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FIFA/COCA-COLA WORLD RANKINGS ON THE PREDICTABILITY OF THE MENS AND WOMENS FIFA WORLD CUP: A COMPARATIVE ANALYSIS

*BRANDON JOLY, **TOM STOJSAVLJEVIC ***MEHMET DIK
*RESEARCH ASSISTANT, BELOIT, WISCONSIN, USA. ORCID ID: 0000-0002-5793-6753
**PROFESSOR, BELOIT, WISCONSIN, USA. ORCID ID: 0000-0003-0958-4025
*** PROFESSOR, BELOIT, WISCONSIN, USA. ORCID ID: 0000-0003-0643-2771

Abstract. Since 1992, the International Federation of Association Football (FIFA) has been ranking senior mens national soccer teams based on a variety of criteria. In 2003, FIFA extended the FIFA/Coca-Cola World Rankings into ranking senior womens national soccer teams. The FIFA/Coca-Cola World Rankings published just before the 1994 FIFA World Cup USA, 1998 FIFA World Cup France, 2002 FIFA World Cup Korea/Japan, 2006 FIFA World Cup Germany, 2010 FIFA World Cup South Africa, 2014 FIFA World Cup Brazil, 2018 FIFA World Cup Russia, 2003 FIFA World Cup USA, 2007 FIFA World Cup China, 2011 FIFA World Cup Germany, 2015 FIFA World Cup Canada, and the 2019 FIFA World Cup France were considered. These rankings were compared to the final results of those FIFA World Cups based on two different methods of displaying the teams finish and were analyzed. Of the top 16 teams in each of the Mens FIFA World Cups, 74.1% of those teams advanced to the Round of 16. Meanwhile, 83.9% of the top 12 teams in each of the Womens FIFA World Cups advanced to the Round of 16 or Quarterfinals. The Pearson correlation coefficient between the Pre-Tournament rankings and final results was calculated using both ranking methods. The Womens World Cups had higher Pearson correlation coefficients for both methods than the Mens World Cups. In addition, the Womens World Cups had higher t-values and z-scores than the Mens World Cup when tested for independence and association between the Pre-Tournament rankings and final results using both ranking methods. These findings indicate that the Womens World Cups were more predictable than Mens World Cups based on the FIFA/Coca-Cola World Rankings.

1. Introduction

In December 1992, FIFA instituted a ranking system of mens senior national soccer teams. The first iteration of the ranking system was in place from 1993 until

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1998. The system gave teams one point for a tie or draw, three points for a win, and no points for a draw in games that were acknowledged by FIFA. Over this time period, FIFA saw the need for improvement in the ranking of senior national teams. This improvement included the addition of criteria to the ranking procedure such as considering the results of games played by senior national teams over the last 8 years and including data such as game outcome (win, loss, or draw), number of goals, location of the game (home, away, or neutral), importance of the match, and strength of the region.

The weighting procedure for the importance of the match assigned a 1.0 weight for a friendly match, a 1.50 weight for a continental championship group stage or qualifying match and a FIFA World Cup qualifying match, group stage match, a 1.75 weight for a Continental Finals match or a FIFA Confederation Cup match, and a 2.0 weight for a FIFA World Cup finals match. Additionally, different regions had different weights added to their matches. For example, the Union of European Football Associations (UEFA) had a weight of 1, Confederacin Sudamericana de Ftbol or the South American Football Federation (CONMEBOL) had a weight of 0.99, the Confederation of North, Central America and Caribbean Association Football (CONCACAF) had a weight of 0.94, the Asian Football Confederation (AFC) had a weight of 0.93, and the Oceania Football Confederation (OCF) had a weight of 0.93. In the case of a negative point total, the points would be rounded up to 0 (FIFA, 2005).

A third iteration of the rankings made their debut in 2006 following the 2006 FIFA World Cup in Germany. This ranking system was based off of the match outcome which awarded 3 points for a win, 1 point for a tie, and 0 points for a loss. This varied the importance of matches from a weighted multiplier of 1 for a friendly to 4 for a FIFA World Cup match. The strength of the opponent formula was ({200-Position in rankings}/100) and the strength of the region which was based on the regions results at the last 3 FIFA World Cup. The occurrence of the game with more recent games have more of an impact on the ranking, and the average number of points won from matches in the last 12 months prior to the ranking (FIFA, 2007).

Although not relevant for any of the World Cups considered in this study, the FIFA/Coca-Cola World Ranking changed again in 2018 following the 2018 FIFA World Cup and then had an additional change made in 2022 to round decimals to the nearest hundredth to promote accuracy. The current ranking format follows the formula:

$$P = P_{\text{before}} + I(WW_e). \tag{1.1}$$

The P of the equation stands for total points. The P_{before} stands for points before a particular game. I stands for the importance of the match with a value of 5 for international friendlies played outside of the International Match Calendar (windows set aside for senior national team matches), 10 for international friendlies played within these windows, 15 for matches that happen during the group stage of Nations League matches within each region, 25 for any playoff and finals matches in these Nations Leagues and qualifying matches for the FIFA World Cup and Confederations finals, 35 for matches that occur between the group stages and quarterfinals of a Confederations Final, 40 for Confederations Final matches from the quarterfinal stage onwards and all games that happen at the FIFA Confederations Cup, 50 for FIFA World Cup matches that occur between the group stages

and quarterfinals, and 60 for FIFA World Cup quarterfinals, semifinals, 3rd place, and finals matches. W stands for the outcome of the match with 1 for a win, 0.5 for a draw, and 0 for a loss. W_e stands for expected win and is defined as

$$W_e = \frac{1}{10^{(P_{\text{before,B}} - P_{\text{before,A}})/600} + 1}. \tag{1.2}$$

Additionally, this model analyzes results from a penalty shootout and other results with different weights (FIFA, 2018). The FIFA Womens World Rankings havent changed since their inception in 2003. The FIFA Womens World Rankings has the formula

$$\text{WWR}_{\text{new}} = \text{WWR}_{\text{old}} + (\text{Actual} - \text{Predicted}). \tag{1.3}$$

This is where WWR_{new} stands for the new senior national team Womens World Ranking. WWR_{old} stands for the old Womens World Ranking. The actual and predicted value come from the match outcome, goal differential, goals scores, location of the match, importance of the match, and difference in their and their opponents points before a match (FIFA). While the FIFA/Coca-Cola Mens World Rankings have had three different formats under which World Cups have been played, the FIFA/Coca-Cola Womens World Rankings have had one iteration of the rankings. However, the Womens FIFA World Cup has undergone changes including going from 16 to 24 teams and increasing the number of teams who make the knockout rounds, while the Mens World Cup has increased from 24 to 32 teams, but has not increased the number of teams who make the knockout rounds. For this reason, the predictability of both of the FIFA World Cup final results was studied based on two methods of classification of those results against the Pre-Tournament Rankings.

2. Methods

2.1. **Data Collection.** The data collected for this study include the results of the Mens 1994 FIFA World Cup USA, 1998 FIFA World Cup France, 2002 FIFA World Cup Korea/Japan, 2006 FIFA World Cup Germany, 2010 FIFA World Cup South Africa, 2014 FIFA World Cup Brazil, and the 2018 FIFA World Cup Russia. Additionally, results of the Womens 2003 FIFA World Cup USA, 2007 FIFA World Cup China, 2011 FIFA World Cup Germany, 2015 FIFA World Cup Canada, and 2019 FIFA World Cup France were also obtained. The FIFA/Coca-Cola Mens and Women's Ranking was gathered from the ranking that occurred in March before the Womens FIFA World Cup and May for the Mens FIFA World Cup. These results are all publicly available on the FIFA website (fifa.com). The organized data of both the Pre-Tournament Rankings and final results are available in the appendix.

2.2. **Analytical Procedures.** The acquired data was studied using Chi-Square tests to standardize the data, rules were adapted and implemented to try to understand how FIFA World Cups would play out based on suggested Group winners and teams that would advance to the Round of 16. This data was supplemented by results of teams ranked in the top 12 or 16 of the respective FIFA World Cup Pre-Rankings against those outside of the top 12 or 16. The effectiveness of these predictive methods was tested by running the Fisher Transformation Hypothesis Test and the Students t-test to analyze the effectiveness of using the FIFA/Coca-Cola World Rankings in predicting FIFA World Cup final results (Suzuki & Ohmori, 2008).

2.3. **Rules Analysis.** The first step in analyzing these results is to create rules to sort the data and evaluate the effectiveness of rankings between the Mens and Womens FIFA World Cup. First, the teams that qualified for the FIFA World Cup in their respective year and classification had their ranking documented and then sorted to get a list of 16 teams (Womens 2003 FIFA World Cup USA, 2007 FIFA World Cup China, and 2011 FIFA World Cup Germany), 24 teams (1994 FIFA World Cup USA Womens 2015 FIFA World Cup Canada, and 2019 FIFA World Cup France), 32 teams (all other Mens FIFA World Cups besides the 1994 FIFA World Cup USA). The game results of teams that fell within the top 16 teams qualified for the Mens FIFA World Cups and top 12 for the Womens FIFA World Cup against teams below these marks were gathered and sorted for testing. The final placement of teams was determined using two methods.

For the Mens World Cups, in Method A, the top 4 finishing teams were given a 1,2,3, or 4 based on their corresponding place. Then, if a team was eliminated in the Group Stage, they were assigned a 7, teams eliminated in the Round of 16 assigned a 6, and teams eliminated in the Quarterfinals a 5. In Method B, the top 4 teams were given a 1,2,3, or 4 based on their corresponding place. Then, if a team was eliminated in the Group Stage, they were assigned a 24 (if this was the 1994 FIFA World Cup USA) or 32 (if this was any other Mens FIFA World Cup), teams eliminated in the Round of 16 a assigned 16, and teams eliminated in the Quarterfinals assigned an 8.

For the Womens World Cups, in Method A, the top 4 finishing teams were given a 1,2,3, or 4 based on their corresponding place. Then, if a team was eliminated in the Group Stage, they were assigned a 7 (if this was the 2015 or 2019 FIFA World Cup) or 6 (if this was the 2003, 2007, or 2011 FIFA World Cup), teams eliminated in the Round of 16 are assigned a 6, and teams eliminated in the Quarterfinals are assigned a 5. In Method B, the top 4 teams were given a 1,2,3, or 4 based on their corresponding place. Then, if a team was eliminated in the Group Stage, they were assigned a 16 (if this was the 2003, 2007, or 2011 FIFA World Cup) or 24 (if this was the 2015 or 2019 FIFA World Cup), teams eliminated in the Round of 16 were assigned a 16, and teams eliminated in the Quarterfinals were assigned an 8.

3. Statistical Testing Analysis

3.1. **Fisher Exact Test.** The study used the Fisher Exact Test to test the number of top 12 or 16 teams that advanced from the Group Stage vs the number of lower ranked teams advancing from the Group Stage. A second Fisher Exact Test was run on the differences in winning percentage in games played by teams ranked in the top 12 or 16 teams of the World Cup and against those of lower ranked teams. This allowed the study to determine if the association between the differences in advancement or winning percentage was different or not. Thus, consider the population in the study to be the FIFA World Cups in which there was a ranking that was available right before the World Cup was played. For simplicity, let there be variables S and F such that there are m and n collected states in S and F that creates an mxn matrix (Hoffman, 2014). Then, to represent a specific cell in the m n matrix, let's denote this x_{ij} such that $s = i$ and $f = j$. Then the total sum of observable states is $N = \Sigma_i R_i = \Sigma_j R_j$ such that C_j is the sum of the columns and R_i is the sum of the rows. The Fisher Exact Test calculates the conditional

probability that this matrix exists through the formula (Weisstein)

$$p = \frac{(R_1!R_2!\dots R_m!)(C_1!C_2!\dots C_n!)}{N!\ \prod_{i,j} x_{ij}}. \tag{3.1}$$

Fishers exact test is then paired with the Chi-Square Test so that the study has a standard measurement of association between variables.

3.2. **Chi-Square Test.** Since the measurement for over 80% of the variables used and boolean values, a Chi-Square Test is also considered. The Chi-Square test statistics is classically defined as

$$\chi^2 = \sum_{i=1}^{k} \frac{[n_i - E(n_i)]^2}{E(n_i)} = \sum_{i=1}^{k} \frac{[n_i - np_i]^2}{np_i}, \tag{3.2}$$

where n stands for total number of games or teams, n_i stands for a particular number of teams advancing or not or games won, loss, or drawn, and p_i is the probability of this event happening. Expected cell frequencies are calculated using $E(\hat{n}_{ij}) = (r_i c_j)/n$ where n stands for total number of games or teams, and r_i and c_j stand for specific row and column totals (Wackerly et al., 2012).

3.3. **Pearson Correlation Coefficient.** The rules analysis described by Methods A and B, in combination with the Fisher Exact Test and Chi-Square Test set the basis which allows the study to take into account the Pearson correlation coefficient because the graphs of our rules vs final results are not monotonic. Therefore, the study draws a line of best fit of the form $Y = \beta_0 + \beta_1 x + \varepsilon$ such that the parameter $\beta_1 = \frac{\sigma_y}{\sigma_x}\rho$ and $E(Y|X = x) = \beta_0 + \beta_1 x$. This implies that ρ is positive when, generally, as X increases Y increases and that ρ is negative when as Y decreases, X increases. Going forward, ρ can be expressed in terms of r where

$$r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2 \sum_{i=1}^{n}(Y_i - \bar{Y})^2}}. \tag{3.3}$$

Here, n is the total teams that participated in the FIFA World Cups considered and X_i and Y_i are sample team rankings within the World Cups considered, and $\bar{X}$ and $\bar{Y}$ are the sample means (Wackerly et al., 2012). The study will use the Fisher Transformation when constructing the null and alternative hypotheses.

3.4. **Fisher Transformation Hypothesis Test.** Consider the null hypothesis $H_0 : \rho = 0$ with an alternative hypothesis $H_a : \rho \neq 0$ using a level of $\alpha = 0.05$. From the Fisher transformation, the study has $F(r) = \frac{1}{2}\ln\left(\frac{1+r}{1-r}\right)$. The Fisher transformation will allow for $F(r)$ to follow an approximately normal distribution such that the mean= $F(\rho) = F(0) = 0$ with standard deviation $\frac{1}{\sqrt{n-3}}$, where n is the number of teams that have played in the FIFA World Cup since the Ranking system began. Using these variables, a z-score is obtained (Vrbik, 2005) such that

$$z = \frac{x}{\frac{1}{\sqrt{n-3}}} = F(r)\sqrt{n-3}. \tag{3.4}$$

To further strengthen the argument for whether the Mens or Womens World Cup is more predictable, this test is paired with a Students t-distribution.

3.5. **Student's t-test.** The t-distribution test is defined from a bivariate normal distribution of a population value (which is consistent with this studys data) with the null hypothesis. The null hypothesis is that there is no correlation between the final finish ranking through Methods A and B against the Pre-Tournament Rankings of the teams participating in the FIFA World Cup. The t-test has n-2 degrees of freedom where n stands for the total number of teams that participated in the Mens or Womens World Cup. In this studys analysis this will be 216 for Men and 96 for Women. The Students t-test statistic (Rahman, 1968) is calculated by

$$t = r\sqrt{\frac{n-2}{1-r^2}}. \tag{3.5}$$

The critical value of r (Soper et al., 1917) is determined as

$$r = \frac{t}{\sqrt{n-2+t^2}}. \tag{3.6}$$

Using the results from the statistical tests, this study will aim to define whether the Mens or Womens World Cup is more predictable based on Pre-Tournament Rankings.

4. Results

4.1. **Mens World Cup Analysis.**

4.1.1. *Tests of Association.* The Fisher Exact Test was used to determine if there was a nonrandom association between the number of teams in the Top 16 that advanced to the Round of 16 against the teams in the lower 16 based on each of the different ranking formats.

Table 1: Tests of Association

Advancement from Group Stage in FIFA World Cup				
Type	FIFA World Cup 1994 and 1998	FIFA World Cup 2002 and 2006	FIFA World Cup 2010, 2014, and 2018	Total
Top 16 Ranked Teams Advancing to the Round of 16	25 (23.714)	22 (23.714)	36 (35.571)	83
Lower 16 Teams Advancing to the Round of 16	7 (8.286)	10 (8.286)	12 (12.429)	29
Total	32	32	48	112

Note: the number in parenthesis are the expected counts. From the information detailed in **Table 1**, we find the p-value to be $p = 0.679$. From this we find that there is not a statistically significant association between the number of teams that were ranked in the top 16 of the World Cup that advanced to the Round of 16

against the number of teams that were ranked in the lower 16 of the World Cup that advanced.

As a standardizing tool, we use a Chi-Squared test of association. Using the data from **Table 1**, we find the Chi-Square value to be 0.768 with degrees of freedom $(d.f.) = 2$, and a p-value $(p)= 0.681$. Thus, there is not a statistically significant association between the number of teams that were ranked in the top 16 of the World Cup that advanced to the Round of 16 against the number of teams that were ranked in the lower 16 of the World Cup that advanced. This is consistent with our findings from the Fisher Exact test.

Another Chi-Squared test of association was run using the win, loss, and draw data from matches played of teams ranked in the top 16 against those from outside of the top 16 based on each of the different ranking formats.

Table 2: Tests of Association				
Win/Loss/Draw Record Comparison				
Type	FIFA World Cup 1994 and 1998	FIFA World Cup 2002 and 2006	FIFA World Cup 2010, 2014, and 2018	Total
Win	32 (32.888)	39 (39.981)	67 (65.131)	138
Loss	10 (8.579)	10 (10.430)	16 (16.991)	36
Draw	9 (9.533)	13 (11.589)	18 (18.879)	40
Total	51	62	101	214

Note: The numbers in parenthesis are the expected counts. From the data in **Table 2**, we find the Chi-Squared value is 0.655 with a p-value of $p= 0.957$. Note, the Fisher Exact Test cannot be used since the number of matches played was over 90. Since the p-value was found to be greater than 0.05, there is not a statistically significant association between the win, loss, draw records of the teams ranked in the top 16 against those from outside of the top 16.

4.1.2. *Rules Analysis.* Using the Chi-Square test and Fisher Exact test as a baseline, the rules described were analyzed by finding the Pearson Correlation Coefficient and running the Fisher Transformation Hypothesis Test and the Students t-test to test the independence of the Pre-Tournament Rankings and the Final Results analyzed by the rules of Methods A and B.

In **Figure 1**, the Pre-Tournament Rankings and Final Results using Method A. The Pearson Correlation Coefficient (r) was computed by taking the square root of R^2 to obtain $r = 0.405$. Next, a Fisher Transformation Hypothesis Test is done using a two-tailed test to test if $r \neq 0$. Thus, in running the test, $\mathrm{F}(0.405) = \frac{1}{2}ln(2.361) = 0.430$, with $n = 216$, and $z = (0.430)\sqrt{213} = 6.270$. Hence, there is a correlation between the Pre-Tournament Rankings and Final Results using Method A. To further provide evidence of the existence of a correlation between Pre-Tournament Rankings and Final Results using Method A, a Students t-test was run and gave the following data: $t = 6.006$, $r = 0.380$, and $d.f. = 214$. Similarly, the probability of this happening by chance is found to be roughly 0, and this provides further evidence of a correlation between Pre-Tournament Rankings and Final Results using Method A.

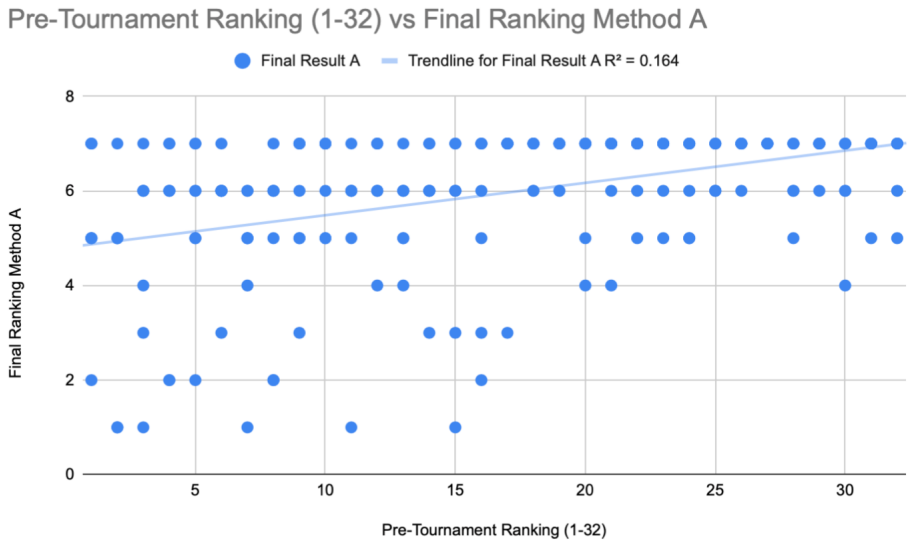

FIGURE 1.

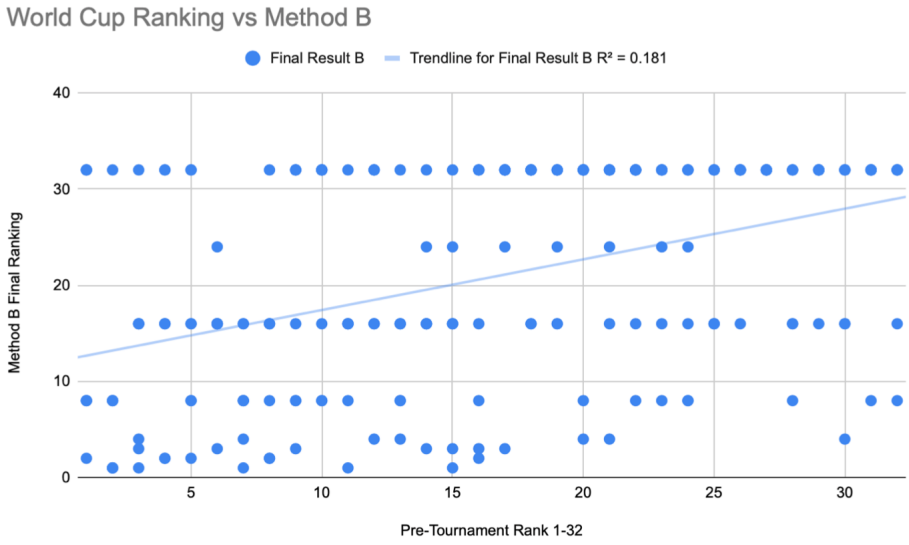

FIGURE 2.

To determine which method was better at predicting the outcome of the World Cup, the same steps were taken in regards to Method B. In **Figure 2**, the Pre-Tournament Rankings and Final Results using Method B were analyzed via a scatter plot. As before, the Pearson Correlation Coefficient (r) was computed by taking

the square root of R^2 to get $r = 0.425$. The Fisher Transformation Hypothesis Test is done using a two-tailed test to test if $r \neq 0$. Thus, we find $F(0.425) = \frac{1}{2}ln(2.489) = 0.454$, $n = 216$, and $z = (0.454)\sqrt{213} = 6.631$. Hence, we find there is a correlation between the Pre-Tournament Rankings and Final Results using Method B. To further provide evidence of the existence of a correlation between Pre-Tournament Rankings and Final Results using Method B, a Students t-test was run and gave the following data: $t = 6.878, r = 0.425$, and $d.f. = 214$. Likewise the probability of this happening by chance is found to be roughly 0, and this provides evidence of a correlation between Pre-Tournament Rankings and Final Results using Method B.

4.2. **Womens World Cup Analysis.**

4.2.1. *Tests of Association.* In a similar fashion to the Mens World Cups, the Womens World Cups are analyzed first by using the Fisher Exact Test to determine if there is a nonrandom association between the number of teams in the Top 12 that advanced to the Round of 8 or 16 against the teams in the lower 12 based on each of the Womens World Cup formats.

Table 3: Tests of Association

Advancement from Group Stage in FIFA World Cup			
Type	FIFA World Cup 2003, 2007, and 2011	FIFA World Cup 2015 and 2019	Total
Top 12 Ranked Teams Advancing to the Round of 8 or 16	24 (20.143)	23 (26.857)	47
Lower Ranked Teams Advancing to the Round of 8 or 16	0 (3.857)	9 (5.146)	9
Total	24	32	56

Note: The numbers in parenthesis are the expected counts. We find the two-tailed p-value to be $p = 0.007$. From this we find that there is a statistically significant association between the number of teams that were ranked in the top 12 of the World Cup that advanced to the Round of 8 or 16 against the number of teams that were ranked in the lower 12 of the World Cup that advanced.

Proceeding as we did before, we use a Chi-Squared test of association to compute the Chi-Square value. We found the value to be 8.043 with degrees of freedom $d.f. = 1$, and a p-value $(p) = 0.005$. Thus, there is a statistically significant association between the number of teams that were ranked in the top 12 of the World Cup that advanced to the Round of 8 or 16 against the number of teams that were ranked in the lower 12 of the World Cup that advanced. This is consistent with our finding using the Fisher Exact Test.

Another Chi-Squared test of association was run using the win, loss, and draw data from matches played of teams ranked in the top 12 against those from outside of the top 12 based on each of the Womens World Cup formats.

Table 4: Tests of Association			
Win/Loss/Draw Record Comparison			
Type	FIFA World Cup 2003, 2007, and 2011	FIFA World Cup 2015 and 2019	Total
Win	31 (29.494)	44 (45.506)	75
Loss	0 (1.180)	3 (1.82)	3
Draw	4 (4.326)	7 (6.674)	11
Total	35	54	89

Note: The numbers in parenthesis are the expected counts. We computed the Chi-Squared value as 2.112 with a p-value of $p = 0.348$ and $d.f. = 2$. Thus we find that there is not a statistically significant association between the win, loss, draw records of the teams ranked in the top 12 against those from outside of the top 12.

4.2.2. *Rules Analysis.* Using the Chi-Square test and Fisher Exact test as a baseline, the rules ranking the teams described were analyzed by first calculating the Pearson Correlation Coefficient and then running Fisher Transformation Hypothesis Test and the Students t-test to test the independence of the Pre-Tournament Rankings and the Final Results analyzed by the rules of Methods A and B.

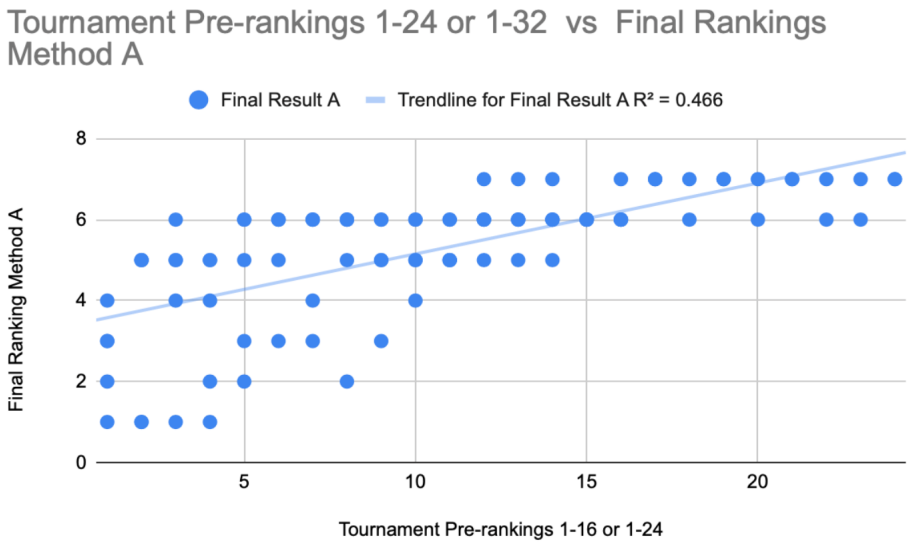

FIGURE 3.

In **Figure 3**, the Pre-Tournament Rankings and Final Results using Method A were analyzed via a scatter plot. The Pearson Correlation Coefficient (r) was computed by taking the square root of R^2 to get r= 0.683. Next, a Fisher Transformation Hypothesis Test is done using a two-tailed test to test if $r \neq 0$. The Fisher Hypothesis Test results in F(0.683)= 0.835, with $z = 8.052$, and $n = 96$.

This leaves the study with a critical value that is less than 0.05 since $z = 8.052$, which has a p-value of approximately 0. Hence, there is a correlation between the Pre-Tournament Rankings and Final Results using Method A. To further support our claim that there is a correlation between Pre-Tournament Rankings and Final Results using Method A, a Students t-test was run and gave the following data: $t = 9.062, r = 0.683$, and $d.f.$=94. Similarly the probability of this happening due to chance is found to be approximately 0, and this provides evidence of a correlation between Pre-Tournament Rankings and Final Results using Method A.

In order to discuss which method is better in analyzing the outcome of the World Cup, the same analysis was conducted using the rules described in Method B.

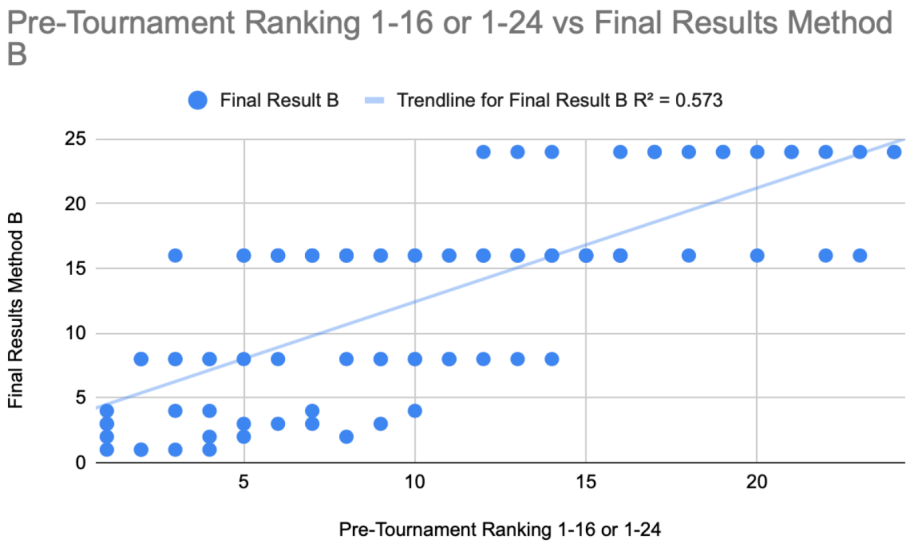

FIGURE 4.

The Pre-Tournament Rankings and Final Results using Method B were analyzed via a scatter plot. From here, the Pearson Correlation Coefficient (r) was computed by taking the square root of R^2 to get $r = 0.757$. Next, a Fisher Transformation Hypothesis Test is done using a two-tailed test to test if $r \neq 0$. The Fisher Transformation F(0.757) = 0.989, $z = 9.538$, and $n = 96$. This leaves the study with a critical value that is less than 0.05 since $z = 9.538$, which has a p-value of approximately 0. Hence, there is a correlation between the Pre-Tournament Rankings and Final Results using Method B. To further support our claim that there is a correlation between Pre-Tournament Rankings and Final Results using Method B, a Students t-test was run and gave the following data: $t = 11.232, r = 0.757$, and $d.f. = 94$. Similarly, the probability of this happening by chance is found to be roughly 0, and this provides further support of our claim of a correlation between Pre-Tournament Rankings and Final Results using Method B.

5. Discussion

Our objective was to determine which FIFA/Coca-Cola World Ranking system was better at predicting the Mens or Womens World Cup winner when changes in the ranking and FIFA World Cup format and rules based Final results ranking were taken into account. Based on **Table 1** and **Table 3**, the majority of teams advancing to the Round of 8 or 16 were teams that were in the top 12 or 16 of the Pre-Tournament Rankings. This proves to be a good indicator because each FIFA World Cup Champion has been ranked inside the top 12 or 16 in the rankings prior to each tournament. One can argue that if the FIFA/Coca-Cola World Ranking system was completely accurate at predicting the World Cup, then 100% of the teams in the top 16 or 12 of the rankings should be in the World Cup and advance to the Round of 16 or 8. However, this is not the case because each region has different allotments for teams that qualify to the World Cup, and sometimes a higher ranked team doesnt qualify for the FIFA World Cup. For that reason, teams were then re-ranked based on the qualified teams for the FIFA World Cup. Additionally, FIFA does not have a way in drawing the groups such that each of the top 12 or 16 teams do not end up in the same group. For that reason, there are instances where a group may have had three or four teams in the top 12 or 16 with only the top two advancing, while others may only have one team. This would mean that there are some groups where a team from outside of the top 16 would be guaranteed to make the Round of 16 or 8, such as in Group A of the 2018 World Cup where Uruguay and Egypt were predicted to advance, but Uruguay was the only team in the Top 16 of the Pre-Tournament Rankings, meaning the other prediction would not be as accurate and subsequently was not as Russia advanced.

For this reason, winning percentages are also taken into account when determining the validity of the FIFA/Coca-Cola World Rankings. With the top 16 teams of the Mens World Cup having an overall winning percentage of 73.8% and the top 12 teams of the Womens World Cup having a winning percentage of 90.4%, the trend is that the top 16 or 12 teams often beat teams outside of the top 16 or 12. Based on our analysis using the Fisher Transformation Hypothesis Test and the Student t-test, we found evidence that a correlation between the Pre-tournament rankings and the final outcomes of the FIFA World Cup was present using both ranking methods. This implies that the FIFA/Coca-Cola World Rankings are a reliable predictor of World Cup outcomes, to an extent.

Having shown that the FIFA/Coca-Cola World Ranking, to an extent, are a predictor of the FIFA Mens and Womens World Cup winners, it became an objective to find which World Cup it predicted better. First, from Table 1 and Table 3, the Womens World Cup has 83.9% of their top 12 teams advancing to the Round of 8 or 16 in comparison to the 74.1% of the Mens World Cup top 16 teams advancing to the Round of 16. Our analysis demonstrates that the Womens World Cup has statistically significant values from the Fisher Exact test and Chi-Square test for association, while the Mens World Cup does not. This implies that there is a statistically significant association between the number of teams that were ranked in the top 12 of the Womens World Cup that advanced to the Round of 8 or 16 against the number of teams that were ranked in the lower 12 of the Womens World Cup that advanced. Similarly, in **Table 2** and **Table 4**, Womens World Cup top 12 teams have a winning percentage of 90.4% in comparison to the 73.8% winning percentage of the top 16 Mens World Cup teams against those outside of the top 12

or 16. Furthermore, while the win, loss, and draw records did not have statistically significant results, the Womens World Cup had lower Chi-Square test for association values. This shows the Womens World Cup win, loss, and draw values for teams in the top 12 against those outside of the top 12 is more statistically significant than the match results of the teams in the top 16 of the Mens World Cup against those who are not. When doing the rules analysis, Method B has higher Pearson Correlation Coefficients in **Figure 2** and **Figure 4** when compared with their corresponding graph (0.425 vs 0.405 and 0.757 vs 0.683), but the Womens results are more statistically significant. For example, when comparing **Figure 1** and **Figure 3**, the Mens World Cup has a lower t-value (6.006 vs 9.062), z-score (6.269 vs 8.052), Pearson Correlation Coefficient (0.405 vs 0.683) than the corresponding Womens World Cup values. Moreover, in **Figure 2** and **Figure 4**, the Mens World Cup has a lower t-value (6.630 vs 11.232), z-score (6.878 vs 9.538), Pearson Correlation Coefficient (0.425 vs 0.757) than the corresponding Womens World Cup values. This demonstrates that the Womens World Cup is more predictable than the Mens World Cup.

6. Conclusion

Based on our analysis, we have established statistical justification to the claim that the Womens World Cup is more predictable than the Mens World Cup based on the Final Results using Methods A and B and the Pre-Tournament Rankings from the FIFA/Coca-Cola World Rankings. However, there are some crucial differences between the Mens and Womens World Cups outside of the ranking structure and World Cup format that this study did not consider such as the qualifying formats (this sets the field of teams that will participate in the FIFA World Cup), different playing surfaces (Womens World Cup are sometimes played on artificial turf while the Mens World Cups are not), the differences in prize money ($400 million for the Mens World Cup and $30 million for the Womens World Cup), and differences in accommodations (Womens teams are forced to share hotel accommodations while Mens teams do not). For example, all of these factors may impact the results of this study and were not taken into consideration (Prahl, 2019). For that reason, as the FIFA Womens soccer game grows worldwide and fights for equal pay such as that undertaken by the United States Womens National Team (USWNT), the results of this study may change. Like the Womens World Cup, the Mens will soon be changing as the 2026 FIFA Mens World Cup will feature 48 teams in 16 groups of three where the top two teams from each group will progress through to a 32-team knockout stage (FIFA, 2017). This would potentially weaken the results of this model as the methods of ranking and the format of the World Cups are ever changing and this model only utilized two rules for determining the final ranking. However, our results are consistent with other studies that have used similar ranking procedures and have found the process to be reliable. The results of our analysis pointed to the Womens game having less independence between the final results and pre-tournament ranking. Thus, under the current format, we conclude that the Womens World Cup is more predictable than the Mens World Cup.

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7. Appendix

Table 1: FIFA 1994 Mens World Cup

FIFA 1994 Mens World Cup				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
1	1	Germany	5	8
2	2	Netherlands	5	8
3	3	Brazil	1	1
4	4	Italy	2	2
5	5	Spain	5	8
6	6	Norway	7	24
7	7	Romania	5	8

Continuation of Table 12				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
8	8	Argentina	6	16
10	9	Sweden	3	3
11	10	Nigeria	6	16
12	11	Switzerland	6	16
14	12	Republic of Ireland	6	16
16	13	Mexico	6	16
17	14	Colombia	7	24
19	15	Russia	7	24
23	16	United States	6	16
24	17	Cameroon	7	24
27	18	Belgium	6	16
28	19	Morocco	7	24
29	20	Bulgaria	4	4
31	21	Greece	7	24
34	22	Saudi Arabia	6	16
37	23	South Korea	7	24
43	24	Bolivia	7	24
End of Table				

FIFA 1994 Mens World Cup Suggested Outcomes		
Group	Suggested Outcome by Rules	Actual Outcome by rules
A	Romania, Switzerland	Romania, Switzerland
B	Brazil, Sweden	Brazil, Sweden
C	Germany, Spain	Germany, Spain
D	Argentina, Nigeria	Nigeria, (Bulgaria)
E	Italy, Norway	(Mexico), (Ireland)
F	Netherlands, (Belgium)	Netherlands, Belgium

Note: Parenthesis in the Suggested outcome by rules column is representative of an outside of the top 16 that is predicted to move on, while parenthesis around teams in Actual Outcome by Rules are results that were different than predicted results.

Table 2: FIFA 1998 Mens World Cup

FIFA 1998 Mens World Cup				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
1	1	Brazil	2	2
2	2	Germany	5	8
4	3	Mexico	6	16
5	4	England	6	16

Continuation of Table 12

FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
6	5	Argentina	5	8
7	6	Norway	6	16
8	7	Yugoslavia	6	16
9	8	Chile	6	16
10	9	Colombia	7	32
11	10	United States	7	32
12	11	Japan	7	32
13	12	Morocco	7	32
14	13	Italy	5	8
15	14	Spain	7	32
18	15	France	1	1
19	16	Croatia	3	3
20	17	South Korea	7	32
21	18	Tunisia	7	32
22	19	Romania	6	16
24	20	South Africa	7	32
25	21	Netherlands	4	4
27	22	Denmark	5	8
29	23	Paraguay	6	16
30	24	Jamaica	7	32
31	25	Austria	7	32
34	26	Saudi Arabia	7	32
35	27	Bulgaria	7	32
36	28	Belgium	7	32
41	29	Scotland	7	32
42	30	Iran	7	32
49	31	Cameroon	7	32
74	32	Nigeria	6	16

End of Table

FIFA 1998 Mens World Cup Suggested Outcomes		
Group	Suggested Outcome by Rules	Actual Outcome by rules
A	Brazil, Norway	Brazil, Norway
B	Italy, Chile	Italy, Chile
C	France, (South Africa)	France, (Denmark)
D	Spain, (Paraguay)	(Nigeria), Paraguay
E	Mexico, (South Korea)	Netherlands, (Mexico)
F	Germany, Yugoslavia	Germany, Yugoslavia
G	England, Colombia	(Romania), England
H	Argentina, Japan	Argentina, (Croatia)

Table 3: FIFA 2002 Mens World Cup

FIFA 2002 Mens World Cup				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
1	1	France	7	32
2	2	Brazil	1	1
3	3	Argentina	7	32
5	4	Portugal	7	32
6	5	Italy	6	16
7	6	Mexico	6	16
8	7	Spain	5	8
11	8	Germany	2	2
12	9	England	5	8
13	10	United States	5	8
15	11	Republic of Ireland	6	16
17	12	Cameroon	7	32
18	13	Paraguay	6	16
19	14	Sweden	6	16
20	15	Denmark	6	16
21	16	Croatia	7	32
22	17	Turkey	3	3
23	18	Belgium	6	16
24	19	Uruguay	7	32
25	20	Slovenia	7	32
27	21	Nigeria	7	32
28	22	Russia	7	32
29	23	Costa Rica	7	32

Continuation of Table 12				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
31	24	Tunisia	7	32
32	25	Japan	6	16
34	26	Saudi Arabia	7	32
36	27	Ecuador	7	32
37	28	South Africa	7	32
38	29	Poland	7	32
40	30	South Korea	4	4
42	31	Senegal	5	8
50	32	China	7	32
End of Table				

FIFA 2002 Mens World Cup Suggested Outcomes		
Group	Suggested Outcome by Rules	Actual Outcome by rules
A	France, Denmark	Denmark, (Senegal)
B	Spain, Paraguay	Spain, Paraguay
C	Brazil, (Turkey)	Brazil, Turkey
D	Portugal, United States	(South Korea), United States
E	Germany, Ireland	Germany, Ireland
F	Argentina, England	(Sweden), England
G	Mexico, Italy	Mexico, Italy
H	(Belgium),(Japan)	Belgium, Japan

Table 4: FIFA 2006 Mens World Cup

FIFA 2006 Mens World Cup				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
1	1	Brazil	5	8
2	2	Czech Republic	7	32
3	3	Netherlands	6	16
4	4	Mexico	6	16
5	5	United States	7	32
5	6	Spain	6	16
7	7	Portugal	4	4
8	8	France	2	2
9	9	Argentina	5	8
10	10	England	5	8
13	11	Italy	1	1
16	12	Sweden	6	16
18	13	Japan	7	32
19	14	Germany	3	3

Continuation of Table 12				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
21	15	Tunisia	7	32
23	16	Iran	7	32
23	17	Croatia	7	32
26	18	Costa Rica	7	32
29	19	South Korea	7	32
29	20	Poland	7	32
32	21	Ivory Coast	7	32
33	22	Paraguay	7	32
34	23	Saudi Arabia	7	32
35	24	Switzerland	6	16
39	25	Ecuador	6	16
42	26	Australia	6	16
44	27	Serbia and Montenegro	7	32
45	28	Ukraine	5	8
47	29	Trinidad and Tobago	7	32
48	30	Ghana	6	16
57	31	Angola	7	32
61	32	Togo	7	32
End of Table				

FIFA 2006 Mens World Cup Suggested Outcomes		
Group	Suggested Outcome by Rules	Actual Outcome by rules
A	Germany, (Costa Rica)	Germany, (Ecuador)
B	England, Sweden	England, Sweden
C	Argentina, Netherlands	Argentina, Netherlands
D	Portugal, Mexico	Portugal, Mexico
E	Czech Republic, United States	(Italy), (Ghana)
F	Brazil, Japan	Brazil, (Australia)
G	France, (South Korea)	France, (Switzerland)
H	Spain, Tunisia	Spain, (Ukraine)

Table 5: FIFA 2010 Mens World Cup

FIFA 2010 Mens World Cup				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
1	1	Brazil	5	8

Continuation of Table 12

FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
2	2	Spain	1	1
3	3	Portugal	6	16
4	4	Netherlands	2	2
5	5	Italy	7	32
6	6	Germany	3	3
7	7	Argentina	5	8
8	8	England	6	16
9	9	France	7	32
13	10	Greece	7	32
14	11	United States	6	16
15	12	Serbia	7	32
16	13	Uruguay	4	4
17	14	Mexico	6	16
18	15	Chile	6	16
19	16	Cameroon	7	32
20	17	Australia	7	32
21	18	Nigeria	7	32
24	19	Switzerland	7	32
25	20	Slovenia	7	32
27	21	Ivory Coast	7	32
30	22	Algeria	7	32
31	23	Paraguay	5	8
32	24	Ghana	5	8
34	25	Slovakia	6	16
36	26	Denmark	7	32
38	27	Honduras	7	32
45	28	Japan	6	16
47	29	South Korea	6	16
78	30	New Zealand	7	32
83	31	South Africa	7	32
105	32	North Korea	7	32

End of Table

FIFA 2010 Mens World Cup Suggested Outcomes		
Group	Suggested Outcome by Rules	Actual Outcome by rules
A	France, Uruguay	Uruguay, (Mexico)
B	Argentina, Greece	Argentina, (South Korea)
C	United States, England	United States, England
D	Germany, Serbia	Germany, (Ghana)
E	Netherlands, Cameroon	Netherlands, (Japan)
F	Italy, (Paraguay)	Paraguay, (Slovakia)
G	Brazil, Portugal	Brazil, Portugal
H	Spain, Chile	Spain, Chile

Table 6: FIFA 2014 Mens World Cup

FIFA 2014 Mens World Cup				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
1	1	Spain	7	32
2	2	Germany	1	1
3	3	Brazil	4	4
4	4	Portugal	7	32
5	5	Argentina	2	2
6	6	Switzerland	6	16
7	7	Uruguay	6	16
8	8	Colombia	5	8
9	9	Italy	7	32
10	10	England	7	32
11	11	Belgium	5	8
12	12	Greece	6	16
13	13	United States	6	16
14	14	Chile	6	16
15	15	Netherlands	3	3
17	16	France	5	8
18	17	Croatia	7	32
19	18	Russia	7	32
20	19	Mexico	6	16
21	20	Bosnia and Herzegovina	7	32
22	21	Algeria	6	16
23	22	Ivory Coast	7	32
26	23	Ecuador	7	32
28	24	Costa Rica	5	8
33	25	Honduras	7	32

Continuation of Table 12				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
37	26	Ghana	7	32
43	27	Iran	7	32
44	28	Nigeria	6	16
46	29	Japan	7	32
56	30	Cameroon	7	32
57	31	South Korea	7	32
62	32	Australia	7	32
End of Table				

FIFA 2014 Mens World Cup Suggested Outcomes		
Group	Suggested Outcome by Rules	Actual Outcome by rules
A	Brazil, (Croatia)	Brazil, (Mexico)
B	Spain, Chile	Chile, (Netherlands)
C	Colombia, Greece	Colombia, Greece
D	Uruguay, England	(Costa Rica), Uruguay
E	France, Switzerland	France, Switzerland
F	Argentina, (Bosnia and Herzegovina)	Argentina, (Nigeria)
G	Germany, Portugal	Germany, (United States)
H	Belgium, (Russia)	Belgium, (Algeria)

Table 7: FIFA 2018 Mens World Cup

FIFA 2018 Mens World Cup				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
1	1	Germany	7	32
2	2	Brazil	5	8
3	3	Belgium	3	3
4	4	Portugal	6	16
5	5	Argentina	6	16
6	6	Switzerland	6	16
7	7	France	1	1
8	8	Poland	7	32
10	9	Spain	6	16
11	10	Peru	7	32
12	11	Denmark	6	16
12	12	England	4	4
14	13	Uruguay	5	8

Continuation of Table 12				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
15	14	Mexico	6	16
16	15	Colombia	6	16
20	16	Croatia	2	2
21	17	Tunisia	7	32
22	18	Iceland	7	32
23	19	Costa Rica	7	32
24	20	Sweden	5	8
27	21	Senegal	7	32
34	22	Serbia	7	32
36	23	Australia	7	32
37	24	Iran	7	32
41	25	Morocco	7	32
45	26	Egypt	7	32
48	27	Nigeria	7	32
55	28	Panama	7	32
57	29	South Korea	7	32
61	30	Japan	6	16
67	31	Saudi Arabia	7	32
70	32	Russia	5	8
End of Table				

FIFA 2018 Mens World Cup Suggested Outcomes		
Group	Suggested Outcome by Rules	Actual Outcome by rules
A	Uruguay, (Egypt)	Russia, (Uruguay)
B	Spain, Portugal	Spain, Portugal
C	France, Peru	France, (Denmark)
D	Croatia, Argentina	Croatia, Argentina
E	Brazil, Switzerland	Brazil, Switzerland
F	Germany, Mexico	(Sweden), Mexico
G	Belgium, England	Belgium, England
H	Argentina, Japan	Argentina, Japan

Table 8: FIFA 2003 Womens World Cup

FIFA 2003 Womens World Cup				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
1	1	United States	3	3
2	2	Norway	5	8
3	3	Germany	1	1
4	4	China	5	8
5	5	Sweden	2	2
6	6	Brazil	5	8

Continuation of Table 12				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
7	7	North Korea	6	16
9	8	France	6	16
11	9	Russia	5	8
12	10	Canada	4	4
14	11	Japan	6	16
15	12	Australia	6	16
23	13	Nigeria	6	16
25	14	South Korea	6	16
35	15	Argentina	6	16
53	16	Ghana	6	16
End of Table				

FIFA 2003 Womens World Cup Suggested Outcomes		
Group	Suggested Outcome by Rules	Actual Outcome by rules
A	United States, Sweden	United States, Sweden
B	Norway, Brazil	Norway, Brazil
C	Germany, Canada	Germany, Canada
D	China, Russia	China, Russia

Table 9: FIFA 2007 Womens World Cup

FIFA 2007 Womens World Cup				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
1	1	United States	3	3
2	2	Germany	1	1
3	3	Sweden	6	16
4	4	Norway	4	4
5	5	North Korea	5	8
6	6	Denmark	6	16
8	7	Brazil	3	3
9	8	Canada	6	16
10	9	Japan	6	16
11	10	China	5	8
12	11	England	5	8
15	12	Australia	5	8
23	13	New Zealand	6	16
24	14	Nigeria	6	16
29	15	Argentina	6	16
47	16	Ghana	6	16
End of Table				

FIFA 2007 Womens World Cup Suggested Outcomes		
Group	Suggested Outcome by Rules	Actual Outcome by rules
A	Germany, Japan	Germany, (England)
B	United States, Sweden	United States, (North Korea)
C	Norway, Canada	Norway, (Australia)
D	Denmark, Brazil	Brazil, (China)

Table 10: FIFA 2011 Womens World Cup

FIFA 2011 Womens World Cup				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
1	1	United States	2	2
2	2	Germany	5	8
3	3	Brazil	5	8
4	4	Japan	1	1
5	5	Sweden	3	3
6	6	Canada	6	16
7	7	France	4	4
8	8	North Korea	6	16
9	9	Norway	6	16
10	10	England	5	8
11	11	Australia	5	8
22	12	Mexico	6	16
24	13	New Zealand	6	16
27	14	Nigeria	6	16
31	15	Colombia	6	16
61	16	Equatorial Guinea	6	16
End of Table				

FIFA 2011 Womens World Cup Suggested Outcomes		
Group	Suggested Outcome by Rules	Actual Outcome by rules
A	Germany, Canada	Germany, (France)
B	England, Japan	England, Japan
C	Sweden, United States	Sweden, United States
D	Brazil, Norway	Brazil, (Australia)

Table 11: FIFA 2015 Womens World Cup

FIFA 2015 Womens World Cup				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
1	1	Germany	4	4
2	2	United States	1	1
3	3	France	5	8
4	4	Japan	2	2
5	5	Sweden	6	16
6	6	England	3	3
7	7	Brazil	6	16
8	8	Canada	5	8
10	9	Australia	5	8
11	10	Norway	6	16
12	11	Netherlands	6	16
14	12	Spain	7	24
16	13	China	5	8
17	14	New Zealand	7	24
18	15	South Korea	6	16
19	16	Switzerland	6	16
25	17	Mexico	7	24
28	18	Colombia	6	16
29	19	Thailand	7	24
33	20	Nigeria	7	24
37	21	Costa Rica	7	24
48	22	Ecuador	7	24
53	23	Cameroon	6	16
67	24	Ivory Coast	7	24
End of Table				

FIFA 2015 Womens World Cup Suggested Outcomes		
Group	Suggested Outcome by Rules	Actual Outcome by rules
A	Canada, Netherlands	Canada, (China)
B	Germany, Norway	Germany, Norway
C	Japan, (Switzerland)	Japan, (Cameroon)
D	United States, Sweden	United States, (Australia)
E	Brazil, Spain	Brazil, (South Korea)
F	France, England	France, England

Table 12: FIFA 2019 Womens World Cup

FIFA 2019 Womens World Cup				
FIFA Ranking	World Cup Ranking	Country	Final Result A	Final Result B
1	1	United States	1	1
2	2	Germany	5	8
3	3	England	4	4
4	4	France	5	8
5	5	Canada	6	16
6	6	Australia	6	16
7	7	Japan	6	16
8	8	Netherlands	2	2
9	9	Sweden	3	3
10	10	Brazil	6	16
12	11	Norway	5	8
13	12	Spain	6	16
14	13	South Korea	7	24
15	14	Italy	5	8
16	15	China	6	16
19	16	New Zealand	7	24
20	17	Scotland	7	24
34	18	Thailand	7	24
37	19	Argentina	7	24
38	20	Nigeria	6	16
39	21	Chile	7	24
46	22	Cameroon	6	16
49	23	South Africa	7	24
53	24	Jamaica	7	24
End of Table				

FIFA 2019 Womens World Cup Suggested Outcomes		
Group	Suggested Outcome by Rules	Actual Outcome by rules
A	France, Norway	France, Norway
B	Germany, Spain	Germany, Spain
C	Brazil, Australia	(Italy), Australia
D	England, Japan	England, Japan
E	Netherlands, Canada	Netherlands, Canada
F	United States, Sweden	United States, Sweden

Brandon Joly,
700 College Street Beloit College Box 693, Beloit, Wisconsin, USA 53511, Phone: (920)639-3849, ORCID ID: 0000-0002-5793-6753
Email address: jolybs@beloit.edu

Tom Stojsavljevic,
700 College Street, Beloit, Wisconsin, USA 53511, Phone: (608)363-2404, ORCID ID: 0000-0003-0958-4025
Email address: stojsavljevictg@beloit.edu

Mehmet Dik,
700 College Street, Beloit, Wisconsin, USA 53511, Phone: (815)226-4135, ORCID ID: 0000-0003-0643-2771
Email address: mdik@rockford.edu