Exploring Benford's Law in the Context of Elections in Israel: Unveiling Insights and Analyzing Anomalies

Introduction:

Elections form the cornerstone of democratic processes, serving as a vital mechanism for the expression of citizen voices and the selection of representatives. In recent years, statistical analysis has emerged as a powerful tool for examining electoral data and uncovering potential irregularities or anomalies. One such statistical phenomenon is Benford's Law, which provides a unique lens through which to explore the distribution of leading digits in election data.

The relationship between Benford's Law and elections in Israel presents an intriguing avenue for investigation. Israel, with its vibrant democracy and complex electoral system, offers a fertile ground for studying the application of this mathematical principle. By examining the distribution of leading digits in vote counts, voter turnout, or other relevant electoral metrics, we can gain insights into the authenticity, integrity, and fairness of the electoral process.

The fundamental premise of Benford's Law, asserting that certain leading digits appear more frequently than others in naturally occurring datasets, raises intriguing questions in the context of elections. Does the distribution of leading digits in Israeli election data conform to Benford's Law? If so, to what extent? And what insights can be gleaned from deviations or anomalies in the observed distribution?

This project aims to explore the relationship between Benford's Law and elections in Israel, with a specific focus on the 25th Knesset general elections. By analyzing real datasets and simulating variations based on known ward divisions and assumptions, we seek to uncover potential deviations from Benford's Law and evaluate their significance. Through statistical analysis and data visualization, we aim to identify patterns, detect irregularities, and gain a deeper understanding of the electoral process.

The implications of this research extend beyond the realm of elections in Israel. By studying the application of Benford's Law in the electoral context, we contribute to the broader field of electoral integrity and data analysis. The insights gained from this project may inform future investigations, enhance fraud detection mechanisms, and contribute to the refinement of electoral practices.

In the following sections, we will outline the methodology, data sources, and analysis techniques employed to explore the relationship between Benford's Law and the elections in Israel. Through this research, we endeavor to shed light on the hidden patterns and potential anomalies in the electoral data, fostering transparency, accountability, and trust in democratic processes.

Introduction to Benford’s Law:

Benford's Law, also known as the first-digit law or the law of anomalous numbers, is an intriguing mathematical principle that describes the distribution of leading digits in many naturally occurring datasets. It states that the probability of a number having a specific leading digit is not uniform, contrary to what our intuition might suggest. Instead, certain leading digits appear more frequently than others, following a predictable pattern.

Named after the American physicist and astronomer Frank Benford, who first articulated the law in 1938, Benford's Law has found application in various fields, including finance, economics, forensic accounting, and data analysis. What makes it particularly fascinating is its ability to unveil hidden patterns and uncover anomalies in datasets.

According to Benford's Law, the digit "1" tends to be the most common leading digit, appearing approximately 30.1% of the time, while the digit "9" occurs only about 4.6% of the time. The frequencies of the other digits gradually decrease in a logarithmic fashion: "2" appears around 17.6% of the time, "3" around 12.5%, and so forth, creating a predictable distribution.

While initially observed in naturally occurring datasets, Benford's Law has also been found to hold true in diverse sets of numbers, including populations of cities, financial transactions, mathematical constants, and even numbers listed in books. This empirical observation has led to its application as a powerful tool for fraud detection, error identification, and quality control.

It is important to note that Benford's Law is not a universal rule that applies to every dataset. Certain contrived or artificial datasets may deviate significantly from the expected distribution. However, in large and diverse datasets reflecting real-world phenomena, Benford's Law tends to hold remarkably well, making it a valuable tool for data analysis and anomaly detection.

By understanding and applying Benford's Law, researchers, auditors, and data analysts can gain insights into the authenticity, integrity, and reliability of datasets. It serves as a reminder that numbers in our world are not always as randomly distributed as they may initially appear, opening up new avenues for exploration and uncovering hidden patterns in the data that surrounds us.

Background about Israel elections and procedures:

Elections in Israel are based on nationwide proportional representation. The electoral threshold is currently set at 3.25%, with the number of seats a party receives in the Knesset being proportional to the number of votes it receives. The Knesset is elected for a four-year term, although most governments have not served a full term and early elections are a frequent occurrence. Israel has a multi-party system based on coalition governments as no party has ever won a majority of seats in a national election, although the Alignment briefly held a majority following its formation by an alliance of several different parties prior to the 1969 elections. Suffrage is universal to all Israeli citizens above the age of 18. Israeli citizens living abroad must travel to Israel in order to vote. Voting booths are made available on Israeli ships. Elections are overseen by the Central Elections Committee and are held according to the Knesset Elections Law.

Under normal circumstances, Israel's Basic Law requires national elections for the Knesset to take place on a Tuesday in the Jewish month of Cheshvan (early October through mid-November) four years following the previous elections. However, it is possible, and it often happens, that early elections can take place prior to the date set in the basic law. Early elections can be called by a vote of the majority of Knesset members, or by an edict of the President, and normally occur on occasions of political stalemate and of the inability of the government to get the parliament's support for its policies. Failure to get the annual budget bill approved by the Knesset by March 31 (3 months after the start of the fiscal year) also leads automatically to early elections. It is also possible to postpone the date of the election by a special majority of the Knesset members.

Israel uses the closed-list method of party-list proportional representation; thus, citizens vote for their preferred party and not for any individual candidates. The 120 seats in the Knesset are then assigned proportionally to each party, provided that the party vote count met the 3.25% electoral threshold. The D'Hondt (also known as Jefferson method) method is used for marginal votes, slightly favoring the bigger parties. Parties may form electoral alliances and run as a single unified party to gain enough collective votes to meet the threshold (if so, the alliance *must* meet the threshold, not the individual parties) and thus be allocated seats. The relatively low threshold makes representation of minor parties more likely under the Israeli electoral system than many comparable systems used in other countries. Two parties can make an agreement so that both parties' sum of surplus votes is combined, and if the combined surplus votes amount to an extra seat, the extra seat goes to the party with the greater number of surplus votes.

Israel's voting method is simplified by the fact that voters vote for a political party and not specific candidates in a closed list system.

On election day, and upon entry to a polling station, the voter is given an official envelope, and shown to a voting booth.

Inside the booth is a tray of slips, one for each party. The slips are printed with the "ballot letters" of the party (between one and three Hebrew or Arabic letters), and the full official name of the party in small print. Each party publicizes their letters prior to election day, with most election posters featuring them. As many political parties in Israel are known by their acronyms, several parties can spell out their name in two or three letters, and thus use their name as their ballot letters (e. g., Meretz and Hetz).

The voter chooses the relevant slip for their party, puts it in the envelope, seals it, and then places the envelope into the ballot box. The system is simple to use for those with limited literacy. This is especially important in Israel where many new immigrants struggle with the language. Each party must register its chosen letters with the Israeli Central Elections Committee, and certain letters are reserved. If a new party wishes to use letters from an older party, it must receive permission from that party. Example of reserved letters are מחל for Likud and שס for Shas.

Voting is by paper ballot and votes are counted manually before being entered into a computer system which is not connected to the Internet. Israel does not employ electronic voting due to fears that elections could be vulnerable to cyber threats from those trying to influence the results.

Our methodology:  
  
The election simulator considers various factors, including the number of people who voted, the votes included, and the cancelled votes, to accurately calculate the distribution of votes based on the percentages observed in the real dataset. By simulating the election process, we aim to explore the potential implications of these factors on the final outcomes and identify any irregularities or deviations from the expected distribution.

Methodology:

1. Data Input: The simulator consumes real data collected from past elections in Israel. This includes information about different wards, the total number of people who voted in each ward, the votes included in the count, and the number of cancelled votes.
2. Vote Calculation: Based on the real data, the simulator calculates the votes for each candidate or political party in each ward. It considers the percentages observed in the real dataset to determine the distribution of votes among the candidates or parties.
3. Simulation: The simulator generates synthetic data by applying the calculated vote distribution to simulate the election outcomes. It accounts for the number of eligible voters in each ward and uses the calculated percentages to distribute the votes among the candidates or parties.
4. Analysis and Visualization: The simulator provides visualizations of the simulated vote counts, allowing for a comparative analysis between the real data and the simulated outcomes. This enables the identification of any deviations or irregularities in the distribution of votes.

Bibliography:

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