

Which country is best?

Student Worksheet

7 8 9 10 11 12



Which country is best at the *World Games*?

At each *World Games*, the performance of each country is ranked by the total number of medals obtained. Is this the most suitable method for ranking country performance? In this task you will analyse the medals results over the last century and explore other possible ways of ranking performance, factoring in variables such as the type of medal, and the population and economic wealth of each country.

Working with the *World Game medals database file*

The *World medals database* (in the calculator file **worldgames.tns**) is a collection of medal records for each country that has been represented at the *World Games* over more than a century. As well as medals won, it provides some other basic data about country population, GDP per capita, and land area. Note that some of the data will refer to countries that no longer exist (e.g. Soviet Union), and occasionally some demographic information is based on the most recent estimates of their values (e.g. GDP per capita).

There are 9 statistical variables in this database, gathered from various sources. These variables contain data about each of the 215 countries listed.

- *country* The name of the country/nation represented at each *World Games*
- *games* The number of World Games at which each country was represented
- *gold* The total number of gold medals won by each country
- *silver* The total number of silver medals won by each country
- *bronze* The total number of bronze medals won by each country
- *medals* The total number of medals (of any type) won by each country
- *pop_mill* The population of each country in millions, rounded to 2 d.p.
- *area_km2* The total area of each country in square kilometres
- *gdp_cap* The gross domestic product (per capita) of each country

Here is a screen shot of some of the data – each **column** represents one of the nine statistical variables, and each **row** represents the collected records for each of the 215 listed countries.

	A country	B games	C gold	D silver	E bronze	F medals	G pop_mill	H area_km2	I gdp_cap
1	Afghanis...	14	0	0	2	2	27.66	652230	549
2	Albania	8	0	0	0	0	2.89	28748	5064
3	Algeria	13	5	4	8	17	40.4	2381740	4363
4	American...	8	0	0	0	0	0.06	199	11200
5	Andorra	11	0	0	0	0	0.08	468	40403
6	Angola	9	0	0	0	0	24.38	1246700	2891
7	Antigua a...	10	0	0	0	0	0.09	443	12870
8	Argentina...	24	21	25	28	74	43.59	2780400	8693
9	Armenia	6	2	6	6	14	2.96	29743	4364
10	Aruba	8	0	0	0	0	0.11	29	21833
11	Australia	26	147	166	188	501	24.17	7741220	56307
12	Austria	27	18	33	36	87	8.74	83871	47055
13	Azerbaija...	6	7	11	24	42	9.76	86600	5593
14	Bahamas...	16	6	2	6	14	0.38	13878	23971
15	Bahrain	9	2	1	0	3	1.57	760	11011

[Note: the screens shown have been taken using the TI-Nspire CAS Teacher Software, which helps display the database – scroll through to view the records].

Maintaining database integrity

The TI-Nspire **Lists and Spreadsheet App** is a powerful and flexible tool for analysing numerical data, and is particularly useful for column-wise and cell-wise analysis. However, the analysis of the *World Games* medals database requires ‘row-wise’ calculations (each country has its own row of data), particularly the ability to sort complete rows of the database by one or more of the column variables (eg medals). To maintain the integrity of the database, all the above 9 variables have been locked. When sorting is needed, the data from relevant variables are first copied to new variables, and then the sorting command is executed.

How to sort the *World Games Medals Database*

To sort a statistical variable (e.g. “sortvar”) from the *World Games Medals Database* in descending order by a particular variable (e.g. “byvar”), the following command is used.

SortD byvar, sortvar (or **SortA** for an ascending sort)

This command can be used in conjunction with a couple of commands to store the relevant variables to achieve the required sorted results. The use of *sortvar* and *byvar* is necessary to avoid any potential changes to the row structure of the original database.

As an example, to sort and display the performance of each country by total number of gold medals won, the following four commands are needed:

1. **sortvar:=country** [stores the values of the variable *country* into a variable *sortvar*]
2. **byvar:=gold** [stores the values of the variable *gold* into a variable *byvar*]
3. **SortD byvar,sortvar** [performs a descending sort of *sortvar* (*country*) by *byvar* (*gold*)]
4. **sortvar** [display the values of sorted values of *sortvar*]

These commands can be typed in a single line, separated by the colon (“:”) character. The following screen shows the result of these commands in a single line.

```
sortvar:=country: byvar:=gold: SortD byvar,sortvar: sortvar
{ "United States", "Soviet Union", "Great Britain", "China", "France", "Italy" }
```

[Note: You will need to make use of similar commands to answer some of the questions below.]

How to count values in the *World Games Medals Database*

The TI-Nspire has a **countif** command that can be used to count the number of values that meet a particular condition [syntax is **countif(list, condition)**]. Here are some examples for the number of gold medals won (using the *gold* variable).

Note that the examples shown make use of the ‘?’ character, which can be located on the calculator keyboard just below the **ENTER** key.

Command	Result
countif(<i>gold</i> ,?=0)	112
countif(<i>gold</i> ,?>200)	6
countif(<i>gold</i> ,50≤?≤200)	18
countif(<i>gold</i> ,?>500 or ?≤10)	169

Analysing the performance of countries

Use the **sortD**, **SortA** and/or the **countif** commands (as shown above) and the data from the *World Games Medals Database* to help answer the following questions.

[Note: variable names can be entered via the **VAR** key].

Question 1

List the top 10 ranked countries by **total** medals.

Rankings

<i>1st</i>	<i>2nd</i>	<i>3rd</i>	<i>4th</i>	<i>5th</i>
<i>6th</i>	<i>7th</i>	<i>8th</i>	<i>9th</i>	<i>10th</i>

Question 2

List the top 10 ranked countries by **gold** and **silver** medals.

Rankings

<i>1st</i>	<i>2nd</i>	<i>3rd</i>	<i>4th</i>	<i>5th</i>
<i>6th</i>	<i>7th</i>	<i>8th</i>	<i>9th</i>	<i>10th</i>

Question 3

How many countries have won between 100 and 500 medals (inclusive) in total?

Question 4

How many countries have won more than 200 medals that were either gold or silver?

Question 5

How many countries have never won a World Games medal?

Question 6

In official overall rankings used for the *World Games*, only total medals are considered. An alternative 'weighted' system of ranking is to award 3 points for a gold medal, 2 points for a silver medal, and 1 point for a bronze medal. The following command will produce the country rankings for this alternative ranking system.

How would this alternative ranking system affect Australia's overall ranking?

Question 7

Can you find another 'weighted' system of that would improve Australia's overall ranking?

Question 8

Another way of ranking the performance of countries is to consider the number of *World Games* in which each country is represented. List the top 10 ranked countries by using the ratio **medals/games**.

Rankings

<i>1st</i>	<i>2nd</i>	<i>3rd</i>	<i>4th</i>	<i>5th</i>
<i>6th</i>	<i>7th</i>	<i>8th</i>	<i>9th</i>	<i>10th</i>

Comment on any changes in the rankings from the official overall rankings.

Question 9

It has been suggested that the ranking performance of countries should also consider each of the following factors:

- the population of each country (for example using population in millions [*pop_mill*])
- the relative wealth of each country (for example by using the GDP per capita [*gdp_cap*])
- the geographic size of each country (for example the area in square kilometres [*area_km2*])

Use appropriate ratios to determine the effect of each of the above three factors to see how the top 5 ranked countries is affected.

a. Top 5 rankings using the ratio _____

<i>1st</i>	<i>2nd</i>	<i>3rd</i>	<i>4th</i>	<i>5th</i>

b. Top 5 rankings using the ratio _____

1st	2nd	3rd	4th	5th

c. Top 5 rankings using the ratio _____

1st	2nd	3rd	4th	5th

Comment on any changes in the rankings from the official overall rankings due to these 3 factors.

Question 10

Multiple factors can be considered. For instance, the ratio $(\text{medals}/\text{games})/\text{gdp_cap}$ considers the impact of the average number of medals per *World Games*, as well as the relative wealth of each country. Which of the countries in this 'top 10' are also in the 'official top 10' (total medals)?