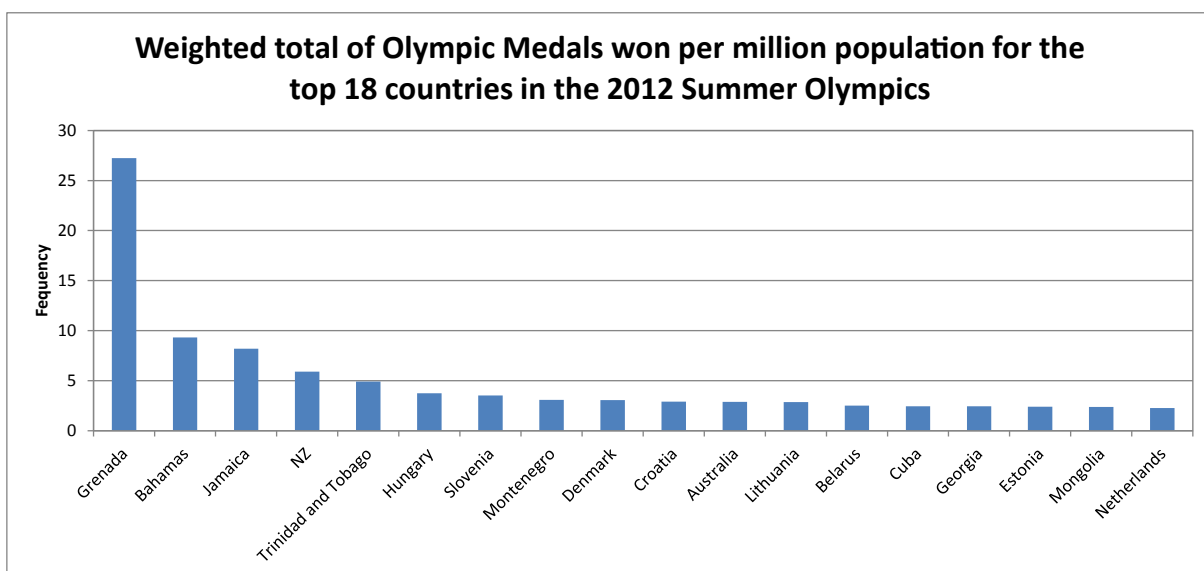
- d) Display the ranking of New Zealand in the weighted number of medals won per million of population at the 2012 Summer Olympics.

To calculate the weighted total number of medals won per million of population

- Add an appropriate header in I1
- Enter the formula below in I2 to calculate the weighted total number of medals per million of population:

$$=G2/B2*1000000$$

- Copy this formula for all the other countries
- Sort according to column I
- Plot a bar chart of the first 18 countries.
- **Save your work**



New Zealand is ranked 4 for the weighted total number of medals won per million of population at the 2012 Summer Olympics.

Report

Comment on the success of New Zealand at the 2012 Summer Olympic Games.

New Zealand is given a different ranking depending on how the medal tally is reported.

New Zealand is:

Ranked 16 for number of gold medals won

Ranked 19 for total number of medals won

Ranked 18 for weighted total number of medals won

Ranked 4 for weighted total number of medals won per million of population.

When reporting team success it is important to state how the comparisons have been made.

Extension

1. Display the ranking for the top 10 countries who took part in the 2012 Summer Olympics by the weighted total number of medals won per team size.
2. Investigate the success of Wales at the 2014 Commonwealth Games:
 - a) Find the ranking of Wales for the number of gold medals won
 - b) Display the ranking of Wales for the weighted total number of medals won
 - c) Display the ranking of Wales in the weighted total number of medals won per million of population.

The data is in the Excel workbook '**2014Commonwealth Games.xlsx**'.

Wales is:

Ranked 13 for number of gold medals won.

Ranked 9 for weighted total number of medals won.

Ranked 8 for weighted total number of medals won per million of population.