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Journal of Research in Educational Sciences

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The Journal is designed to promote scholars' thought in the field of education with the clear mission to provide an interdisciplinary forum for discussion and debate about education's most vital issues. We intend to publish papers that contribute to the expanding boundaries of knowledge in education and focus on research, theory, current issues and applied practice in this area.

The Editor in Chief would like to invite submissions for the **Volume XV, Issue 2(18), Winter 2024** of the **Journal of Research in Educational Sciences** (JRES).

The primary aim of the Journal has been and remains the provision of a forum for the dissemination of a variety of international issues, empirical research and other matters of interest to researchers and practitioners in a diversity of subject areas linked to the broad theme of educational sciences.

The aims and scope of the Journal includes, but is not limited to; the following major topics as they relate to the Educational Sciences:

- Educational Psychology;
- Engagement and Community;
- Leadership in Education;
- School Improvement;
- Human Resources in Education;
- Education and Information Science;
- Global strategies in Higher Education;
- Learner's Needs in the 21st Century;
- The Role of Education in The Globalization World;
- Technology-Based Learning.

All papers will first be considered by the Editors for general relevance, originality and significance. If accepted for review, papers will then be subject to double blind peer review.

Statistics in Social Sciences

Laura UNGUREANU
Spiru Haret University, Romania
laura.ungureanu@spiruharet.ro

Abstract: This work is the result of some research and documentation of the theoretical problems of statistics and its applications in the study of phenomena and processes in nature and society. Statistics has applications in the most diverse fields, such as: medicine, natural sciences, economics, politics, human behavior sciences, etc. Practically, in any field of human existence we witness operations of gathering, systematizing and interpreting information. That is why its role is very important. Therefore, this paper reviews some statistical methods that are used in social sciences. The focus is mainly on the applied aspect of the techniques and the author give insights about techniques that can be used to answer problems in the abovementioned areas of research.
The article focuses on detailed explanations in the presentation of the consequences of the application of statistical procedures in the social sciences.

Introduction

Today we are dealing with statistics viewed as a resource, with statistics of sciences and fields of activity, in the sense that it has become omnipresent in every phase of our lives. Whether we like it or not, whether we are aware of it or not, we are dealing with statistical data, with the need for quantitative knowledge whenever the results of an experiment vary in an unforeseen or "random" manner ". A. Wald's prediction that "one day statistics will become as necessary for man as writing and reading" has become a reality.

Contemporary civilization cannot be imagined without numerical data because quantitative expression has become a necessity in all fields of knowledge. The practical needs related to the expression and transformation of social life determined the emergence and evolution of statistics.

Unlike the ancients who were satisfied with incomplete and occasional records and censuses made for administrative, military and financial purposes, nowadays we want permanent information in all fields.

Social science is one of the branches of science, devoted to the study of societies and the relationships among individuals within those societies. The term was formerly used to refer to the field of sociology, the original "science of society", established in the 18th century. In addition to sociology, it now encompasses a wide array of academic disciplines, including anthropology, archaeology, economics, human geography, linguistics, management science, communication science, psychology and political science (*"Social science: History, Disciplines, Future Development, and Facts". Britannica. April 27, 2023*)

Statistics play a crucial role in the social sciences for several reasons. Firstly, they allow researchers to make sense of large amounts of data and draw meaningful conclusions. Whether it's analyzing survey responses, economic trends, or demographic data, statistics help researchers identify patterns and relationships within complex social phenomena.

Secondly, statistics provide a way to test hypotheses and theories in the social sciences. By applying statistical methods, researchers can determine the likelihood that their findings are due to chance or if they reflect real relationships in the data. This helps ensure the validity and reliability of research findings.

Moreover, statistics allow for generalization. By collecting data from a sample of a population and using statistical techniques, researchers can make inferences about the entire population. This is particularly important in fields like sociology, where it's often impractical or impossible to study every individual in a population.

Additionally, statistics help policymakers and practitioners in the social sciences make informed decisions. Whether it's designing social programs, crafting public policy, or evaluating the effectiveness of interventions, statistics provide valuable insights into social issues and help guide decision-making processes.

Also, it is known that the majority of those who want to understand the human psyche do not show a special sympathy for numbers, formulas and calculation algorithms. However, today, statistics play an important role in psychology. Therefore, Statistics is also indispensable in psychology, contributing to the validation of theories, the improvement of clinical practices and the advancement of scientific knowledge. By using statistical methods, psychologists can ensure that their conclusions are based on solid evidence and can trust the results obtained from their research.

This is also valid in the use of statistics in law.

The scientific approach that we must use whenever we carry out a serious and valid study in the social sciences is a strictly staged process, which refers to (Dowdy et al. 2004):

1. Problem formulation;
2. Formulation of hypotheses;
3. Research design;
4. Carrying out observations;
5. Data interpretation;
6. Formulation of conclusions.

The success of the research can be appreciated by the correctness of the conclusions and by deepening the knowledge of the data recorded based on the indicators resulting from the statistical processing. If the assessments made on the basis of the research are inconsistent, the obvious nature of the studied group means that important errors have occurred.

In general, in the real world and in the economy in particular, no sequence of events is repeatable at the same level of manifestation, therefore probabilistic models are much more suitable for modelling phenomena in nature and society.

Deterministic models imply the possibility of making error-free predictions about the future states of a system, based only on the knowledge of previous states, which does not constitute a relevant scheme of the mechanism of human knowledge. Therefore, any conclusion and decision made following the application of the statistical method is a probabilistic and not certain decision.

Overall, statistics serve as a powerful tool for understanding, analysing, and addressing complex social phenomena, making them indispensable in the social sciences.

1. Literature Review

The multitude of fields in which statistics are applied allowed M.G. Kendall (1953) to say that "Statistics, in the broadest sense, is the matrix of any experimental science".

Statistics studies pressing problems from across the social sciences: economics, policy, and quantitative finance; the census, official statistics, and demography; political science and election integrity and security; sociology, social network analysis, and computational social science; and education and psychometrics. Thus, Petros Maravelakis (2019) reviews some of the statistical methods used in the field of social sciences, and Hesse and Ofosu (2017) presents many applications of statistics in engineering and social sciences.

The fact that statistics represent the scientific foundation of disciplines such as psychology, sociology, anthropology, econometrics and many others has been emphasized by Opariuc-Dan since 2009.

A literature review on the use of statistics in economics highlights the crucial role that statistical methods play in economic research and policy analysis. Methods such as regression analysis, time series analysis, and panel data analysis are widely used to understand relationships between economic variables and to forecast future trends (Samila, S., and Sorenson, O. 2011)

The application of statistics in psychology is a critical aspect of research, enabling psychologists to analyze data, validate hypotheses, and draw meaningful conclusions. Olsson-Collentine et al. (2019) explores the multifaceted use of statistics in psychology, highlighting its importance in various research methodologies and the development of psychological theories. Descriptive statistics allow psychologists to summarize data related to human performance, happiness, and other metrics (Nitsch, J. R., and Hackfort, 2016).

Quantitative methods in various subfields, from psychology to economics, are under demand for constant development and refinement in *Statistics in the Social Sciences: Current Methodological Developments* (2010), volume focused on fostering collaboration among mathematical statisticians and social science researchers.

Recent articles on the use of statistics in the social sciences have highlighted several important trends and methodologies.

Multilevel Modelling and Categorical Data is one key area of focus is multilevel modelling, which is used to analyze data involving nested structures, such as students within schools. This approach helps in understanding the effects of both individual and group-level variables. Categorical data analysis, including logistic regression and log-linear models, is also vital. These methods are crucial for dealing with variables that fall into discrete categories, such as survey responses categorized by demographic groups. For example, Jessica M E Herzing et al. (2024) demonstrates how an alternative parametrization of the random components in multilevel models, so-called separate coding, delivers valuable insights into differential interviewer effects for specific groups of sample members.

Time series analysis is another significant method, particularly in fields like economics and marketing. Techniques such as autoregressive models (AR), moving average models (MA), and their combinations (ARMA and ARIMA) are commonly used to analyze data collected over time. These models help in understanding patterns and making forecasts based on historical data. With the growing availability of multi-wave surveys, social scientists are turning to latent trend models to examine changes in social and political attitudes. Kołczyńska and Bürkner (2024) propose a framework for estimating trends in public opinion consisting of three components: the measurement model that links the observed survey responses to the latent attitude, the latent trend model that estimates a trajectory based on aggregated individual latent scores, and representativeness adjustments.

The increasing availability of large datasets has led to the adoption of data mining and machine learning techniques in social sciences. These methods, derived from statistics and artificial intelligence, are used to uncover patterns and make predictive analyses. This is especially important in handling large-scale social phenomena and deriving insights from complex data sets. For exemple, numerous researchers have developed different algorithms for automated occupation coding. Schierholz and Schonlau (2021) demonstrate the best results are obtained by merging the list of job titles with coded answers from previous surveys before using this combined training data for statistical learning.

Recent advancements also emphasize the importance of causal inference in understanding relationships between variables. Techniques like nonparametric estimation and dynamic graphics for statistics are being utilized to improve the robustness of statistical tests and the interpretation of high-dimensional data. This is crucial for making accurate inferences in complex social systems.

The integration of various data sources, including administrative, commercial, and digital trace data, is becoming more prevalent. This integration allows for more comprehensive analyses and the ability to address new research questions that were previously infeasible due to data limitations.

These advancements underscore the dynamic nature of statistical applications in social sciences, highlighting the continuous evolution of methodologies to address complex and large-scale data challenges.

2. Statistics in Sociology

Sociology deals with studying various social phenomena such as inequality, social mobility, and cultural norms. Statistics provide a way to quantify and measure these phenomena, allowing sociologists to describe and analyze them systematically.

Sociologists often formulate hypotheses about social relationships, behaviour, or the effects of certain variables. Statistics allow them to test these hypotheses rigorously using empirical data, determining whether their hypotheses are supported or refuted.

Sociologists use statistical analysis to identify patterns and trends in social data. This could include trends in marriage rates, crime rates, educational attainment, or income distribution. By understanding these patterns, sociologists can gain insights into societal changes and dynamics.

Also, sociologists frequently engage in comparative studies to understand how societies differ or are similar. Statistics enable them to compare social indicators across different groups, regions, or time periods, providing valuable insights into social structures and processes.

Sociology often deals with studying large populations. Statistics provide methods for sampling from these populations in a way that ensures representativeness and generalizability of findings. This allows sociologists to draw conclusions about entire populations based on data from a subset.

Statistics play a crucial role in evaluating social policies and programs. Sociologists use statistical methods to assess the impact of policies on various social outcomes, such as poverty rates, crime rates, or educational attainment. This information helps policymakers make informed decisions about policy design and implementation. In some cases, sociologists use statistical techniques for predictive modelling, forecasting future social trends or outcomes based on historical data and current trends.

In summary, statistics are indispensable in sociology for studying, analysing, and understanding the complexities of social life, as well as informing policy decisions and interventions aimed at addressing social issues.

2.1 Study Case. The study of Income Inequality in a Society

One example of the use of statistics in sociology is in the study of income inequality within a society.

Let's say a sociologist wants to investigate the level of income inequality in a particular country. Here's how statistics would be used in this study:

- **Data Collection**: The sociologist would collect data on income from a representative sample of individuals or households within the country. This could involve surveying a random sample of the population or using data from government sources such as tax records or household surveys.
- **Descriptive Statistics**: Descriptive statistics would be used to summarize the distribution of income in the sample. Measures such as the mean (average) income, median (middle) income, and measures of dispersion like the Gini coefficient could be calculated to describe the level of inequality.
- **Comparative Analysis**: Statistics allow sociologists to compare income levels and inequality across different demographic groups, such as gender, race, age, education level, or geographic region. This comparative analysis can reveal disparities in income distribution and highlight patterns of inequality within society.
- **Trend Analysis**: Sociologists can use statistical techniques to analyze changes in income inequality over time. By comparing data from different time periods, they can identify trends, such as whether inequality is increasing or decreasing, and understand the factors driving these changes.
- **Multivariate Analysis**: To understand the factors contributing to income inequality, sociologists may conduct multivariate analysis using regression techniques. This involves examining the relationship between income and various demographic, social, and economic variables, such as education, occupation, marital status, or industry sector.
- **Spatial Analysis**: Statistics can also be used to analyze spatial patterns of income inequality within a country. Geographic information systems (GIS) and spatial statistical techniques allow sociologists to map income distribution and identify areas with high levels of inequality or poverty concentration.
- **Policy Evaluation**: Sociologists may use statistics to evaluate the effectiveness of policies aimed at reducing income inequality, such as minimum wage laws, social welfare programs, or progressive taxation. Statistical methods help assess the impact of these policies on income distribution and social outcomes.
- **Reporting Findings**: The results of the study, including statistical analyses, charts, and tables, would be reported in a research paper or report. This allows other researchers, policymakers, and the public to understand the extent of income inequality and its implications for society.
- The share in poverty in any country depends on two factors: the average level of income and the level of inequality.

The EU statistics on income and living conditions (EU-SILC) indicators provide insights on the economic wellbeing and other living conditions on EU residents based on data collected during a specific year, denoted as N. This data encompasses both the characteristics of households for that year (N) and the income from the preceding year, N-1. The income for year N-1 is an estimate for income of year N within EU-SILC. To take into account differences in household size and composition and thus enable comparisons of income levels, the concept of equivalised disposable income is used. It is based on the total net (also referred to as disposable) household income divided by the number of 'equivalent adults', using a standard (equivalence) scale.

For example, the indicators on poverty and income inequality are based on EU statistics on income and living conditions (EU-SILC). The AROP rate is part of the at risk of poverty or social exclusion rate defined in the framework of the EU 2030 target on poverty and social exclusion.

Providing timelier social statistics – especially indicators on income poverty and inequality – is a priority for the Commission and the European Statistical System. In order to better monitor the effectiveness of social policies at EU level, Flash Estimates (FE) offer early indicative results for income year N, until EU-SILC data become available.

These estimates, that are part of the experimental statistics produced by Eurostat, have a release date appreciably earlier than the survey data.

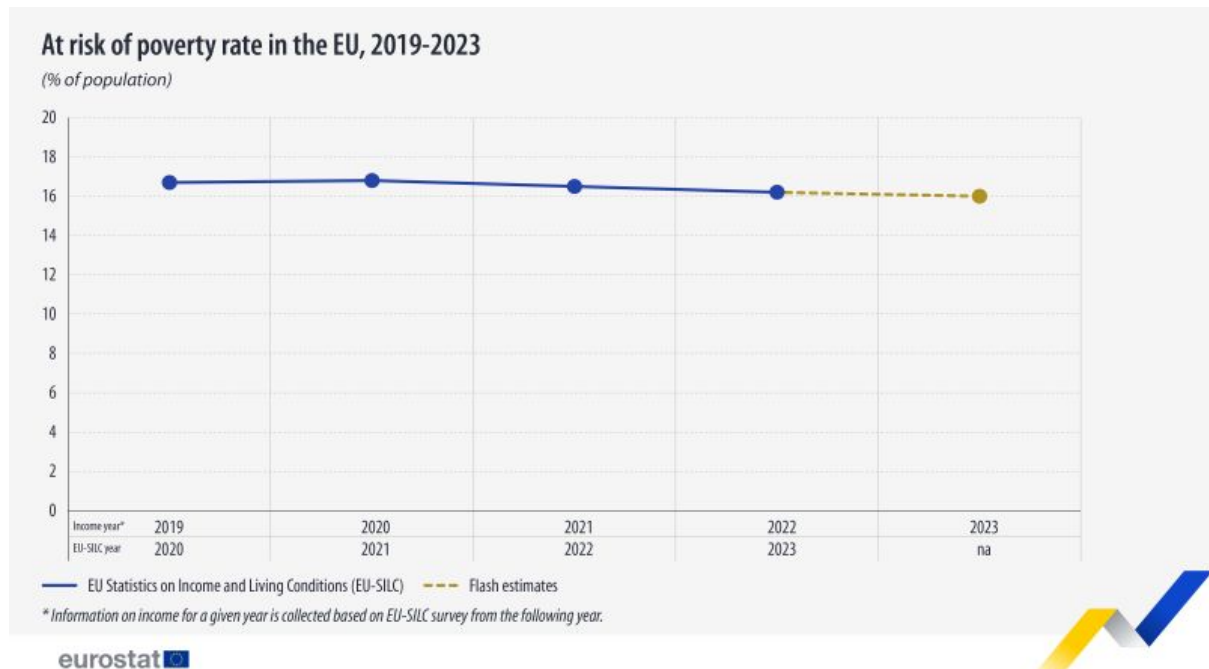Figure 1. At risk of poverty rate in the EU, 2019-2023

Figure 1 shows the at-risk-of-poverty (AROP) rate in EU-SILC 2023 (2022 income), complemented by the flash estimates on the AROP rate based on 2023 income (nowcasting EU-SILC 2024). According to the 2023 EU-SILC results, Latvia, Estonia (both 22.5 %) and Romania (21.1 %) had the highest at-risk-of-poverty rates. On the other side, Ireland, Denmark, and Czechia reported the lowest shares (12.0 %, 11.8 % and 9.8 %, respectively). Flash estimates are represented by arrows indicating the estimated direction and magnitude of change. According to the flash estimates, AROP is expected to remain stable in most countries (17), decrease in 6 (Germany, Estonia, Spain, the Netherlands, Portugal and Finland), and increase in 4 (Greece, France, Luxembourg, and Austria). It should be noted that these indicators are based on nominal values of disposable income and therefore do not incorporate changes in the cost of living and purchasing power (Eurostat).

In order to better monitor the effectiveness of social policies at EU level, flash estimates (FE) have been developed. These estimates are calculated based on nowcasting and modelling techniques and have a release date appreciably earlier than the survey data: i.e., FE of income year 2023 published in June 2024 complementing EU-SILC 2023 data that refers to income year 2022.

In summary, statistics are indispensable in sociology for studying, analysing, and understanding the complexities of social life, as well as informing policy decisions and interventions aimed at addressing social issues.

3. Statistics in Psychology

The systematic use of statistics in psychology dates back to the early 1950s. At the time, when computers were still in the electromechanical age, the biggest problem was computational effort. For this reason, learning statistics then meant above all learning formulas and procedures that would simplify the computational effort as much as possible. The appearance of computers and statistical processing programs made it possible to move to the face where the emphasis is on understanding statistical reasons.

Even when engaged in an activity with a strongly individual orientation, such as psychotherapy, the psychologist cannot dispense with statistics. It is necessary for its evaluation of a new therapeutic method, compared with other differences, or for the identification of certain conditions that can influence the effectiveness of therapy sessions (time of day, gender similarity between the patient and the therapist, etc.). Also, integration into the professional scientific environment forces the psychologist to use statistical methods in the elaboration of his own studies or in the understanding of studies from specialized literature.

Psychologists use statistical methods to design studies and analyze data. Whether conducting experiments, observational studies, or surveys, statistical techniques help psychologists make sense of the data they collect and draw valid conclusions about behavior and mental processes.

Psychology often deals with abstract concepts such as personality traits, intelligence, or mental health. Statistics provide a way to quantify and measure these constructs, allowing psychologists to assess and compare them across individuals or groups. Like in sociology, psychologists formulate hypotheses about behavior, cognition, or the effects of interventions. Statistics allow them to test these hypotheses rigorously, determining whether their predictions are supported by empirical evidence. Individuals vary in their behaviors, thoughts, and emotions. Statistics help psychologists understand the extent of this variability and identify factors that contribute to differences between individuals or groups.

Psychologists need to ensure that their measures are reliable and valid. Statistics provide methods for assessing the consistency and accuracy of measurements, helping researchers determine whether their instruments are measuring what they intend to measure.

Also, psychologists often study relationships between variables. Statistics enable them to examine correlations between different factors and assess the strength and direction of these relationships. While correlation does not imply causation, statistical methods can help researchers infer causality in certain situations.

Psychology relies heavily on empirical research findings. Meta-analysis, a statistical technique that combines results from multiple studies, allows psychologists to synthesize evidence from a body of research and draw more robust conclusions about a particular phenomenon. In clinical psychology, statistics are used in the assessment and diagnosis of mental disorders. Psychologists employ statistical methods to interpret psychological tests, evaluate symptoms, and determine appropriate interventions for clients.

Moreover, psychologists working in applied settings, such as therapy or organizational psychology, use statistics to evaluate the effectiveness of interventions and programs. By analysing outcome data, psychologists can assess whether their interventions are achieving the desired outcomes and make adjustments as needed.

Data is needed to conduct studies. There is a primary registry of clinical trial (ISRCTN at https://www.isrctn.com) registry recognised by World Health organization (WHO) and International Committee Medical Journal Editors (ICMJE) that accepts all clinical research studies (whether proposed, ongoing or completed), providing content validation and curation and the unique identification number necessary for publication.

3.1   Study Case. The Cognitive-Behavioural Therapy (CBT) for Treating Depression

Cognitive behavioural therapy (CBT) is one of the most evidence-based psychological interventions for the treatment of several psychiatric disorders such as depression, anxiety disorders, somatoform disorder, and substance use disorder. The uses are recently extended to psychotic disorders, behavioural medicine, marital discord, stressful life situations, and many other clinical conditions (Gautam *et al.*, 2020).

Let's say a group of researchers wants to investigate whether CBT is effective in reducing symptoms of depression compared to a control group that receives no treatment. Here's how statistics would be used in this study:

- **Study Design**: The researchers would design a study where participants with depression are randomly assigned to either the CBT group or the control group. This is important to ensure that any differences observed between the two groups are due to the treatment and no other factors.
- **Data Collection**: Before and after the intervention, participants would complete a depression symptom questionnaire, such as the Beck Depression Inventory (BDI). These questionnaires provide numerical data on the severity of depressive symptoms.
- **Descriptive Statistics**: Descriptive statistics would be used to summarize the characteristics of the participants in each group (e.g., mean age, gender distribution) and the initial levels of depression symptoms.
- **Inferential Statistics**: The main analysis would involve inferential statistics to determine if there is a significant difference in depression scores between the two groups after the intervention. This could be done using a statistical test such as the t-test or analysis of variance (ANOVA), depending on the study design and assumptions.
- **Effect Size**: In addition to testing for statistical significance, researchers would calculate the effect size to quantify the magnitude of the difference between the groups. This helps to determine the practical significance of the intervention.
- **Control for Confounding Variables**: Statistics may also be used to control for potential confounding variables that could influence the results, such as initial severity of depression, demographic factors, or

medication use. This could be done through techniques like analysis of covariance (ANCOVA) or propensity score matching.

- **Interpretation of Results**: Based on the statistical analysis, the researchers would interpret the findings. If the CBT group shows a significant decrease in depression symptoms compared to the control group, they would conclude that CBT is effective in reducing depressive symptoms.
- **Reporting Findings**: The results of the study, including statistical analyses, effect sizes, and any relevant graphs or tables, would be reported in a research paper or article for publication in a peer-reviewed journal.

Next, we will give the example of a research carried out by academic staff from the University of Bristol, together with colleagues from the universities of Exeter, Oxford, Glasgow and University College London (Nicola *et al.*, 2016). This study found when CBT was given, in addition to usual care that included antidepressants, it was effective in reducing depressive symptoms and improving quality of life over the long term – on average 46 months – for patients whose depression had not responded to medication. These benefits were found on average, 40 months after the end of therapy.

Figure 2. CoBalT trial profile extended to include long-term follow-up
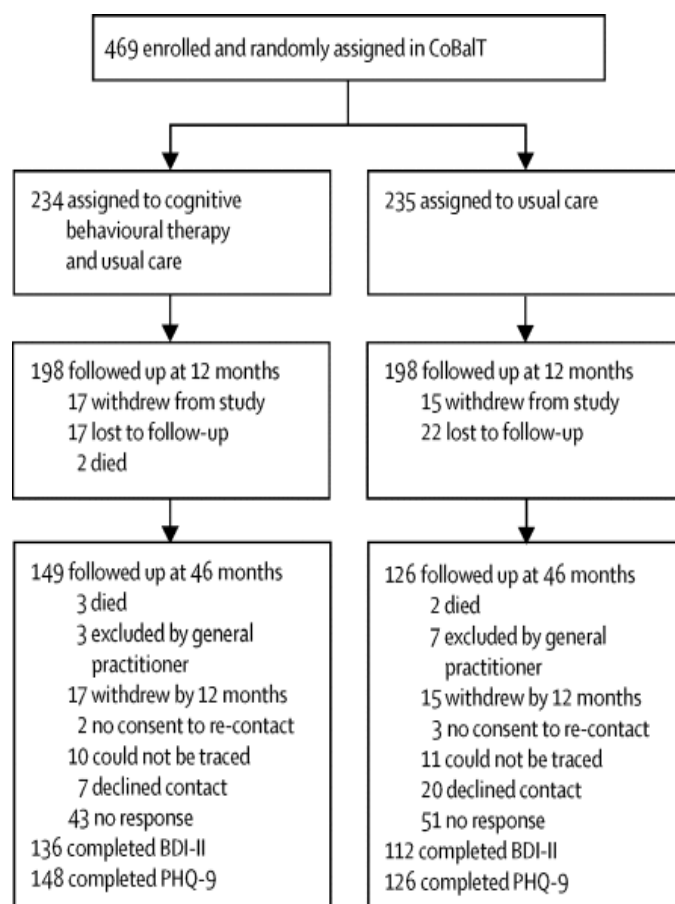
Source: Nicola et al., 2016, https://www.thelancet.com/journals/lanpsy/article/PIIS2215-0366(15)00495-2/fulltext

Statistical analyses were done with Stata version 13.1. According to this study, more than 50% of primary care patients with depression do not respond to antidepressants. The findings provide robust evidence for the effectiveness of CBT given as an adjunct to usual care that includes medication in reducing depressive symptoms and improving quality of life over the long term. Also, the effects observed were substantial and represented good value for money. As most of the CoBalT participants had severe and chronic depression, with physical or psychological comorbidity, or both, these results should offer hope for this population of difficult-to-treat patients. Clinicians need to discuss referral for CBT with all those for whom antidepressants are not effective.

The phenomena of intense closeness and increasingly accentuated collaboration between the contemporary psychologist and the modern statistician are turning each of them more and more into interdisciplinary team researchers, enriching each one's specific language, the medical one with the statistical one or vice versa, contributing to the structuring of increasingly efficient research methodologies.

4. Statistics in Political Sciences

Statistics play a crucial role in political science, offering tools to analyse, interpret, and understand political phenomena.

Political scientists often use statistics to analyze election results, voter behavior, and turnout rates. They employ techniques like regression analysis to understand how factors such as demographics, economic indicators, and campaign strategies influence electoral outcomes. Surveys and opinion polls are common tools in political science for gauging public opinion on various issues, candidates, and policies. Statistical methods help in sampling, data collection, and analysis of survey data, allowing political scientists to draw accurate conclusions about public sentiment.

Also, comparative politics involves studying political systems, institutions, and behaviors across different countries. Statistics enable political scientists to compare political indicators such as government stability, corruption levels, or policy outcomes across nations, using techniques like cross-national regression analysis.

Statistical methods are used to evaluate the effectiveness of public policies and programs. Political scientists employ techniques such as difference-in-differences analysis or randomized controlled trials to assess the impact of policies on outcomes such as poverty rates, crime rates, or economic growth. Moreover, statistics help political scientists study individual and collective behavior in politics. This includes analyzing factors that influence voting behavior, political participation, party affiliation, and political mobilization.

Political scientists often use mathematical models and game theory to understand strategic interactions among political actors. Statistics are employed to estimate parameters in these models and test their predictions against empirical data.

In the study of political networks, statistics are used to analyze the structure and dynamics of relationships among individuals, organizations, or governments. Network analysis techniques like centrality measures or community detection help identify key actors and patterns of influence.

Political scientists often analyze data over time to understand trends and patterns in political phenomena. Longitudinal statistical techniques allow researchers to track changes in variables such as public opinion, policy outcomes, or political attitudes over multiple time points.

Political scientists use statistical models to forecast election outcomes, predict policy impacts, or anticipate political events. These models integrate historical data, current trends, and relevant predictors to make informed predictions about future developments.

4.1 Study Case. Analysis of Voter Behaviour

This example illustrates how statistical analysis can help political scientists understand voter behaviour, identify key factors influencing voter turnout, and suggest evidence-based policies to improve democratic participation.

Understanding voter behavior in the context of the European elections of 2024 involves analysing various factors that influence how individuals and groups decide to vote. This includes demographic, economic, social, and political influences. Here are several key aspects to consider:

1. Demographic Factors
- Age: Younger and older voters often have different priorities and political leanings.
- Gender: Voting patterns can differ between men and women, influenced by issues such as gender equality, social policies, and economic opportunities.
- Education: Higher levels of education often correlate with different political preferences and voter turnout rates.
- Urban vs. Rural: Voters in urban areas may prioritize different issues compared to those in rural areas, such as public transportation versus agricultural policies.

2. Economic Factors
- Employment Status: Unemployment or job security concerns can significantly influence voting behavior, often swaying voters towards parties that promise economic stability and job creation.
- Income Levels: Economic disparities can lead to differing priorities, with wealthier voters potentially focusing on tax policies, while lower-income voters may prioritize social welfare programs.
- Economic Outlook: General perceptions of the economy, including inflation, cost of living, and economic growth, impact voter sentiment.

3. Social Factors
- Migration and Integration: Attitudes towards immigration and the integration of migrants can be a significant factor, particularly in regions experiencing high levels of immigration.

- **Social Justice Issues:** Topics such as LGBTQ+ rights, gender equality, and minority rights can influence voter behavior, especially among younger and more socially progressive voters.
- **Environmental Concerns:** Climate change and environmental policies are increasingly important, particularly for younger voters and those in regions affected by environmental issues.

4. Political Factors

- **Party Loyalty:** Historical loyalty to specific parties can influence voting behavior, though this is often less rigid in modern European elections.
- **Populism and Extremism:** The rise of populist and extremist parties can shift traditional voting patterns, appealing to voters disillusioned with mainstream parties.
- **Political Campaigns:** The effectiveness of political campaigns, including the use of social media, advertisements, and public debates, can sway undecided voters.
- **European Integration:** Attitudes towards the European Union and further integration can significantly influence voter behavior, with some voters supporting parties that advocate for more integration and others favoring Eurosceptic parties.

5. Cultural Factors

- **National Identity:** Issues of national identity and sovereignty can play a crucial role, especially in regions with strong nationalist movements.
- **Historical Context:** Historical events and long-standing regional issues can shape voter behavior and party preferences.

6. Media Influence

- **Traditional Media:** Newspapers, television, and radio can shape public opinion and influence voter behavior through their coverage of the election and political issues.
- **Social Media:** Platforms like Facebook, Twitter, and Instagram are increasingly important for reaching younger voters and shaping political discourse.

7. Voter Turnout

- **Motivation to Vote:** Factors that motivate voters to turn out, such as perceived stakes of the election, satisfaction with democratic processes, and the impact of grassroots mobilization efforts.
- **Barriers to Voting:** Practical issues such as voter registration processes, accessibility of polling stations, and availability of early or postal voting options.
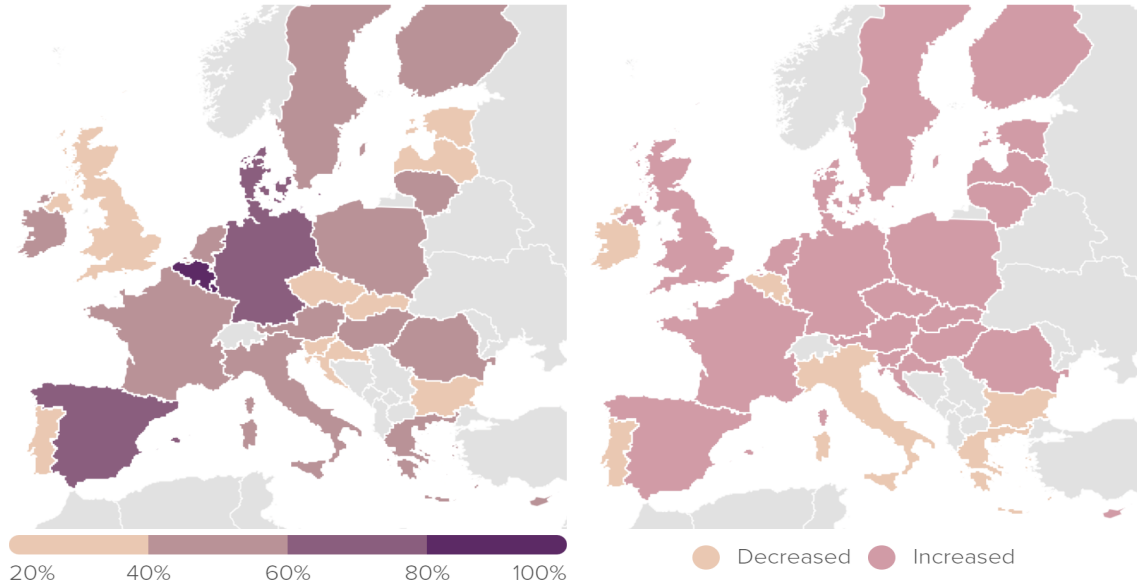
Figure 3. Turnout in the European election compared with the average turnout in national parliamentary and presidential elections in EU9* and EU28** countries
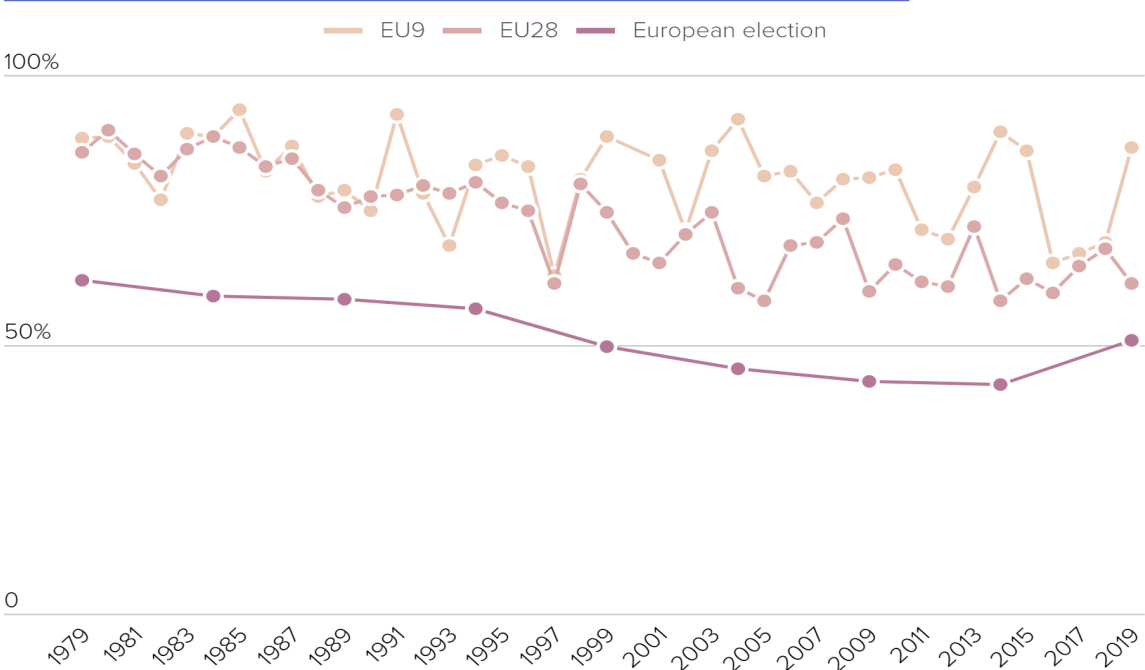
*Belgium, Luxembourg, the Netherlands, Italy, Germany, the U.K., Ireland, France, Denmark. **EU27 countries plus the U.K.
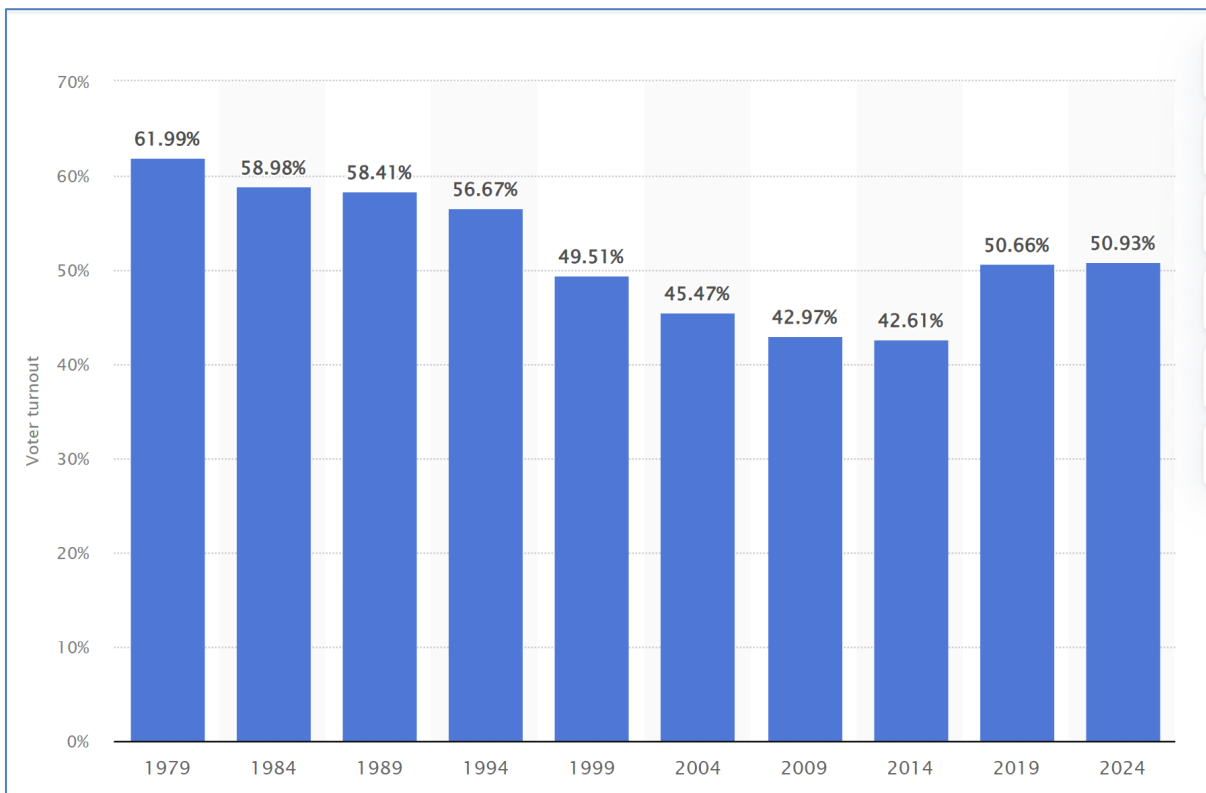
Figure 4. Turnout in the 2019 European election by country and change compared with 2014

Turnout in the 2019 European election by country and change compared with 2014.

For the 2024 elections, the only accessible data are those in Figure 5 and Figure 6.

Figure 5. Voter turnout in the European Parliament Elections in the European Union (EU) from 1979 to 2024
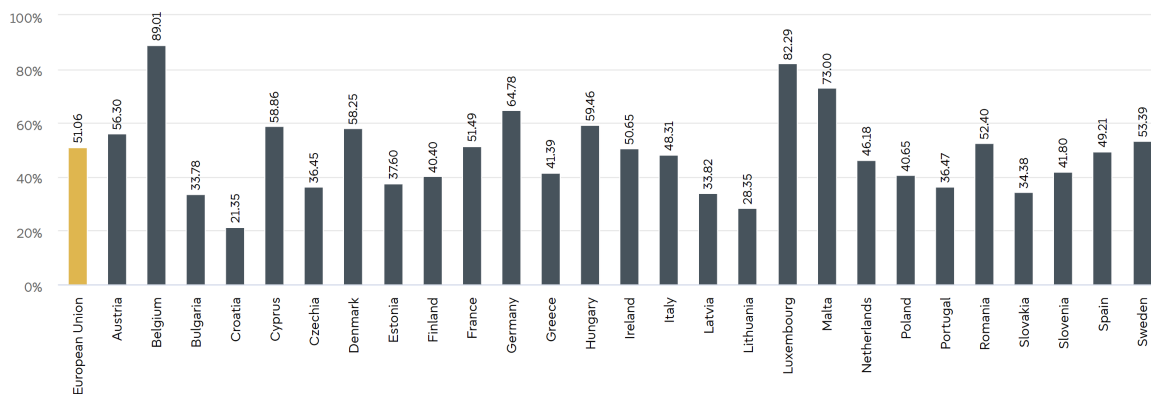

Source: Statista 2024

Figure 6. Turnout by country, 2024

Turnout by country (%)

Provisional results

Source: Statista 2024

To analyze voter behavior for the European elections of 2024, several methodologies can be employed:

- Surveys and Polls: Conducting pre-election and exit polls to gauge voter intentions and understand the issues that matter most to them.
- Statistical Analysis: Using regression models and other statistical tools to identify correlations and causations in voter behavior.
- Case Studies: Examining specific regions or demographic groups to gain deeper insights into localized voting patterns.
- Comparative Analysis: Comparing voter behavior across different European countries to identify common trends and unique factors.

Understanding voter behavior in the 2024 European elections requires a comprehensive approach that considers a wide range of demographic, economic, social, and political factors. By analyzing these influences, researchers and political analysts can gain valuable insights into the motivations and preferences of European voters, helping to predict election outcomes and inform future political strategies.

This example illustrates how statistical analysis can help political scientists understand voter behaviour, identify key factors influencing voter turnout, and suggest evidence-based policies to improve democratic participation.

5. Statistics in Economics

Statistics play a crucial role in economics by providing tools and methodologies to analyze data, test theories, and make informed decisions.

Economists use statistical methods to collect and analyze data. This involves designing surveys, experiments, and other data collection methods to gather relevant information. Once data is collected, statistical techniques are used to analyze it, identify trends, and make sense of complex datasets.

Statistical models are essential for understanding economic phenomena and making forecasts. Econometric models, which combine economic theory with statistical methods, allow economists to estimate relationships between different economic variables. These models are used to predict future economic conditions, such as inflation rates, unemployment levels, and GDP growth. In economics, hypotheses about how different factors influence economic outcomes can be tested using statistical methods. By applying techniques such as regression analysis, economists can determine whether there is a statistically significant relationship between variables and test the validity of economic theories.

Also, statistics are used to evaluate the impact of economic policies. By analyzing data before and after the implementation of a policy, economists can assess its effectiveness and make recommendations for future policy decisions. This involves using control groups and statistical techniques to isolate the effects of the policy from other factors.

Many key economic indicators, such as inflation, unemployment, and GDP, are derived from statistical analysis. These indicators are vital for understanding the state of the economy and for making comparisons over time or between different countries.

In financial economics, statistics are used to assess and manage risk. This involves analyzing historical data to estimate the likelihood of various outcomes and to develop strategies for mitigating potential risks. Techniques such as value at risk (VaR) and stress testing are commonly used in this context.

Statistics are used to analyze market trends and behaviors. This includes studying consumer behavior, market competition, and price dynamics. Statistical tools help economists understand how markets operate and how various factors influence supply and demand.

Experimental economics uses controlled experiments to study economic behavior. Statistics are crucial in designing experiments, analyzing the results, and drawing conclusions about economic theories and human behavior.

Common Statistical Techniques in Economics are:

- Descriptive Statistics: Summarizing data using measures such as mean, median, mode, and standard deviation.
- Inferential Statistics: Making predictions or inferences about a population based on a sample of data.
- Regression Analysis: Examining the relationship between a dependent variable and one or more independent variables.
- Time Series Analysis: Analyzing data points collected or recorded at specific time intervals to identify trends, cycles, and seasonal variations.
- Panel Data Analysis: Using data that tracks the same subjects over multiple time periods to analyze dynamic changes and causality.

Statistics provide the foundation for empirical research in economics, enabling economists to test theories, evaluate policies, and make predictions. The integration of statistical methods into economic analysis ensures that conclusions drawn are based on robust, quantifiable evidence. This, in turn, helps in formulating sound economic policies and making informed decisions that can positively impact economies.

Knowledge of daily events such as the evolution of prices and wages, the exchange rate, inflation, etc. is not possible without quantitative expression.

5.1. Study Case. Relationships between Economic Variables

The analysis of the interdependence between phenomena, in general, and between economic ones, in particular, is a particularly difficult problem. Defining the causal connection between two events A and B in the economy should not be done abstractly, but considering the concrete conditions in which these events occur. Thus, the analysis of the causal connection begins with a qualitative approach, considering the foundations of economic theory and the experience gained in studying a phenomenon, and only after that quantitative methods specific to statistical research will be used. The series of data obtained following the observation process will be processed through appropriate statistical methods.

The market economy required that the statistical survey be an important element in the study of the social and economic phenomenon and in the elaboration of statistical information.

The Internet has enabled changes in communication between people in terms of how to do business, including in marketing research. The business environment embraced online research, which led to the realization of qualitative and quantitative research, due to the advantages related to speed, the reduction of material costs, etc. The limitations are also considerable, deriving for example from the low, uneven penetration of the Internet in certain geographic areas, poorly developed in terms of infrastructure.

The relationship between advertising and sales volume is often explored through correlation analysis to understand how changes in advertising expenditure impact sales. Correlation analysis measures the strength and direction of the linear relationship between two variables. Here's a step-by-step example of how such an analysis might be conducted:

Step 1: Collect Data

Gather data on advertising expenditure and sales volume over a specific period. For this example, let's assume we have monthly data for one year.

Table 1. Advertising expenditure and Sales volume

Month	Advertising Expenditure (in $1000s)	Sales Volume (in units)
January	10	200
February	15	220
March	14	210
April	20	250
May	18	210
June	25	300
July	22	280
August	30	320
September	28	310
October	35	350
November	33	340
December	40	400

Step 2: Plot the Data
Create a scatter plot to visualize the relationship between advertising expenditure and sales volume. This helps to see if there is a visible pattern or trend.

Figure 7. A scatter chart to compare the two sets of values. The trendline
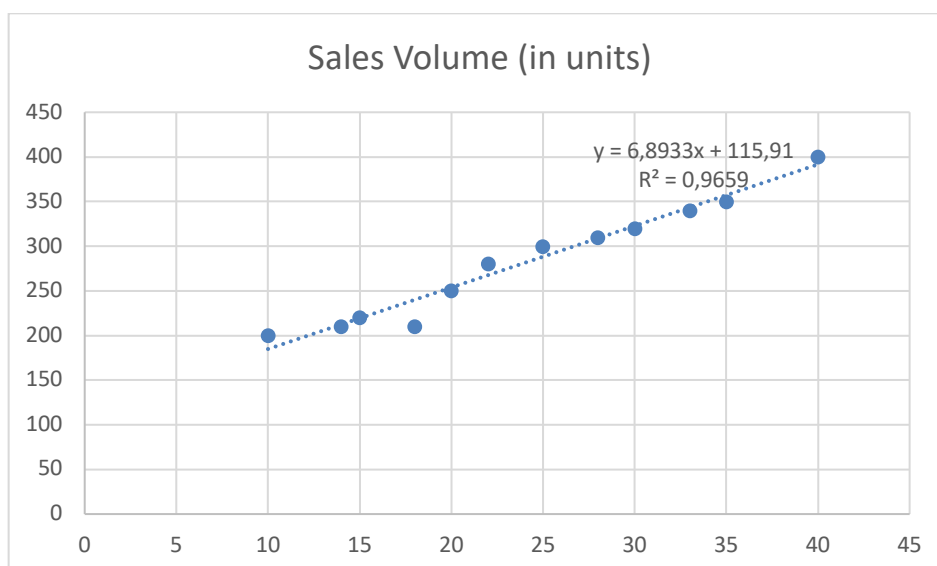
Step 3: Calculate the Correlation Coefficient
The correlation coefficient values satisfy the inequality $-1 \leq r_{xy} \leq 1$ and their interpretation is as follows:

- if $0 \leq r_{xy} \leq 0,2$ there is no connection between variables x and y or this connection is very weak; if $0,2 \leq r_{xy} \leq 0,5$ the link is weak; if $0,5 \leq r_{xy} \leq 0,75$ the connection is of medium intensity; if $0,75 \leq r_{xy} < 1$ there is a deterministic or functional link. The type of connection between the two variables is determined by the

sign of *r*, if *r* is positive the connection is direct, for $r < 0$ the connection is indirect. When $r = 0$ the variables are independent or uncorrelated.

$$r_{xy} = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{\sqrt{\left[n\sum x_i^2 - \left(\sum x_i\right)^2 \right]\left[n\sum y_i^2 - \left(\sum y_i\right)^2 \right]}}$$

where:
- n is the number of data points
- x is the advertising expenditure
- y is the sales volume

Example Interpretation

The calculated correlation coefficient is r=0.96.

A correlation coefficient of 0.96 indicates a very strong positive linear relationship between advertising expenditure and sales volume. This means that as advertising expenditure increases, sales volume tends to increase significantly as well.

This example demonstrates how to perform a correlation analysis between advertising and sales volume. A strong positive correlation suggests that increasing advertising expenditure is associated with higher sales volume, which can help businesses make informed decisions about their advertising strategies.

Conclusions

Today, statistics are a powerful tool for learning about the world around us. Most disciplines borrow from statistics its models and procedures, otherwise indispensable for fulfilling their role. It should be mentioned, however, the great danger to which these disciplines can be subjected in case of improper use of statistical methods and procedures. Analysis and knowledge of socio-economic phenomena and processes can only be achieved as a result of rigorous and methodical observation, during which they can be measured. Within the operation of modelling phenomena and processes, a process of symbolizing and abstracting them takes place in order to analyse them quantitatively.

Based on what has been presented, the role and importance of knowing the methods and procedures made available by statistics in the knowledge process can be emphasized once again. The contribution of statistics is not unimportant even in fields such as: medicine, biology, physics, chemistry, legal sciences, etc. There are frequent cases in which studies undertaken in these fields draw conclusions that are based on a lot of data resulting from statistical observations, directly involving models of statistical inference.

Therefore, the systemic vision of researching economic and social phenomena requires interdisciplinarity within which statistical analysis occupies an important place.

Declaration of Competing Interest

The author is Editor in Chief and was not involved in the editorial review or the decision to publish this article.

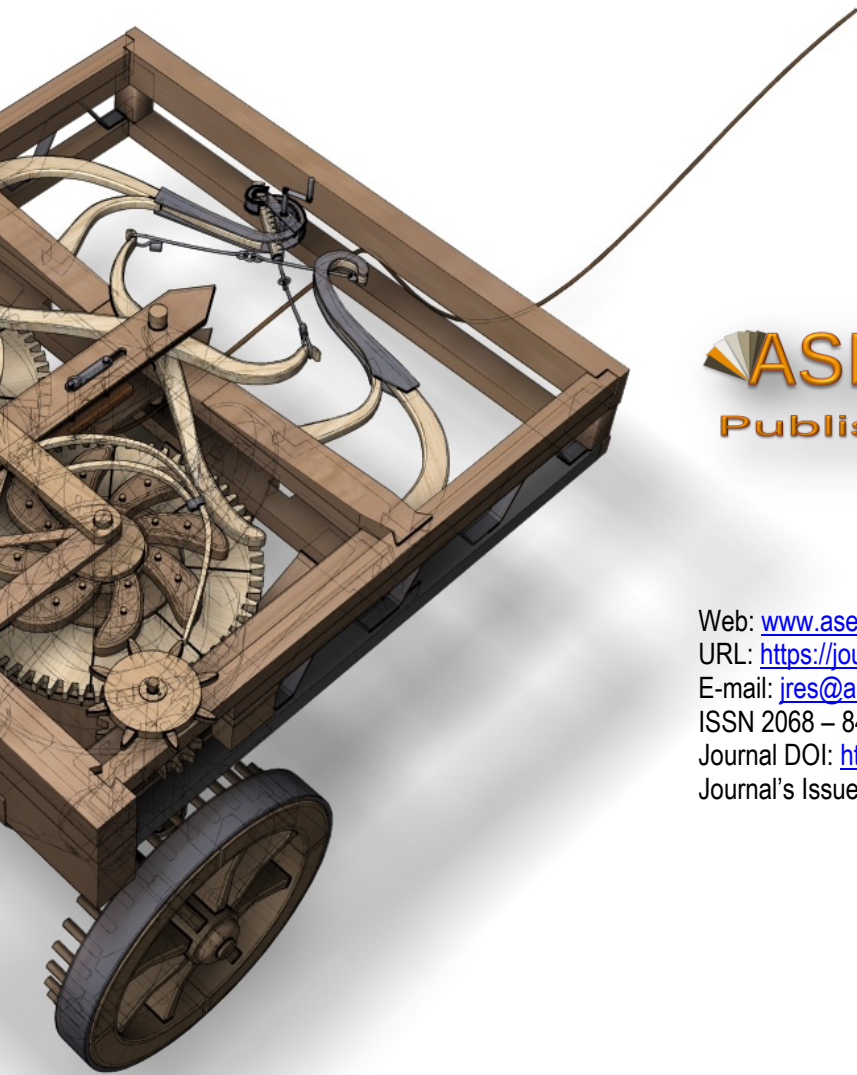## Declaration of Use of Generative AI and AI-Assisted Technologies

The author declares that he has not used generative AI and AI-assisted technologies during the preparation of this work.

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