Olympics History:
A Data Visualization Application

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1.   Summary

On May 12, 2014, Team Thundercats presented our final project for CS235. Our web application uses various data visualization techniques to provide insight into the history of the summer Olympics. This document provides an overview of the application including its expected users, architectural components, as well as a detailed description of the conclusions that can be drawn from each of its data visualizations.

2.   Application Overview

Every two years, the world gathers to celebrate amateur sports at the Olympic Games. While over 219 million Americans watched the London 2012 summer Olympics and cheered as the United States won more medals than any other nation, most viewers failed to understand the varied dynamics associated with the US' perceived Olympic dominance.

When ranking a nation's performance at the Olympic Games, most think solely about the total number of medals won. However, this formula is overly simplistic. Our application uses Olympic historic data to enable users to more broadly understand the factors that contribute to a nation's performance at the Olympics. The following is a list of the key dynamics we wanted users to more completely understand when considering a nation's Olympic performance:

a.   Geopolitics
b.   National Economic Output
c.   National Population
d.   Games' Host City
e.   Number of Participating Athletes
f.   Event Bias

These guiding concepts/goals served as the core of our thought process when selecting our data visualizations.

It is important to note that while this report and our application discusses the Olympics generally, we chose to focus solely on the summer Olympics for clarity of data presentation.

3.   Typical Users

The potential user base for our Olympics history application is very broad. It is intended to cover anyone who is interested in learning more about the summer Olympics. However, we did focus more on an American audience in many of our visualizations. While some in the class may not originally come from this country, the United States has one of the richest and most extensive Olympic histories, which makes it a prime subject for study and analysis.

4.   Application Presentation

All semester, our team has avoided slide-focused presentations as they can cause the audience to quickly lose interest and/or become distracted. It was our position that a very short presentation followed by a longer demonstration would be more engaging and informative to the audience. Given the very positive feedback we received from both Professor Mak and the class regarding our previous presentations, we saw no need to change our approach for the final project.

Despite being the first team to present and the only ones who presented early, we felt our presentation was very successful. Our application has a clear story, and the dynamic data visualizations lend themselves well to an interactive presentation.

We have included our presentation slides with this submission. The file name is: "CS235 - Team Thundercats - Final Project Presentation.pptx".

5.   Application Components

Our application has three primary components, which are described in the following sections. In addition, we included with our submission our source code, which is in the zip file named "CS235 – Final Project – Source Code.zip".

As a note to any users of our application, we fully populated the navigation menus to give the site an increased feeling of realism. However, only of a subset of the links take the user to actual pages. For a list of the application's working pages, kindly see the section entitled "Data Visualizations" where each subsection corresponds to a page on our site.

5.1.   Website Template

Our application adapted an existing HTML5 and CSS template[1]. We selected this template because it had a professional appearance and due to its effective use of multiple web design patterns including:

a.   **Visual Framework** – Across all pages, our application has a common framework that allows users to access all of the application's features. Providing a persistent and consistent navigation platform enables users to build a strong, working base of knowledge on how to access various site features.

What is more, an advanced feature of this template's navigation structure is that it includes embedded images as part of the navigation bar (shown inside blue rectangles in figure 1). This allows users to use recognition when identifying the menu item that aligns with their goals and not solely recall.

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[1] For a link to the template, please see: http://themeforest.net/item/alexx-multipurpose-html5-theme/3370259
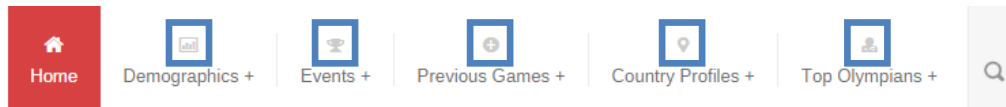
Figure 1 – Persistent Navigation with Embedded Images for Recognition

b. **Carousel** – On the front page, there is a carousel of iconic Olympic images. Most users (in particular those who already have some knowledge about the Olympics) will recognize that many of these images came from multiple games, as far back as 1936. This recognition will assist in the cultivation of the mental modal that this site is focused on Olympic history.

c. **Escape Hatch** – In the upper left corner of each page is our application's "Olympics History" logo (see figure 2). By clicking on the logo, the user is returned to our application's home page. This approach allows users to feel freer when exploring the site as they have reduced fear of not being able to return.

Figure 2 – Olympics History Application Logo

d. **Breadcrumbs** – With the exception of the home page, all pages on the site have breadcrumbs that allow users to know the current page they are on and to return to parent pages in the navigation heirarchy.

Figure 3 – Breadcrumbs in the Application's "United States" Page

5.2.   Tableau

Since this project is, at its core, focused on data visualization, the software used to visualize that data is critical. The reasons we chose Tableau as the data visualization tool for our application were:

a. **Full Version for Students** – As part of its "academic program", Tableau offers the full version of its software free to students. For more information on this, please see here:

https://www.tableau.com/academic/students

b. **Large User Base** – A user must spend a non-insignificant amount of time experimenting with Tableau before s/he is able to efficiently create good visualizations. For our team, it generally took at least 8 hours before we reached that threshold. If Tableau did not have as large of a user base as it does, it would have taken us much longer because we would not have had the

opportunity to reference all the user generated tutorials and YouTube videos that helped us learn the tool's finer details.

c. **Advanced Feature Set** – Different features within Tableau allow users to include multiple data visualization design patterns into their applications. The follow subsections enumerate different data visualization design patterns we used in our application. Note that this is not a complete list. Rather, we focused on those aspects we found could be described effectively in a text document.

5.2.1.   Multiple Visualization Types

The heart of any data visualization tool is the different types of visualizations it can create. The following is a list of the types of visualizations we used in our application; below each type are the names of visualizations that used that visualization model.

a. **Normal Bar Chart**
   i. Dollars for Medals – Relation between a Nation's GDP and the Number of Medals Won at the London 2012 Olympics
   ii. Quantifying the Most and Least Athletic Countries – Country Population per Medal at the London 2012 Olympic Games

b. **Stacked Bar Chart**
   i. United States Medal Wins – A Home Advantage
   ii. If Michael Phelps were a Country

c. **Line Graph**
   i. Effect of Geopolitics on Olympic Medal Wins – Charting the Rise and Fall of Superpowers
   ii. Growth in the Number of Olympic Events

d. **Filled Map**
   i. Total Summer Olympic Medals Won

e. **Symbol Map**
   i. Summer Olympic Games Host Cities
   ii. Athletes Attending the 2012 London Olympics by Country

Note that the preceding list of visualization types is only a subset of those supported by Tableau.

5.2.2.   Data Spotlighting

Data spotlighting allows users to select to emphasize a particular portion of the data without losing its context with respect to the rest of the data. Figures 4 and 5 show the same graph displayed normally and

with data spotlighting respectively. Note that in Figure 5, the red line becomes prominent as the rest of the data is dimmed.
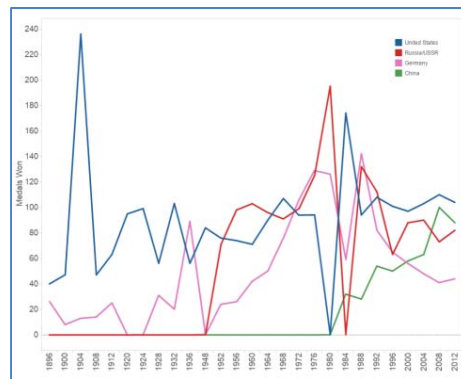
Figure 4 – Olympics Geopolitics Graph Displayed Normally
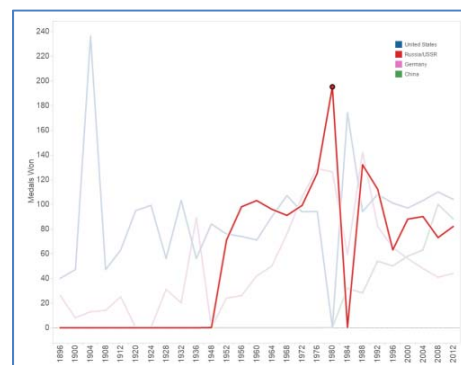
Figure 5 – Olympics Geopolitics Graph Displayed with Data Spotlighting

Data spotlighting is enabled in all of our application's data visualizations.

5.2.3.   Data Tips

In displays where there is a significant amount of data, getting the exact value of a particular entity may be difficult. Data tips allow users to get more information about a specific portion of the data by hovering over it.   Figure 6 shows a data tip (surrounded by a green rectangle) in our data visualization "If Michael Phelps were a Country". Note that the tool tip displays the country name along with the number of bronze medals and the total number of medals the country (i.e. Poland) won; these types of tool tips make information readily available to a user which would otherwise be more onerous if not impossible to determine.
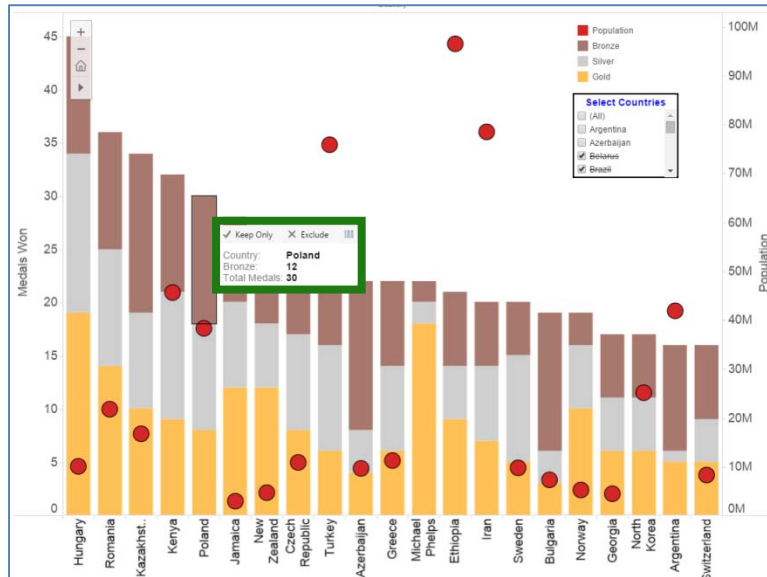
Figure 6 – Data Tip for the Displaying the Total Number of Medals Won by Poland and How Many were Bronze

Data tips are enabled in all of our application's data visualizations.

5.2.4. Multi-Y Graphs

When trying to identify a relationship between two distinct but related data variables, it is often not possible to use the same scale/axis to display them both. In such cases, using multiple Y-axes is the best solution. Figure 7 has two Y-axes; on the left Y-axis, the population per Olympic medal is displayed while on the right Y-axis is the number of medals won. Note that the common X-axis is a set of countries.
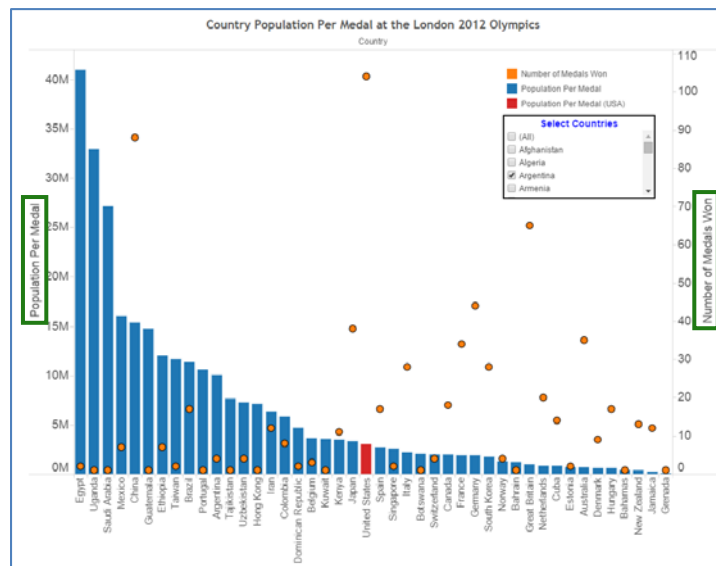
Figure 7 – Multi-Y Graph Comparing Population per Medal versus Total Medals Won

Our application used multi-Y graphs in the following data visualizations:

a. Dollars for Medals – Relation between a Nation's GDP and the Number of Medals Won at the London 2012 Olympics

b. Quantifying the Most and Least Athletic Countries – Country Population per Medal at the London 2012 Olympic Games

c. Growth in the Number of Olympic Events

d. If Michael Phelps were a Country

5.2.5.   Sortable Table

The Sortable Table design pattern is something of a misnomer as while it specifically mentions tables by name, the pattern applies to more than that. As shown in the in-class lecture material, it can also apply to bar graphs as well.

In our application, the default was to always sort data according to the left Y-axis. However, if the user wanted to sort according to the right Y-axis, s/he does so by hovering the mouse over axis title and selecting sort ascending or descending.

Figure 8 shows the same graph sorted by the left Y-axis (see left graph) and by the right Y-axis (see right graph).

Figure 8 – Multi-Y Graph Sorted by Either the Left or Right Y-Axis

Our application supports sortable tables on the data visualizations with multiple Y-graphs namely:

    a. Dollars for Medals – Relation between a Nation's GDP and the Number of Medals Won at the London 2012 Olympics
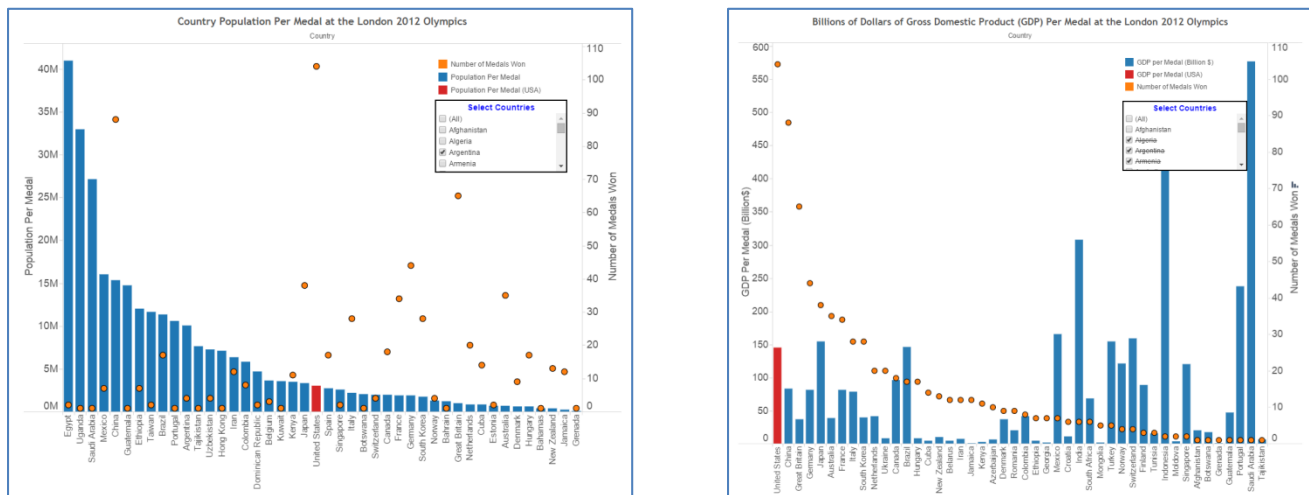
    b. Quantifying the Most and Least Athletic Countries – Country Population per Medal at the London 2012 Olympic Games

    c. Growth in the Number of Olympic Events

    d. If Michael Phelps were a Country

5.3. GitHub – The Application Runtime Platform

Throughout the semester, Team Thundercats used GitHub as our revision control repository. One of GitHub's lesser known features is that built into every GitHub repository is a free web server. To run our application, we recommend that you access our GitHub page directly. A link to the application's home page is below.

http://rawgit.com/ZaydH/CS235/master/Final_Project/index.html

As a service to future students, we will keep our project live in perpetuity as part of our group's GitHub repository. It is our humble recommendation that for subsequent classes, it be a requirement that the students publish their projects to a course GitHub repository so students may view them easily for inspiration, ideas, and to better understand the professor's expectations.

6. Data Sources

Multiple different data sources were used to generate the different data visualizations included with our applications. Below is a list of the data sources we used; included with each is a reference to the data visualization where the data set was used:

1. **Olympic Medal Wins by Games**
   A. **Description:** This dataset lists the number of gold, silver, and bronze medals won by the United States at each summer Olympic Games.
   B. **Data Source:** http://chandoo.org/wp/2008/08/06/olympic-medal-country-year-excel-bubble-chart/
   C. **Data Visualization:** Effect of Geopolitics on Olympic Medal Wins – Charting the Rise and Fall of Superpowers

2. **United States' Olympic Medals Won by Games**
   A. **Description:** This dataset lists the number of gold, silver, and bronze medals won by the United States at each summer Olympic Games.

B. **Data Source:** http://www.olympic.org/united-states-of-america
C. **Data Visualizations:**
  a. Effect of Geopolitics on Olympic Medal Wins – Charting the Rise and Fall of Superpowers
  b. United States Medal Wins – A Home Advantage

3. **China's Olympic Medals Won by Games**
   A. **Description:** This dataset lists the number of gold, silver, and bronze medals won by the People's Republic of China at each summer Olympic Games.
   B. **Data Source:** http://www.olympic.org/people-s-republic-of-china
   C. **Data Visualization:** Effect of Geopolitics on Olympic Medal Wins – Charting the Rise and Fall of Superpowers

4. **Soviet Union's Olympic Medals Won by Games**
   A. **Description:** This dataset lists the number of gold, silver, and bronze medals won by the Soviet Union at each summer Olympic Games.
   B. **Data Source:** http://www.pbs.org/redfiles/sports/stry/medals.htm
   C. **Data Visualizations:** Effect of Geopolitics on Olympic Medal Wins – Charting the Rise and Fall of Superpowers

5. **The Russian Federation's Olympic Medals Won by Games**
   A. **Description:** This dataset lists the number of gold, silver, and bronze medals won by the Russian Federation at each summer Olympic Games.
   B. **Data Source:** http://www.olympic.org/russian-federation
   C. **Data Visualizations:** Effect of Geopolitics on Olympic Medal Wins – Charting the Rise and Fall of Superpowers

6. **Germany's Olympic Medals Won by Games**
   A. **Description:** This dataset lists the number of gold, silver, and bronze medals won by Germany at each summer Olympic Games.
   B. **Data Source:** http://www.olympic.org/germany
   C. **Data Visualizations:** Effect of Geopolitics on Olympic Medal Wins – Charting the Rise and Fall of Superpowers

7. **Total Medals by GDP**
   A. **Description:** This dataset quantifies the relationship between a nation's economic output (measured as GDP – Gross Domestic Product) and the number of medals it won at the 2012 London Olympics.
   B. **Data Source:** http://www.medalspercapita.com/#medals-by-gdp:2012
   C. **Data Visualizations:** Dollars for Medals – Relation between a Nation's GDP and the Number of Medals Won at the London 2012 Olympics

8. **Total Medals Won Per Capita**
   A. **Description:** This dataset quantifies the relationship between a nation's population and the number of medals it won at the 2012 London Olympics.

B. **Data Source:** http://www.medalspercapita.com/#medals-per-capita:2012

C. **Data Visualizations:** Quantifying the Most and Least Athletic Countries – Country Population per Medal at the London 2012 Olympic Games

9. **Olympic Events by Games**
    A. **Description:** This dataset provides a table enumerating the events each summer Olympics. Note that we excluded the 1906 Intercalated Games since that is no longer considered an official Olympic Games by the International Olympic Committee (IOC).
    B. **Data Source:** http://en.wikipedia.org/wiki/Olympic_sports
    C. **Data Visualization:** Growth in the Number of Olympic Events

10. **Summer Olympic Games Host Cities**
    A. **Description:** This dataset provides a list of host cities for each of the summer Olympic games.
    B. **Data Source:** http://www.olympic.org/olympic-games
    C. **Data Visualization:** Summer Olympic Games Host Cities

11. **Athletes Attending the London 2012 Olympics by Country**
    A. **Description:** This dataset provides a list of host cities for each of the summer Olympic games.
    B. **Data Source:** http://en.wikipedia.org/wiki/2012_Summer_Olympics
    C. **Data Visualization:** Athletes Attending the 2012 London Olympics by Country

12. **All Time Olympic Medal Totals by Country**
    A. **Description:** This dataset provides a table listing the number of summer Olympics medals won by each country.
    B. **Data Source:** http://www.olympic.it/english/medal/id_summer.htm
    C. **Data Visualization:** Total Summer Olympic Medals Won

13. **Olympic Medals Won by Michael Phelps**
    A. **Description:** This dataset provides a list of the Olympic medals won by athlete Michael Phelps at each of the summer Olympics at which he competed.
    B. **Data Source:** http://www.olympic.org/michael-phelps
    C. **Data Visualization:** If Michael Phelps were a Country

7.   Webpage Text

Since this project is intended to be a user interface design course's culminating experience, we did not consider that it would be necessary (much less important) to write original text for each of the application's pages. Rather, the vast majority of the text on our application's pages is merely a tool to lend realism and context. As such, other than the headlines for each of the pages and the graph titles, none of the text in our application is original. It was all sourced from different web pages we found.

The section entitled "List of Webpage Text References" includes a list of pages from which we borrowed text content. Any pages missing from this list are an oversight on our part since we fully acknowledge that all of the text content (excluding the previously mentioned exceptions) is not original.

8. Data Visualizations

The following subsections enumerate the nine data visualizations included in our application. Each subsection also describes our motivations when creating the visualization and how the visualization addresses our original goals.

8.1. Total Summer Olympic Medals Won

Web Page Address: http://rawgit.com/ZaydH/CS235/master/Final_Project/country_profiles.html
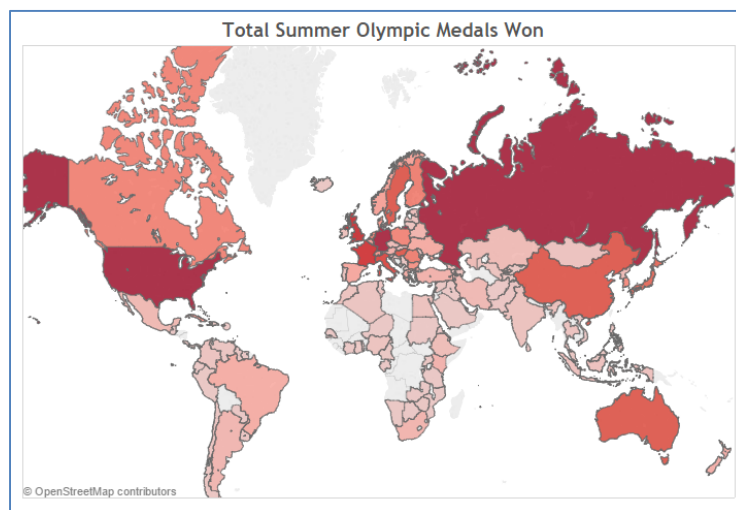

Figure 9 – Filled Map Showing the Total Number of Summer Olympic Medals Won by Country

When determining the country that has performed the best at the Olympics, most think only of total medal count; some may have considered our application would be incomplete without this clichéd visualization. However, we deliberately kept the visualization as simple as possible because while it does clearly show that the nations that have won the most Olympic medals are the United States, Germany, and Russia, we know it does not tell the whole story; instead this visualization will serve as a point of contrast to show the user that Olympics performance is much more complex than just who won the most medals.

8.2. Effect of Geopolitics on Olympic Medal Wins – Charting the Rise and Fall of Superpowers

Web Page Address: http://rawgit.com/ZaydH/CS235/master/Final_Project/geopolitics.html
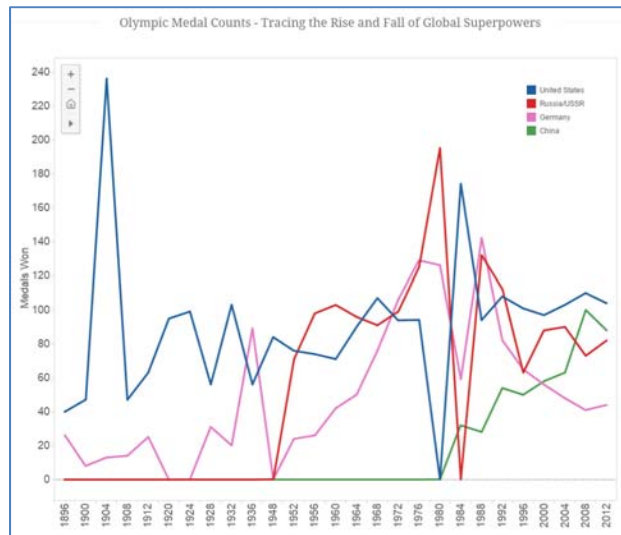
Figure 10 – Line Graph Showing the Effect of Geopolitics on Summer Olympic Medal Counts

Chapter 5 of the Olympics Charter states, "No kind of demonstration or political, religious or racial propaganda is permitted in the Olympic areas." While this may technically be true, it somewhat belies the reality that the entire Olympic movement is often dominated by political propaganda. To illustrate this point, we have graphed the medal totals at each summer Olympic Games for the 20th Century's dominant superpowers. The following list describes how each nation's medal count is deeply reflective of the on-going geopolitical situation.

1. **Germany** – Leading up to World War II, Nazi Germany was intent on showing the superiority of the Aryan race, and at the behest of the Nazi propaganda minister Joseph Goebbels, Nazi Germany pushed its athletes to perform well at the 1936 Berlin games. Due to this pressure, Germany won more medals in those games than any other nation.

   It must also be noted that Germany is the only country to have lost two world wars. Its defeats are clearly shown in our data visualization as Germany won no medals in 1920, 1924, and 1948.

   Once Germany had begun to rebuild after World War II, East Germany wanted to show its superiority over West Germany and began an extensive doping program. This led to a surge of Olympic medal wins until the Berlin Wall fell in 1989, after which there was a precipitous drop in the number of medals won by the united Germany.

2. **Soviet Union/Russia:** Before 1950, the Soviet Union was very domestic centric in its politics, and only looked outside its borders regarding matters of national security (e.g. Molotov-von Ribbentrop Pact, World War II related diplomacy, etc.). This inward focus is reflected in the fact the Soviet Union never competed in a summer Olympics before 1952.

   By 1952, the Cold War had already become hot in places like the Korean Peninsula. What is more, communist and democratic nations were pitted against each other to show the superiority of their political systems. Similar to Nazi Germany in the 1930's, the Soviet Union invested

heavily in athletes at this time, which is reflected in the number of summer Olympic medals it won. The only exception to this is when it boycotted the 1984 Olympics for the geopolitical reason that the games were held in Los Angeles.

3. **China:** Before 1980 when President Richard Nixon visited mainland China, the nation was politically isolated. The infrastructure had been largely destroyed by Japan in World War II and civil war. This national isolation is reflected in that China won no Olympics medals before 1984. However, China, as a nation, is on the rise both economically and at the Olympic Games. It has steadily won an increasing number of medals, and just like it does economically, China now only trails the United States in medals won at the summer Olympics.

4. **United States:** The 20th Century was America's century. It won two World Wars and is the only one of the four major superpowers on this graph to not have had any political revolutions. Rather, the United States has been the hallmark of stability. This political stability is reflected in US' comparatively stable medal win count. The only two outliers are the 1904 games, when the Olympics were still in their infancy, and in 1980-1984, when the games were dominated by Cold War politics, which led to alternating boycotts.

8.3. Dollars for Medals – Relation between a Nation's GDP and the Number of Medals Won at the London 2012 Olympics

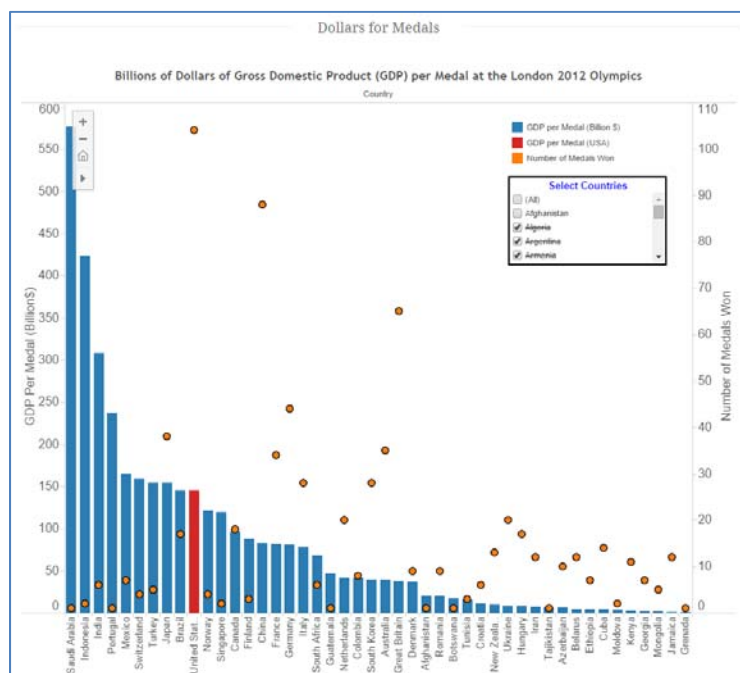**Web Page Address:** http://rawgit.com/ZaydH/CS235/master/Final_Project/economics.html

Figure 11 – Multi Y-Axis Bar Graph Contrasting GDP to Medal Ratio and the Total Number of Medals Won

Competing in the Olympics can be expensive. While some sports like marathon have very low cost barriers to entry, others like swimming and equestrian events require specialized equipment that may be unavailable to many people. Hence, even if an individual has the maximum potential to achieve greatness, that greatness may be squandered if they cannot afford to utilize that potential. Figure 11 illustrates the relationship between a nation's economic output and the medals won at the London 2012 games.

To quantify how well a nation translates its economic output to Olympic medals, we calculated the GDP to Medal ratio via the simple formula:

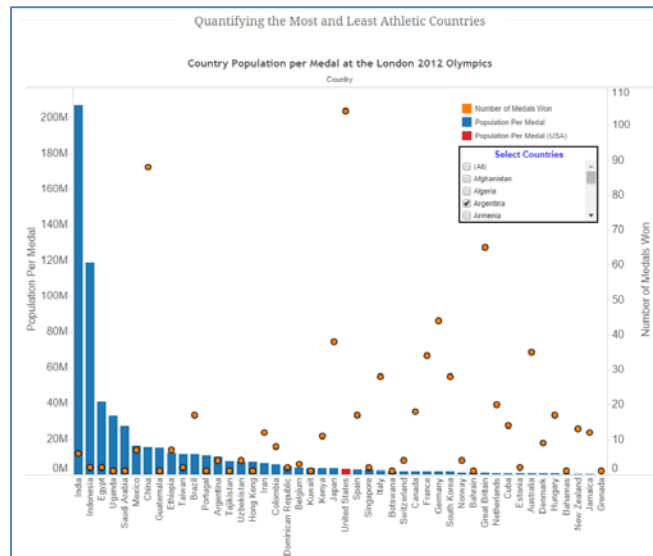$$GDP\ to\ Medal\ Ratio = \frac{National\ GDP}{Number\ of\ Medals\ Won}$$

Note we only considered the number of medals won at the London 2012 games (i.e. the most recent).

As shown in figure 11, the country that had the best GDP to medal ratio was Grenada at $800M per medal; however, it only won a single medal. As such, it should be considered an outlier; this type of outlier necessitated we also include in the visualization the number of medals won. Rather, we would argue Jamaica's $1.3B per medal is a much greater accomplishment as it won 12 medals. In contrast, Saudi Arabia had $576B of GDP for the single medal it won.

While this visualization works well for countries with low to moderately sized GDPs, it can be overly harsh in punishing countries with very large GDPs. For example, if the United States had won every medal at London 2012, its GDP to medal ratio would have only been $15.7B well behind nations like Tunisia, Ethiopia, Kenya, Georgia, and Mongolia, much less Jamaica.

8.4.   Quantifying the Most and Least Athletic Countries – Country Population per Medal at the London 2012 Olympic Games

Web Page Address: http://rawgit.com/ZaydH/CS235/master/Final_Project/population.html

Figure 12 – Multi Y-Axis Bar Graph Contrasting Population to Medal Ratio and the Total Number of Medals Won

Concerning the lottery, it is often said that the more tickets one buys, the better the chances of winning. Some argue that this applies to the "genetic lottery" for Olympic athletes. For example, most people could never have been as fast as Usain Bolt or as athletic as LeBron James even if they did everything they possibly could.

As shown in figure 12, India and Indonesia are exceptionally poor at cultivating Olympic medal winning athletes despite having very large populations. What is more, some countries like Pakistan and the Philippines do not even appear on this graph because they did not win any medals at all. In contrast, Jamaica won twice the number of medals as India at the London 2012 Olympics despite India having more than 450 times the population. Hence, this visualization shows that certain nations are far better at producing Olympic medal winning athletes than others, which shows the "more chances to win" argument has fundamental flaws.

This visualization does not stray far from the theme that no one statistic can completely quantify a nation's Olympic performance. At the Olympic Games, the number of athletes a nation can send is not proportional to population size. For example, a nation can only send 12 players to represent it in men's basketball irrespective of a nation's population. This cap will make countries with large populations like China and the United States appear worse despite potentially performing well at the games in particular in those games where the result has some degree of chance associated with it and where the best athlete does not always win.

8.5. United States Medal Wins – A Home Advantage

Web Page Address: http://rawgit.com/ZaydH/CS235/master/Final_Project/united_states.html
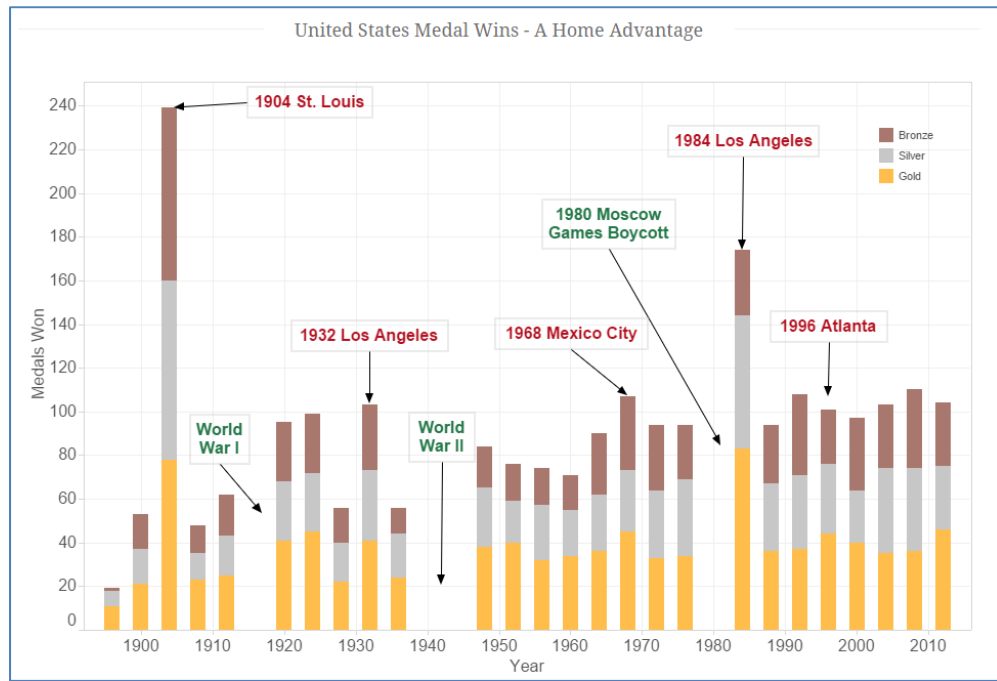
Figure 13 – Stacked Bar Chart of the Medals Won by the United States at the Summer Olympics

When most fans of the Olympics envision their city or nation hosting the games, they think primarily in terms of national prestige or glory; politicians may even think of the economic benefits. However, few think of how the selection of the host city affects medal totals. As shown in figure 13, the two summer Olympics where the United States won its most medals, the games were hosted domestically. In particular, during the 1904 games, the United States won more than 85% of the medals as it fielded 81% of the athletes. Similarly in the 1984 games, the United States' two biggest rivals, the Soviet Union and East Germany boycotted the games solely because they were held in the US. These two outliers greatly skew the US medal total much higher. What is more, with the exception of the 1996 Olympics, the United States had sizeable, one off increases in the numbers of medals won when the games was hosted in the United States or a neighboring country. As such, these effects contribute to the United States winning more medals in total than any other nation.

8.6. Summer Olympic Games Host Cities

Web Page Address: http://rawgit.com/ZaydH/CS235/master/Final_Project/previous_games.html
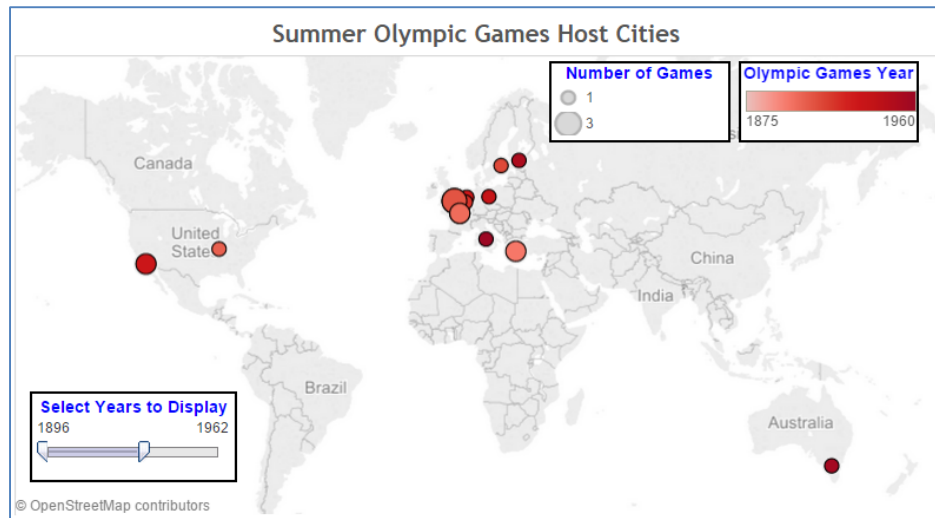
Figure 14 – Symbol Map of the Summer Olympic Games Host Cities

Section #8.5 clearly showed that the medal totals for the United States tended to go up when the Olympics were hosted in the United States or in a neighboring country. What is more, in section #8.2, China won its most medals when the Olympics were held in Beijing. There is no reason to believe this phenomenon does not apply to other countries as well. In contrast, obvious factors, including the cost to travel and supporting fans, would lead one to believe this effect applies global.

Before 1964, all Olympics had been held in developed Western countries with only three being held outside of Europe. This would naturally skew Olympic medal totals toward these countries. As the Olympics have become more of a truly global events, it has been (and will be) held in more non-traditional cities including Moscow, Tokyo (twice), Rio de Janeiro, Beijing, and Seoul. This increased global participation may lead to a more balanced total medal table in the future.

8.7. Athletes Attending the 2012 London Olympics by Country

Web Page Address: http://rawgit.com/ZaydH/CS235/master/Final_Project/previous_games.html
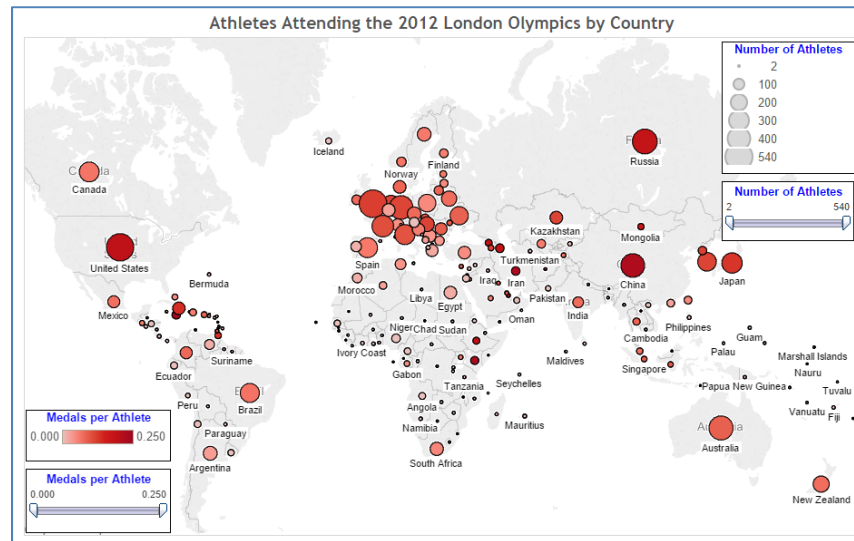
Figure 15 – Symbol Map showing the Number of Athletes that Attended the London 2012 Olympics and the Average Number of Medals per Athlete

Figure 15 is perhaps the most important visualization in our project. It brings together two important data sets for the London 2012 Olympics; they are:

1. Number of Athletes from Each Nation
2. Number of Medals Won per Athlete

If two nations sent comparable numbers of athletes to the same Olympics, then one of the ways to compare them is to look at the medal totals. For example, at London 2012, the United Kingdom had 540 participating athletes and won 65 medals. In contrast, the United States had 530 athletes and won 104 medals (note this detailed information is available for this visualization as a tool tip). All other factors being equal, this would imply the United States did substantially better than the UK at this games.

Using solely the medal count metric, it is not possible to compare for instance the United States to Jamaica (which sent only 50 athletes yet won 12 medals). One of the ways you can normalize these results is by calculating the medals per athlete ratio defined by:

$$Medals\ per\ Athlete = \frac{Number\ of\ Participating\ Athletes}{Number\ of\ Medals\ Won}$$

When this scale is used, Jamaica significantly outperformed the United States with a medals per athlete ratio of 0.240 versus 0.196.

Another important aspect of this visualization is that it supports dynamic queries via sliders. For example, a user can select a minimum and maximum athletes per medal ratio range to be displayed. One interesting note is that when the medals per athlete ratio is set just above zero (i.e. the nation had to win at least one medal), most of Africa is no longer included on the map. This shows Africa's generally poor performance at the games.

It is also worth noting that this visualization does not correct for the fact that for some sports like basketball, synchronized swimming, field hockey, etc., a team can consist of ten or more players but only a single medal could be awarded to the entire team. This can skew the medals per ratio value low. However, for countries with large Olympic contingents (e.g. Russia, China, the United Kingdom, Germany, France, Japan, etc.), we expect that this skew would become a non-factor as it would affect all of the nations about the same amount. To address this concern, we included the second slider to filter nations based off the number of athletes they sent to the games.

8.8.   Growth in the Number of Olympic Events

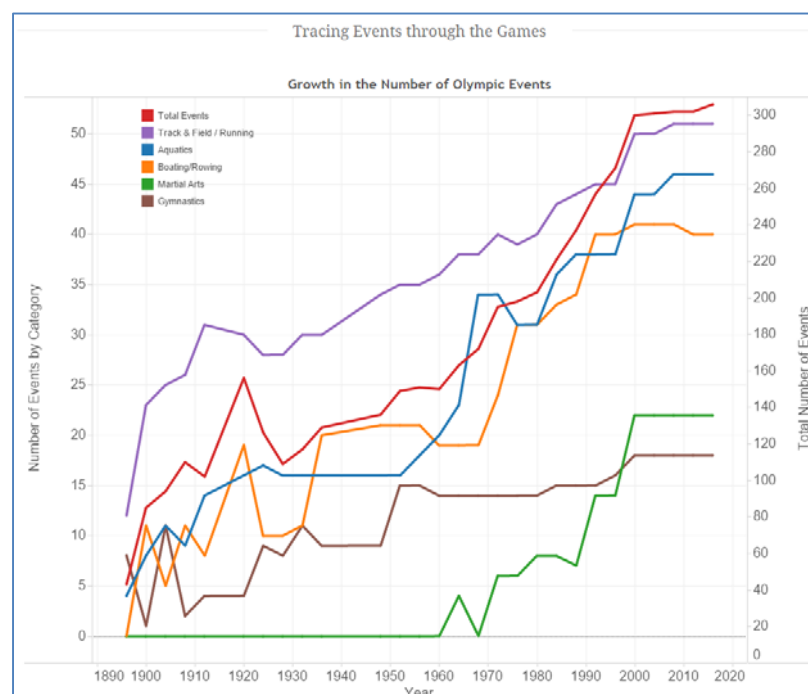**Web Page Address:** http://rawgit.com/ZaydH/CS235/master/Final_Project/events.html

Figure 16 – Line Graph Showing the Growth in the Number of Events at the Summer Olympics

It is only possible to win an Olympic medal in events that actually exist. This may seem like an obvious statement, but it is not one that can be overlooked. The types of events included in the Olympics were originally set primarily by Americans and Europeans. As shown in figure 16, while the number of events at the Olympics has grown substantially since the first Olympics in 1896, their growth has largely been in the same original core group (with the exception of martial arts).

Some argue that the types of events at the Olympics benefit specific countries over others. An example of this is cricket, which has only ever appeared at a single Olympic games (1900) despite being one of the most popular games on the planet. The International Olympic Committee (IOC) decides which events to

include and exclude from each games. In recent years, there has been a shift towards a more global centric event line-up by removing games such as softball and baseball and replacing them with more international games like rugby.

   If past trends are an indication, it is unlikely that the Olympics will adopt a significant number of new events that are more traditionally eastern focused. Rather, what is more likely is that the sports played in different countries will drift towards those that are already popular internationally. Until a more global uniformity of sports popularity is reached, the types of events at the Olympics will continue to disenfranchise certain nations.

8.9.   If Michael Phelps were a Country
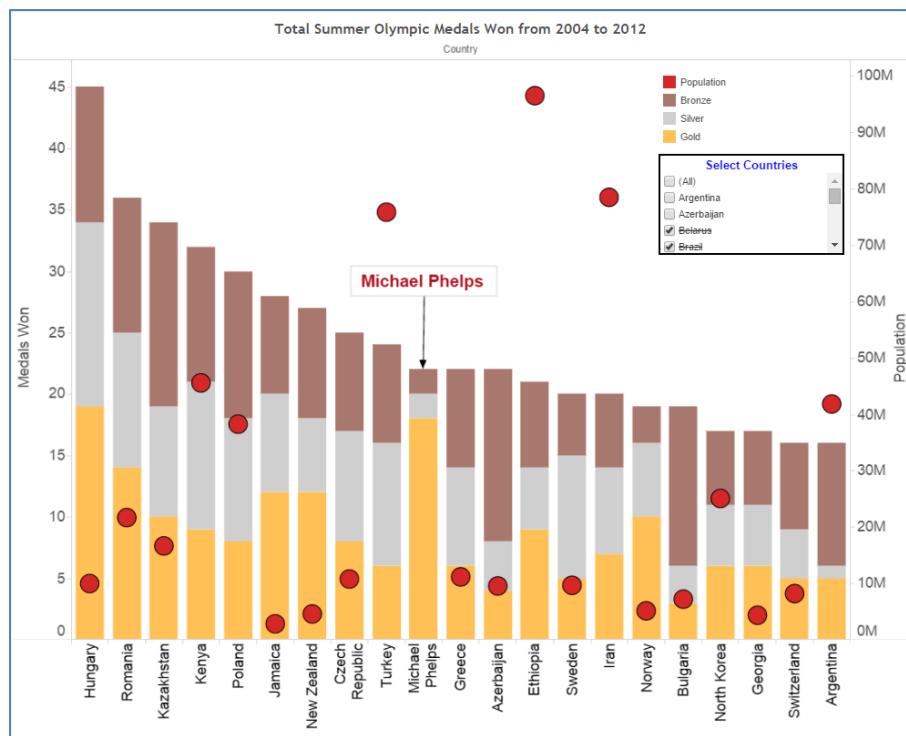
Web Page Address: http://rawgit.com/ZaydH/CS235/master/Final_Project/michaelphelps.html

Figure 17 – Stacked Bar Graph Comparing Michael Phelps Medal Total to Various Countries

   The previous visualizations were intended to show some of the nuances associated with describing Olympic performance. In contrast, the final visualization in figure 17 is intended as a tool to show the dominating Olympic performance of a single individual: Michael Phelps. It does this by bringing together three distinct pieces of data, namely:

   1. Total Number of Medals Won by Country
   2. Country Population Size

3. Medal Breakdown between Gold, Silver, and Bronze

With the exception of population size, this data applies to only the three Olympic Games at which Michael Phelps competed (specifically the years 2004, 2008, and 2012).

This visualization shows that no country with comparable medal counts had nearly the ratio of gold medals to total medals that Michael Phelps had. What is more, despite having millions or even tens of millions of people, these countries had similar medal totals to Phelps. As an example, the combined medal output of over 95 million Ethiopians could not match Michael Phelps by himself. This visualization succinctly, and perhaps a bit entertainingly, shows Phelps' superior and dominant Olympic performance in the last three games.

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