ETHICAL CHALLENGES IN STATISTICAL RESEARCH

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Abstract: *This paper discusses some of the most common ethical challenges that arise in the course of statistical research, from the initial stages of research design and data collection, and into the final stages of data presentation and statistical inference. For each of the stages involved in conducting statistical research, the present paper offers relevant, real-life examples of unethical practices and misleading statistical studies encountered in scientific publications as well as in the media. The goal of this paper is two fold: first, it is an attempt to familiarize the readers with ways in which unethical practices in statistical research lead to misleading results and the potential effects of such practices; and secondly, the paper aims to encourage the scientific community to engage in similar discussions regarding the role of ethics in their respective disciplines.*

1. INTRODUCTION

Mark Twain said: "There are three kinds of lies: lies, damned lies, and statistics" [15].

Much scientific literature has been devoted to the development and application of statistics in every area of research: from medicine to politics and economics; most of the studies focus on statistics as a means to further knowledge of a particular field of interest. Statistical research is an invaluable tool that allows an organized, quantitative and qualitative understanding of a particular subject, and also serves as the basis for future decision-making. Public policy and medical research are just two of the many branches of learning that have benefited greatly from the use and application of statistics. In recent years, there has been a notable increase of this type of analyses within the financial sector, from risk analysis and market predictions, to portfolio diversification strategies based on stock market data.

This paper has been largely influenced by the current economic crisis, when misapplied statistical research and a misunderstanding of probability have been important factors that contributed to the financial meltdown. This provided a framework that compels us to address the ethical dimensions and challenges in conducting statistical research, from data gathering, to data presentation and finally to statistical inference. The present paper does not aim to conduct an in-depth analysis of complex statistical models; it is meant to be merely a summary of the most important ethical challenges that we have identified within the field of statistics. However, it is the authors' hope that other fellow scholars will feel encouraged to address the notion of ethics within the greater context of academic research and development. Furthermore, it is our belief that Romania's future as a competitive market economy depends greatly on laying a solid basis of knowledge and fair business practices, and understanding that ethical issues and profitability are complementary, not mutually exclusive. Finally, the present paper urges all academic professionals, instructors, teachers and professors to advance the open discussion of ethics within the context of their respective subjects of study, and to emphasize ethics as a prerequisite in the pursuit of academic degrees.

2. ETHICAL THEORY AND STATISTICS

According to the Princeton dictionary, the notion of ethics is defined as the "system of principles governing morality and acceptable conduct". The idea of ethics has been the subject of much debate throughout the history of philosophy, and it is worth recognizing that ethical principles also depend on the characteristics, history and culture of a social group. However, two major schools of thought have been particularly influential in their approach to the theory of normative ethics: Kantianism and utilitarianism. In formulating his theory, Kant focused on reason as the highest instance of morality, and established the formula of the Universal Law of Nature, stating that people ought to "act only in accordance with that maxim through which you can at the same time will that it become a universal law" [6, 17]. Utilitarianism, a 19th century ethical theory developed by John Stuart Mill and Jeremy Bentham, states that the appropriate way to evaluate the ethical value of an action is by looking at the results, and formulates a Principle of Utility: the greatest good of the greatest number [12]. Throughout the years, utilitarianism has changed its focus from individual acts, to the laws and rules that regulate individual acts in a society. The issues of morality and acceptable conduct encompassed in these two theories are being

complementary and serve merely as a starting point for certain guidelines that govern the collection, presentation and interpretation of statistics, and for the code of conduct that governs the individuals performing these analyses.

During the course of performing statistical research, professionals and academics may encounter a wide range of ethical challenges, and it is equally important to be able to identify these concerns, as it is to understand the ways in which statisticians cope, respond to, resolve and prevent these problems. In recognizing these challenges, national and international statistical bodies have established certain principles to ensure that reflect the professional responsibilities of statisticians and researchers. Most notable of these are the "Declaration on Professional Ethics" adopted by the **International Statistical Institute** [2], and, on a regional scale, the "European Statistics Code of Practice For the National and Community Statistical Authorities" adopted by **Eurostat** [3]; the common themes are respect, professionalism, objectivity, integrity, transparency and responsibility. This paper echoes the same general principles, and in addition provides several real life cases of situations where these guidelines were disregarded, analyzes the effects of some of these ethical violations, and provides several opinions on how to resolve and prevent such situations.

3. ETHICAL CHALLENGES IN STATISTICAL RESEARCH

In conducting a statistical study, the typical start is identifying the question or area of concern and determining whether data is obtainable in an ethical manner, within a reasonable amount of time, and at a reasonable cost. The next step involved is the design of the study – at which stage the population of interest is identified; a survey or an experiment is conducted, or exploratory data analysis is performed. Once the design of the study is complete, the researchers will typically collect and organize the data by identifying the variables and the limits of measurement. Data analysis is the next stage of the study, followed by the final step: conclusions, inferences and a discussion on the limitations of the study.

3.1. Initial stages: goal of survey, design and data collection

From the start, several ethical challenges surface: first, the most important question that arises concerns the purpose of the study – is the study being conducted to prove or reinforce a particular point of view, or is it to find the truth? The pursuit of truth, without catering to any subjective view, is essential to the ethical and scientific integrity of the study. Often times, it is a challenge that is extremely difficult to identify – however, a close look at the party responsible for financing the study may reveal potential conflicts of interest that will have a bearing on the methods employed in the study, the final results as well as the way the study is interpreted. Moreover, because statistical studies are widely used by individuals and groups in support of a particular economic, social or political agenda, those with an interest in the debates will often times employ the services of statisticians who appear as experts and professionals of the field, thus lending legitimacy to the issue at hand (this, in itself, is the logical fallacy of appeal to authority; it is worth pointing out that information is not correct because of the credentials of the provider, but information is correct if it can be tested for trustworthiness and if it can survive scrutiny). It is of particular importance that researchers and statisticians maintain their professional integrity and resist any influence to distort or misrepresent scientific facts. Personal beliefs are inherently subjective and should not interfere with statistical research.

In particular, researchers should employ special care when deciding what questions to ask, which groups to study and how to categorize the results of the survey. If the study requires asking certain questions to a group of individuals, these questions must be formulated using simple, clear, easily understandable and concise terms. Special care should be paid to logical fallacies that can be easily used to craft questions designed to elicit a particular response. For instance: during a study the respondents were asked whether they believed that the government is spending too little money on welfare, and 19% of them said "yes". Next, the same question was asked, with the only difference that the word "welfare" was replaced by the phrase "assistance to the poor". In the second instance, 63% answered "yes" [16]. This is a huge difference between two apparently identical polls performed on similar samples of the same statistical population; it can be easily explained however: the word "poor" elicits a strong emotional response of compassion, whereas the word "welfare" tends to produce more negative responses because most people associate it with government waste [4, 13].

Another example in which language plays an important role is the way the survey scales are written. For example, in one recent poll, those interviewed were asked if they believed that scientists falsified research to support their theories on Global Warming. [8] The respondents had to choose one of three possible answers: 'somewhat likely', 'very likely', 'and not very likely' (Fig.1).

The problem with this type of labeling is that those who are 'somewhat likely' to make a certain decision, are at the same time 'not very likely' to make that decision. As a side note, there is another, much more blatant mistake in the above study: when adding the percentages of the answers in the above reports poll, we obtain a total of 120%!

When considering which group to study, there is always an implicit bias that only those available for survey were polled. However, the statistician must avoid any practice that implies a rational bias – such as selecting a particular sample because it tends to reinforce a point of view, rejecting data that tends to disagree with a particular opinion, or eliminating low and high values in an attempt to create a more coherent appearance. Data selection based on bias or discrimination is both unprofessional and unethical, and results in scientifically

unreliable studies. An example of potential data selection would be a survey on the average price of houses in a city, where only the rich or poor neighborhoods are sampled, in order to prove that the average price of properties is either high or low. Another example is a relatively recent study published by the New York Times and extensively reported and cited by a variety of other newspapers and medical publications. The study concluded that a diet low in fat accounted for a 25% reduction in the risk of cancer return in women. This seems an impressive result; however a closer look at the sample used for this survey will show that the sample consisted only of women who had already had the standard cancer treatment in the form of surgery, chemotherapy and other hormonal therapy [7].

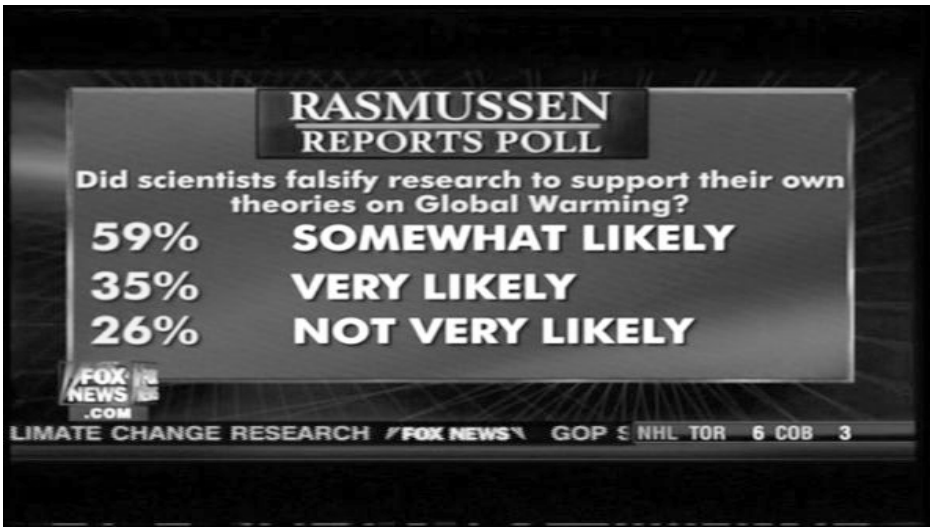

Fig.1 The answers in one poll concerning Global Warming

3.2. Intermediary stages: data organization, analysis and presentation

Once a study moves from the initial phases of planning, design and data collection, scientists must then organize the information in a rational, relevant and logical way. One area of concern is the way in which data is stored and the nature of the study: ideally, special attention must be paid to storing the data in a way that does not allow an individual to be associated with a potentially vulnerable group [11]. This prevents potential misuse of data that may ultimately result in harm to individuals; among the examples most frequently cited in scientific literature regarding the extent of potential harm are those concerning abuses in the field of medicine, which resulted in extraordinary harm to political or social groups at risk (such is the case of the medical experiments conducted by the Nazis during World War II). Therefore, it is the moral obligation of the statistician to take all the precautions necessary to prevent the misuse of data that may potentially harm individuals. While the possibility of such harm occurring in present times seems distant and unlikely because of national and international laws, it is important to keep in mind that the legality of an action does not necessarily imply that an action is also ethical; furthermore, history offers important lessons on how we may prevent potentially tragic events from occurring in the future.

We focus next on the use of averages and how statisticians must pay close attention to the type of averages used and their relevance in the context of the particular study conducted. For instance, let's assume we are trying to calculate the values of land properties in a neighborhood of 100 land plots, where 90 of them are valued between 180,000 to 200,000, and 10 of the properties have values between 500,000 and 550,000. If we were to compute the mean property value, the figure would be skewed by the extremely high values of the 10 land plots, and would present an unrealistic assessment of the property values. By using the median values instead, we would obtain a result likely between 180,000 to 200,000; this offers a more realistic view, without having to remove the extremely high values (suppressing data, as we have previously mentioned, is unethical and should be avoided).

Another area of particular concern is the use of graphical representation of statistical results, as graphs and charts have widely been used to misrepresent data – from political polls, to economic trends - no area of research is immune to such practices. Let us consider the two graphs below (Fig.2 and 3): they both depict a decrease in the average house values from $63,000 in 2009, to $59,000 in 2011 (note: these are fictional values used only to illustrate an example). By looking at the graph from Fig.2, it would appear that in 2011 the average house value declined to almost half of the average 2009 value. However, the numbers prove this conclusion to be incorrect. The reason for this apparent huge decline in value comes from the fact that the scale represented on the vertical axis is extremely narrow in range, depicting only values from 55,000 to 65,000. A more accurate representation can be observed in the graph in the Fig.3, which reduces the differences by using a scale from 0 to 100,000.

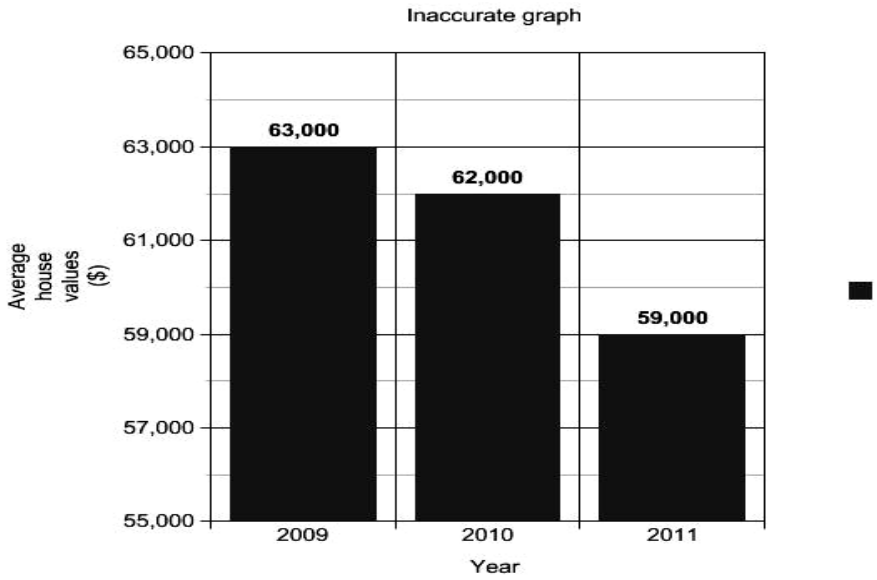

Fig.2 Decrease in the average house values-inaccurate graph

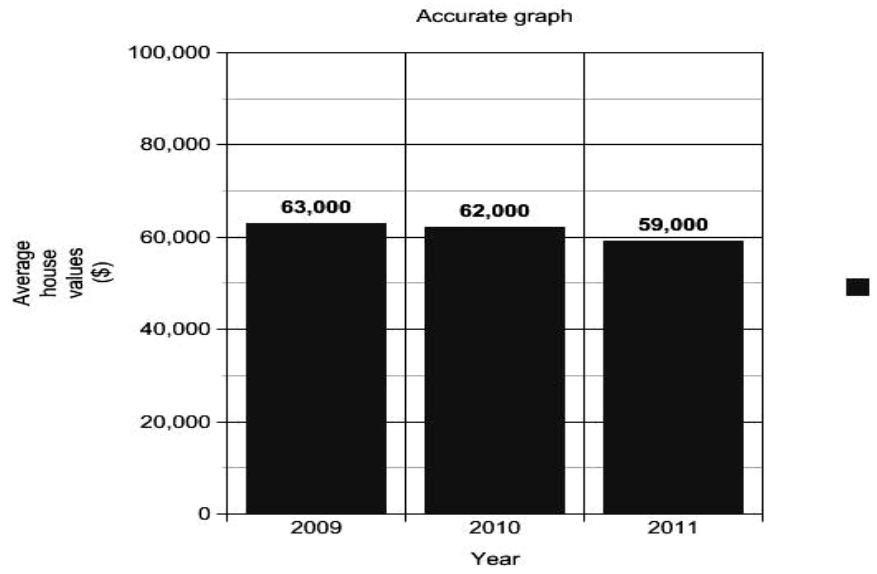

Fig.3 Decrease in the average house values-accurate graph

In the Fig.4 is another example of misleading charts used by the news channel MSNBC in March of 2009, suggesting that the Dow Jones Industrial Average has declined considerably since the 2008 elections [10].

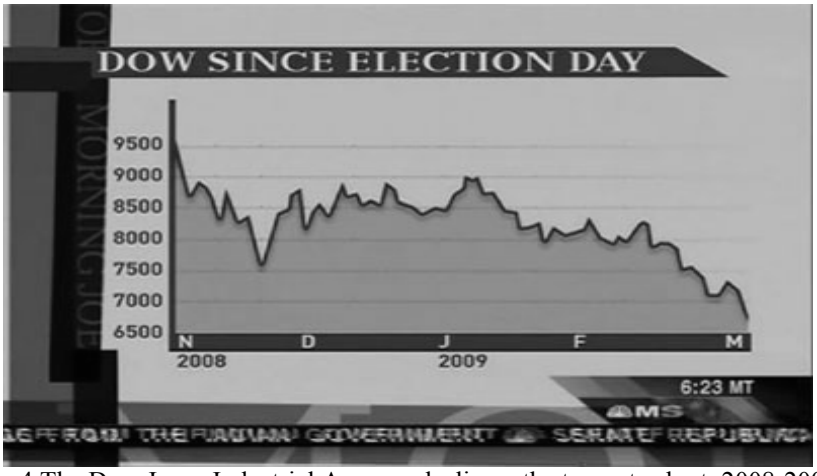

Fig.4 The Dow Jones Industrial Average decline – the truncate chart: 2008-2009

And below (Fig.5) it is the complete chart showing the entire downward trend, which started in 2007 – this offers an accurate representation of the facts [10].

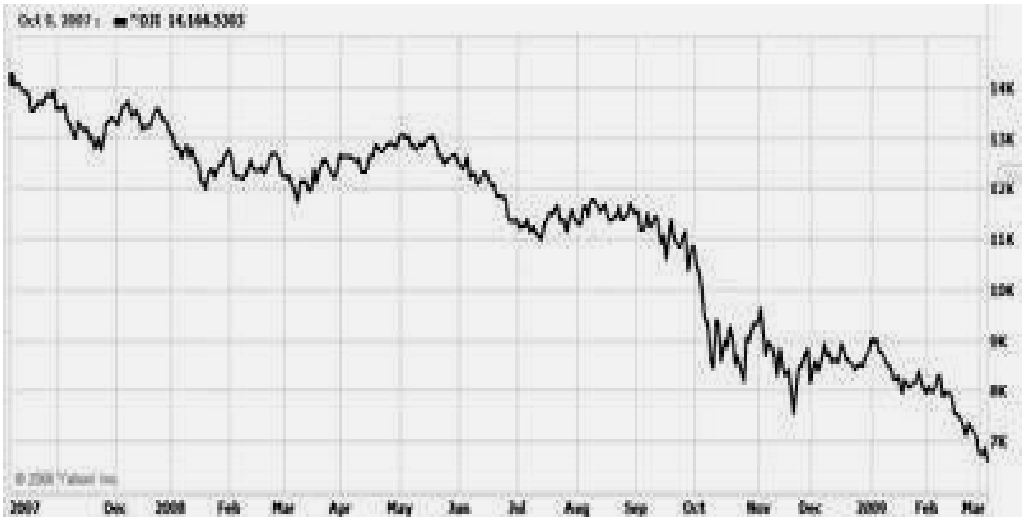

Fig.5 The Dow Jones Industrial Average decline – the complete chart: 2007-2009

We conclude by emphasizing the importance of using accurate, relevant scaling in presenting data; any misrepresentations are unethical, unprofessional, and render any scientific study irrelevant.

3.3 Final stages: conclusions and inferences

The final stages of a statistical study consist of drawing conclusions and making inferences based on the values of the sampled data. At this stage, **one of the most common errors involve mistaking correlation with causality**, a situation in which two factors that are correlated are misrepresented as one factor causing the other. The media provides us with numerous examples of misapplied causality in statistical research, but to better illustrate the concept, we'll start with a joke: a patient in a mental institution is walking around the hospital yard with a spider in his hand. He encounters a doctor and tells him "Look, doctor, I can talk to spiders." He looks at the spider and shouts "Spider, go to the right!" and indeed, the spider moves to the right in the palm of his hand. Then, the patient screams "Spider, go to the left!" and the spider moves to the left. The doctor replies to the patient "That's very interesting", to which the patient responds "Wait, doctor, you haven't seen the most interesting part yet." He then starts pulling off each one of the spider's legs. Next, he screams "Spider, go right!" but this time, the spider doesn't move anymore. The patient looks at the doctor and says "See, doctor, if you pull off a spider's legs, he'll go deaf!"

As we have mentioned previously, confusing correlation with causality is a fallacy encountered numerous times in mass media – in many cases, the title of the article grossly misrepresents the findings of the study, simply because causality makes for a much more exciting title. An example would be a study published by Reuters under the title "TV raises blood pressure in obese kids: study" in which the news agency reports the findings of a new research study conducted by a team of doctors from several universities in the United States. One of the authors of the study is quoted as saying: "There is a significant association between hours of television watched and both the severity of obesity and the presence of hypertension in obese children" [17]. However, further research will reveal that there are, in fact, other variables and conditions that may be responsible for this increase in blood pressure: first of all, one of the main consequences of obesity is high blood pressure; secondly, it is in fact much more likely that children watch TV at the detriment of physical activity, and that they also tend to eat more while watching TV – lack of physical activity coupled with eating more are important factors that cause obesity and increase blood pressure. Therefore, the activity of watching TV does not in and of itself raise blood pressure. Other examples of this type of logical fallacy are studies and articles with titles such as: "Diet of fish can prevent teen violence" [5], "Reading diet articles could be unhealthy" [1], or "Credit cards can make you fat" [9]. Being able to distinguish these fallacies is critical not just for professionals who use statistical research to make decisions in their areas of specialty, but also for ordinary people who sometimes form opinions or make decisions based on polls or surveys.

4. CONCLUSIONS

Ethical challenges in statistics do not arise only for those conducting the research; they are equally important for those who are receiving the information as well: by contesting misleading and erroneous research or data presentation, and by calling into question potential unfairness, anyone may be able to prevent deceptive surveys

from being conducted or published in the future. In other words, addressing corrupt practices is the ethical thing to do. That is why it is important to educate ourselves and the others about the issues of morality and ethics and how they affect both our everyday life, and also our professional lives. This paper is a modest effort to raise awareness in relation to some of the ethical issues encountered in the field of statistical research, and our hope is that other professionals will feel confident about engaging in similar discussions in their respective fields. The future of a country depends on its human capital: the more educated and informed its citizens are, the more likely it is that they will become productive members of society, contributing with their knowledge to the advancement of the country and, ultimately, of the entire human race. Knowledge, information and moral virtue represent the basis on which future generations can build a more dynamic and competitive culture.

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