

## TEACHING PROBABILITY AND INFERENCE TO STUDENTS OF BIOENGINEERING IN ARGENTINA

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*In this paper it is described why and how the subject Probability and Statistics is included in the curriculum of the Bioengineering career in Argentina, explaining the profile of this career and the importance of teaching Probability and Statistics in it.*

### INTRODUCTION

I'm going to present how the subjects Probability and Inference are taught to students of Bioengineering in Argentina.

To begin with, I'm going to describe the professional profile of the career and its general objectives.

### PROFESSIONAL PROFILE

The bioengineering graduate has a wide knowledge on electronics, mechanics and computer science as well as on biological systems structure and functioning ; he is able to apply this knowledge to the utilization and creation of medical and biological instruments; he will be able to evaluate the installation, functioning and utilization of medical and biological instruments and materials in general.

### GENERAL OBJECTIVES OF THE BIOENGINEERING CAREER

- To develop creativity and capacity of research.
- To get the knowledge on organization and direction in the biomedical area.
- To develop systems or parts of acquisition system and processing signals of biological systems.
- To advice about technology of medical application.
- To design prosthesis and artificial organs.

### HOW THE SUBJECT PROBABILITY AND STATISTICS IS INCLUDED IN THE CURRICULUM

Statistics is an immense and rapidly growing subject, with applications to physical and biological sciences, engineering, and computer science. One of the fields where

statistics has a bigger impact is Engineering. Actually, it is not an exaggeration to mention its contribution to production problems, to the efficient usage of materials and labor, to basic investigation, to the development of new products and medical instruments, to signal processing, etc.

Statistics and Probability theory are vital tools for engineers. They permit them to understand phenomena subject to variation and to predict and control them efficiently, in this way being avoided mistakes produced by human failure or instrumental defects.

The random processes are particular important in the bioengineering area, where very often, signals with random noise components are registered.

For example, we make the hypothesis that the electroencephalogram (EEG) recorded is a sample function of a common random process. After recording  $n$  sample functions we have for each time  $t_i$   $n$  values of the random variable  $x(t_i)$ . We can use these values to estimate the probability distribution function of  $x(t_i)$  and with this make inferences.

Some statistical parameters and those of recording correlation in their temporal representation and the spectrum equivalents in the frequency space, as well as its application to calculate the transmission function of systems from the input and output recordings are described.

The subject *Probability and Statistics* is dictated in the 4<sup>th</sup> course of the career. The prerequisite is differential and integral calculus.

It's a semester course (15 weeks) with five hours per week.

## SYLLABUS OF THE SUBJECT PROBABILITY AND STATISTICS

Unidimensional and bidimensional random variables

Distributions and characteristics of random variables

Probability distribution functions

Probability density functions

The Poisson Process

The Gaussian Process

Punctual estimation and intervals of confidence

Hypothesis tests

Non-parametric tests

## GENERAL OBJECTIVES

Students is expected:

- To know the specific terminology of this discipline
- To apply different probabilistic models.
- To have a real comprehension of the specialized bibliography.
- To relate the contents of this subject with other areas of the career.
- To understand the benefits and possibilities of applied statistic in concrete problems.
- To understand sample theory.
- To interpret the principal sample methods and sample estimates.
- To evaluate the importance of inference in solving problems related to biology and medicine.

## TEACHING METHODOLOGY

Classes are theoretical and practical in character.

- *Teaching Technique*

During the theoretical part of the class the interaction between teacher and student is held in two forms : dialogue and questioning. When the subject requires direct exposition, exposition and demonstration are included. The heuristic method is applied to search the results in an autonomous way.

In the practical class the importance is held on in the communication around the work by solving problems. Two kinds of problems are used: applied exercises to acquire the skill in the use of formulas, tables, numerical calculus to obtain the best comprehension in the theoretical field; and real problems based on new situations to apply the theoretical knowledge, and to develop a critical spirit and a reflexive capacity.

According to the subject being treated, technique of guided study is used so that students can do bibliographical consults and discuss the problems proposed by the teacher.

- *Students Activities*

- ◇ Demonstration of some properties of theorems.
- ◇ Text consults.
- ◇ Solving problems of guides.

- ◇ Solving problems proposed by students.
- ◇ Comments and discussions of the developed subject studied.
- ◇ Obtaining and checking the results using statistical software.

- *Teaching Materials And Devices*

The elements used are: texts stated in the bibliography, class notes, guides with exercises and problems, statistical software, scientific calculators, mathematical tables, papers given by students, teachers or professionals.

## EVALUATION

The evaluation is carried out with written tests as follows:

- partial tests, where conceptual aspects and solving problems and exercises are evaluated.
- brief theoretical and practical tests, where questions are to be answered.
- a final theoretical and practical test.

## BIBLIOGRAPHY USED IN THE COURSE

### *Specific Bibliography*

- MEYER, P.: “Probabilidad y Aplicaciones estadísticas”, edi. revisada. Adisson Wesley. 1992.
- MILLER, I.; FREUND, J. y JOHNSON, R.: “Probabilidad y estadística para ingenieros”, cuarta edi., Prentice Hall. México. 1995.
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### *General Bibliography*

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- KREISIG, E.: “Introducción a la estadística matemática”, Limusa. México. 1983.
- SOKAL, R. y ROHLF, F.: “Introducción a la Bioestadística”, Reverté. Barcelona. 1986.
- STEEL, R. y TORRIE, J.: “Bioestadística: Principios y Procedimientos”, Mc. Graw Hill. México. 1993.

The aim of this course is to provide a solid base in statistical theory and at the same time to show the uses and importance of theory in solving problems of daily life.

I try to give the same importance to theory and applications showing the statistical method development with outstanding examples emphasizing its useful application in Engineering and Biological Sciences.

After finishing this course, students can proceed to further applications of probability by themselves or have an additional formal course.

Finally, students apply intensively the knowledge acquired in the elaboration of final projects, since *Probability and Statistics* become a vital tool to test the hypothesis proposed.