

## POSTER SESSION

### Abstracts

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### DRAWING LSE REGRESSION LINE: AN EDUCATIONAL COMPUTER PROGRAM FOR IBM PC

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Although some people do not realize it yet fully, educational packages are something different from professional computational packages. Educational statistical packages have as their aim the explanation and reinforcement of some of the concepts and basic ideas of probability and mathematical statistics. When working with the package the student must be active, i.e. being faced with some questions he is forced to make some decisions or to undertake some actions.

PS-STAT elaborated in Wrocław is such a package for IBM PC computers with EGAVGA or HERC graphical cards. The package is designed as an auxiliary tool for a laboratory supplementing a course for non-mathematical students, e.g. psychologists or biologists. It comprises at present 18 separate modules - each of them can be run separately without keeping the others in the computer core.

One of these modules has as its aim the training of students to draw a regression line. First the data are read in or the rule of generating pseudorandom data is established. The data points  $(x, y)$  appear on the screen together with two pivotal points. Each of these pivotal points can be moved (displaced) on the screen so long as the student thinks that a line passing through these two pivotal points would be the LSE regression line. After pressing the F3 and the F4 keys, the student's line and the true LSE line appear (or disappear) on the screen. The respective residual sums of squares and the regression equations are exhibited too. The student can obtain additional information (help) about the principles of estimation the LSE line and the formulae used. Formally the program is part of the package PS-STAT and can be called from a common menu, none the less it can be run separately without keeping the others in core.

The package was partially sponsored by the Polish Research Council and can be obtained free after sending two HD diskettes to the authors.

## NEW OPENINGS FOR TEACHING APPLIED STATISTICS IN THE ACADEMIC COURSES

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This poster shows the results of a survey carried out in order to verify the diffusion of the teaching of applied statistics at the Faculties of Economics and Commerce and Statistical Sciences in the Italian University.

Particular attention has been paid to the identification of disciplines that, in recent years, have increasingly required the adoption of statistical methodology as an analytical tool.

The research has been extended to the fields of interest for the applicability of technical methods of statistics. Consideration has also been given to the developments achieved in those subjects which have existed for a long time in the Italian university didactic system (demography, social statistics and economic statistics).

Information has been obtained through a questionnaire sent by mail and submitted to instructors of applied statistics who are also members of the Italian Statistical Society.

The questions were fundamentally concerned with the framework of the courses with regard to possible collaborators, to the features of the statistical work done with students and also to new teaching methods adopted, if any.

Instructors have been invited to express their opinions in relation to the connections between their subject and the disciplines which are propaedeutical to it, and those ones with respect to which applied statistics has a supportive role.

Moreover, some remarkable shortcomings came out during the interview due to the lack of co-operation and co-ordination between statistical subjects and the disciplines with probabilistic-mathematical contents.

Instructors also complained about the limited availability of stable collaborators and about the lack of equipment suitable for the more sophisticated methods.

Nevertheless, the increase and the great range of today's methods used in statistical training are exhibited together with the traditional ones, as both constitute a substantial support to the teaching of applied statistics.

Finally, some proposals are outlined with regard to the efficient reorganization of academic courses, on the basis of indications which arose from the survey.

### STUDENTS' VIEWS ON EDUCATIONAL ASPECTS OF STOCHASTICS

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This presentation summarizes answers of 250 students of the Middle East Technical University who are subjected to a compulsory course in probability and/or statistics. A questionnaire, which aimed at collecting information about:

- their views on the educational aspects of statistics;
- their personal views and experience of other people's perception of the random phenomena and ways of thinking;

was administrated in various groups of university students either before or after taking such a course in January 1993.

The poster details the questions asked, and a number of bivariate contingency tables and the frequency distributions of some items.

We are aware that our data provides just a rough orientation. Nevertheless, some of the findings may be generally valid. We have not found any significant difference between the answers of boys or girls. Neither does there appear to be any significant difference between the age groups or students of different attendance years. It is somewhat surprising that students' opinions do not depend strongly on the number of courses completed. The difference can be spotted, however, if the courses were completed with good grades.

It is also instructive that more than 40 per cent of the students has definite opinions on how to improve teaching. The majority of them consider everyday examples, classroom experiments and discussions of games as important means in this direction. Some of them urge an improvement of the quality of teacher training or suggest increasing the allocated time.

## THE TEACHING OF STATISTICS AT THE UNIVERSITY LEVEL

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The recent inclusion of Statistics in faculties where it is of an applied nature raises questions concerning the diverse contents and approaches in the various fields of study and also the instructors' adaptability in teaching the peculiar features of each field.

To determine how statistics courses are inserted in the different university degree programmes we sent out a questionnaire with a few, essential questions about the instructor's position, classes offered, textbooks and possible experimental didactic methods.

On a first glance basis, we have observed that the instructors generally are on the roll of other faculties. We have also noted that the contents and textbooks per course differ greatly and generally the contents are taught using traditional methods.

The responses appear to show that close collaboration between statisticians and the various field instructors has not yet been established.

## STATISTICAL EDUCATION IN MEXICO

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The teaching of statistics at university level in Mexico is a relatively recent development. The majority of statisticians with doctorates have completed their studies in other countries. This study offers an analysis of the situation as regards the teaching of statistics at university. In this case emphasis is placed primarily on two examples of the National Autonomous University of Mexico (UNAM) and the Mexican Autonomous Institute of Technology (ITAM). Two different aspects are considered: the professions that produce statisticians and those which make use of statistics as an aid to their work.

## REACHING OUT TO INSTITUTIONS BEYOND LAHORE

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One of the main problems faced by the existing system of statistical education in Pakistan is that, during the past few years, the programs of study have not been application oriented. Undue emphasis on textbook material at the FA/FSc and BA/BSc levels promotes in the students rote-learning of definitions and formulae, and impedes students' ability to apply statistical concept and techniques to real-world situations.

The academic year 1991-92 witnessed a number of efforts made by the author to promote the idea of project-based teaching and learning of introductory statistics in the city of Lahore. These included Kinnaird's Visiting Statistical Exhibition (KVSE) which aimed at motivating students of various colleges to participate in Kinnaird's Inter-collegiate Statistical Competition (KISC), and was taken to thirteen different colleges of Lahore.

The academic year 1992-93 has witnessed efforts aimed at extending KVSE and KISC to other cities and towns of Pakistan. In doing so, the objective is to spread the message to various parts of the country that small-scale statistical projects can prove to be very interesting for students, not to mention the benefits of such projects in enhancing students' understanding of statistical concepts and techniques. Wide-spread acceptance of statistical project-work at the FA/FSc and BA/BSc levels may play a key role in the improvement of statistical education in Pakistan.

This paper presents the methodology that was adopted to extend KVSE and KISC to other towns/cities during 1992-93, the response received from the institutions that were approached, and some possible strategies for greater success in future years.

## SPRINT - ANALYSIS OF A GAME

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Sprint is a simple game for children: there are four runners (the Hare, the Squirrel, the Tortoise and the Snail) each one with a given speed (expressed by the values shown on the sides of the relative dice, that is, 4-3-3-2-2-2, 3-3-2-2-1-1, 2-2-2-1-1-0, 1-1-1-1-0-0, respectively), who must complete four different rounds of the length, in the order, of 32, 24, 16 and 8 squares. At each turn, each runner throws his dice and goes forward the number of steps indicated.

To win two different hypotheses were taken into consideration:

- a) The person who reaches the last square first wins (without needing to pass it);
- b) the person who passes the last square wins, and if two players pass the last square at the same time, the one who goes furthest wins.

A class experience (in a third year elementary) resulted in the following conclusions:

Under hypothesis a) each runner needed an average of 12 throws to finish the round. Therefore equal probability of winning; the game was said to be well balanced.

Under hypothesis b) it was maintained that the Hare had an advantage, followed by the Squirrel, the Tortoise and the Snail, in that order.

But computer simulation using a Pascal programme gave different results:

Under hypothesis a) the winning percentages out of 80,000 races were: Hare 16.06%, Squirrel 20.54%, Tortoise 27.16%, Snail 36.24%.

Under hypothesis b) the winning percentages out of 80,000 races were: Hare 22.97%, Squirrel 24.8%, Tortoise 27%, Snail 25.16%.

The most important aspect from a didactic point of view isn't to have found the solution of the game, but to have discovered what the computer can do; it allowed us to notice the error and helped us to remediate it.

## TEXTBOOKS AND STATISTICS IN ITALIAN PRIMARY SCHOOL

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The poster presents a critical comparison between the objectives of the educational material covered under probability and statistics for the primary school and some of the teaching proposals presented in textbooks and teacher's guides.

In the statistical section there is a critical analysis of the most common approaches:

- It is noted that, in general, no difference is made between quantitative characters and qualitative ones.
- Errors in graph construction are observed.
- Reference is made to the fact that there is a constant incoherence between the minimum and very important objectives posed by Education Ministry Programmes and the teaching proposals that tend to convey a much wider array of subjects but in a mistaken, confused and superficial manner.

In the probability section there is an indication of the characteristics that are generally found in textbooks and teachers' guides:

- Some of the proposals introduce the classical measurement of probability already in the first year or at the beginning of the second year of the primary level, and then move on to explain situations that apply in complex events. This material is not requested in the programmes and is very difficult to understand.
- These proposals consider the terms "probability" and "possibility" as synonymous; the term "probable" is used as synonymous of "easy" or "frequent".
- Very often the classical probability is introduced by means of frequency methods that are based on coin tossing or dice rolling, both of which exclude the fundamental aspects of uncertain situation observance (information analysis) and substitutes it with some trials.
- The probability value found by means of frequency seems to correspond to the trials already done; no importance is given to the



assumption that this can be taken as measurement of probability that results from random experiments.

- The number of trials is decided in an arbitrary way.
- The probability measurement using frequencies, which is relevant in cases where classical measurement cannot be applied, is totally ignored.

### USES AND MISUSES OF STATISTICAL METHODS IN FORMULATING AND IMPLEMENTING EDUCATIONAL POLICIES IN A CENTRALLY CONTROLLED EDUCATIONAL SYSTEM

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The Greek government that took office in the Spring of 1990 decided to make changes at all levels of education in Greece.

In order to make the intended changes more easily acceptable to voters the Ministry of Education decided to send out questionnaires to all persons that could be affected (directly or indirectly) by the intended changes.

As far as university education was concerned questionnaires were sent to all faculty members of all the universities in Greece, to university students (through their representatives) and to interested parents.

For primary and secondary education similar questionnaires were sent to teachers (through their unions) to parent groups and to students.

The negative aspects of the results of the approaches and the methodology employed, as well as the misuse of statistical methods by the government in order to achieve its political objectives are discussed.

STUDY OF DISTRIBUTIONS OF SAMPLE MEAN AND  
SAMPLE VARIANCE OF RANDOM SAMPLES  
FROM A STANDARD NORMAL DISTRIBUTION:  
COMPUTING SIMULATION

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This experience, made in a statistical laboratory for the more advanced class in a technical institute for computer science, is realized to verify that the sample mean and the sample variance have, respectively, a normal distribution and a chi-square distribution.

The steps to follow are:

- 1) to generate  $m$  random samples each of  $n$  elements from a standard normal distribution;
- 2) to calculate, for each sample, the mean and the sum of the squares of the observations;
- 3) to make the frequency distribution of the  $m$  sample means and of the  $m$  sample variances (grouping the observations into  $k$  class intervals);
- 4) to determine, for each distribution, the probability,  $p_i$ , that the particular hypothesized distribution would assign to the  $i$ th class interval by a numerical method of integration (Bezout, Cavalieri Simpson), and to calculate the expected number,  $m \times p_i$ , of observations in the  $i$ th class interval ( $i = 1, 2, \dots, k$ );
- 5) to apply the chi-square test to verify the goodness of fit.

The result of the chi-square test and the graphic comparison between the generated distributions and the hypothesized distributions by modifying the input parameter  $m$  and  $n$  allow to confirm what it was studied during the theoretical lessons.

## MULTI-MODAL LEARNING IN STATISTICS

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A pilot project in *multi-modal learning* (MML) is under way this year for Applied Science students at Swinburne's small Eastern Campus (EC). The introductory applied statistics unit "Data analysis and Probability" is one of four taught by this method. MML involves students in different "modes" of interaction with staff and peers on the main campus (i.e., EC). Other modes involve the student working at home and communicating via e-mail and electronic bulletin board with staff and peers (home mode) and meeting at local "learning centres" for remote tutorials and discussion groups (sub-core mode).

A first requirement of teaching in a MML context is the preparation of a comprehensive "Learning Guide".

The poster discusses progress so far with MML as a whole and the Learning Guide.

## STATISTICAL EDUCATION IN GREECE

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Statistical education has not made great steps at the primary and secondary levels of education in Greece. As a result, school leavers who seek entrance to the university do not have a very clear idea as to what exactly statistics is. On the other hand, potential employers of university graduates both in the public as well as in the private sector appear not to be fully aware of the advantages of employing persons with statistical training.

The opportunities and constraints faced in an environment of such factors, among others, by the Department of Statistics of the Athens University of Economics and Business are discussed, four years after its establishment.

## CURRENT DEVELOPMENT OF STATISTICAL EDUCATION IN CHINESE AGRICULTURAL UNIVERSITIES

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### 1. A comparison of statistical education contents

In the early 60s, statistical education in Chinese agricultural universities was very limited. Four year B.Sc students had only about 20 hours of statistical education and 50 hours of mathematics on the average. Only a few staff could give lectures on the level of multiple regression in these universities.

There were no significant changes until 1976. However, a big innovation occurred in 1977. During the 1980s, calculators were widely used in classes. The lecture programs in statistics increased to 60-70 hours plus 20-30 hours practice. Probability and statistics, linear algebra and computer programming were designed for first degree students. However, there was a slower increase in statistical education programs in the 1990s due to the limitation of computer facilities.

Table 1. *A list of statistical education contents and lecture hours on B.Sc students (Jilin Agricultural University, P. R. China)*

	1960s	1980s	1990s
Mathematics	50	90	120
Linear algebra	0	20	30
Probability & statistics	0	30	40
Biomerry	20	80	90
Sample statistics	12	10	10
Experimental design	2	10	20
Analysis of variance	4	25	20
Regression	2	35	40

A survey example of Jilin Agricultural University, P.R. China is given in Table 1. The results, to some extent, represent the average level of

statistical education in about 80 Chinese agricultural and forestry universities. It has reached the theoretical level of the current British education on M.Sc. programs of non biometry students.

## **2. Problems and discussion**

(1) Computer facilities in Chinese agricultural universities are much more limited in both numbers and efficiency. The lack of computers is caused by financial problems. The lower efficiency of computers is due to software problems and computer supported services systems.

(2) There is a gap between those who teach mathematical statistics and those who teach biometry. Statistical instructors lack knowledge in biological science, and on the other hand, most biometry teachers are agronomists who are short of statistical knowledge. This gap will be a big obstacle to the further development of statistical training and education in agricultural universities.

(3) Existing teaching materials, such as text books and teaching facilities, need to be enriched by current statistical theories and methods as the majority of text books in Chinese agricultural universities were edited and written in early 1980s. Some of the contents are out of date and simplistic, and new statistical methods are not included.

(4) Statistical service centres and computer service centres need to be established in agricultural universities so as to meet the need of further development of statistical education in agricultural universities.