

Projecting FIFA World Cup 2018 using Monte Carlo simulations

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A match of soccer, a wildly popular sport, is about two teams of players competing against each other. Typically these teams are rated on a system which awards points at the end of a match, or by process of elimination. The more points a team earns, the higher their perceived status is. The Fédération Internationale de Football Association[9], or FIFA, uses a different system for rating teams based on recent performances. This rating[2] system deviates from the more commonly used Elo rating system[1]. We introduce the Elo rating system to provide another way of calculating expected win through the use of the Monte Carlo method[5]. We learned that Monte Carlo performs exceptionally well for Elo based simulation problems. Elo also appears to be effective for comparisons between teams, as opposed to its original purpose of comparing two individuals. Our results expose the distribution of skill between participants in the World Cup main event to be of such size that the expected win chance varies wildly. We encourage others to implement such a system for tournaments which revolve two teams competing against each other. This study can be used as a starting point for further research into tournament setting and matchmaking.

Subject terms

FIFA world cup, 2018, simulation, Monte Carlo method, football, soccer, international tournament, prediction, sport, elo rating

Main

It is difficult to predict the winner of a sports event without any prior knowledge about the sport. We want to assess the situation with a scientific approach. The process of doing this is by introducing a system in which you can compare participating members against each other, Elo rating is such a system [1]. FIFA also has a similar system in which they rank countries based on past performances. The key difference between the two ranking systems is that FIFA places emphasis on recent performances, and only takes those into account, as well as evaluating after a time frame has passed. Elo rating however re evaluates rating after each match. We choose to use elo rating since it has been adopted in many other sports such as chess[1], and American football[3]. We'll be using this self generated ranking to simulate the main event of the World Cup by utilising the Monte Carlo method[5]. A similar experiment has been done by David Dormagen in his work: Development of a Simulator for the FIFA World Cup

2014[4]. At the time of writing, the participants of the World Cup 2018 are to be determined. This is in contrast with Dormagen's research. The FIFA World Cup consists of a qualification process which leads up to the main event. The main event involves 32 countries, the first team to enter the main event is the tournament's host country. The qualifiers are separated into 5 regions: AFC, CAF, OFC, CONCACAF, CONMEBOL, and UEFA. In each region a select number of slots for the main event is available for countries to earn based upon past performance of the region. Each region organizes their own tournament for qualification. The 2018 main event has 32 teams, 8 groups and a total of 64 matches. The FIFA World Cup 2018's Match Schedule[7] will be used to simulate the main event.

Methods

An unmodified version of the elo formula will be used for calculating the resulting elo of a match between two participants, as well as win chance for the simulation. Where E is the expected win chance, S is the result of the match, and K is a value which defines the weight of the match towards the rating.

$$E_a = \frac{1}{1 + 10^{(RatingDifference)/400}}$$

$$E_b = 1 - E_a$$

$$Rating'_x = Rating_x + (K * (S - E_x))$$

All results from the qualification process, and main event starting from 1994 up until the finals of the World Cup in 2014 are used for calculating the elo of countries. Since the main event is the only occasion where the regions compete against each other, the k value should be higher than that of the qualifiers. This is to distribute the average of elo between the regions to represent the differences in skill. We chose k values of 10 for the qualifiers and 30 for the main event.

Some countries have been represented by one or multiple teams, one of these is Czechoslovakia. As of the 1st of January in 1993, the state of Czechoslovakia had dissolved into Czech Republic and Slovakia. During the 1994 qualifiers, the two countries were represented as one. This leads to the introduction of 2 new subjects and 1 that will never return. We solve this by taking the elo of the disbanding team, and assigning this to the 2 new teams. Then, deducting an amount of elo all across the board of countries to restore the average of 1500.

The simulation stage consists of all 32 qualified countries which are taken from the top of the generated elo leaderboard, and are sorted into four pots(see supplementary materials: World Cup Pots) based on 2014 FIFA draw procedures. Each pot requires eight countries, however pot 3 will only have seven, and pot 4 has nine countries. One country will be selected on randomness from pot 4 and placed into pot 3 The World Cup 2018 will be simulated using the generated elo leader-board, the FIFA draw procedures, the FIFA match schedule and the Monte Carlo method.

The result of a simulated match is calculated based on a random draw which

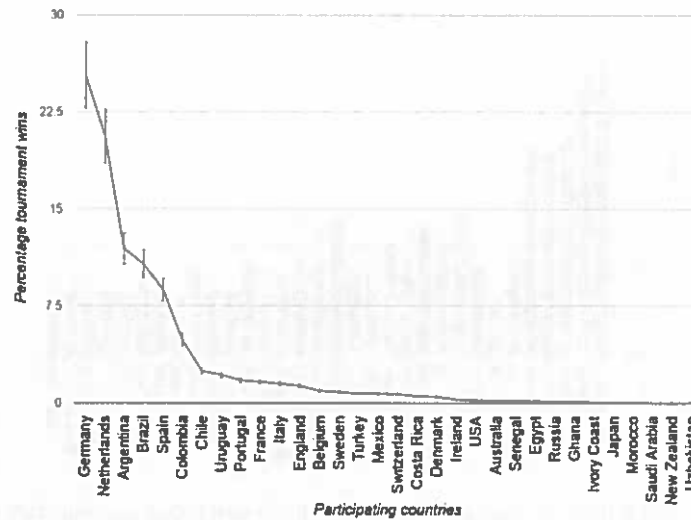


Figure 1: The figure displays the resulting win distribution from 10,000 simulation iterations. The percentages shown are direct observations from the tournament simulations and represent how many times a country has won the simulated tournament.

takes expected win chance into account of the two countries. During group stage of the main event, a conflict can occur where countries are tied in points. Since only 2 countries can proceed into the next stage of the tournament, this needs to be addressed. All tied countries will be reordered through a random draw.

Results

We generated our results, figure1(see supplementary material: Simulation Results), through 10,000 iterations of the simulation. Because the win chance is calculated off of elo ratings, that have been previously assigned, there is an expectance of high correlation between percentage of tournament wins, and elo rating. Figure 2 suggests this correlation as well. When tested, the correlation appears to be 0.9321 which indicates a very strong correlation. The results from the simulations show that the 5 highest performing countries win 77.44% of the World Cups. As can be seen from figure 2 the difference in elo rating between the top 5 teams and the rest of the participating countries is apparent. The average elo rating of the top 5 being 1710, and that of the lower 27 countries at 1573 illustrates the division between the higher rated countries and the lower rated ones. The 20 lowest rated countries have a collective tournament win percentage of 6.7%. Table 1 illustrates that the UEFA and CONMEBOL region make up for 97.54% of all simulated tournament wins. With CONMEBOL being the leading region where the average tournament win percentage per country is

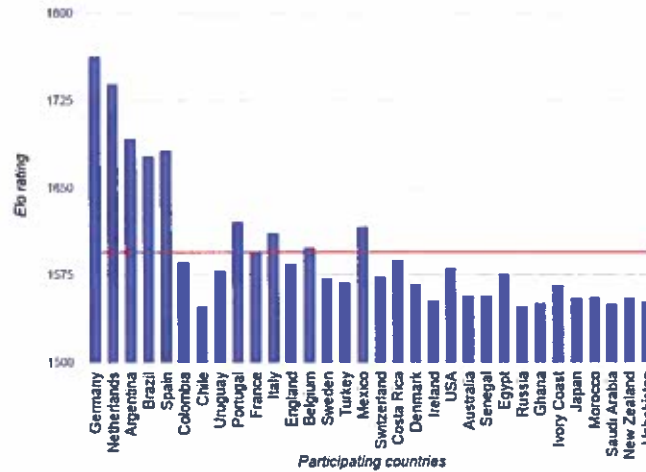


Figure 2: The figure displays the elo rating of the participating countries sorted by win rate (High to low). The average elo of the tournament is 1594, which is illustrated by the horizontal bar.

	Countries	Tournament win % per region	Tournament win % per region per country
UEFA	14	65.25	4.660714286
CONMEBOL	5	32.29	6.458
CAF	5	0.66	0.132
OFC	4	0.29	0.0725
CONCACAF	3	1.49	0.496666667
AFC	1	0.02	0.02

Table 1: The table displays the regions that participate in the simulation tournament. The last column gives insight into the win percentage for a country of the region on average.

6.458%.

Discussion & Conclusion

In essence there is a small number of countries that are rated as dominant forces when it comes to winning the tournament, this can be seen from the win chance of just 5 countries projected at 77.44%. Only 2 regions out of the 6 that make up the FIFA World Cup are estimated at 97.54% expected win chance of the tournament. These 2 regions are allotted 19 slots in total for participating in the tournament, which leaves 13 slots for the other regions that have an expected win chance of less than 3%. This raises questions as to whether the distribution between slots for entering the tournament is fair when it comes to competition. Under the assumptions that we made regarding ranking countries that participate in the FIFA World Cup, by using available data from 1994 to 2014. The expected chance of Germany, or The Netherlands winning the 2018

World Cup is respectively 25.35% and 20.62%. That is to say, in our simulation because there are variables that simply can not be accounted for such as these countries not being able to qualify for the main event at all. In this study we learned to use elo rating and create a simulation using the Monte Carlo method. Our study involved generating an elo ranking and simulate a tournament with this data. Future research should focus on using more data to calculate the ranking, use a different ranking system such as TrueSkillTM [8] or reevaluate the way the slots are distributed between the regions, and whether or not this is fair.

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Supplementary Online Material

3 sheets with additional data.

https://docs.google.com/a/students.uu.nl/spreadsheets/d/1Ee2A2LMKBvJW0aq_v7aiosA-LR5s0F8ufvccvht-x4/edit?usp=sharing

