

## MATH 118 PROBABILITY AND STATISTICS FINAL PROJECT

**Research Question:** Is there a statistical difference between chess scores by gender in different age ranges?

**Researcher:** Uğur Er 1901042262

### 1. INTRODUCTION

Chess is a fun and competitive strategy game played between two players on an eight-by-eight chessboard that originated in the 19th century. Today, chess is one of the world's most popular games, played by millions of people worldwide at home, in clubs, online, by correspondence, and in tournaments.<sup>1</sup>

The international governing body of chess (usually the French abbreviation FIDE or) is known as the International Chess Federation, or ICF. More than 180 countries have memberships in FIDE organizations. The International Chess Federation uses the Elo rating system developed by Arpad Elo to rank players. Generally, when calculating a player's score, it is calculated as 1 point for each game won and 0.5 point for each game drawn. Although a different scoring system is used in some tournaments, the Elo scoring system is based on the victories reported to the federation. Club players have an average of 1500 ratings. The highest FIDE rating in the history of the federation belongs to Magnus Carlsen with 2882. Some titles may be given to players by FIDE. These titles are listed below in general terms and there is no distinction between male and female titles.<sup>1</sup>

- Grandmaster (GM) is the highest title a chess player can win other than a world championship. A player must have an Elo rating of 2300 to receive the GM title from the International Chess Federation. Player must also have at least three wins with other grandmasters in countries other than his home country.
- International Master (IM). Its conditions are the same as the grandmaster, except he needs 2200 Elo points.
- FIDE Master (FM). It is enough for players to earn 2000 Elo points to receive this title.

The main purpose of this project is to understand whether there is a statistical difference between gender-related classical chess scores in different age ranges, according to data published by the International Chess Federation in 2015. According to the distribution of the data set, statistical analyzes will be performed in order to answer various research questions correctly.

## 2. MATERIALS AND METHODS

### 2.1 Data Collection

The data to be used in this project are taken from Kaggle, an online dataset platform. The dataset contains information such as age, gender, chess title and chess rating of more than 420,000 chess players registered with the International Chess Federation.

### 2.2 Pre-processing Stage

It is not possible to use every single data in the data set we have obtained. There are missing/wrong entries in some parts of the dataset. In the data set we used in this research, at least one of the age, title and chess rating information of some players was missing. Therefore, data analysis will not be efficient and will lead to erroneous results. Therefore, we removed missing/misleading players from the dataset of over 420,000 players using PYTHON. At the end of the day, more than 14,000 player data were available for analysis. Before performing data analysis, we divided the players into categories of rank, age and gender. We then calculated the average chess scores of men and women in each ranking within a given age range (table 1).

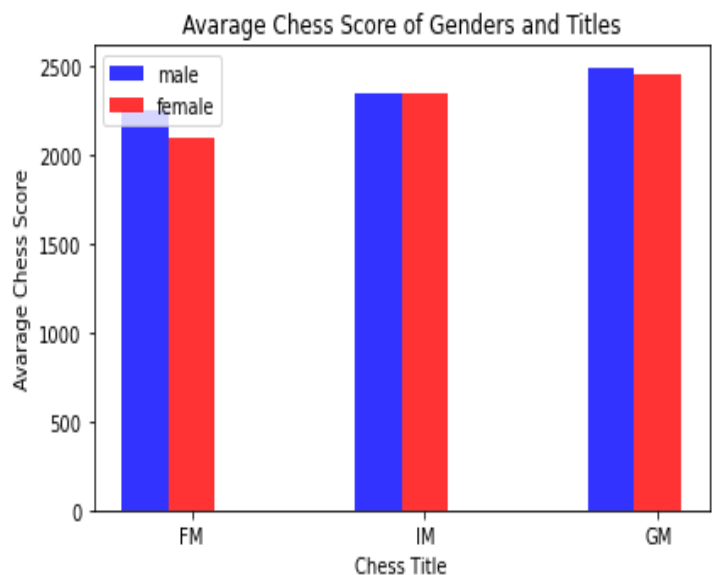
## 3. RESULTS AND DISCUSSIONS

### 3.1 Point Estimates for Sample Parameters

Age Range	FM		IM		GM	
	Male	Female	Male	Female	Male	Female
13-23	2267	2230	2387	2372	2549	2516
24-33	2273	2231	2378	2362	2521	2493
34-43	2261	2165	2358	2325	2496	2482
44-53	2242	2003	2335	2328	2469	2500
54-80	2211	1846	2300	2345	2423	2300
Mean	2251	2095	2352	2347	2491	2458
Variance	591	25496	1054	434	1889	7490

Table 1: Average ratings for men and women in three different chess categories

Average chess scores of three different chess titles for male and female in certain age ranges are given in table 1. Due to the lack of data, the first parameter of the age range was chosen as 13-23, and the last parameter as 54-80. Three categories were created between the ages of 24 and 53. We can consider the 13-23 age range of the table 1 as young players, 24-53 age range as middle-aged players, and finally the 54-80 age range as older players. The title of grandmaster (GM) is the highest, and the title of FIDE master (FM) is the lowest in our



representation. Therefore, we expect the population to have the lowest average chess score in the FM title and the highest average in the GM title. Looking at Figure 1, it is striking that the average scores of men are higher than women in all title categories. Based on this statistical information, it can be generalized that males in the data set we used in our research play chess slightly better than females. If we look at the variance values in Table 1, we can see that the highest variance value in female FMs is 25496. This means that chess scores in female FMs vary a lot with age. The value between the largest and smallest score is large. When we look at the lowest variance value in Table 1, we can see that it is 591 in male FMs. This means that the chess scores of male FMs do not show very high differences by age. The value between the largest and smallest score is small.

### 3.2 T Interval

Parameters	FM		IM		GM	
	Male	Female	Male	Female	Male	Female
Mean	2251	2095	2352	2347	2491	2458
Std Dev	25,06	167,40	35,00	20,36	48,41	89,15
N	5	5	5	5	5	5
Alpha	0,05	0,05	0,05	0,05	0,05	0,05
T (a/2,n-1)	2,776	2,776	2,776	2,776	2,776	2,776
Error	31,11	207,82	43,45	25,28	60,10	110,68
Upper Bo.	2282,2	2302,9	2395,2	2372,4	2551,5	2568,9
Lower Bo.	2220	1887,1	2308,3	2321,8	2431,3	2347,5
T interval	[2220,2282]	[1887,2303]	[2308,2395]	[2321,2372]	[2431,2552]	[2347,2569]

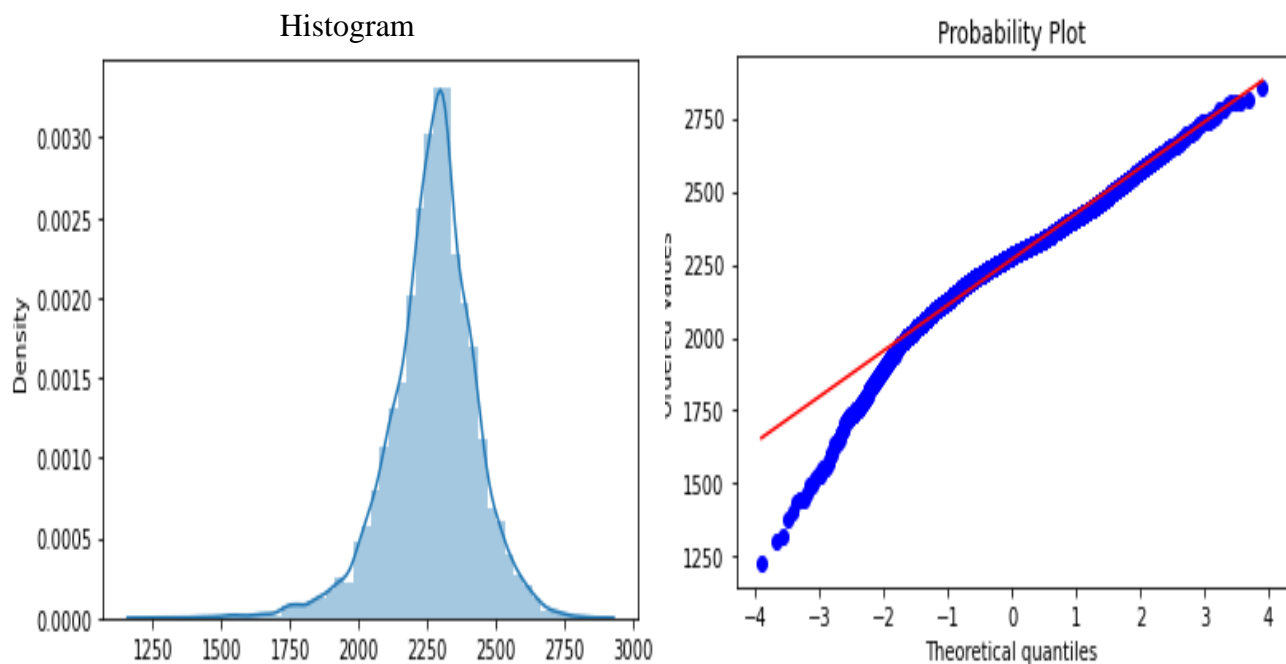
Table 2: T intervals of male and female ratings for three title categories

The confidence interval (CI) is a range of values that's likely to include a population value with a certain degree of confidence. It is often expressed as a % whereby a population mean lies between an upper and lower interval<sup>3</sup>. The parameter is present in 95% of confidence intervals evaluated at the 95% confidence level. In our research, the alpha value was chosen as 0.05. It means that we are 95% confidence that upper bound and lower bound of the chess scores will be placed indicated t-intervals. For instance, we are 95% confidence that male FMs chess scores will be located from 2220 to 2282 chess scores.

Sample size, confidence level, and sample variability are all factors that influence the breadth of the confidence interval. The confidence is in the method, not in a particular CI. If we repeated the sampling method many times, approximately 95% of the intervals constructed would capture the true population mean.

Therefore, as the sample size increases, the range of interval values will narrow, meaning that you know that mean with much more accuracy compared with a smaller sample. <sup>3</sup>

### 3.3 Normality Test



*figure 2: Normality check of the population and sample*

The normal distribution also known as the Gaussian distribution is a probability function that describes how the values of a variable are distributed. It is a symmetric distribution where most of the observations fall around the central peak and the probabilities for values further away from the mean taper off equally in both directions with fewer outliers on the high and low ends of the data range. A normal distribution is the most important probability distribution in statistics because many processes in nature follow the Normal distribution, Some of the examples are age, height, weight and blood pressure of a person.<sup>2</sup> As a result of test, figure 2 shows that both samples are normally distributed.

### 3.4 Correlation Score

Age Range	FM		IM		GM	
	Male	Female	Male	Female	Male	Female
13-23	2267	2230	2387	2372	2549	2516
24-33	2273	2231	2378	2362	2521	2493
34-43	2261	2165	2358	2325	2496	2482
44-53	2242	2003	2335	2328	2469	2500
54-80	2211	1846	2300	2345	2423	2300
Correlation Score	0,990		0,508		0,828	

Table 4: Correlation score calculations

The correlation coefficient is a statistical indicator of the degree of relationship between the relative motion of two points and is variable and ranges from -1.0 to 1.0. A perfect negative correlation is represented by a correlation of -1.0, while a perfect positive correlation is represented by a correlation of 1.0. A correlation of 0.0 indicates a non-linear link between the movement of the two variables. In addition, the relationship between the classical score of women and men will be examined in this section. The main international correlation between the genders is very high (0.990) and close to 1, Hence, there is a high positive correlation between the two genders. Other chess titles (IM and GM) also have a high correlation between the two genders. Therefore, the classical chess score relationship between the genders for each title is highly correlated.

#### 4. CONCLUSION

In this research, it was investigated whether there is a statistical difference between classical chess scores in different age ranges depending on gender. In order to answer our research question stated in the title, various statistical analyzes were applied to the data obtained from the Kaggle site. First, the point estimation test is applied to calculate the mean and variance values for each subcategory on the data. As a result of this test, it was noticed that there was a contrast between the two genders by looking at the maximum and minimum variance values. For example, male minimum variance is calculated under FM chess title, and female maximum variance is calculated under FM chess title. It shows that male classical chess scores according to different age groups are not far from the population average in the lower ranks (FM). However, the scores of women in the lower ranks (FM) vary more and the samples are farther from the sample mean than the other chess ranks. Second, the t-interval test was performed, and the alpha probability confidence level was chosen as 95%. We obtained results similar to the point estimation tests with the T-interval test. A normality check is then applied to determine whether the data is normally distributed. According to the results of the normality test, it was determined that the population and the samples we collected were normally distributed. On the other hand, the research question also questions whether there is a relationship between the genders' classical chess scores. For this reason, correlation analysis was performed to see the relationship between the genders. Statistical findings show a high positive correlation between class chess scores for both genders according to three different chess titles. In conclusion, we can say that traditional chess score has a statistical correlation with gender.

#### Reference List

<sup>1</sup> Chess. Wikipedia. Link: <https://en.wikipedia.org/wiki/Chess>

<sup>2</sup> Link: <https://towardsdatascience.com/normality-tests-in-python-31e04aa4f411>

<sup>3</sup> Link: <https://www.simplypsychology.org/confidence-interval.html>

The link for the dataset: <https://www.kaggle.com/rohanrao/chess-fide-ratings>