Table of Contents

1. Introduction

The year 2023 is quite meaningful for Turkish people. Marking the 100th anniversary of the foundation of the Republic of Turkey by Mustafa Kemal Atatürk and the effective date of the Lausanne Agreement, it has been a widely marketed date in Turkish politics. Especially, the current incumbent president, Recep Tayyip Erdoğan, and his ruling party, Justice and Development Party (AKP or AK Party), have been giving out election promises that they will carry the country into a much better place by 2023, which raised public expectations of the government throughout their incumbency.

In 2017, Turkey held a constitutional referendum, under the emergency laws that resulted from the coup attempt of July 2016, to decide whether to change a set of laws proposed by AK Party and their supporting coalition partner Nationalistic Movement Party (MHP). The proposal consisted of replacing the parliamentary system and the office of the prime minister with a presidential system and executive presidency on top of other changes that gave the president power to dominate the independent public institutions such as the Supreme Board of Judges and Prosecutors (HSYK). After the proposal was accepted by the public by 51%, The President of the Republic Erdoğan and MHP Chairman Devlet Bahçeli decided to move the presidential elections, that was supposed to take place in November 2019, to an earlier time of June 2018 in order to “not wait any longer” to exercise the laws passed in the referendum. Following, the first presidential election took place on 24th of June 2018 alongside the parliamentary elections. This decision, also, made it possible for the second presidential election of Turkey to take place in 2023 around June which is only one month away from the 100th anniversary of the Lausanne Peace Agreement (July 24, 1923). In the elections of 2018, Erdoğan won by the majority of the popular

vote (52.59%) by receiving more than 10 million more votes than his closest candidate, Muharrem İnce (30.64%). Similarly, his alliance with MHP (People's Alliance) received 53.66% of the votes, winning them the majority in the parliament as well. Since the elections, Erdoğan and his alliance have been ruling the country without needing any support from other parties as he gained the power to issue decrees and the majority of the parliamentary seats.

2. Overview of Turkish Politics Since the Elections of 2018

Turkish politics has always been open to surprises and sudden changes in the public agenda. Since 2018, there have been numerous global and local events that caused radical changes in Turkish public opinion a couple of which will be discussed in this section.

The Turkish public is divided into two parts for the upcoming election: Those who support Erdoğan and the ones who do not regardless of their political stance. This part will start with the arguments of the ones against Erdoğan, and it will continue with the other.

Even before the elections of 2018, the opposition parties, the tRepublican People's Party (CHP), the Good Party (IYI), the Felicity Party (SAADET or SP), and the Democrat Party (DP), have formed an alliance called Nation's Alliance to compete against Erdoğan and Bahçeli's People's Alliance and to overthrow them by joining forces. It was an unexpected action as the political ideologies of the participating parties were quite different from each other (CHP – Secular Centre-Left, IYI – Secular Nationalistic Centre-Right, SAADET – Islamist Extreme Right Wing, DP – Liberal Centre).

The positive effects of forming the Nation's Alliance started with the March 31st Mayoral Elections which was one of the most surprising results for Erdoğan. AK Party put forward one of the strongest candidates possible for

the biggest cities: Binali Yıldırım (the last prime minister of Turkey) for İstanbul, Mehmet Özhaseki (former Minister of Environment and Urban Planning) for Ankara, and Nihat Zeybekçi (former Minister of the Economy) for İzmir. They lost all three biggest cities in Turkey. In İstanbul, the election was called rigged by AK Party and immediately a rerun was proposed and accepted by them, which in turn turned out to be an even bigger defeat (Sariyuce & Kottasová, 2019).

On top of that, at the end of 2019 and the beginning of 2020, two of the founders of the AKP (Ahmet Davutoğlu - Former Prime Minister, Ali Babacan – Former Minister of the Economy and Deputy Prime Minister) who previously resigned from AK party because of severe disagreements with president Erdoğan decided to form their own political parties. Ahmet Davutoğlu founded the Future Party (GP) and Ali Babacan founded the Democracy and Progress Party (DEVA) both of which surprisingly later decided to join Nation's Alliance and formed the so-called Table of Six.

However, in 2021, Muharrem İnce (previous presidential candidate of the opposition and a parliamentary group leader of CHP) and Ümit Özdağ (a very well-known parliamentary representative of the IYI Party) strongly opposed the leadership of their parties and got separated from them, forming their own parties Homeland Party (MP) and Victory Party (ZP) respectively. It was interpreted as an unlucky situation for those who want to overthrow AKP and MHP's majority in the parliament as they were projected to get less than the national vote percentage threshold while stealing at least 2-3% from the opposition votes owing to their popularity among the young people due to their abundant social media presence.

2.1 The Economic Matters

The share of imports in Turkey's GDP has constantly risen starting from the pre-pandemic periods. However, the catastrophic consequences only began to hurt the consumers' daily life during the COVID-19 pandemic. Combining that with the fall of the Turkish Lira against the US Dollar and Euro, led the Minister of Treasury and Finance and Erdoğan's son-in-law, Berat Albayrak, to resign following extreme public dissatisfaction with Turkey's current economic state.

Figure 1: Turkish Lira Against the US Dollar when Berat Albayrak resigned (Pitel, 2020)

Meanwhile, Erdoğan was openly supporting the unorthodox idea of cutting the interest rates even though inflation was soaring (Kandemir & Bilgic, 2022). That caused a further fall in the Lira as the interest rates went from 19% to 9% in around a year as inflation went from 20% to as high as 85%. This was also inclined by the Russian-Ukrainian War that started in December 2021, hurting the Turkish trade as these two countries were among the biggest exporters of food products for Turkey. Furthermore, the opposition parties and other independent financial institutions argued that the official figures were not reflecting the truth and the real inflation was, in fact, around 190%.

Further, the sources in the opposition claimed that the government was spending the central bank's foreign currency reserves to peg the Turkish Lira to US Dollar. A report from Goldman Sachs estimated at least 100 billion

dollars were spent and the opposition claimed that 128 billion dollars were sold up to date and it has become around 400 billion today (128 Milyar Dolar" Tartışması Nasıl Başladı, türkiye'nin Döviz Rezervleri ne durumda?, BBC).

2.2 The Socio-Political Matters

Apart from the economic problems, AKP had problems with social matters. They have withdrawn from the Istanbul Convention which was put in place in order to defend the rights of the women. As might be expected, this move was heavily opposed by the Turkish women who were concerned about their safety. They also put Ekrem İmamoğlu, Mayor of Istanbul, on trial on the accusation of calling the rerun of the Istanbul Election "fools". He was then sentenced to 2 years 7 months and 15 days imprisonment and a political ban according to Article 53 of the Turkish Criminal Law. This was interpreted as a strategically unfair move of Erdoğan to eliminate one of the presumptive nominees for the Table of Six's presidential candidate because of his increasing popularity.

Only a month later, the leaders of the Table of Six started gathering to decide on the novel overview of the country they would try to create in case they win the election. On January 30th, 2023, they published the 250-page long "Common Policies Agreement" which sets forward the issues they will address and how they will address them. They were, consequently, highly praised by the people who were not expecting the so-called "six dissimilar" who are unable to come up with an agreement on the topics regarding the ways they prefer to rule the country. Shortly after the publication of the Common Policies Agreement, they further announced the "Strengthened Parliamentary System" indicating that they will get rid of the so-called "one-man regime" that Erdoğan has brought to the country with the 2017 Presidential Referendum.

A week later, on February 6th, South of Turkey was hit by two major earthquakes of magnitudes 7.8 and 7.7. It was the most catastrophic earthquake in Turkey's history and was named the "Disaster of the Century" by the government. It displaced more than 10 million people while killing over fifty-thousand people and injuring over hundred-thousands. AKP and Erdoğan were strongly criticized for not being able to respond to people's calls for help and not being able to maintain order in the earthquake region. Everything was looking good for the opposition until March 3rd, 2023. The Table of Six gathered to decide on their presidential candidate. However, the leader of the second biggest party, Meral Akşener, decided to leave the alliance and announced that they will not support the leader of the CHP, Kemal Kılıçdaroğlu, as their joint presidential candidate as they thought İmamoğlu or Mansur Yavaş (Mayor of Ankara) would be much better candidates to win an election against experienced Recep Tayyip Erdoğan. However, only three days later, she announced that they were rejoining the alliance and accepting Kılıçdaroğlu as the candidate under the conditions of appointing İmamoğlu and Yavaş as the vice presidents.

On the other side, Erdoğan has tried to consolidate his voters in many ways since the last election. Turkey's popularity has grown in the field of combat drones since the Azerbaijani-Armenian combat in Nagorno-Karabakh. It has constantly improved its military strength during the AKP period, adding several drones and aircraft carriers to the inventory. Following, Turkey played a very strong role (also thanks to Erdoğan's personal stance) in the initialization of Russian-Ukrainian peace talks during the war. Erdoğan kept the country neutral during the war which helped him keep a sincere relationship with Putin despite being a NATO member country. Then, unlike other Western countries, he declined to impose sanctions on Russia (Turkey will not join sanctions against Russia - erdogan. TASS. (n.d.)). Therefore,

among the Turkish voters, his popularity increased as he could both sell drones to Ukraine and maintain steady relationships with Russia.

Figure 2: Erdoğan standing next to the first electric car and first vehicle ever made in Turkey's car industry, TOGG (Ünveren, 2022).

Moreover, he realized one of the most awaited, allegedly, dreams of the Turkish people which is a 100% domestic and national automobile. There have been several attempts at producing a domestic and national car in Turkey's history, all of which have failed due to plenty of reasons. After a rough period of finding the means to produce the car, he kept his promise and completed the production of the prototypes as a part of his 2023 promises.

Additionally, he managed to convince the leader of the New Welfare Party (YRP), Fatih Erbakan, who is the son of the Welfare Party, Necmettin Erbakan to join the election on his side so that he could further secure the votes of his supporters. Although the party is quite new in the Turkish political arena, Fatih Erbakan had a very strong base of voters who were strongly supporting his father. Necmettin Erbakan was also called the "teacher" of Erdoğan which made it easier for him to appeal to his supporters. His voters have several other reasons not to deviate from their choices such as the natural gas reserves found in the Black Sea, oil reserves found in Şırnak, and increased social aid.

3. Turkish Electoral System

Using a party-list proportional representation system called the D'Hondt method, explained below, Turkey elects 600 members of parliament to the Grand National Assembly. A party must obtain more than 7% of the national vote in order to return MPs, or it must be a part of an electoral alliance whose combined vote totals surpass the aforementioned level. This implies that parties might receive huge support in some districts yet fail to secure any MPs due to poor overall performance (“Electoral system of Turkey”, 2023).

In Preparation for the 2018 general election, the electoral system was changed to account for election alliances. The change was, at first, opposed by the opposition parties who were going to be hurt quite badly by the changes. However, since AKP and MHP had the majority in the parliament, there was nothing they could do. These changes allowed parties to run in elections as coalitions of multiple parties, where the electoral threshold (10% in the Turkish Electoral System) is effectively bypassed for the parties within the coalition as long as the alliance's total votes exceed it. The change's effects were first felt in the same elections, where even though the Good Party received 9.96% of the national votes, it was nevertheless permitted to enter the legislature because it was a member of the bigger Nation Alliance, which received 33.95% of the vote.

The D'Hondt method was initially applied proportionally to all alliance members, but a bill overseeing changes to the election law passed on March 2022, changed the system so each party that passes the new 7% threshold either by itself or by being a member of an electoral alliance are directly represented by their own votes, rather than the alliance’s, in each constituency when the calculations of D'Hondt are being made, preventing smaller members of an electoral alliance from gaining MPs in the district

where their allies are stronger (Turkey lowers national threshold to 7% with New Election Law. Daily Sabah, 2022).

3.1 D'hondt Method

Systems of proportional representation seek to distribute seats to parties roughly proportionally to the number of votes they got. For instance, a party should win around one-third of the seats if it receives one-third of the votes. Due to the fractional numbers of seats produced by these divisions, precise proportionality is typically not achievable. Many techniques, like the D'Hondt method, have been developed consequently to guarantee that the parties' seat allocations, which are made up of whole numbers, are as proportionate as feasible (Gallagher, 1991).

Following the totaling of all votes, each party's subsequent quotients are determined. One seat is awarded to the party with the highest quotient, and the quotient is then updated. Up until the necessary number of seats are filled, this is repeated.

The formula for the quotients is:

$$Quotient = \frac{V}{s+1}$$

where:

- V is the total number of votes that the party received, and
- s is the number of seats that the party has been allocated so far, initially 0 for all parties.

The total votes cast for each party in the electoral district is divided, first by 1, then by 2, then 3, up to the total number of seats to be allocated for the district/constituency. Let's say there are s seats and p parties. The number of votes gained by the i^{th} party divided by j can then be entered in the i^{th} row and j^{th} column of a grid of numbers with p rows and s

columns. Each party receives the same number of seats as there are winning entries in its row since the winning entries are the ones with the greatest total in the whole grid (“D’Hondt method”, 2023b) .

Round (1 seat per round)	1	2	3	4	5	6	7	8	Seats won (bold)
Party A quotient seats after round	**100,000 1**	50,000 1	**50,000 2**	33,333 2	**33,333 3**	25,000 3	25,000 3	**25,000 4**	**4**
Party B quotient seats after round	80,000 0	**80,000 1**	40,000 1	**40,000 2**	26,667 2	26,667 2	**26,667 3**	20,000 3	**3**
Party C quotient seats after round	30,000 0	30,000 0	30,000 0	30,000 0	30,000 0	**30,000 1**	15,000 1	15,000 1	**1**
Party D quotient seats after round	20,000 0	20,000 0	20,000 0	20,000 0	20,000 0	20,000 0	20,000 0	20,000 0	**0**

Figure 3: An example of the allocation of 8 seats in a district using the D’hondt method (“D’Hondt method”, 2023b).

4. Election Prediction Techniques

Understanding the dynamics of political systems and influencing the direction of political campaigns rely heavily on election prediction techniques. Accurate estimates of parliamentary seat distributions offer helpful insights into voter behavior, party performance, and the likely results of elections. Election prediction techniques aid political strategists, media analysts, and policymakers in determining the balance of power, foreseeing electoral trends, and making educated judgments by predicting the distribution of seats among political parties. Additionally, precise forecasts promote openness and accountability by increasing public awareness of and participation in the political process.

Election prediction is the name of the process during which the distribution of the parliamentary seats is estimated for the upcoming election in a country. It seeks to offer insights into the probable outcome of the election by examining historical trends, voter behaviors, polling data, demographic patterns, and other relevant data.

One of the main ways of predicting the result of an election is to carry out political polls which is basically just asking a stratified sample of people from

various administrative districts who they intend to vote for in the upcoming election and documenting the results. In pursuance of further improving the accuracy of the estimation, one could consider polls aggregation which is a data-driven approach that combines the results of multiple polls to produce a more comprehensive and statistically robust prediction of election outcomes (Silver, 2008). This method is known to be more reliable than considering only the individual polls because it reduces the impacts of the potential individual biases and outliers of the polls which greatly impacts the overall result. Several studies back this claim up by applying the technique to real-life situations (Silver, 2008; Erikson & Wlezien, 2012; Linzer, 2013; Linzer & Lewis-Beck, 2015). Aggregation is accomplished by averaging the findings of the polls, weighing them in some certain ways deemed appropriate (sample size, recency), and trying to account for the quality and reliability of the pollster organization.

However, polling might still be misleading. The process of polling is quite prone to certain biases. For instance, if the sampling of people is not done correctly, it might lead to sampling bias. In Turkey, the Central Anatolian region historically votes for AKP while the Aegean region historically votes for CHP and the Eastern Anatolian region for pro-Kurdish parties. Therefore, any kind of sampling bias could very easily lead to quite improbable estimates for the election.

On top of that, in countries where freedom of speech and thought is questionable, some participants might be reluctant to answer truthfully when indicating their unpopular political preferences. Previously, several pollsters have announced that they encountered numerous people who chose not to participate in the poll since they believe something bad might happen to them and their families if their unpopular beliefs are recorded.

On the other hand, one might utilize some fundamental quantifiable demographic data alongside polling aggregation. For instance, the economic or social welfare indicators, public perception and satisfaction indexes, and policy performance rates might be highly correlated with the changes in the votes of the incumbent party as they are perceived as the main drivers of voting preferences. Furthermore, in countries where demographic data tells a lot about people's preferences, such as Turkey, it would also be plausible to study the trends and tendencies in voting patterns based on voter demographics. For instance, conducting an ethnopolitical analysis or a study of the correlation between certain characteristics of voters and their voting preferences might be informative of the results of the upcoming election in a certain district.

Nonetheless, these methods are also prone to some biases. Any regional analysis might include essentialism bias which is basically overgeneralizing or overestimating the views of a certain social group and underestimating the probability of some people having diverse opinions.

As seen previously, each aforementioned prediction technique has its own inherent biases and potential sources of error. One might consider employing several methods and combining them together with certain weights in order to achieve better estimates with minimized biases and errors. In addition, it is known that different methods rely on different data sources and analytical frameworks. Thus, combining the techniques might provide a better understanding of context-specific factors that influence voter behavior, such as regional dynamics, demographic variations, coalition possibilities, or the impact of specific policy issues, and help cover a broader range of data and perspectives. Combining approaches allows us to evaluate the degree of uncertainty related to each methodology and take into account the confidence levels in each prediction. This makes it possible

to estimate election results in a more complex and probabilistic manner, considering the wide range of possible outcomes and the inherent uncertainty involved. Another positive aspect of combining the methods could be the potential increase in reliability in one's prediction if different methods yield similar results. Because it would mean that in spite of the different potential biases and errors, one's null hypothesis is in some interval with a higher degree of confidence. Similarly, if conflicting results are seen, the researcher must further investigate the issues and rethink their potential solutions.

5. Methodology

In this paper, the chosen methodology is a combination of polling aggregation with a fundamental model (explained below) by taking the polling aggregation method as a benchmark for the error margin in order to be able to assess the success of the combined model. Additionally, the coding language Python is used for the analysis.

The polling data is mainly gathered from Wikipedia since it updates the relevant section on its website on a regular basis[1]. The other data frames that are used to build the fundamental model are collected from the Turkish Statistical Institute (TURKSTAT or TUIK) which is a Turkish government agency commissioned with producing official statistics on Turkey, its population, resources, economy, society, and culture. Therefore, it is assumed that the data is provided without any incentives to deviate from reporting truthfully. Also, it must be noted that the data and the code are available upon request.

In the polling aggregation model, it was aimed to capture the real-time overall voter tendencies by utilizing the data that are, reportedly, taken out

[1] https://tr.wikipedia.org/wiki/Ülke_çapında_2023_Türkiye_genel_seçimleri_için_yapılan_anketler

from the streets, while in the fundamental model, the aim was to incorporate the socio-economic aspects of political decisions that shape the outcome of the election.

It is crucial to acknowledge that every technique has its limitations. Unexpected occurrences have the potential to have a big influence on election outcomes, and political landscapes are vulnerable to dynamic shifts. Because of the inherent limitations and complexity of political forecasting, it is important to interpret the findings even if the approach used in this study offers useful insights into predicting parliamentary seats.

5.1 First Method: Polling Aggregation

The first approach for predicting the results of the 2023 Turkish Parliamentary Election and therefore how the distribution of the seat allocations will be by aggregating the available polls regarding the election. This method will also be the benchmark for assessing the success of the chosen model when evaluating the results.

Firstly, the data of the polls for the 2018 general elections was collected from the relevant sources but mainly from Wikipedia's page where the results of almost all the known pollster firms' polls are documented. This was then followed by certain data preprocessing steps that were necessary to tidy the dataset so that the analysis part is easier and more eye-pleasing. After that, a function that takes a row, the number of valid votes of the previous election, a threshold (default value set to 1.5), and lastly a maximum weight (default_value set to 1.5) as arguments was defined in order to weigh each poll according to its recency and the sample size.

Following a few intermediary calculations, the weighted average of polling dataset is created by using only the valid rows which means that the row is not null and not equal to zero for the current party column to calculate the weighted average for those rows.

Averaging only the valid rows might cause the final percentage predictions to not add up to 100 at the end. Therefore, the algorithm also ensures that the sum of the percentages is always 100 by scaling the sum back to 100. After noting the estimation errors for the 2018 polling dataset, the same procedure is applied to the 2023 polling dataset and the results are documented. Finally, the number of seats each party might receive is estimated using the following formula: $s_i = p_i * s + p_i * \frac{c*n}{2} - \frac{c}{2}$

where s_i is the estimated number of seats for the i-th party p_i is the share of votes cast for that party (normalized after removing non-relevant parties), s is the total number of seats, c is the number of districts, and n is the number of "relevant" parties according to Flis, Słomczyński & Stolicki, (2020).

5.2 The Fundamental Model:

Apart from averaging the polls, the next method is trying to estimate the amount of change in the votes of the major parties since the last election by utilizing the research on the behavior of the Turkish voters that demonstrate certain characteristics. Starting with the most fundamental conclusion from the main information sources such as polls, news, or economic and demographic indicators, the incumbent parties- AKP and MHP- must lose a significant number of votes because of economic and social crises that the country have gone through in the last 5 years since the previous election. Therefore, in the fundamental model, it is assumed that AKP and MHP had lost some votes and gained none from any district. According to Doğan, S. (2018) and Uncu, B. A. (2018) done under KONDA Research and Consultancy and Bilecen (2015) the following characteristics for the voters of certain parties are determined for the 2018 elections:

- AK Party: They get more votes from women, the elderly, those with less than a high school education, religious and conservative

lifestyles, than those with higher incomes, middle income brackets, and middle class than the national average.

- CHP receives higher votes from men, elderly people, university educated people, those with a modern lifestyle, upper income groups, and upper classes than the country average.
- MHP receives more votes than its average from men, young people, those with high school education, and those with a traditional conservative lifestyle.
- Iyi Party receives relatively higher votes among young people, those with university education, and those with a traditional lifestyle.
- HDP mainly stands out among the Kurds and any far-left supporters.

The datasets at hand were the election results of 2018 by parties and alliances, the information about the total votes, the number of people according to their education levels, median ages, and rankings and index values of well-being index for each province in Turkey. Since all of the datasets available list the values by province, it made it easier to evaluate each province according to its own figures.

The fundamental model, first, starts with the updating of the election datasets according to the new legislation that was updated after the election. Following, from the education dataset, an education index" is calculated by the following formula: $\frac{(Upper\ secondary\ diploma + University\ diploma)}{Total\ voters\ in\ the\ province}$.

Similarly, an age index was created by calculating the following: $1 / (1 + np.log(age\_df['Total'] / Turkish\ median\_age))$. This ratio made sure that the index increases as the province gets younger and is potentially normalized. Lastly, from the well-being dataset- which is a composition of housing, work life, income and wealth, access to infrastructure services, and social life indexes- a well-being index was created by averaging those already created indexes.

As one of the key points of the fundamental model, an opposition index that can also be interpreted as the tendency to vote for the opposition was created by normalizing the indexes by min-max normalization, namely: $X_{normalized} = \frac{X - X_{min}}{X_{max} - X_{min}}$, and weighing them in a way that education and well-being are given greater importance than age index.

After that, CHP and IYI votes for the 2023 election is estimated by using the opposition index in such a way that it is assumed that in the province where the index is the minimum the opposition parties will not be able to increase their votes because in that province, they are the least likely to gain any supporters.

Accounting for Homeland and Victory Party, some of the newly added votes of the main opposition parties are then shifted towards them. It is believed that IYI Party will lose more votes to those parties because of Akşener's dismissal of Table of Six and her change of mind 3 days later raised questions in her voters' minds about her stability and reliability in addition to the fact that those parties' policies are deemed similar to IYI's as all three of them are right-wing parties.

The algorithm also takes into account the fact that the new votes are unlikely to go to CHP and IYI in the east where the Kurdish people dominantly live. Instead of increasing only the votes of CHP and IYI, it also increases the votes of HDP. It then decreases some of the new votes from AKP and MHP to account for the changes in the public opinion. In Kurdish-dominated provinces where HDP got more than 25% of the votes, the deducted votes are mostly added to HDP as the voters are usually Kurdish-descent and more likely to vote for the pro-Kurdish party if they do not want to vote for the incumbents. In the west, since The Workers' Party of Turkey (TIP) participated in the 2018 election from the HDP's lists, HDP's votes might go down so much that they might lose a few representatives.

However, there is no data for the TIP voters as the 2023 election will be their first. Thus, their votes will be predicted together with HDP's. One must keep in mind that the predicted seats for HDP have the tendency to be more than the actual number and this is a non-remediable limitation of the model. Also, not all the new votes for the opposition parties are deducted from the incumbent parties as it is expected that around 5 million new young voters will be able to vote for the first time in the 2023 election and a margin for them must be left. It must also be noted that votes for the New Welfare Party (YRP), Great Unity Party (BBP), and Free Cause Party (HÜDA-PAR) are counted in AKP's votes as they are in an alliance and are likely to participate in the 2023 elections from AKP's list of representatives, and the same reasoning also applies for The Party for Change in Turkey (TDP) and Independent Turkey Party (BTP) as they are openly supporting CHP.

The last step before calculating the estimated number of parliamentary seats for each party in each province is the matter of joint lists of the main opposition parties. CHP did not submit any list of candidates in 7 provinces while IYI did not submit in 9. They put their own candidates on each other's lists in those provinces. Therefore, the algorithm sums the predicted votes of those parties for those provinces when calculating the predicted seats.

Finally, the predicted seats for each party in each province are calculated using the D'hondt method considering the national percentage threshold and the results are documented. In principle, there must have been a final model that combines the results from the polling aggregation method with the fundamental model to obtain a more accurate and significantly less biased model. However, after analyzing the results in the upcoming section, it was decided that combining the techniques is not a good idea since one performs considerably better than the other and the combined model would not have the properties that were previously assumed it would have.

6. Results and Discussion

In this section, the results of the aforementioned prediction methods are presented and compared to the actual results of the election.

The following analysis will be the benchmark when evaluating the success of the chosen model.

6.1 Polling Aggregation

Table 1: The official results of the 2018 Turkish General Elections

PARTY	*VOTE*	*PERCENTAGE*	*SEATS*
AKP	21.338.693	42,56%	295
CHP	11.354.190	22,65%	146
HDP	5.867.302	11,70%	67
MHP	5.565.331	11,10%	49
IYI	4.993.479	9,96%	43
SP	672.139	1,34%	0

The result of the polling aggregation is found to be as follows:

AKP	CHP	İYİ	HDP	MHP	SP	Diğer
42.053068	22.231878	13.079372	9.105944	8.91652	2.416083	2.197135

Figure 4: Predicted 2018 Results

Therefore, the estimated seats would be calculated like the following:

$$s_{AKP} = 0.4205 * 600 + 0.4205 * \frac{87 * 6}{2} - \frac{87}{2} = 318$$

$$s_{CHP} = 0.2223 * 600 + 0.2223 * \frac{87 * 6}{2} - \frac{87}{2} = 148$$

$$s_{MHP} = 0.0891 * 600 + 0.0891 * \frac{87 * 6}{2} - \frac{87}{2} = 33$$

$$s_{HDP} = 0.091 * 600 + 0.091 * \frac{87 * 6}{2} - \frac{87}{2} = 35$$

$$s_{IYI} = 0.1308 * 600 + 0.1308 * \frac{87 * 6}{2} - \frac{87}{2} = 6$$

It is obvious that the model estimated the overall national percentages of the two biggest parties with less than 2% errors for both of them. However,

it performed significantly worse for the other relevant parties and the estimation bias has risen as high as 30% for IYI which is a significant margin of error.

It should also be noted that this formula is for the new system and the results indicate the results for the system that was in place at the time of the 2018 election. Thus, the accuracy of the aggregation must be analyzed using the figure below.

	party	old_seats	2018_seats_new_system
0	AK	295	306
1	CHP	146	129
2	HDP	67	73
3	MHP	49	53
4	IYI	43	38

Figure 5: The calculation of the parliamentary seats if the new system was in place back in the 2018 elections.

Again, the estimation bias is smaller for the bigger parties and way higher for the relatively small parties as seen in the table below.

Table 2: The calculation of error in seat estimation for each party and each alliance in the 2018 Turkish General Election using poll aggregation.

*PARTY/**ALLIANCE***	*Estimation*	*Actual Result*	*Error*
AKP	318	306	+12, 3.77%
CHP	148	129	+19, 12.83%
HDP	35	73	-38, 108.57%
MHP	33	53	-20, 60.60%
IYI	68	38	+30, 44.11%
PEOPLE	**351**	**359**	**-8, 2.28%**
NATION	**216**	**167**	**+49, 22.68%**

For the 2023 Turkish General Election, the actual election results according to the official figures are announced as follows:

Table 3: The official results of the 2023 Turkish General Elections

PARTY	*VOTE*	*PERCENTAGE*	*SEATS*
AKP	19.387.412	35,61%	268
CHP	13.791.299	25,33%	169
MHP	5.484.515	10,07%	50
IYI	5.272.482	9,68%	43
YSP(HDP)	4.803.774	8,82%	61
YRP	1.529.119	2,81%	5
ZP	1.215.264	2,23%	0
TIP	940.230	1,73%	4
BBP	533.409	0,98%	0
MP	502.802	0,92%	0

Keeping the results in mind, the same procedure for the 2023 election yielded:

AKP	CHP	BBP	YRP	MHP	IYI	YSP	TIP	ZP	MP
35.651395	30.084261	0.151544	1.191011	8.098776	12.193467	9.681002	1.430683	1.517861	1.172365

Figure 6: Predicted 2023 results

Therefore, the estimated seats would be as follows:

$$s_{AKP} = 0.3565 * 600 + 0.3565 * \frac{87 * 7}{2} - \frac{87}{2} = 263$$

$$s_{CHP} = 0.3008 * 600 + 0.3008 * \frac{87 * 7}{2} - \frac{87}{2} = 215$$

$$s_{MHP} = 0.0809 * 600 + 0.0809 * \frac{87 * 7}{2} - \frac{87}{2} = 26$$

$$s_{YSP} = 0.0968 * 600 + 0.0968 * \frac{87 * 7}{2} - \frac{87}{2} = 40$$

$$s_{IYI} = 0.1219 * 600 + 0.1219 * \frac{87 * 7}{2} - \frac{87}{2} = 60$$

$$s_{YRP} = 0.0119 * 600 + 0.1219 * \frac{87 * 7}{2} - \frac{87}{2} = 0$$

$$s_{TIP} = 0.0143 * 600 + 0.1219 * \frac{87 * 7}{2} - \frac{87}{2} = 0$$[2]

Similar to the predictions for the 2018 elections, the prediction for AKP is almost perfect. However, this time the prediction for CHP has an 18% of bias. Again, the predictions for the smaller parties have quite high biases up to more than 100% for YRP. This should not come as a surprise as YRP is one of the newest parties and their potential voter bases are almost the same as AKP, their biggest ally. Therefore, it is reasonable to think that some voters were indifferent between voting for AKP and YRP and even higher percentages are probable.

Table 4: The calculation of error in seat estimation for each party and each alliance in the 2023 Turkish General Election using poll aggregation.

*PARTY/**ALLIANCE***	*Estimation*	*Actual Result*	*Error*
AKP	263	268	-5, 1.90%
CHP	215	169	+46, 21.39%
YSP	40	61	-21, 52.50%
MHP	26	50	-24, 92.30%
IYI	60	43	+17, 28.33%
YRP	0	5	-5, -
TIP	0	4	-4, -
PEOPLE	**289**	**323**	**-36, 12.46%**
NATION	**275**	**212**	**+63, 22.90%**
LABOUR & FREEDOM	**40**	**65**	**-25, 62.50%**

As a side note, we can safely say that the pollsters have the tendency to overestimate the parties in the Nation Alliance. This is an interesting finding

[2] The calculations for the Workers' Party of Turkey and the New Welfare Party are also included as those parties are publicly expected to gain parliamentary representatives even though their votes are expected to be way below the national threshold since they are part of a bigger alliance.

as sometimes it is said that pollsters sell hope to the opposition supporters. These findings, apparently, support the claim.

6.2 The Fundamental Model

Taking the results above as benchmarks, the next step towards building the final model is the fundamental model.

As described in 5.2, the predicted votes and corresponding predicted seats were determined as follows:

	party	2018_seats	predicted_2023_seats
0	AK	306	276
1	CHP	129	162
2	HDP	73	71
3	IYI	38	50
4	MHP	53	41
5	MPZP	0	0

Figure 7: The predicted seats for each party using the fundamental model.

Therefore, the table of errors looks as follows:

Table 5: The calculation of error in seat estimation for each party and each alliance in the 2023 Turkish General Election using the fundamental model.

*PARTY/**ALLIANCE***	*Estimation*	*Actual Result*	*Error*
AKP	276	268	+3, 1.08%
YRP	Included in AKP	5	-
YSP	71	61	+6, 8.45%
TIP	Included in YSP	4	-
IYI	50	43	+7, 14%
CHP	162	169	+-7, 4.32%
MHP	41	50	-9, 21.95%
PEOPLE	**317**	**323**	**-6, 1.89%**
NATION	**212**	**212**	**0, 0%**
LABOUR & FREEDOM	**71**	**65**	**+6, 8.45%**

Even though it is not crucial to the analysis, the predicted percentages are

```
party
AK      38.722519
CHP     27.092715
HDP     10.743961
IYI     11.400918
MHP      9.611389
MPZP     2.428498
Name: predicted_2023_votes, dtype: float64
```

Figure 8: The predicted percentages for each party using the fundamental model.[3]

As it is seen from Table 3, the fundamental model performs significantly better than the poll aggregation model despite the fact that it does not rely on any political surveys but rather considers only the possibility of some amount of change in votes in certain provinces according to overall characteristics of the people living in it.

The fundamental model also considers the existence of new voters and the possible voter turnout as it predicted 53,836,288 valid votes which is only 1.11% away from the actual result of 54,442,419 valid votes.

The overall outlook of every province in the country according to the fundamental model is:

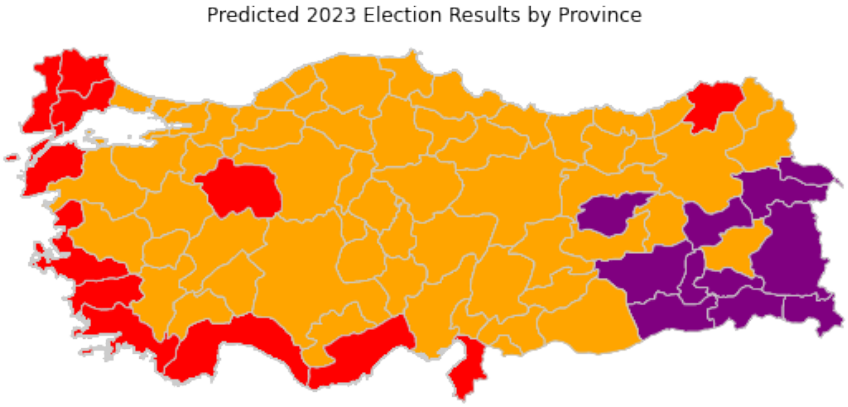

Figure 9: Turkey's map according to the leading parties in each province[4] (fundamental model's estimate)

[3] AKP's percentage also includes YRP, BBP and HÜDA-PAR's share, HDP's include all the parties in the Labor and Freedom Alliance, and MPZP is the sum of the percentages of both MP and ZP. This is a result of the fact that this election was the first election of those parties whose votes are difficult to estimate due to lack of historical data.

[4] Red: CHP, Orange: AKP, Purple: HDP

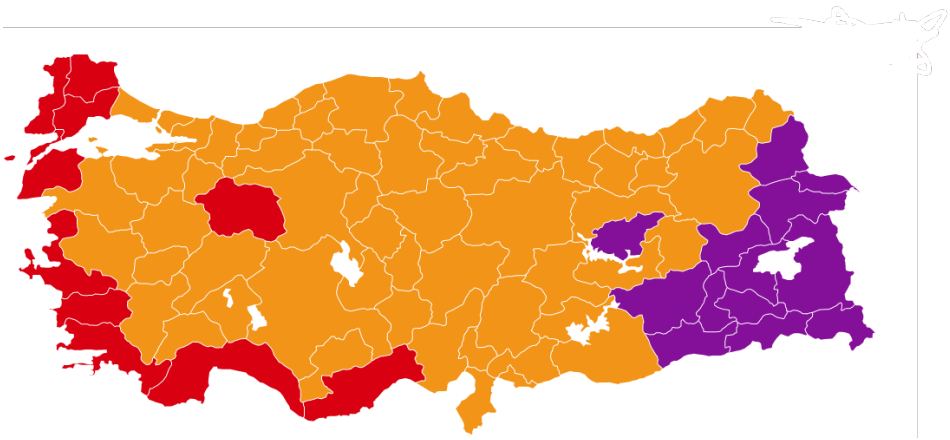

Figure 10: Turkey's map according to the leading parties in each province (official results)

The fundamental model failed to predict the leading party in 3 provinces: Artvin, Bitlis, and Hatay. The causes of the differences are explained as follows:

Artvin – It has the 13th highest opposition index (out of 81) at 0.687525 mainly driven by its highly educated population. It is uncommon for a dominantly AKP or MHP voting province to have high opposition index since those provinces are usually conservatives. The fundamental model predicted:

	party	province	votes_2018	percentage_2018	seats_2018	predicted_2023_votes	percentage_2023	predicted_2023_seats
73	CHP	Artvin	36969	32.72	1	48733.0	37.66	1
72	AK	Artvin	46760	41.38	1	45102.0	34.85	1
74	IYI	Artvin	11824	10.46	0	15116.0	11.68	0
75	MHP	Artvin	11772	10.42	0	10438.0	8.07	0
76	HDP	Artvin	5674	5.02	0	5674.0	4.38	0
78	MPZP	Artvin	0	0.00	0	4352.0	3.36	0

Figure 11: Predictions for Artvin

The real results show that most of the new opposition votes went to IYI instead of CHP as it is more sensible for a conservative province to vote for a right-wing party than a left-wing one. Moreover, it seems like the number of votes that AKP, IYI, and MHP received got predicted with very high accuracy, while the votes for CHP got predicted around 13,000 off target.

This shows that the number of total voters in Artvin was less than predicted as the total population declined which could not have been predicted.

Bitlis – The fundamental model predicted an AKP lead of 3900 votes. However, the official results demonstrate an HDP lead of 4300 votes. Considering that there were 177,784 valid votes in the province, the model was wrong only by 4% and that caused a change in the leader party in the province and also a representative difference.

	party	province	votes_2018	percentage_2018	seats_2018	predicted_2023_votes	percentage_2023	predicted_2023_seats
151	AK	Bitlis	73693	45.99	2	73733.0	46.05	2
153	HDP	Bitlis	69961	43.66	1	69802.0	43.60	1
154	IYI	Bitlis	5396	3.37	0	9867.0	6.16	0
152	MHP	Bitlis	6713	4.19	0	6714.0	4.19	0
147	MPZP	Bitlis	0	0.00	0	-6.0	-0.00	0
150	CHP	Bitlis	4488	2.80	0	0.0	0.00	0

Figure 12: Predictions for Bitlis

Hatay – First, it must be noted that Hatay was one of the provinces that got seriously affected by the earthquakes of the 6th of February 2023. Therefore, the behavior of voters in Hatay was extraordinarily difficult to foresee as it was already a swing province. The model predicted a CHP lead of around 20,000 votes while the results stated that AKP won by a 49,000 votes difference. Considering that there were around 900,000 valid votes, the model was wrong by around 7.5% which is not insignificant but quite expected as AKP is stronger than ever in the provinces in the earthquake region. This difference did not lead to any bigger problems as the number of MPs for every party was predicted perfectly.

	party	province	votes_2018	percentage_2018	seats_2018	predicted_2023_votes	percentage_2023	predicted_2023_seats
288	CHP	Hatay	287130	30.95	4	355876.0	34.94	4
287	AK	Hatay	340007	36.65	5	332784.0	32.67	4
289	MHP	Hatay	135679	14.63	1	129536.0	12.72	1
290	HDP	Hatay	103583	11.17	1	103583.0	10.17	1
291	IYI	Hatay	61303	6.61	0	74146.0	7.28	1
294	MPZP	Hatay	0	0.00	0	22691.0	2.23	0

Figure 13: Predictions for Hatay

7. Conclusion

In this thesis, the main aim was to build a model that predicts the results of 2023 Turkish General Election by predicting the number of parliamentary seats each party gains. Throughout the research, valuable insights into the accuracy and performance of different techniques were gained.

The polling data for the 2018 election served as the foundation for a model that was then applied to forecast the 2023 election. Then, a fundamental model that updates each party's votes from the previous election and returns the expected seats for them was constructed using a mix of datasets of socio-economic characteristics of the voters. The fundamental model outperforms the poll aggregation model since it is more accurate and consistent across all provinces. It is important to note that even though the results appeared to be satisfactory for this specific election, it may not be equally accurate for a different one and the model may be vulnerable to overfitting due to a lack of available data. In a country where demographics are significant in politics, it would not be a bad idea to use the relevant data to estimate the results of the elections. However, it is crucial to acknowledge the inherent limitations and uncertainties of the model.

By shedding light on the varying effectiveness of several predictive models for predicting parliamentary seats in the Turkish elections, the findings of this thesis provide an asset to the fields of political science and electoral forecasting. The fundamental model might be a useful resource for scholars, policymakers, and political analysts who are trying to make precise assumptions about the makeup of the Turkish Parliament.

In conclusion, the thesis found the fundamental model to be the most useful. However, further research on predictive models in the context of the Turkish election is still needed to more deeply understand the dynamics of the political landscape of Turkey to make more informed decisions for various stakeholders.

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