

EDUCATIONAL MATERIAL FOR CLASSES ON PROBABILITY AND STATISTICS

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ABSTRACT

The aim of this work is to develop educational material applied to transport matters to support practical classes on Probability and Statistics of the Civil Engineer Course. This material concerns Descriptive Statistics, Probability Theory and Inference, and the data used comprises (i) flow of people by mode of transport that arrive at the university campus, (ii) the number of passengers that get and alight buses, and (iii) queue of buses at bus stops (iv) number of ships that arrive at the Port of Santos. The method comprises practical work on computers which shows basic commands of the statistical software MINITAB to be used in the solution of proposed exercises. Tutorial is provided by a discussion list of a kind of university intranet for such a group of students.

Keywords: Probability and Statistics, Computer-based learning, Instructional material

1 - INTRODUCTION

The aim of this work is to present educational material for the discipline Probability and Statistics. It is part of a project called REENGE - Reengineering of Teaching

Engineering that has been carried out by the Department of Production Engineering of Espírito Santo Federal University.

The project intends to approach the practice of transport studies to the theory that is taught in Probability and Statistics through computer-based learning and instructional material.

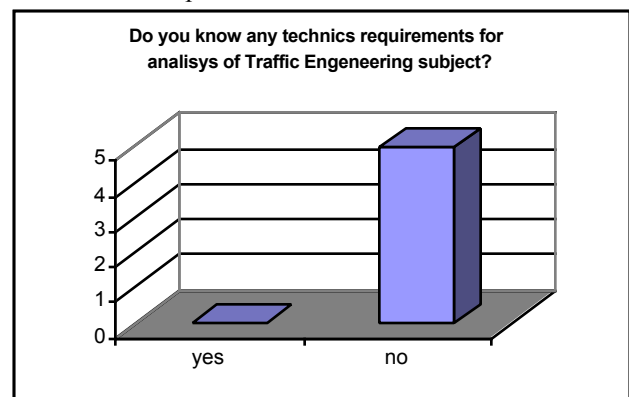
A part of this project is the evaluation of students' satisfaction during the course on Probability and Statistics, as well as the applicability of this subject to subjects related to Transport. It is also

evaluated the students ability to use personal computers.

Questionnaires, based on Ramos, E. et al. [4], have been applied to Civil Engineering students who have attended Probability and Statistics in 1996 and 1997. The analysis of the information collected along the academic cycle life of a group of students allows the identification of necessary changes that are required to be applied in the teaching of Probability and Statistics in order to match this subject to the requirements of transport matters.

2 - SOME RESULTS

The site www.ufes.br/ctufes/reenge shows some results of this project. A brief analysis of the tabulated data is presented here.



Picture 1 – Do you know any technics requirements for analyses of Traffic Engineering subject?

Data collected on the professional students of the course showed that the large majority of them did not have the necessary knowledge on Probability and Statistics to attend classes on Traffic Engineering. This is clearly shown in picture 1.

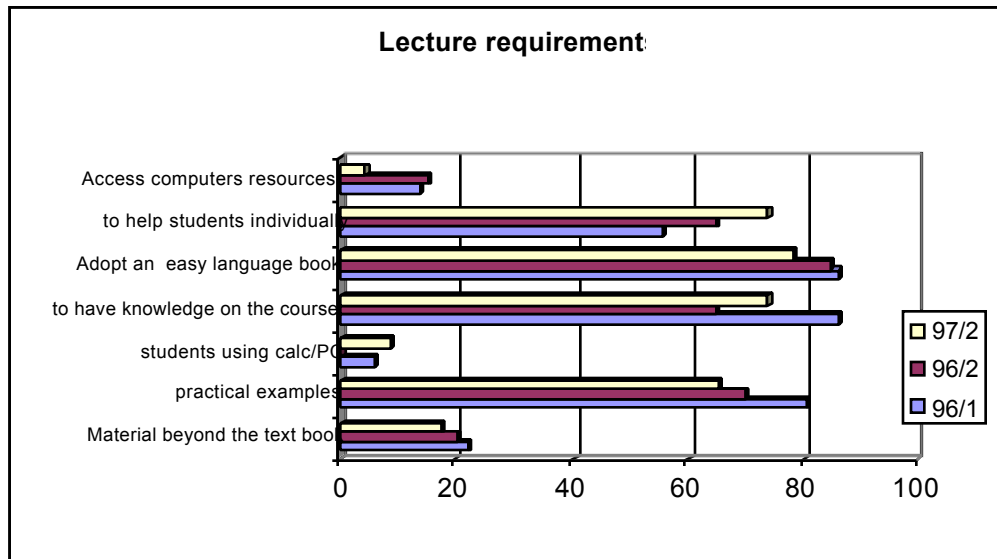
There were approximately equal percentages of students by sex in the 1996/1 to 1997/2 surveys. About 60% of the undergraduate students had technical degrees on the secondary school, what

reflects the lack of philosophical scientific background of them.

Concerning computers, 76% of the students researched in 1996/1 make use of computers at home, while decreasing percentages of 61% and 47,8% were observed in 1996/2 and 97/2 surveys respectively. On the other hand, the use of university machines have increased from 12%, in 1996/1 to 21,7% in 1997/2, what leads to the conclusion that the university has

been improving infrastructure and also encouraging the use of such a technology . Unfortunately, the use of computers as a typing machine is reported by an increasing number of students : 71% in 1996/1, 80% in 1996/2 and 1997/2.

In 1996/1, a percentage of 44% of the students failed once on Probability and Statistics, while 25% in 1996/2 and 8,7% in 1997/2.



Picture 2 – Lecturer requirements

The cause of the failure were 73,3% related to insufficient final mark, rather than to facts like abandonment and faults, what reinforces the need of a more attractive and understanding methodology for the subject.

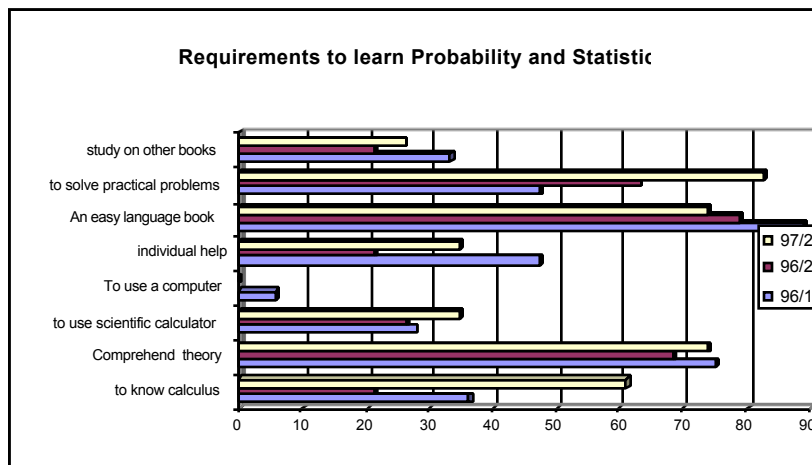
Regarding the instructional material, an average of 83% of the students reported that a good text book is a basic requirement to learn Probability and Statistics. The students also agreed that it is very important to know very clearly the objectives of the discipline, as well as to understand theoretical concepts through practical examples. The questionnaire of 1996/1 showed that 82,4% of the students suggested reformulation in the contents of the subject, while only 60% of them in 1996/2 and 17,6% in 1997/2. In the vision of those researched, Probability and Statistics is a tough subject to learn and about 66% of the students would not attend it in case they were not obliged to.

To support the students' learning, it is provided instructional material which comprises practical exercises on Probability and Statistics applied to the area of transport. It is provided a kind of menu containing the basic steps and commands of the software MINITAB necessary for the resolution of the proposed exercises.

The instructional material was based on two dataset collected by the “Nucleo de Transportes- NUT” , UFES shown by Faé (1996), and also in the data shown by Novaes (1975). The data by NUT is given by a origin and destination survey applied to a sample of the academic community. The sample was segmented by functional category and faculty The other data collected is based on a survey carried out on bus stops.

and statistics

3 - INSTRUCIONAL MATERIAL



Picture 3 - Requirements to learn Probability

A practical example of the instruction material using the data by Novaes (1975) is giving below :

Given the attached data concerning the number of ships that arrive at the Port of Santos during 1971,

- (i) Set up a table of relative frequencies
- (ii) Find the Poisson probabilities considering the mean \bar{X} as an estimate of λ .
- (iii) Compare the empirical and theoretical results by drawing graphics.

Steps to open the database (see figure n.º1).

Open the MINITAB software.

In the menu *File* click the option *Open Worksheet*. Select the drive and the work directory (chose *Poisson.mtw*)

Click the option *OK*.

- (i) Steps to set up a table of relative frequencies

Click in the menu item *Stat*, followed by *Tables* and *Tally*

Select the variable **NumDias** and then select the options *Percents* e *Cumulative percents* as shown in figure 2.

Click *OK*.

Using the results previously obtained, generate new variables as shown in the figure n.º3

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
1	NumDias	Percent	PercAcum							
2	4	0	0.00	0.00						
3	8	1	0.27	0.27						
4	6	2	1.10	1.37						
5	12	3	1.37	2.74						
6	6	4	1.10	3.84						
7	11	5	6.03	9.86						
8	8	6	8.22	18.08						
9	8	7	8.27	26.35						
10	5	8	13.15	40.00						
11	11	9	10.68	50.68						
12	8	10	15.89	66.58						
13	13	11	9.86	76.44						
14	11	12	6.30	82.74						
15	3	13	7.40	90.14						
16	13	14	2.74	92.88						
17	13	15	3.29	96.16						
18	2	16	1.10	97.26						
19	15	17	0.55	97.81						
20	6	18	1.10	98.90						
21	6	19	0.82	99.73						
22	11	20	0.27	100.00						
23	8									
24	10									
25	13									

Figure n.º 1

Computation of relative frequencies

Click in *Calc* followed by *Mathematical Expressions...*

Select the variable **Percent** in the menu item *Variable (new or modified)*.

Type **Percent / 100** in the item *Expression*

Click *OK*

Repeat the above steps for the variable

PercAcum

(ii) Steps to find the Poisson probabilities considering the mean as an estimate of λ .

Computation of the mean

Click in *Stat* followed by *Basic Statistics* and *Descriptives Statistics*.

Select the variable **NumDias**.

Click in *OK*.

Computation of Poisson probabilities

Click in the option *Calc* followed by *Probability Distributions* and *Poisson*.

Type 9.47 for the mean, and chose **Frequen** in the item *Input column* and **C5** in *Optional storage* (see figure no.

4).

Click *OK*

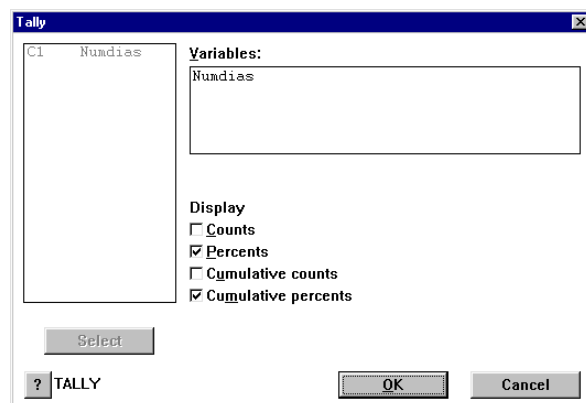


Figure n.º 2

Figure n.º 3

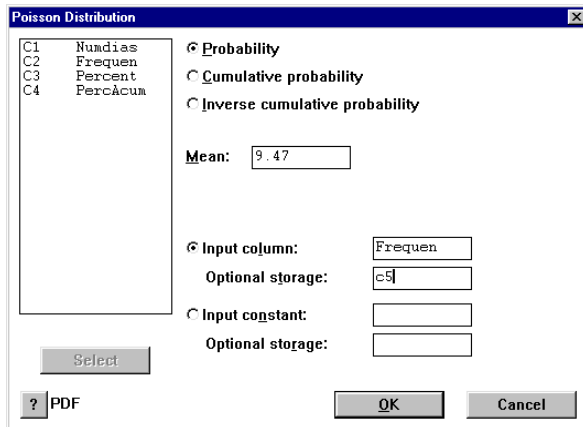


Figure n.º 4

Compute the accumulated probabilities, considering **C6** in the menu item *Optional storage*. Rename the variables **C5** and **C6** as **ProbPos** and **ProAcuPo** respectively.

(iii) Steps to drawing graphics in order to compare the empirical and theoretical results

Click in the menu item *Graph* followed by *Plot*. Select the variables **Percent** and **ProbPos** for the axis Y and **Frequen** for the axis X. In the command *Display* chose the option *Connect*. In the menu item *Frame* select *Multiple Graphs* and then select the option *Overlay graphs on the same page*. Click in *Ok*. The window shown in the figure n.º 5 will appear.

In the menu item *Edit Attributes* select *Line Type* and *Solid*. Chose *Line Color* and select the colors for the graphics (in this exercise chose 2 colors).

Click in *OK* twice.

Repeat the above steps to drawing graphics for the variables **PercAcum** and **ProAcuPo**.

4 - ELETRONIC TUTORIAL

A computer laboratory was projected with the following facilities : machines Pentium, printers, statistical and transport related software, intranet and connection to the internet. Electronic tutorial system was proposed by Meneses and Tavares (1996), giving the students the opportunity to have an electronic discussion list. Such a list may contain handouts, exercises list, database and FAQ - Frequent Attention Questions for the doubts on the subject contents and the proposed exercises.

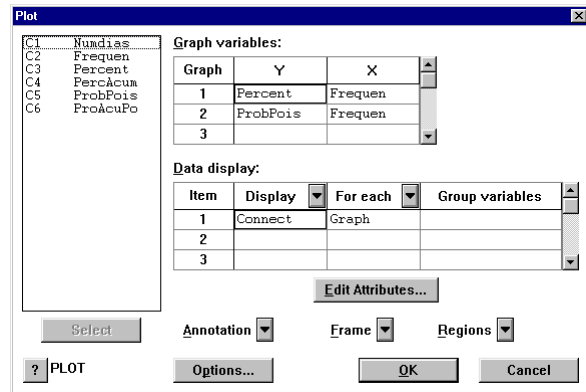


Figure n.º 5

REFERENCES

- [1] Faé, M.I. (1996) Notas de aula do curso Engenharia de Tráfego. Núcleo de Transportes, Departamento de Engenharia de Produção, UFES. Vitória, ES, Brasil.
- [2] Meneses, C. S. and Tavares, O. L. (1997) Networked Environment goes inquiry-based learning. International Federation of Information Processing, Santa Catarina, Brasil.
- [3] Novaes, A. (1975) Pesquisa Operacional e Transportes - Modelos Probabilísticos. Ed. Universidade de São Paulo. São Paulo, Brasil.
- [4] Ramos, E., Mendonça, N., Nasser, S. (1994) Avaliação da qualidade do ensino : fazendo e aprendendo. UFSC. Santa Catarina, Brasil