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RESEARCH ARTICLE

EFFECTIVENESS OF MATHEMATICS IN THE ELECTORAL SYSTEM: AN ANALYSIS

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Abstract

Mathematics studies numbers and quantities, space, structure, patterns and mathematics involves quantitative calculation and logical reasoning to explore patterns, formulate ideas and it establishes truth through deduction. Mathematics is important in the fields namely engineering, science, medicine, and finance. Electoral System is used in politics to elect a government and it is a set of rules used to determine the outcom es of an election. Generally, the common categorizations of electoral sy stem are single winner vs. multi winner system, proportional representa tion vs. winner take all systems vs. mixed systems. The aim of the pres ent study is to analyse the effectiveness of Mathematics in the electoral system.

Introduction:-

Mathematics plays a key role in Electoral System. Mathematics helps in forming electoral methods, analyzing data, and predicting results. electoral systems can be classified into three main families namely majoritarian, proportional and mixed. The key features of electoral system are electoral formula, district magnitude, ballot structure, electoral thresholds, other procedural features,etc. Mathematics plays a vital role in the analysis, design and evaluation of electoral system. It is important in the electoral system because it provides the theoretical foundations as well as practical tools needed to design, analyze and protect fair elections. mathematical principles are important for auditing elections and protecting sensitive data.

Objectives:-

- To understand the importance of mathematics in voting system.
- To analyze the effectiveness of mathematics in the electoral systems

Methodology:-

The current literature review related to mathematics and the Electoral System. The descriptive method has been applied to conduct the present study. Data have been collected from secondary sources namely books, articles, research papers and other existing literature.

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What is mathematics :

Mathematics is the study of numbers, patterns, shapes and logical reasoning. It is one of the most important fields in human knowledge. From the beginning of civilization mathematics has been used to count things, calculate time, measure land etc. Today, mathematics has grown into a very vast subject, it helps to know the real world and abstract ideas. Mathematics has so many branches like geometry, algebra, arithmetic, trigonometry, probability etc. In short, mathematics is more than numbers . It helps to sharpen the mind, increase logical ability , develop reasoning and that is why mathematics is called the "queen of all sciences".

Relationship Between Electoral System and Mathematics in Contemporary Areas:

The study of elections is not only a part of politics but also closely connected with Mathematics. Nowadays Mathematics is used as a tool to make elections transparent, fair and logical. The relationship between Mathematics and electoral system is very important because it helps in understanding voting methods, predict outcomes and reduce injustices.

- **Mathematics in Design, Analysis and Evaluation of Electoral System:**

Using Mathematics is very important in design, analysis and evaluation of electoral systems. Different countries use different systems of voting. Each of these system is based on Mathematics to count votes and declare results . With the help of Mathematics it is easy to explain how the system work and what outcomes it can produce.Mathematics is also used in prediction and analysis. Branches of Mathematics such as statistical models and Probability help media and researchers to predict the results even before the counting the votes or the conduct of the election. Also survey, opinion polls etc. give a very close idea that where people are more interested to give their valuable vote. Evaluation in electoral system means determining the good and bad sides of the system. Mathematics helps to inquiry questions like

- Do all parties get seats according to their votes?
- Is the system fair to majority of people?
- Can the system give trusted results?

By using statistics, data analysis and computer models, Mathematics helps to conclude the system is fair and useful or not.

- **Designing Different Voting Methods:**

Mathematics is used in designing different voting methods. Different countries use different voting methods.

- **First-Past-the-Post (FPTP):** India, UK use this method in elections. In this method, the candidate who gets the highest votes wins, no matter whether that candidate has received votes above the half. FPTP method is very simple to design and understand , however, candidates can win without receiving more than half of the votes.
- **Proportional Representation (PR):** Germany and other European countries use this method. In this method, seats are given to political parties in according to the amount of votes received. Mathematics is applied in the system of dividing the seats to be distributed by either the Quota method or the Divisor Method.
- **Ranked- Choice Voting (RCV):** In this method of voting, the choice of the candidate is placed on a chosen list and are ordered for preference from first to last and the candidate is voted either to stand or be removed. When no candidate gets a majority, the candidate with the fewest votes is eliminated, and their votes are reassigned to the remaining candidates.

- **Analysis Gerrymandering:**

Gerrymandering means drawing the boundaries of voter areas. It helps to prevent unfair way to give more advantage to one party. Mathematics is very useful in analysing and learning gerrymandering.

- **Using Geometry:** Mathematics is used to determine the shape of a district. If a district has a very unusual shape, it may be a sign of gerrymandering. A fair district usually has a simple and compact shape.i.e, more compact = more fair.
- **Using Statistics:** Statistical methods are used to compare votes and seats. Vote seat comparison, efficiency gap, mean-median test, simulation method are the main parts in Statistical methods.
- **Using Graph Theory:** Graph theory is mainly used to show the map for various district. It helps to connect populations.

- **Predicting Voter Behaviour and Outcomes:**

With the help of Mathematics, researcher and the media can predict the election results even before the counting. It includes historical data, surveys and mathematical models.

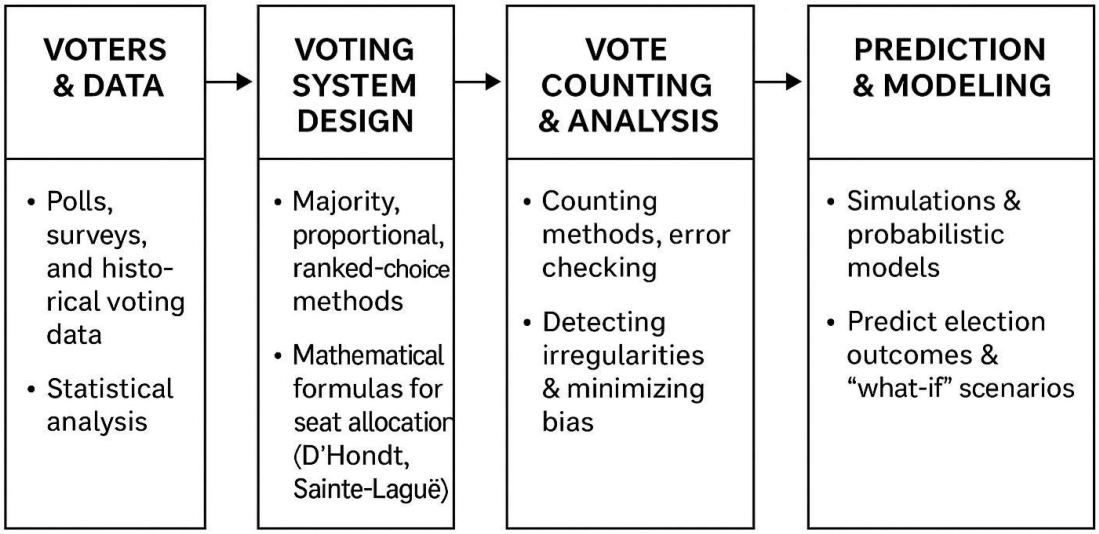
- **Opinion Polls and Surveys:** Opinion poll is the fast method to know what people thinking about upcoming election. In this method research ask a small group of people about their choice of voting and it shows which party might win. Survey is slow method. It refers collected information from people. Government can conduct surveys to know how many people are satisfied with education, healthcare or the other schemes provided by the government.
- **Predictive Models:** Regression analysis, machine learning and Bayesian statistics are the main techniques in predictive models. It helps to predict results based on various factors like economy, candidate popularity etc. If economic growth is low, establishment is low then votes may shift against the ruling party.
- **Simulation of Electoral System:** Simulation means an experiment to see how something will work in real life. In election simulation of electoral system is used to predict results, test voting methods before the real election conduct. Collect data, build a model, test with different voting methods, compare results, make analysis are the major parts of this method.

- **Principles of Mathematics in Voting System:**

Mathematics plays a main part in presenting fair and effective voting system. Counting Methods, fairness, representation and probability are the main principles in voting system.

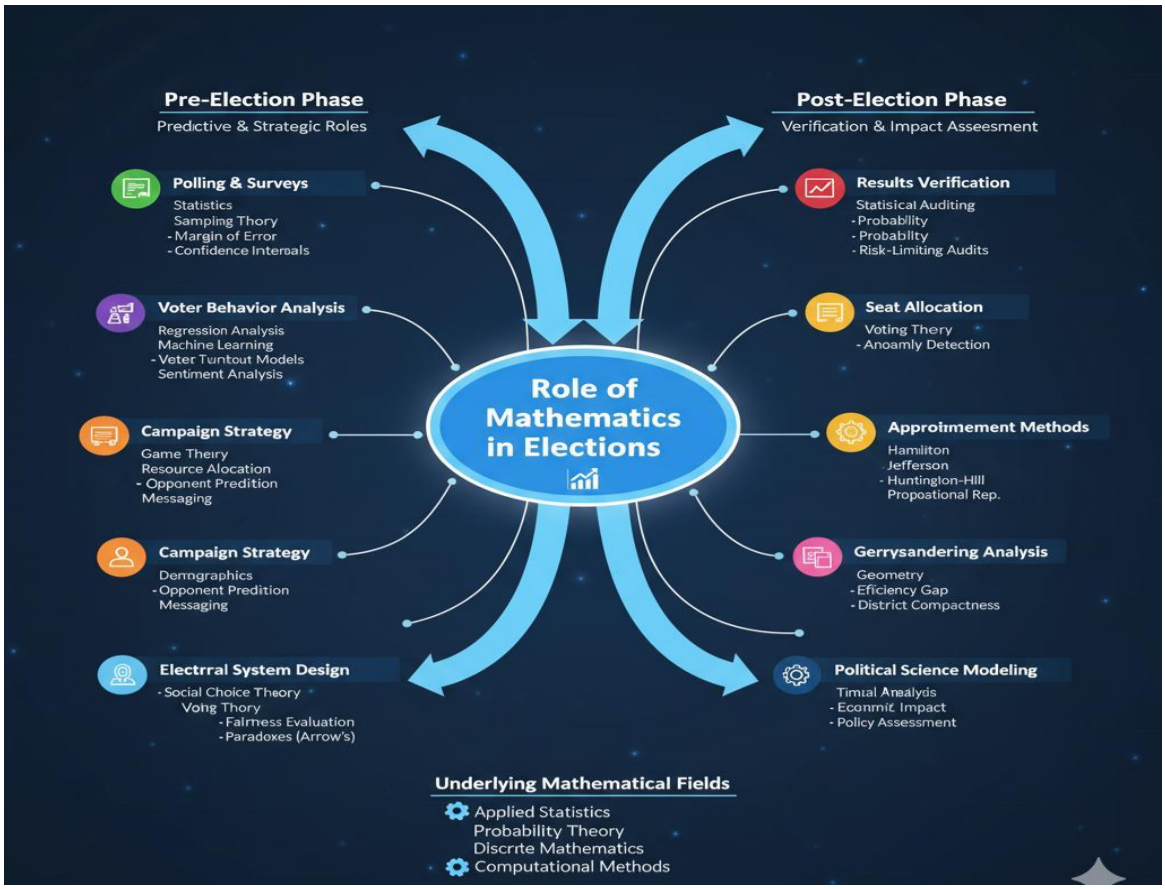
- **Majority Rule:** It is the simplest principle that says the candidate who recieves more than half of the votes will win. Mathematics assure that the counting process is correct and transparent.
- **Ranking and Preferences Voting:** In this method, voters rank their candidates in order of their preferences. The Instant Runoff Voting (IRV) or Borda Count System are used arithmetic to calculate winners based on their ranking. Mathematics ensures that the most supported candidate wins, not that one who get most first choice votes.
- **Probability and Statistical Analysis:** Using probability election result can be predicted which handle uncertainty. Statistical analysis like polling data, historical trends, voter turnout helps to predict the result.

Applications of Mathematics in the Electoral System:



Role of Mathematics in the Pre and Post Elections:

Effectizeness:



Mathematics makes election system more fair and transparent. It helps in several ways:

- **Improving Fairness:** There are various mathematical models like proportional representation formulae , ranked choice methods that reduce the chance of unfair outcomes.
- **Predicting Outcomes:** Probabilistic and statistical methods can help political analysts, parties and the public to understand possible outcomes. Polls, historical data and demographic data are the main models of predicting Outcomes.
- **Designing Voting Methods:** Various voting methods like ranked choice or mixed systems can be tested mathematically for fairness, transparent and voter satisfaction.
- **Decision-Making and Policy Planning:** Governments and policymakers can use mathematical models to design better electoral rules, or plan strategically.

Shortcomings:

- **Simplifying complex behaviour:** As voter behaviour is affected by culture, emotions, and social factors, so mathematical methods cannot fully connected with human psychology.
- **Dependence on Data Quality:** As mathematical models depends on polls, surveys and historical data, so inaccurate data can be give on to a wrong prediction.
- **Complexity:** Simulations or game theory models are the advanced mathematical models that can be too complicated for practical use.
- **Predictive Limitations:** Some offensive behavior, sudden voter mobilization can make predictions inaccurate.

Conclusion:-

In conclusion, mathematics plays a vital role in electoral system by making elections fair and transparent. Using mathematical models we can design various voting systems, analyze voting patterns, predict the result and also can

study about gerrymandering. Probability, statistics, game theory, graph theory are the branches of mathematics. With the help of these election system can be more fair and transparent.

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