

## NEW METHODOLOGY FOR TEACHING STATISTICS IN BIOLOGY: AN INTERACTIVE GUIDE TO LEARNING WITH SPSS

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*An interactive guide of the SPSS programme is presented, consisting of a web portal and a programme emulator. From the webpage, students will be able to download didactic material that will introduce them to the programme. The developed SPSS emulator allows the student to learn how to use the programme and guides in the execution of Statistics exercises in an interactive way. Once the student has worked with these tools, the SPSS statistics package can be experimented on directly. It is intended that the student have available a complementary teaching aid to that of the instructor facilitating the learning of statistics by computer.*

### INTRODUCTION

In this paper we show an interactive guide of the *SPSS* programme. The development of the interactive guide is part of a wider project, the objective of which is to reform and improve the methodology utilised in the two statistics courses in the degree of Biological Sciences at the University of Granada (Spain).

The project arises from the reality of the statistical needs of a Biological Sciences graduate in the workplace and professional environment. The literature about teaching statistics and topics in this field is wide (Batanero, 2001; Batanero *et al.*, 2000; Lara Porrás, 2001, 2002). An updated programme is required that includes advanced techniques and computer training. This will serve as an indispensable tool for the analysis of data which students will come up against in their professional career. Additionally, it is intended that answers be found to the needs of teachers dealing with a series of difficulties within these courses, among which the following can be highlighted:

- A limited number of course units, insufficient to introduce all the contents specified by the Ministry of Education and Science.
- A high number of students in different teaching groups, requiring good coordination of imparted content.
- Biological Sciences students have no previous background in statistical sciences, due to it being non compulsory in their secondary education.
- The student's lack of basic computational knowledge and motivation in the usage of statistical programmes, which they will invariably use throughout their professional lives.

These problems were the motivation for a group of lecturers to initiate this project. Over a number of academic years, the teaching methodology for statistics in the Biology Degree has been modified and an *SPSS* emulator has been created to serve as an interactive guide for learning statistics by computer (our university has the licence for the *SPSS* programme).

### PREVIOUS EFFORTS

At the beginning of the Academic Year 2002-2003, the lecturers teaching the Biostatistics course and the statistics module in the Basics of Applied Biology initiated a joint venture, creating a workgroup for the renovation of both courses. The implementation of this project during the Academic Year 2002-2003 consisted of incorporating the computer into the classroom, the students' active participation in both subjects and the devising of specific documentation for the student body. From this venture, the following references have arisen: *García Leal et al.* (2003a, 2003b).

After a year of experience with the new methodology and having made an evaluation of the initial stage of the project, the following have been implemented:

- student specific documentation has been revised from a theoretical and practical point of view;
- a web portal has been created (<http://www.ugr.es/~bioestad/>) where the students may find all that is necessary for the courses;
- the utilization of multimedia for the clarification of student queries and tutorials;
- a handbook indicating necessary steps for the completion of analyses developed in theoretical sessions the application of which have been carried out during computational statistics tutorials;
- the efficient use of tutorials via electronic mail;
- the editing of *García Leal et al.* (2004).

Keeping in mind the experience acquired during the implementation of previous projects, and being conscious of the importance of computer training for the students' professional development as well as the little time available for that training, we have set as an objective to drive forward interactive and autonomous learning, achieving this through the creation of an emulating programme, new didactic material and a new web portal. For this purpose, an interactive learning guide has been created for the use of the *SPSS* emulator which incorporates several didactic advantages over the actual *SPSS* package. This interactive programme facilitates self-learning for students in and out of the classroom.

#### COMPUTATIONAL INTERACTIVE GUIDE

What follows is a description of an interactive guide (performed by the authors of this paper) meant to act as a teaching aid for course assignments at which the project is specifically aimed. With this guide, it is intended that the student be able to self-learn the use of the *SPSS* programme with only the computer as assistance.

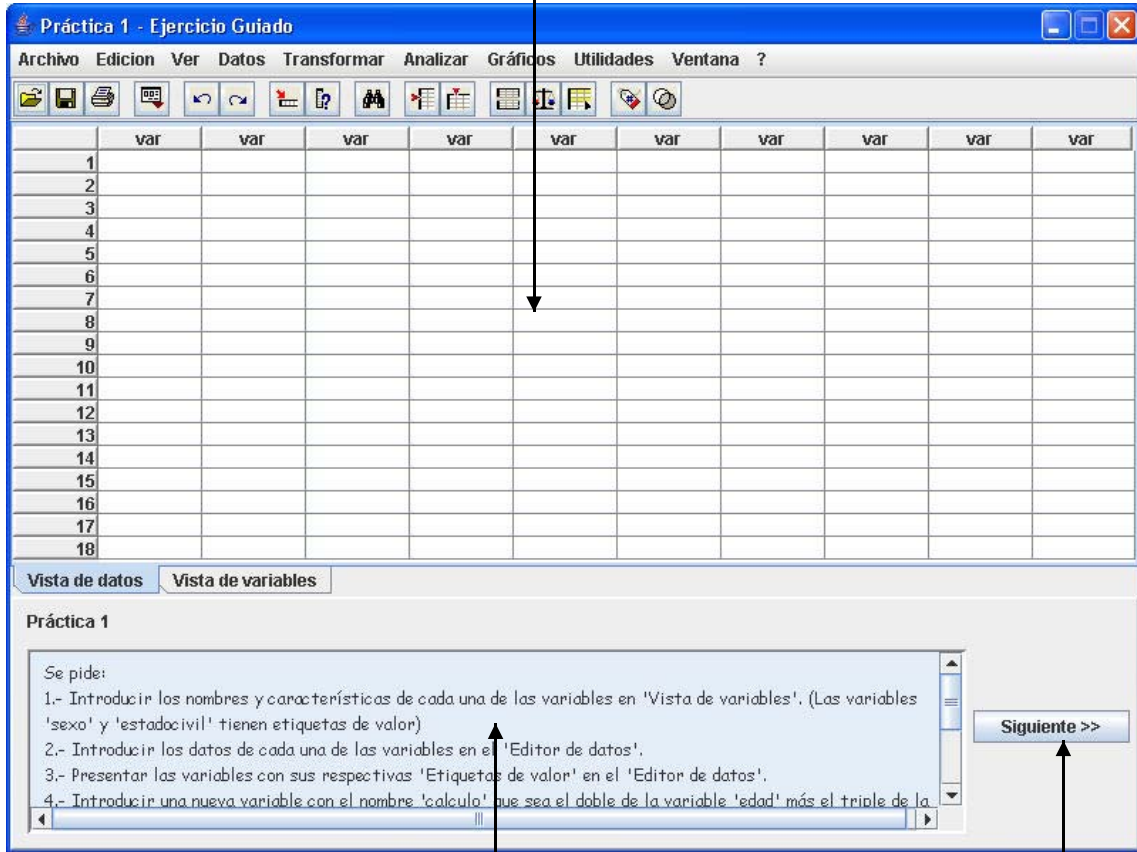
The guide consists of two sections:

1. *A Web Portal* where the students are presented with different exercises based on *SPSS*. Each session contains an introduction to the use of the programme via an *SPSS* exercise completed step by step using the emulator. In this manner, the student will become familiar with the interface and different options and screens of the *SPSS* programme. Finally, a full exercise is presented.
2. *An SPSS programme emulator*. The *SPSS* emulator is to be used once the student has read the documentation and information relevant to the exercise presented (all this through the web portal). At this stage, interactive contact is made with the programme, its function being to guide the student through a specific exercise. The principal characteristics of the *SPSS* emulator are as follows:
  - It outlines several exercises with tips which the student must complete step by step, simulating a real *SPSS* environment.
  - The programme will supervise progress, informing with pop-ups when errors are made and even providing clues to help the student think about any mistakes and correct them.
  - Completion of an exercise under the guide of the *SPSS* emulator is always divided into steps. Each step is interactively explained in a sequential manner, i.e., it is not possible to proceed to the next exercise until the previous is correctly completed.

The functionality of the implemented emulator is but a simplification of the *SPSS*. The emulator only has available to it the options specific to the correct completion of the guided exercises (only accepting data specified by the exercise). Other functions are deactivated. It is not intended that the emulator be a substitute for the *SPSS* programme, rather that it act as a simplified parallel application presenting a graphic interface similar to that of *SPSS*. The student should be completely familiarised with the environment and with part of the functionality, such that at the time of actual usage there is the necessary knowledge for completion of real assignments. It can be said that the computer is a virtual tutor, which will guide through self-

learning, indicating and advising when errors are made. Below is shown an image of the emulator indicating its main segments.

*Upper segment:* An interface similar to that of the SPSS programme, but with limited functionality.



*Lower segment:* dialogue window where step-by-step completion of the exercise is provided, briefly outlining any actions to be taken on the upper segment (the emulated SPSS interface).

*Next button:* This button must be clicked by the user in order to indicate to the emulator that a step has been completed. If the step is completed satisfactorily, the dialogue window will show the completion of the next step of the exercise; if the step was not completed, the error will be indicated to the student and will remain in this state.

Various technologies have been used for the creation of the two parts of the interactive guide:

- *Web Portal:* implemented via *HTML + JavaScript*, easier access to information is achieved. Any internet user may access this portal, which is intended to be the environment the sessions are completed in. The user is not restricted to a specific operating system or web navigator, as the web technology utilised is universal.
- *SPSS programme emulator.* For the purposes of ensuring that the application is fully portable to any user environment, the implementation of the emulator has been executed using JavaScript, one of the most commonly used programming languages due to its multi-functionality across any operating system (Windows, Linux, Mac,...)

This didactic material will be distributed in CD-ROM format, which will include the Web Portal, the SPSS emulator, additional software such as the Java Virtual Machine and some free licence web navigators. Eventually, this guide will also be available on the internet via the Web Portal.

The final objective of this guide is its availability to students on the internet via the Web Portal, around which the technology for the guide is based. Through the Web Portal, the student will be able to consult the documentation relevant to assignments and complete the guided exercises with the SPSS emulator.

## CONCLUSION

Methodological changes in the teaching of some subjects such as Statistics in experimental degrees are a necessity and a challenge for academic staff. Without losing course content and importance, the introduction of the computer to the classroom, in a bid to involve less theory and more practical work, allows the student to understand and assimilate the contents of the subject in a more efficient way. The development of new technologies and their incorporation into society encourages its use in education. It is already a reality that a student may access, from any location, part of the teaching material and be in touch with teaching staff for any queries that may arise. This new way of teaching Statistics has yielded optimum results during the time it has been implemented. As has been said throughout this paper, we wanted to be more ambitious and have created an interactive computer programme for self-tutoring of the SPSS programme.

We believe that our experience might be useful in similar contexts, i.e., in subjects with wide-ranging content, limited course units and where it is convenient to carry out practical sessions on the computer.

## REFERENCES

- Batanero, C. (2001). *Didáctica de la Estadística*. Granada, Spain: Grupo de Investigación en Educación Estadística, <http://www.ugr.es/local/batanero>.
- Batanero, C. and Godino, J. D. (2000). *Análisis de Datos y su Didáctica*. Granada, Spain: Departamento de Didáctica de la Matemática.
- García Leal, J., Porrás, A., Álvarez, E., Rico Castro, N., Montoya, Y., Castro, J. E. and Sánchez Borrego, I. R. (2004). *Estadística para la Biología* (Plácido Cuadros edition). Granada, Spain.
- García Leal, J., Porrás, A., Álvarez, E., Rico Castro, N., Montoya, Y., Castro, J. E. and Sánchez Borrego, I. R. (2003). *Introducción a la Estadística para Biología* (Plácido Cuadros edition). Granada, Spain.
- García Leal, J., Porrás, A., Álvarez, E., Rico Castro, N., Montoya, Y., Castro, J. E. and Sánchez Borrego, I. R. (2003). *Técnicas Estadísticas para Investigación en Biología* (Plácido Cuadros edition). Granada, Spain.
- Porrás, A. M. (2001). *Diseño Estadístico de Experimentos, Análisis de la Varianza y Temas Relacionados. Tratamiento Informático Mediante SPSS* (Proyecto Sur edition). Granada, Spain.
- Porrás, A. M. (2002). *Estadística para Ciencias Biológicas y Ciencias Ambientales. Problemas y Exámenes resueltos*. (Proyecto Sur edition). Granada, Spain.