

THE DEVELOPMENT OF STATISTICS IN THE STRUCTURE OF THE ARGENTINE NATIONAL EDUCATIONAL SYSTEM

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When the Federal Law of Education in Argentina (1994) changed the curriculum of schools, statistics contents were introduced in the initial level (from 3 to 5 years), in the E.G.B. (from 6 to 15 years) and in the Polimodal (from 15 to 18 years). It was necessary to prepare teachers in statistics as they never have this signature in their curriculum. In this paper I will show how all this process is taking place in Argentine. In the universities, it depends on the careers, but with the curriculum changes, the purpose is to introduce courses of statistics not only on the grade careers, but also in the masters courses.

At the present, the education in Statistics in Argentina is taking place in a new social context. It is influenced by a movement of reform of the teaching of mathematical sciences in general. "The cause of the necessity of substantial changes in the statistical instruction is because there is a strong synergy between the contents, the pedagogy and the technology. The statisticians who teach in introductory courses will have to be familiarized not only in the investigations about the teaching and apprenticeship, but also in the changes in the educational technology. The spirit of the instruction to the contemporary statistics will have to be very different from the traditional one which put the emphasis in the explanations and in the Probability and Inference" (David Moore).

It is in this new frame where we develop this work. Until 1993, as much in the initial level as in the primary level of the obligatory education any theme of Statistics was not dictated. In the secondary level only in the contents of Mathematics of 4th year some themes of Descriptive Statistics were formulated, which rare times were developed by teachers because in the curricula of the teaching profession which accredited them, they did not have Statistics like subject. Few schools dependent of the Universities, dictated the subject Statistics like signature.

Because of this, in 1993 when The Federal Law of Education N° 24.195 was promulgated, Statistics began to be taken in account based in the preoccupation to incorporate in the Common Basic Contents for the different levels and cycles of the new academic structure, elements of Statistics and Probability. Thus, the teaching of Statistics arises, starting of the initial level (5 years), based on the studies made in 1975 by Fischbeim about the capacity of the children to process Statistical information of a useful way where the intuition is a cognitive acquisition that takes part in the practical or mental actions. The initial level began to be a space of appropriation of mathematical contents, because it offers to the children the opportunity to begin a systematic learning. This appropriation of Mathematical Contents ought to be made, then, from the resolution of significative contents because:

- in the daily life children learn solving problems
- the resolution of problems is the essential activity in Mathematics.

The teachers must plan to children significative problems which allow them to use their own knowledge, to complex them, to modify them and to acquire new knowledge. In the Blocks of Mathematics for the initial level it is recommended to introduce the ideas of the probabilistic thinking from its beginnings. It has been studied the origin of the idea of probability in the formation of the thought and there are important studies about them initiated by Piaget and Inhelder (1951) and continued by Fischbeim (1975). It has been arrived to the conclusion that the Probability is not as intuitive as the determinism, but it can become intuitive from early ages with a suitable presentation and practice.

According to Piaget and Inhelder, about Probability, there are distinguished three stages in the intellectual development of children. Before the age of 7 or 8, children do not distinguish the possible from the certain and they move in a sphere strange to the idea of random; their thoughts oscillate between the foreseeable and the unexpected, but without there is in them nothing surely foreseeable.

Glaxman and Varga attempt that above a random situation; until the 5 or 6 years children think that they can anticipate the result, a little later they respond that they cannot affirm nothing and gradually discover that exist laws that allow estimating the reality. In the E.G.B. (Basic General Education) (6 to 14 years) there is a Block in Mathematics about "Notions of Statistics and Probability" begins considering that the Descriptive Statistics takes care of the organization and interpretation of data obtaining measures that summarize the characteristics of the data. The Inferential Statistics uses these measures to make generalizations about the population, on the basis of the information provided by the sample. By the complexity of these methods, in the E.G.B. we will not work with Inferential Statistics, but it will be possible to initiate to the students in the analysis of data and in the extraction of consequences so that they can recognize the value of these procedures in the decision-making. Since 1° Cycle of the E.G.B. simple situations will appear where the students need to collect data and where it is necessary to organize them, to describe them and to interpret them to respond to the questions that we give to them; for example:

- Which is the rainiest month in this zone?

In these cases we can obtain a systematic registry of data and analyze the multiple variables that would define the phenomenon, while with other phenomena that registry and the analysis of the variable is much more difficult. When advancing in the schooling, it is important that the students can not only bind their statistical task to situations of the daily life, but also to use it like an instrument to understand contents and to solve specific problems of other areas of knowledge like social sciences, natural sciences, economy, etc. In the school, we have to dedicate a special time to the analysis of the Statistical Inference that offers mass media, in order to discriminate the correct uses of the incorrect ones of it. One Statistical theme that is interested is the study of correlation between random variables. The expectations of profits when finalizing the E.G.B. are:

- to know how to collect, to organize, to process and interpret information statistically and to understand, estimate and use probabilities, valuing these procedures for the decision making.

In this level: to know, to know how to reason, to know how to be oneself, organize the proposal of conceptual, procedural and attitudinal contents for the development of the personal and social capacities that the school must promote to allow our students to participate like active members of a society that with them recovers and improves the quality of life of all its members. In the Polimodal Education, the fundamental objective of the Block "Statistics and Probability", raised from the space of the discipline Mathematics, is to solve problems that show the necessity of a quantitative theory that allows to make decisions in the presence of the uncertainty. There are retaken here, the considerations of the E.G.B.; the difference resides in the greater amplitude of possibilities which brings a mathematical formation with more technical resources in this level, to which we have to add a greater degree of conceptual maturity and a general formation in the students. The Descriptive Statistics Contents will consolidate and deepen, and we will use them to study contents of other discipline and good part of the information that is received in the daily life; for example, through mass media. The student will have to analyze of which way:

- The form to communicate information affects the interpretation of it.
- The scales of measurement in the graphs have been selected.
- Certain measures are appropriate to interpret certain problems
- The chance, the representative ness and the slants are contemplated in the samples.
- A data set by addition or multiplication by a number, of the average, the median and the mode and the Variance, is modified, discovering because of these generalizations.

Referring to the study of correlation, in this level it will contemplate the registry of data, its representation in coordinates and the initial analysis of the form in which these points are distributed, giving an idea in what trend (functional or not) the data are related. The varied exemplification will alert to the students respect to produce hurried suppositions and the care that must be taken when we are treating this theme. In relation to the Probability, a handling more flowed and general of the combinatory formulas will allow advancing in the calculation of the Probabilities and in the concept of distribution, tools with which the students will be able to begin to work problems of estimation of parameters and Statistical Inference. The formal definitions and the properties of Probability always will be preceded of a good conceptual understanding,

obtained from the experimentation and the simulation of situations where the intuition of the students improves. Some slight knowledge can be formulated now with the precision that demands the scientific language, as it is the experimental practical case of the averages in relation to the Law of the Great Numbers. It is interesting to emphasize that the teaching of the Probability finds in the Algebra elements of conjuncts, and exceptional resource for the introduction of the concepts of conditional Probability and Independence. The profit expectations indicate that when finalizing the Polimodal Education (15 to 18 years) the students will have:

- to interpret the Statistical and Probability terminology, to have notions of the reach and limitations of these disciplines and to apply its concepts to the resolution of problems and their results to the decision making.

The federal Law of Education, as we see, introduces changes in the Educative System which implementation requires like main factors the update and improvement of all whom integrate the different school states. The inclusion of "Notions of Probability and Statistics" in the Common Basic Contents (CBC) of Mathematics generates lots of problems to teachers because they didn't give statistics in their formation, and they have no previous experiences in teaching and learning statistics. So, we have to direct the offer of qualification the teachers, in first term towards the directive personal through procedures of teaching like ones to distance with advising in the study through actual tutorial encounters or others towards teachers with update and advanced training courses, since they have lacked of apprenticeship of Statistics in their formation of degree like Professors of Mathematics. Because of this reason, the teaching of Statistics must tend to provide to the students elements that enable them interpret suitably the information from data in a given context.

The purpose of the teaching of Probability and Statistics as much in the E.G.B. as in the Polimodal Education is to help to form a non-determinist thought that allows approaching simple problems in the presence of uncertainty. Referring to the methodology for the teaching of Statistics one is due to consider:

- The concepts must be developed in a practical context
- The techniques do not completely have to be developed in the first occasion in which they are treated. Many of the ideas introduced in the first years can be treated in later years.
- The theoretical justification of all the themes is not necessary.
- Some questions only are treated in the context of a problem, others will be covered only by means of experiments and they are not justified theoretically
- We must take in account the interdisciplinary character of the Statistics, relating it with biology, politics, economy, engineering, etc.
- The work in groups is recommendable and also the technique of experimentation, test and error.

It is important to take in account the investigations that deal with the teaching and learning of the Statistics and Probability are summarized in Garfield (1995); Garfield and Ahlgreen (1998); Kapadia and Borovnick (1991) and Shaughnessy (1992). So, referring to new pedagogy the point of view that we take in account is the constructivist one, through a new model where the students learn through their own activities and where a good teacher stimulates and guides their apprenticeship. In this process the work in groups, the communication and the feedback help the apprenticeship as well as the formulations of problems. The continuous revolution in computer science chanced the practice of the statistics. If the teacher is a statistician, he influences in the introductory teaching of statistics giving a weighted combination between technology, professional practice and taste by the investigation. There are the goals in the university careers with respect to the statistics, so as David Moore (1997) advises:

- To emphasize the elements of the statistical thought
- To incorporate more data and more concepts and less prescriptions and less deductions
- To be possible to incorporate the use of the computational tool.
- To foment the active learning

The computational technology is essential for the learning of the practical statistics. Referring to the actions of educational qualification in Mathematics in the initial level it must be considered:

- The sense of the resolution of problems in the apprenticeship of Mathematics.

- The relation between solving problems and the contents to teach
- To provide tools so teachers can:
 - o Recognize the knowledge of their students
 - o Analyze which are the situations which take in account the contents to teach
 - o Organize the teaching in a spiral form in order to assure the acquisitions of contents in all the children.

In the E.G.B. we must consider:

- To integrate contents of the different branches from mathematics giving an important paper to statistics.
- To develop in classes a methodology, that can be transferred through to any situation of the real life.
- To privilege the constructions of concepts and procedures thorough games, working in groups and to reflection about them.

In the Polimodal we have to take care of the necessities towards:

- To value the investigation like knowledge source and learning.
- To obtain capacity to make decisions
- To value the contribution of the contents from the statistics to the different areas and different situations from the daily life.

It is important to emphasize that in the curricula of the Teaching Staffs of E.G.B. and of Mathematics now it is getting up the subject Statistics and Probability. This will be a point very important to future teachers. At this moment, teachers do not apply statistics, often by ignorance or fear because they have little knowledge about it. We try to form efficient teachers so that they will give useful classes taking in account the necessities of all the citizens in the present society.

Referring to the Superior Level, the objectives of the Statistics Career are:

- To form professional technicians in an applied branch of Mathematics, closely connected at the present time with all the disciplines that comprise the scientific task.
- To persecute as a fundamental goal to form capable professionals in the handling of methods for the gathering and analyses of quantitative information, possessor of a solid mathematics, probabilistic and statistics formation, skilful in computation, able to face the problems in a large and always increasing range of activities which are demanded from the statistical system in the state scope, and also the activities related with the technological investigation, able to work in groups with professionals of other areas (medicine, economy, engineering, psychology, etc.).
- To make creative investigations and with very good quality, as well as to exert teaching in all the levels to educate in this specialty.
- “In Education the future is today...”
- “If we hope to change the present, without a doubt have faith in the future and we advance....”
- “With the daily reality, with difficulties and slips, with effort and sometimes with pain, crossing ways of change and overcoming, betting to a better life for the future generations...”

Albergucci, Robert

If now we analyze the Statistical Subject in the different careers and if we consider that the subject “Statistics” figure in the currículas of most of the careers that are distributed in the University, from the necessity of the application of its methods in nonspecific careers; it is necessary to raise the question if its location within the respective curricula is the actually adequate and if the contents proposed in each case respond to the requirements of the professional performance. On the basis of this, it is essential that when we determine the contents of each program, we have to point to the basic knowledge of statistics that respond to the necessity to satisfy requirements with other subjects, many of them very important in the career proposed.

We have to become aware from the fact that the reality is permanently changing and the University must go ahead to the changes. Because of this, we have to plan if the present contents in the programs of “Statistics” of the different careers respond to the necessities of the future professional. Will be excessive the contents of the subject given in complete and accelerated form which prevents an interesting, illustrative, and of a specific application that motivates the students

in the apprenticeship of the basic statistics and in the accomplishment of the post degree Statistics Careers. What we pretend is that the future professional handles the statistical language and knows what the statistical methods can offer him, but to accede to the application of them, he must count on the advising of the statistical professional. At this moment, the use of computational tools in the different careers is only taking place in specific subjects. In general, computational tools in the university education of the Statistics are not used. The use of this tool, though suitable software and methodology can improve the teaching. When we incorporate to the teaching of the subject “Statistics” the use of computational tools the classes will be different, the interpretation of the themes will be facilitated and in consequence, it will allow deepening the specific applications in the different areas from interest.

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APPENDIX

E.G.B. 1st Cycle	
Conceptual Contents	Procedural Contents
<ul style="list-style-type: none"> - Forms of data collection from simple experiences and surveys - Tables, graphs and diagrams to organize the information - Elementary knowledge of Probability: <ul style="list-style-type: none"> - Notion of event - Surely event and impossible events - Compatible and incompatible events 	<ul style="list-style-type: none"> - Data collection in different forms - Organization and analysis of the simple information - Description and interpretation of the information offered by tables, diagrams and simple graphs. - Exploration of situations of chance through games - Search of regularities in results - Accomplishment of systematic counts - Discrimination of types of events
2 nd Cycle	
Conceptual Contents	Procedural Contents
<ul style="list-style-type: none"> - Elementary slight knowledge of statistics: compilation, tabulation, and representation of data. Pictograms. Diagrams of bars and circular ones. - Elementary slight knowledge of probability: random experiment. Regularity of the obtained results. - Prediction about the Probability of an event: combinatory. Problems of count. Diagram of tree. 	<ul style="list-style-type: none"> - Interpretation of the information contained in illustrations, tables, invoices, tickets, and graphs presented in mass media and in the daily life. - Processing of surveys and simple experiences. - Harvesting, registry and classification of information. - Interpretation and elaboration of simple statistical graphs. - Formulation and verification of conjectures

	about the behavior of the simple random phenomena.
3 rd Cycle	
Conceptual Contents	Procedural Contents
<ul style="list-style-type: none"> - Elements slight knowledge of Statistics: Population. Samples. Representative ness. Scales of measurement. Tables of frequencies. Histograms. Statistical parameters: arithmetic mean. Mode. Standard deviation. The abuses of the use of the Statistics. - Random phenomena. Allocation of Probability to an event. - Classic definition of Probability Random variable. Frequency and probability of an event. - Combinatory. Strategies for the count of cases. - Permutations, variations and combinations. 	<ul style="list-style-type: none"> - Interpretation of index, rates reasons and proportions like summaries of a data set. - Selection of the scale of measurement suitable to the considered phenomena. - Calculation and interpretation in graphs of statistical representative values. - Discussion and discrimination of statistical information proceeding of different sources. - Elaboration of strategies that guarantee the exhaustivity in the processing of enumeration problems. - Description of relations between data set. - Investigation of what curve fits better to the collected data (correlation) - Decision making according to the obtained results.
Polimodal	
Conceptual Contents	Procedural Contents
<ul style="list-style-type: none"> - Classification of data. Absolute frequency, relative frequency and accumulated frequency. - Tables. Histograms. Circular diagrams. - Graphs of stems and leaves. Graphs of boxes. Average values, Mode and Medium. Variance and Standard Deviations. - Statistical parameters or estimators. - Correlation between variables. - Random experiment Sample Spaces. Events. Probability in discrete spaces. Classic scheme with equiprobable results. Relations with combinatory games of chance. Conditional probability and independence. Repeated experiments - Random variable. Probability distributions Mathematical hope. Variance. Scheme of Bernoulli. Binomial distribution Inequality of Tchebycheff and the Law of the Great Numbers. 	<ul style="list-style-type: none"> - Calculation of the measures of position, measures of dispersion and the form of the distribution through the histogram of a finite group of data and the description on the basis of this data of the general behavior of the data set. - Interpretation of different graphs that imply measures of position and dispersion. Graphs of pairs of values that respond to experimental results and graphical search of an approach curve. Calculation of the correlation coefficient using the computer and analysis of consequences from the found coefficient of correlation. - Prediction of the Probability of a given result and calculation of the Probability for dependent and independent events. - Identification of the space sample that describes an experiment suitable an of the events and the relevant random variables. - Analysis of the criteria to assign Probabilities in the cases in which it is reasonable an equiprobable hypothesis. - Calculation of distribution of probability of discrete variable, mathematical hope and variance. - Interpretation of their results. - Detection of irregularities that favour the validity of the laws of chance in random experiments. - Taking of decisions through the statistical processing of the information.