Math IA Rough Draft

hyg172

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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 Data

2.1.1 USCF vs FIDE

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

Additionally, it is important to note that the USCF top player list was accurate as of December 2019 and the FIDE list was accurate as of January 2020.

Standard Deviation	Mean
54	2715

Table 2: FIDE rating

Standard Deviation	Mean
54	2791

Table 3: USCF rating

2.2 Data Processing

2.2.1 2 Sample T-Test

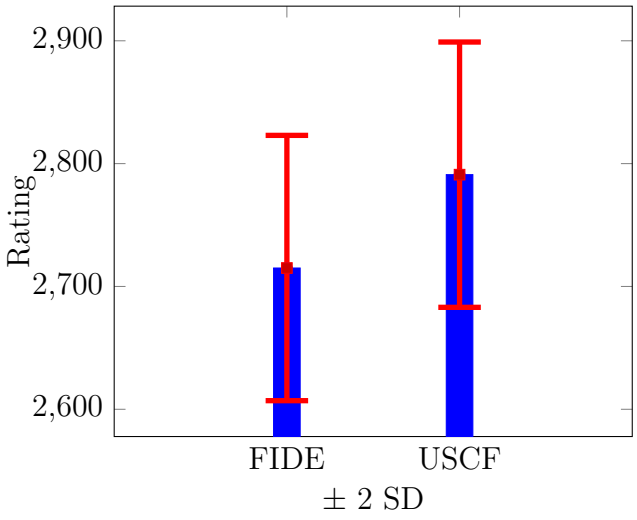

Figure 1: FIDE and USCF Ratings

Null Hypothesis: There is not a significant differece (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:

$$t_{(n-1)}\ \mathrm{d}f = \frac{x}{\frac{y}{z}} = -3.16 \tag{1}$$

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

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.

2.2.2 ANOVA Test

	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

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: $P(F>6.336) = 1.0736 \times 10^{-4}$

The probabilty of the null hypothesis is 1.0736×10^{-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 Evaluation

3.1 Data based answer to the research question

3.2 Extensions

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.

```
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]))
```

Works Cited

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

Top 100 US Chess players as of October: (USCF) http://www.uschess.org/component/option,com_top_players/Itemid,371?op=list&month=1910&f=usa&l=R:Top%20Overall.&h=Overall