Teaching statistics in labor, social, juridical or economic studies

Esteban Navarrete-Álvarez, María Jesús Rosales-Moreno, María Dolores Huete-Morales
(Department of Statistics & O. R., Faculty of Sciences, University of Granada, Granada 18071, Spain)

Abstract: Statistics teaching should not be carried out in the same way for all kinds of university students. Instead, teaching statistics should take into account the different fields of study that students have chosen. For example, students of sciences or engineering have different interests and backgrounds compared to students of any social or juridical field. The authors address this latter group of students (social, juridical, labor or even economics). The authors propose a direct approach: beginning with a real situation or supposition with real data. Questions of interest are explored and put into the language of statistics. To answer the questions, the necessary statistical methods are used. If needed, these methods are presented and explained at that time. Finally, the authors return to the beginning, to give an interpretation of the results. The approach takes into account the students' levels and the kind of studies or professional orientation of these students.

Key words: education; tests; teaching methods

1. Introduction, objectives presentation

In this paper, the authors introduce an experience carried out in the framework of the labor relations degree of the university. The work has the following objectives:

(1) To make learning theory and practice of statistics easier for students to pursue this degree;

(2) To incorporate new technologies in support of teaching statistics.

In today's society, there is a greater need to teach statistics to students with only a basic knowledge of mathematics. The objective for this teaching is to have students learn basic statistics tools and solve real problems that may appear in their future careers. This, related to the possibilities that new technologies will be offered in the teaching field, demands changes in statistics techniques teaching and it is a challenge for the professional teachers. This is the reason why the authors' efforts are oriented to guiding their students:

(1) To understand and appreciate the role of statistics in their future careers;

(2) To assimilate and value the statistics method, that is, the kind of questions that an intelligent use of statistics can answer, the basic ways of statistics reasoning, and the power and limitations of statistical analysis;

(3) To understand the application and interpretation of the different chosen techniques to answer correctly real questions.

It is also desirable that students learn statistics by using new technologies at that time, when they stimulate the learning to become something educational. The presence of these educational resources in the university

Esteban Navarrete-Álvarez, lecturer, Department of Statistics & O. R., Faculty of Sciences, University of Granada; research field: survival analysis.

María Jesús Rosales-Moreno, lecturer, Department of Statistics & O. R., Faculty of Sciences, University of Granada; research field: survival analysis.

María Dolores Huete-Morales, lecturer, Department of Statistics & O. R., Faculty of Sciences, University of Granada; research field: demographic statistical.

teaching is a reality imposed by the practice and a dominant culture, based on the continuous presence of the image that drives all the teachers new ways of performance and expression.

At the same time, it is possible to look in detail the justification of the existence of this tool discipline (statistics), as basic tool to treat data of labor, juridical, economic or social field, and its interpretation. This needs more than 1 or 2 questions for these professionals, avoiding the great practice use that they have with the statistics tools. Moreover, the intellectual foundation is also the knowledge of such tools.

Students in the labor relations degree program need an intuitive, comprehensive approach where they do not get lost because of difficult theoretical developments or calculations. The basic difference in teaching statistics to different audiences (engineering, social sciences, etc.) is usually in the approach, the intensity or the kind of applications used.

The authors propose to generate all the content of the official program of the subject through suppositions directly related to the labor/juridical world. They also propose to generate a large collection of these real suppositions with real data, and develop them for use by the students.

The authors show the students the foundations of statistics (descriptive statistics, probability and inference), as well as solutions to problems, in a direct way. For that, they present the students with the practical reality throughout a real supposition of a labor/social/juridical/economic nature. The authors extract possible questions that can be observed in the supposition and present a solution interpretation within the context of the supposition. Normally, statistic teaching starts by introducing the concepts, developing the study of data characteristics and later, doing examples. This practice has been shown not to motivate students. The authors think that the students have to see the real situation from the beginning, and from this to extract and solve relevant questions.

2. Experience description

All these considerations have been taken into account to overcome the specific difficulties that are present in teaching statistics in the first year of the labor relations degree (there were 683 students registered in this degree program in the previous year, and 724 registered this year). These students are divided into 6 sections. Statistics is considered as a difficult subject for these students. The statistics course carries 6 credits (1 credit=10 working hours). The course is summarized in the following points:

(1) There are a limited number of hours to explain the theatrical and practical aspects for a basic preparation in statistics;

(2) There are a large number of students, most of them having no previous knowledge in statistics and low level of mathematics ability. The authors also emphasize the lack of motivation in the students when faced with a subject they see as unrelated to their chosen degree.

Taking into account the described reality and the proposed objectives, the authors' experience is oriented:

(1) To elaborate a teaching material;

(2) To improve teaching and learning using new technologies.

In relation to the teaching material, there exist many statistical texts oriented to other disciplines (biology, engineering, etc.) that develop the contents at different levels. However, there is a vacuum in the application of statistics to the labor, social or juridical fields. The authors' main objective has been to introduce a collection of suppositions involving real live examples from these fields. Next, to a serial of questions to them, those are logic and interesting to carry out an appropriate analysis of these situations. It will be the statistics method application

of descriptive statistics, calculation of probabilities, statistics inference, regression methods or times series, those that will give answers to the different questions explained. The objective is:

(1) To introduce the course material in an intuitive, natural way that related to the future careers of the students. This is carried out so as to increase the motivation and interest in statistical studies;

(2) To facilitate the learning of the course material by presenting different statistics methods and their application.

In all the suppositions, the following steps will be followed to reach a resolution to different questions proposed:

(1) Translating the questions into statistical;

(2) Justifying the statistical technique that will be used to help answer each question;

(3) Presenting a solution and comment on its interpretation.

The authors' procedure does not consist of creating problems or exercises in the classic sense. Instead, they present and study real situations (suppositions), which include specific data of the area and may be part of the future careers of students.

First of all, the authors start with a collection of real suppositions from the areas related to labor, social, juridical or economic nature, and with real or proposed data. A lot of suppositions have been collected from sources, such as national or local press (El País, El Mundo, Ideal, etc.), different websites of public or private organisms (National Institute of Statistics, Andalusian Institute of Statistics, Ministry of Labor), instructors' own research, etc.. Others, though are invented or inspired by other sources, tried to show a real and current situation. They can be considered as original statements, which cover different problems. In these, the authors made up questions that professionals in the fields would set out to answer. These questions were chosen to coincide with common questions in statistics exercises. The task of creating this collection of suppositions has been difficult. The authors have tried to include questions, at different levels, that cover all the material in the course. In this process, the authors have used other resources for example, Abad, et al. (2001; 2002), Batanero (2001) and Sirkin (1999), daily press, search in websites, etc.. This has obliged to a following treatment of suppositions and complementary questions, trying to introduce an important variety of themes and the use of a greater part of the statistics techniques that a future professional of this field has to dominate.

The authors then classified the suppositions into 3 categories according to the complexity of the statistical methods needed. After moving the authors' questions to the statistics language and justifying the statistics concepts and techniques that could be considered, the authors try to respond in a varied way. In this way, questions were answered by hand or by different statistics packets or programs (SPSS, statgraphics, etc.) or of general purpose, Excel, etc.. The authors translated the subject matter questions into statistical language and justified what statistical concepts and methods were needed. Sometimes, the solutions were produced by hand, at other time, using a statistical package. No statistical package was relied on exclusively. The result of this work is a packet of suppositions with solutions and comments.

At the end, the object was to answer the proposed questions scientifically and explain the solution by using the conventional juridical, labor or social language (Finkelstein & Levin, 2001; Ramsey, et al., 2002). The following is an example of a supposition that includes some questions:

> A study of unemployment benefits is proposed. For that, the following information is known. The average benefit that an unemployed person receives is 540 euros each month, 80% of unemployed people receive between 300 and 750 euros, and 10% receive more than 750 euros, according to a survey of the Centro de Investigaciones Sociológicas (CIS,

Sociological Investigations Centre). 69% of unemployed people consider this a low benefit as compared to 19% that consider that benefit for unemployment is enough. 70% of unemployed people believe that very often people that receive the unemployment benefit continue working, or working sometimes, a situation considered non-acceptable by unemployed people. Necessity and the lack of sufficient benefits justify this. The survey data were collected in November and December 1996 and January 1997 in interviews of 4,700 people.

(1) Identify the basic variable that is considered in this supposition. Comment on the suitability of any probabilistic sample to answer questions related to this supposition.

(2) With the data available, try to get the dispersion level that exists among the unemployed peoples' benefits. Are there contradictions in the data?

(3) Observe and comment on the mixture of different percentages included in this supposition.

The work developed has been fruitful in the publication of the book whose reference is Navarrete, et al. (2005). In regards to the teaching environment and how technology can motivate and facilitate the learning process related to the subject, the authors use Power Point to present the suppositions. They decided to use Power Point mainly because of its easy operation, viewing conditions and the strong support provided for using audiovisuals in the classroom. An example of some Power Point slides appears in Figure 1 and Figure 2. A web site with a clear and simple structure is used to make the material available to students [1].

Figure 1 Power Point slide 1

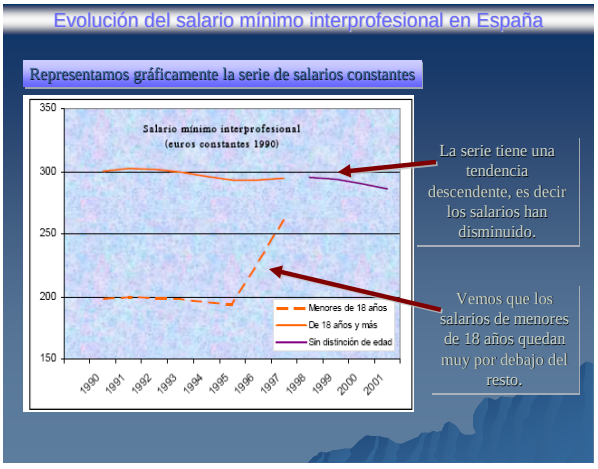

Figure 2 Power Point slide 2

[1] Retrieved from http://www.ugr.es/local/pidestrl.

3. Experience assessment

The authors use the exam for the course as an assessment of the students' progress. A higher percentage of students who used the suppositions pass the exam compared to those who did not use the suppositions. At the end of the course, the students completed a survey about their motivation level and their use of the course material. The data have shown an improvement in the valuation of the subject (see Table 1).

Table 1 Impact of the use of the suppositions

	Number of registered students	Attendance	Presented in an exam from the registered students	Passed the exam from the presented
Before	139	57	63	21
After	133	75	75	42

In order to show the impact of the use of the suppositions, the authors compare the performance of students in a section of the course before the suppositions were developed to a section of the course who used the materials discussed in this paper. The focus on this comparison was on class attendance, attendance at the exam and exam performance.

(1) Hypothesis test concerning the difference between the proportions of 2 samples from binomial distributions (registered-attendance) is shown in Table 2.

Table 2 Hypothesis test of 2 samples (registered-attendance)

Sample proportions	0.41 (sample 1)	0.56 (sample 2)
Sample sizes	139 (sample 1)	133 (sample 2)
Confidence interval for difference between proportions (95%)	(-0.2675; -0.0325)	
Statistic value	-2.47463	
p-value	0.01334	
Reject the null hypothesis for alpha 5%		

(2) Hypothesis test concerning the difference between the proportions of 2 samples from binomial distributions (registered-presented) is shown in Table 3.

Table 3 Hypothesis test of 2 samples (registered-presented)

Sample proportions	0.45 (sample 1)	0.56 (sample 2)
Sample sizes	139 (sample 1)	133 (sample 2)
Confidence interval for difference between proportions (95%)	(-0.2281; -0.0081)	
Statistic value	-1.8138	
p-value	0.0697	
Reject the null hypothesis for alpha 5%		

(3) Hypothesis test concerning the difference between the proportions of 2 samples from binomial distributions (presented-passed the exam) is shown in Table 4.

Table 4 Hypothesis test of 2 samples (presented-passed the exam)

Sample proportions	0.43 (sample 1)	0.56 (sample 2)
Sample sizes	63 (sample 1)	75 (sample 2)
Confidence interval for difference between proportions (95%)	(-0.3916; -0.0684)	
Statistic value	-2.7026	
p-value	0.0069	
Reject the null hypothesis for alpha 5%		

4. Conclusion

The experience in this paper shows that a considerable improvement exists in the students' results; the levels that appear in tables confirm this fact. Statistics teaching should not be carried out in the same way for all kinds of university students; some students' learning is better if the problem appears with real data and suppositions.

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