

TEACHING STATISTICS TO UNDERGRADUATE STUDENTS OF THE SOCIAL SCIENCES

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This paper highlights the need for teaching statistics with real data in order to make statistics attractive and meaningful to social sciences students. Data coming from current research work are ideal for teaching. Students become interested in statistics and keep their interest as long as statistics is applied to data related to their own fields. Promoting discussion in class around current social issues also emphasizes the value of data to public policy, and the need for social theories to explain and interpret social data. This paper also stresses the need for a textbook concentrating on statistical concepts and thinking, with many real-life examples illustrating the relevance of statistics to understand social issues and making the introductory statistics course an attractive and enlightening course for social sciences students.

INTRODUCTION

For more than 30 years the School of Statistics of the University of Costa Rica has taught introductory statistics to undergraduate students of the Faculty of Social Sciences. This Faculty includes the schools of political science, social work, sociology, anthropology, journalism, history, geography and psychology. The Faculty of Social Sciences belongs to the Area of Social Sciences, an Area which also includes the Faculty of Economic Sciences (schools of economics, business administration, public administration and statistics), the Faculty of Law and the Faculty of Education. In this paper we only consider social sciences students belonging to the Faculty of Social Sciences.

All students of the Faculty of Social Sciences - except those in the school of psychology - take at least one of the following two introductory statistics courses of the School of Statistics: Statistics for Social Sciences I (SSSI) and Statistics for Social Sciences II (SSSII).

Statistics for Social Sciences I emphasizes the importance of variability, the planning and design of data collection, questionnaire design, levels of measurement, principles of probabilistic sampling (simple, systematic, stratified, cluster and PPT sampling), types of data collection methods (e.g., face-to-face and telephone interviews), data analysis using basic descriptive statistics, correlation and linear regression, vital statistics, social and economic indicators, and presentation of results and conclusions through the appropriate use of tables and graphs. It also introduces two basic concepts of inferential statistics: confidence intervals for means and proportions and significance tests for Pearson and Spearman correlations.

Statistics for Social Sciences II covers basic probability concepts and distributions, and the traditional topics of inferential statistics: sampling distributions, central limit theorem, confidence intervals, hypothesis testing for means and proportions and applications of the chi-square statistic.

This paper is based on the efforts and experiences of the author and colleagues in teaching Statistics for Social Sciences I, the first of the two introductory statistics courses. We first describe the rewarding and challenging experience of teaching statistics to social sciences students. Secondly, we discuss some recommendations implemented in the course Statistics for Social Sciences I to make it a more attractive and accessible course. Thirdly, we comment on the positive interaction between teaching and research. Finally, we emphasize the need of a pedagogical and attractive textbook for teaching introductory statistics, and describe future projects to incorporate more social research data into teaching.

A CHALLENGING AND REWARDING EXPERIENCE

Teaching statistics faces several challenges. First of all, lecturers must fight against the common aversion that many social sciences students feel against mathematics, which partly explains their choosing of a career in the Faculty of Social Sciences. Naturally, statistics is perceived by many as more unpleasant mathematics. Secondly, although high school mathematics

is enough for an introductory statistics course, some students have difficulties with basic high school algebra and arithmetic. Certain basic statistics and formulas must be taught taking those difficulties into account. Finally, wise teaching and skilled lecturers are needed to make the course attractive to students.

In spite of the above challenges, teaching the first introductory statistics course has been a rewarding and pleasant experience to all lecturers. At the end of the course they feel a great satisfaction when they realize that the negative view of statistics felt by many students at the beginning of the course has disappeared. They are also pleased to hear students acknowledging the relevance of statistics to understand many of the current social issues.

BASIC ASPECTS FOR AN ATTRACTIVE INTRODUCTORY STATISTICS COURSE

Five years ago the Director of the School of Statistics, the teachers of the introductory statistics courses, and the Directors of the schools of the Faculty of Social Sciences met to exchange views on the content and nature of the introductory statistics courses. As a result several recommendations were proposed. The author of this paper, acting as co-ordinator of the teachers in charge of the several classes of Statistics for the Social Sciences I, and assisted by them, implemented various changes in the course. These changes stressed the need of:

- a) Giving more emphasis to statistical concepts and principles, planning and data collection design, probabilistic sampling, measurement levels, data quality, analysis, interpretation and presentation of results.
- b) Eliminating unnecessary formulas and lengthy arithmetical calculations.
- c) Exposing students to current real data to make them appreciate the relevance of statistics to understand social issues and its role in descriptive and explanatory research in the social sciences.
- d) Teaching students the use of Excel's spreadsheet in coding, entering and cleaning survey data, and producing basic statistics, tables and graphs.
- e) Increasing active class participation through more discussion of current social issues, e.g., increasing abstention rates at national elections, aging of population.
- f) Assigning more time to solve practical problems in class.
- g) Setting the maximum class size at 35 to improve active participation and interaction of students in the classroom.
- h) Involving students with current social research work.
- i) Producing a textbook covering all the topics of the course and incorporating the proposed changes in teaching methodology.

In what follows we comment briefly some of the above changes.

EMPHASIS ON INTERPRETATION, STATISTICAL CONCEPTS AND PRINCIPLES

It is obvious that one or two introductory statistics courses cannot make social science students experts in statistical techniques. But even a single course can be of great value if it gives emphasis to statistical concepts, principles and real applications. Proving, or remembering, a formula is not as important as recalling statistical concepts and principles, searching for sources of variability or detecting different sources of bias.

The introductory statistics courses should aim to provide social sciences students with relevant concepts, principles and statistical terminology to enable them to recognize and analyze the statistical aspects of many social research problems, to interpret published results and its potential bias, to understand and use basic statistical methods with the aid of appropriate software (e.g., *SPSS*, *EXCEL*) and to communicate effectively their research findings.

The introductory statistics courses should also stress the value of statistical principles as an integral part of the scientific methodology and their relevance to research.

THE EXPOSURE OF STUDENTS TO REAL DATA

We believe that the best way to make statistics attractive to students and keep their interest in class is through classroom discussion of current social issues with the aid of statistical data. We mean real statistical data not realistic or fictitious data. Classroom discussion becomes

lively and enlightening when real data meaningful to students are described and analysed. This is something to be expected considering the fact that the introductory statistics classes are made up of students coming from such schools as sociology, social work, journalism or political science, where social issues are their main concern.

To make students appreciate the relevance of statistics, lecturers are encouraged to comment in class selected readings from the Annual Reports on the State of the Nation, an objective and extensive analysis of Costa Rican social issues based on recent indicators. Data from other sources, e.g., academic research work, opinion polls reports, newspapers reports, periodic household surveys, vital statistics or national electoral results, are also analyzed critically to illustrate the value of data to understand many current social problems.

Lecturers are also encouraged to divulgate their own research findings and other relevant research conducted within the Faculty of Social Sciences at the University of Costa Rica, e.g., opinion polling results on current social issues carried out by the Institute of Social Research. A closer contact with real data through the World Wide Web has been encouraged too. Students are asked to review electoral returns, unemployment rates, consumer price indices, opinion poll reports, etc. at appropriate sites.

STUDENT INVOLVEMENT IN RESEARCH

Active involvement of social science students in research work is an activity pursued in some of the courses belonging to their own schools, usually through group assignments. For this reason, in the introductory statistics course no group assignments of this type are given. Actually, one of the objectives of the course is to provide students with statistical techniques that they can apply in their own schools' courses.

However, each class of the introductory statistics course is involved in the process of collecting and analysing data through self-administration of a short questionnaire. Students are asked to provide information on variables such as age, weight, height, attended number of courses, current opinion on the performance of the incumbent president, voting intentions for the coming presidential election, etc. Treating the data as a mini-population, the course lecturers use it, as the course progresses, to illustrate different aspects of data management and statistical analysis: coding, entering and cleaning data, tabular and graphical presentation of data, calculation of correlation coefficients, etc.

THE NEED FOR AN APPROPRIATE TEXTBOOK

The success of an introductory statistics course depends to a great extent on the appropriate choice of the textbook. Most of the American introductory statistics textbooks translated into Spanish are not appropriate for teaching statistics to social sciences students taking SSSI. First, most of their examples and data are not attractive to students, either because of their fictitious nature or by not being related to Costa Rican social issues. Secondly, some topics of the SSSI course are not considered or treated appropriately by those textbooks. We must, however, praise an excellent book not yet translated into Spanish: *Statistics Concepts and Controversies*, by David S. Moore, which focus on statistical ideas and statistical reasoning, and makes statistics very accessible and attractive.

For many years the textbook for teaching SSSI was *Elementos de Estadística Descriptiva*, written by former Professor Miguel Gómez, of the School of Statistics of the University of Costa Rica. The book, published in 1979, was clearly written and included Costa Rican data from surveys, censuses and current research that made it very attractive to teachers and students.

At the beginning of 2002 the author of this paper embarked on the elaboration of a textbook that would implement the changes proposed for the SSSI course listed earlier. The book, *Estadística Elemental para Ciencias Sociales*, published by the University of Costa Rica in 2004, was adopted the same year as the textbook for SSSI. It covers all the topics of the course and includes plenty of Costa Rican data coming from the most recent Census, household surveys, vital statistics and national elections data. New editions of the book will include more social data coming from current research carried out in the University of Costa Rica and other academic sites. The aim is to make it an even more useful textbook for social sciences students.

FUTURE PROJECTS

There are several projects for the near future that involve efforts to incorporate more social research findings into teaching:

- a) Production of a series of readings with applications of statistical methodology in social research work carried out in the University of Costa Rica, to be available through the Web.
- b) Building of a collection of data sets using data analyzed in theses submitted at the Faculty of Social Sciences of the University of Costa Rica. These data sets would be used in the introductory statistics course as a means to involve students with social research data from their own fields.
- c) Design of a research project to conduct surveys within the Faculty of Social Sciences to study different aspects of the academic life involving students of the SSSI course to collect the relevant data.

FINAL WORDS

Cooperative efforts involving teachers and researchers should be encouraged for the benefit of effective teaching. Teaching statistics with real data is essential to make statistics attractive to social science students. Students become interested in statistics as long as they see statistics applied to data that have meaning to them. Promoting discussion in class around social issues contributes to highlight the value of data to public policy, and the need of having social theories to explain and interpret them. A textbook focused on statistical concepts, principles and the analysis of real social data, would contribute greatly to make an introductory statistics course an attractive and enlightening course for social sciences students.

The emphasis on real data, concepts and active learning has been prominent in the reform movement in statistical education aimed at the teaching of introductory statistics (e.g., Garfield *et al.* (2000), Moore (1997), and *Journal of Statistics Education*). We acknowledge its influence on the author.

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