Math IA Rough Draft

hyg172

May 2020

Contents

1 Exploration **2**
- 1.1 Introduction . . . 2
- 1.2 Research Questions . . . 2
- 1.3 Hypothesis . . . 2

2 Analysis **2**
- 2.1 USCF vs FIDE . . . 2
  - 2.1.1 Data . . . 2
  - 2.1.2 2 Sample T-Test . . . 4
  - 2.1.3 Data based answer to the research question . . . 4
  - 2.1.4 Linear Regression . . . 4
- 2.2 Comparing Chess Ratings of the Top 6 Countries . . . 5
  - 2.2.1 Data . . . 5
  - 2.2.2 ANOVA Test . . . 6
  - 2.2.3 Data based answer to the research question . . . 7

3 Conclusion **7**
- 3.1 Extensions . . . 7

A Calculating standard deviation using Python **8**

B Works Cited **9**

1 Exploration

1.1 Introduction

As a young child, I've always been interested in the idea of quantifying and relating objects using numbers. This was initially a usefool tool in visualizing basic arithmetic. When I started playing tournament chess, I recieved a chess rating, or a number used to quantify one's chess strength relative to others. There are multiple such systems that give chess player ratings, for example online chess websites such as Lichess and Chess.com have their own rating systems, and even countries have their own rating systems. However, the governing body of chess, FIDE, has their own rating system that allows a standard rating for comparison between countries with otherwise different rating systems. This led to the foci of the investigation on how FIDE ratings compare to USCF ratings with respect to the top 10 players in the US and also comparing the strengths of the top 10 players of the top 6 countries.

1.2 Research Questions

How do the FIDE ratings compare to USCF ratings of the top 10 chess players in the US?

How different are the ratings between the top 10 players of the top 6 chess country federations?

1.3 Hypothesis

I predict that USCF ratings will be not much different from FIDE ratings. However, USCF ratings may be slightly higher as the overall pool of players with FIDE ratings has stronger players.

I predict that there will be a statistically significant difference between the FIDE ratings of the top 10 players of the top 6 countries as they have different concentrations of strong players.

2 Analysis

2.1 USCF vs FIDE

2.1.1 Data

Suprisingly, the top 10 players by USCF rating differ from FIDE's list of the top 10 US players by FIDE rating. This difference is due to the fact that FIDE and USCF tournaments have different criteria for a tournament to be valid. Due to this, we will find the respective USCF ratings of the top 10 US players by FIDE rating. Nevertheless, the top players American players by FIDE and USCF rating are the same, just in different order.

FIDE	USCF
2822	2894
2765	2826
2758	2834
2736	2836
2712	2787
2683	2744
2677	2758
2673	2749
2660	2733
2659	2748

Table 1: FIDE vs USCF ratings

The USCF top player list and the FIDE list was accurate as of December 2019.

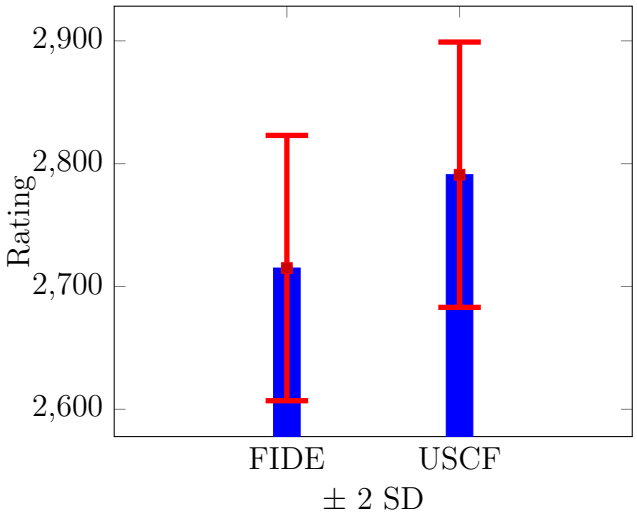

Figure 1: FIDE and USCF Ratings

Standard Deviation	Mean
54	2715

Table 2: FIDE rating

Standard Deviation	Mean
54	2791

Table 3: USCF rating

2.1.2 2 Sample T-Test

Null Hypothesis: There is not a significant difference (no correlation?) between the mean FIDE rating and the mean USCF rating.

Alternate Hypothesis: There is a significant differrence between the mean FIDE rating and the mean USCF rating.

Test Statistic:

$$\begin{aligned} t_{(n-1)}\ \mathrm{d}f &= \frac{(\overline{x_1} - \overline{x_2}) - (\mu_1 - \mu_2)}{\sqrt{\frac{(s_1)^2}{n_1} + \frac{(s_2)^2}{n_2}}} \\ &= \frac{(2715 - 2791) - (0)}{\sqrt{\frac{(54)^2}{10} + \frac{(54)^2}{10}}} = -3.16 \end{aligned} \tag{1}$$

p-value: P(t $\leq$ -3.16) = 0.005

2.1.3 Data based answer to the research question

Because the p-value is less than 0.05, the null hypothesis cannot be accepted. Therefore, we provisionally accept the alternate hypothsis that there is a significant difference between USCF and FIDE ratings.

2.1.4 Linear Regression

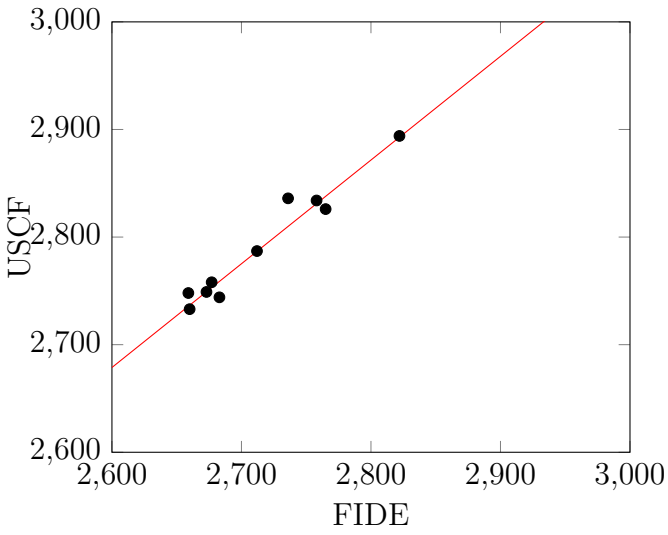

Figure 2: USCF vs FIDE rating

We will use a linear regression to test how well FIDE and USCF ratings relate to each other among the top 10 US players.

USCF = 0.964 FIDE + 172 The linear regression results in an r value of 0.976 and an r^2 value of 0.953. This shows that there is a very strong correlation between USCF and

FIDE ratings. This is true despite the fact that the average USCF and FIDE ratings have a statistically significant difference.

2.2 Comparing Chess Ratings of the Top 6 Countries

2.2.1 Data

	Russia	USA	China	India	Ukraine	Armenia
	2777	2822	2805	2758	2698	2773
	2774	2765	2758	2721	2685	2689
	2753	2758	2732	2716	2685	2663
	2752	2736	2726	2654	2678	2642
	2747	2712	2705	2648	2662	2641
	2731	2683	2683	2639	2660	2641
	2726	2677	2669	2638	2650	2632
	2723	2673	2667	2637	2644	2617
	2705	2660	2664	2636	2634	2613
	2704	2659	2640	2630	2631	2611
$\sum$	27392	27145	27049	26677	26627	26522
$\overline{x}$	2739.2	2714.5	2704.9	2667.7	2662.7	2652.2
SD	25.75	54.40	50.67	45.92	23.15	48.65

Table 4: Top 6 Countries and their top 10 players

This data was retreived from FIDE's Top Chess Federations.

It is interesting to see that Russia is the only country with its top 10 players having a rating higher than 2700.

Standard Deviation (SD) was calculated by plugging in the 10 data points for each country into a python program (see Appendix A).

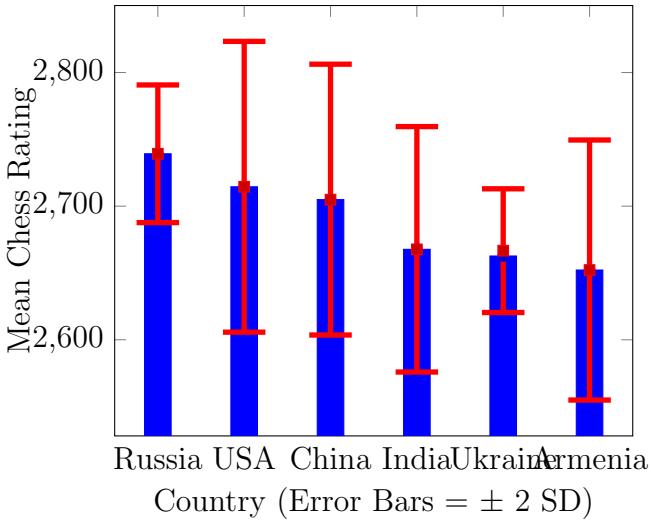

Figure 3: Mean Chess Rating by Country

2.2.2 ANOVA Test

Null Hypothesis: There is not a significant difference in mean ratings among the six countries.

Alternate Hypothesis: There is a significant difference in mean ratings among the six countries.

Variation between groups:

$$\begin{aligned} SST &= [\frac{27392^2}{10} + \frac{27145^2}{10} + \frac{27049^2}{10} + \frac{26677^2}{10} + \frac{26627^2}{10} + \frac{26522^2}{10}] \\ &\quad - [\frac{(27392 + 27145 + 27049 + 26677 + 26627 + 26522)^2}{60}] \\ &= 59140.8 \end{aligned} \tag{2}$$

Variation within groups:

$$\begin{aligned} SSE &= [2777^2 + .. + 2611^2] - [\frac{27392^2}{10} + \frac{27145^2}{10} + \frac{27049^2}{10} + \frac{26677^2}{10} + \frac{26627^2}{10} + \frac{26522^2}{10}] \\ &= 100814.8 \end{aligned} \tag{3}$$

Finding the squared standard error would require squaring each of the 60 data points. As the standard square error is easily calculated using a calculator, only first and last terms are shown.

	SS	DF	MS	F
Treatments	59140.8	k-1=6-1=5	11828.16	6.336
Errors	100814.8	N-k = 60-6=54	1866.94074	

Dividing the sum of the squares by the degress of freedom for both the treatments and the errors results in the mean of the squares. Dividing the mean of the squares of treatments by the mean of the squares of errors results in a Fischer value of approximately 6.336.

Test Statistic: F(5,54) = 6.336

p-value: P(F>6.336) = 1.0736 x 10^{-4}

2.2.3 Data based answer to the research question

The probabilty of the null hypothesis is 1.0736 x 10^{-4}. Therefore the data does not support the null hypothesis and we can provisionally accept the alternate hypothesis that there is a significant difference in mean chess ratings among the top six countries.

3 Conclusion

As we can see, there is a significant difference in the strength of the top 6 chess countries as shown by the ANOVA test. We also found out that a chess federation's rating system can differ from FIDE's ranking system, as shown by the 2 sample test between FIDE and USCF ratings.

3.1 Extensions

It would be interesting to see whether there is still a significant difference between the top 3 chess country federations.

It would also be interesting to look at countries concentration of grandmasters, international masters, as well as titled players as a measure of strength.

It would also be interesting to see which country's rating system is most similar to FIDE ratings.

Additionally, it would be interesting to see how online ratings compared to FIDE ratings.

A Calculating standard deviation using Python

```
import statistics

# Russia
print(statistics.stdev([2777, 2774, 2753, 2752, 2747, 2731, 2726, 2723, 2705, 2704]))

# USA
print(statistics.stdev([2822, 2765, 2758, 2736, 2712, 2683, 2677, 2673, 2660, 2659]))

# China
print(statistics.stdev([2805, 2758, 2732, 2726, 2705, 2683, 2669, 2667, 2664, 2640]))

# India
print(statistics.stdev([2758, 2721, 2716, 2654, 2648, 2639, 2638, 2637, 2636, 2630]))

# Ukraine
print(statistics.stdev([2698, 2685, 2685, 2678, 2662, 2660,2650, 2644, 2634, 2631]))

# Armenia
print(statistics.stdev([2773, 2689, 2663, 2642, 2641, 2641,2632, 2617, 2613, 2611]))
```

B Works Cited

https://ratings.fide.com/top_lists.phtml

http://www.uschess.org/component/option,com_top_players/Itemid,371?op=list&month=1912&f=usa&l=R:Top%20Overall.&h=Overall