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A Larger Section of Literature on Social and Political Sciences Involves Mathematical Modeling and Analysis

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Abstract

The objective of this Paper is to remove this obstruction by introducing elementary concepts of mathematics and statistics mainly used in social and political sciences. It impedes readers like students, researchers, and policymakers with non-mathematical backgrounds from a simple understanding of related literature. Rigorous mathematics is avoided for the convenience of readers of this book. The last chapter of this book are the applications of mathematics and statistics in political science, sociology and psychology. Books and research papers referred to in the bibliography would help readers to go deeper into the subject.

Keywords - Mathematical Modeling, Bibliography, Interpretive, Qualitative Etc.

Introduction-

Social and political sciences are not mathematical like physical science and engineering. They deal with human behavior that is generally non-quantifiable and subjective. Often statistical methods are applied to analyze data, identify patterns, and test hypotheses. Those applications are primarily interpretive and qualitative. The main areas in social science are sociology, psychology, and economics. Political science is a specific branch within the broader field of social science. Among them, economics uses intensive mathematical models to forecast market trends and analyze economic data. Also, there has been an increasing use of mathematics in sociology, political science, and psychology.

But there are opposite arguments. The main mathematical and non-mathematical debate in social science is that mathematical models in these fields often oversimplify reality, failing to account for factors like cultural norms, emotions, and complex, shifting social conditions. In spite of these criticisms, a growing trend is observed driven by the need for greater precision, the availability of big data, and the complexity of modern social Functions are often represented by graphs and diagrams because they provide a visual and intuitive way to understand the relationship between input and output values. Graphs use a coordinate plane to plot points, with the horizontal axis usually representing the input and the vertical axis representing the output. Diagrams like flowcharts or Venn diagrams can also show relationships and how elements are mapped in a function.Graphs and diagrams make complex relationships easier to see and understand at a glance. They provide a compact way to display a large

number of input-output pairs. Also, they make it easier to compare different functions or different points within the same function.

A flowchart (or flow diagram) for a mathematical function f(x) maps an input value (x) through a series of operations to produce an output value (y or f(x)). A flowchart uses oval shapes to indicate start and end, parallelograms for input (x) and output (y), rectangles for processing steps (e.g., arithmetic operations), and diamond shapes for decisions (e.g., whether the value of x is positive or negative).

Research Methodlogy-

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Result and Discussion-

Statistical inference is the process of using data from a sample to make educated guesses, predictions, or conclusions (inferences) about a larger population,Statistical inference is widely used in applied sciences to move beyond mere description of observed data and draw general conclusions about the causes, dynamics, and potential outcomes. Researchers use various methods to analyze large-scale datasets, test hypotheses, and estimate model parameters.

allowing researchers to understand broader trends without studying everyone, using techniques like hypothesis testing and confidence intervals to quantify uncertainty and draw reliable generalizations. It is fundamental in science, business, and social studies, turning limited data into actionable insights about the whole. Common techniques for statistical inference are:

Hypothesis testing-

Formal procedures (like Z-tests, T-tests, ANOVA) to decide if sample results support rejecting a null hypothesis (no effect/difference) or if they likely occurred by chance.

Markov Process-

While a generic "Markov process" is a stochastic model (describing randomness), the inclusion of decisions makes it a direct tool for optimization. Markov processes, specifically Markov decision processes, are a fundamental part of optimization, particularly in sequential decision-making under uncertainty.A Markov process is a random process indexed by time and with the property that the future is independent of the past, given the present. More precisely, it may be stated that a Markov process is a stochastic model describing a sequence of random events where the future state depends solely on the present state, independent of the past. Known as the **Markov property** or memory-lessness, it enables modeling complex systems using only current information. These processes are widely used to analyze time-dependent, probabilistic behaviors.Key aspects of Markov processes are-

State Space: The set of all possible states (discrete or continuous) the process can occupy.

Markov Property-

The probability of transitioning to a future state depends only on the current state not the sequence of events that preceded it. Political science is the study of government systems and political behavior, encompassing areas like political theory, comparative politics, and international relations.[1]

It aims to understand power dynamics, policy-making, and societal decision-making processes. Methodologies include empirical approaches like case studies and statistical analysis. Additionally, mathematical models such as game theory, spatial models, and voting models are used to analyze political behavior and predict outcomes. Key applications involve understanding

Conclusion-

Mathematics and statistics are becoming essential in social and political science for modeling human behavior, analyzing data, and predicting trends. Key applications include modeling conflict and coalitions, policy evaluation, optimal control in governance, modeling social trends, and so on. The quantitative methods have transformed social and political sciences by bringing in rigorous validation, enabling studies that move beyond qualitative analysis to accurate, data-driven understanding of societal

processes.Psychology is the scientific study of the mind and behavior, exploring how thoughts, feelings, and motives influence human and animal actions. It combines biological and social science perspectives to understand conscious and unconscious phenomena, examining both individual brain functions and group behavior. Its objective is to describe, explain, predict, and influence behavior to better understand the human experience and improve quality of life.

Mathematical applications in psychology, often termed mathematical or quantitative psychology, use formal models, statistics, and probability to quantify behavior, perception, and cognition. It transforms theories into testable mathematical expressions, bridging the gap between abstract thought and empirical data. Key applications include modeling learning processes, measuring sensory perception (psychophysics), and creating diagnostic tests.

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