

Which countries win the most medals in the Winter Olympics?

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Introduction

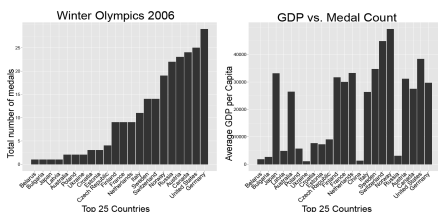
- We seek answers to the following questions:
 - Who is going to win the most Olympic medals in 2010?
 - What are some factors that influence the total medal counts?
 - Are some countries consistently better than others?
 - How can the medal count be predicted for each country?
- Two main factors influencing the total medal count over time are average GDP per capita and population
- Among the top 25 countries, several have consistently outperformed the others
- An individual linear regression model is used to predict the total number of medals
- Most individual models have an overall good fit

Data

- Contents
 - GDP per capita (in US dollars): 1990 – 2009 for 183 countries
 - Population (in millions): 1990 – 2009 for 183 countries
 - Total medal counts by country for the past five Winter Olympic events
- Sources
 - <http://www.imf.org/external/data.htm>
 - <http://www.sports-reference.com/olympics/winter/>
- Cleaning
 - Convert data entries from character to numeric
 - Create averages for GDP per capita and population for time periods prior to the Olympics

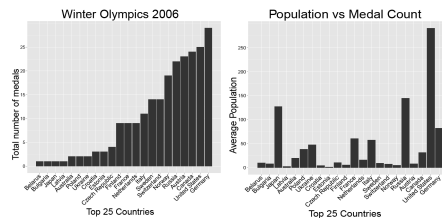
GDP per Capita vs. Medal Counts

- The top six countries are the same for all Winter Olympics (1992 – 2006)
- Five of the six countries have the highest GDP per capita (except Russia)
- Richer countries have more resources for producing world class athletes
- Richer countries usually participate with more athletes, increasing the probability of winning a medal
- Richer countries have athletes participating in more events
- What about Russia?



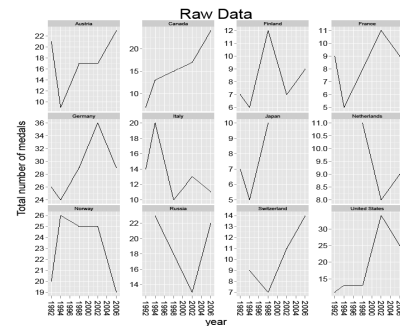
Population vs. Medal Counts

- Four of the top six countries are among those with highest population
- Countries with higher populations choose from a wider pool of athletes
- Countries with higher populations have more athletes participating in the Olympics
- Countries with higher populations have participants in more Olympic events
- Small countries tend to specialize in fewer sports



Total Medals Time Trends

- Countries with less than 5 total medals for any Olympics are excluded
- Countries with average population less than 300 million are excluded



- Austria and Canada have upward trends for the past two Olympics
- Despite Germany's decrease in total medal count, it still won the most medals
- United States, France and Italy have decreased their medal counts in the 2006 Winter Olympics
- Would Russia, Japan and the Netherlands sustain their increasing medal count trend?
- Would Canada and Austria remain two of the most dominant Winter Olympic countries?
- Would United States and Germany change their decreasing trend and continue to lead the total medal counts?

Model

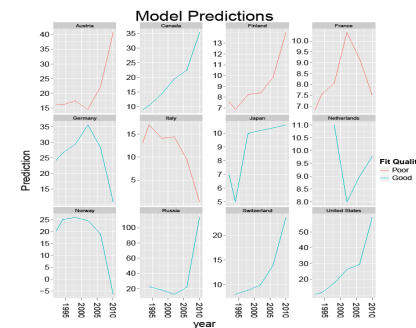
$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \epsilon$$

Y – Total Number of Medals
 X_1 – Average GDP per capita
 X_2 – Average Population

Note: Individual models are estimated for each country

Linear Model Predictions

- Four of the models have a poor fit ($R^2 < 0.7$) as indicated by the red lines in the figure below
- Germany is predicted to continue its decreasing trend and will not even be among the top 5 countries in 2010
- United States is predicted to increase its total medal count
- Canada and the Netherlands will maintain their increasing trend
- Japan is predicted to be among the countries with 5 or more medals in 2010
- Russia and the United States are predicted to dominate the 2010 Winter Olympics



How Well Does the Model Fit the Data?

- Goodness of fit is measured by R^2
- Austria, Finland, France and Italy have very poor fit
- Norway has an R^2 of 0.956, indicating that the model fits the data well
- The goodness of fit for the United States seems to be adequate even though the prediction is not realistic
- Japan, Netherlands and Russia have a perfect fit

Goodness of Fit

Country	R^2
Finland	0.22
Austria	0.30
France	0.40
Italy	0.49
United States	0.73
Switzerland	0.80
Germany	0.87
Canada	0.87
Norway	0.95
Russia	0.99
Japan	1
Netherlands	1

Medal Count Predictions

Country	Total Medal Count
1. Russia	113
2. United States	59
3. Austria	40
4. Canada	35
5. Switzerland	23
6. Finland	13
7. Germany	10
7. Japan	10
8. Netherlands	9
9. France	7
10. Italy	1
11. Norway	-9

- Russia will win more than 100 medals?
- Norway is predicted to win negative number of medals?

Conclusion

- Studied the relationship between average GDP per capita, average population and total medal count by country
- Used individual linear models to predict the total medal counts for twelve countries for the 2010 Winter Olympics
- Only four models yielded an inadequate fit
- Russia, United States, Austria and Canada will again lead the total medal count in the Olympics
- For future work it would be interesting to:
 - Study different models or ways to improve the accuracy of the predictions for each country
 - Examine why Russia and Norway have such unrealistic predictions