

CHAPTER 9

*The Education and Training of Statisticians in
Brazil*

PEDRO A. MORETTIN SÃO PAULO UNIVERSITY

9.1 INTRODUCTION

In this chapter we will describe briefly the present state of the education and training of statisticians in Brazil. By education we shall mean that an academic degree is granted at the undergraduate or graduate level. By training we shall mean that special courses are offered in order to provide skills required for specific tasks (Gura, 1980). Some other aspects related to these topics will also be discussed, such as the role of the professional and scientific societies, meetings, publications, etc.

The República Federativa do Brasil is a huge country (over 8 million square kilometers) with a population of about 130 millions of inhabitants. There are marked geographical and cultural differences among the several regions of the country. The population is concentrated on the northeast, east and south regions, the center and west being only now explored, while the north (the Amazon) is barely occupied. This also implies that there are differences among the various regions concerning the educational system. Portuguese is the official language.

In section 9.2 we describe the educational framework, section 9.3 presents those aspects related to the education and training of statisticians and section 9.4 discusses the employment opportunities. Section 9.5 treats of professional and class associations and finally we present some additional comments in section 9.6.

9.2 THE EDUCATIONAL FRAMEWORK

Education at primary and secondary levels comprises two 'degrees' or 'cycles'. The First Degree includes ages 7 to 14, the first four years corresponding to the old primary level. The Second Degree includes ages 15 to 17 and both degrees are compulsory. The federal and state governments hold most of the school system at these levels, but there is a significant number of private schools, including religious ones.

There is a small number of technical schools, where the students receive some training in diverse areas such as electronics, mechanics, computer operation, statistics, etc. The aim here is to prepare the students to future jobs, especially for those who do not go to higher education. The Second Degree is more or less directed towards the preparation of the students to an examination which is required for admission to the university system.

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For example, if a student desires to pursue an engineer career, he may elect the 'exact sciences' option, receiving a stronger training in mathematics, physics and chemistry.

For entry to a university there is an examination, which may vary from university to university, but usually evaluates the knowledge acquired in the Second Degree. Also, the usual situation, especially for the best universities, is that there are more applicants than places, and many students have to take this test more than once. The usual age of entry is 18.

There are not many universities in Brazil. Typically, there is one federal university in each state (there are 23 states and 3 territories in Brazil), besides state and private universities. The number of universities presently is about 70, of which 70% are public.

Besides the universities, there are isolated higher education schools, which offer courses in one or more areas, for example, a Law School, or an Engineering School. These may be maintained by local city governments or private owners. The total number of these institutions is presently about 800, of which 25% are public.

Table 1 shows total enrolment in 1983, including the number of institutions and percentages corresponding to public sector, for the pre-school, secondary and university levels.

Table 2 shows the total enrolment in 1983 and diplomas granted in 1982, for the universities (public and private) of ten states in Brazil.

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It is difficult to trace the early history of statistics in Brazil. It seems that the first courses of the discipline were taught in Rio de Janeiro and São Paulo in the beginning of the thirties, even though notions of statistics were taught in the schools of medicine, engineering and education, before the appearance of systematic courses and programs. Groups devoted to the teaching of statistics appeared in the University of São Paulo, created in 1935. There was then a large influence of the European School (mainly French and Italian). Until the seventies, statistics was taught in the schools where it was needed: engineering, public health, etc. Starting in 1970, several statistics departments were created in the universities, usually in the area of exact sciences, having strong connections with mathematics.

It seems that the Escola Nacional de Ciências Estatísticas (ENCE), in Rio de Janeiro, was the first center organized, in 1953, to provide undergraduate education in statistics, mainly with the purpose of training statisticians to work at the Brazilian National Statistical Office (IBGE: Instituto Brasileiro de Geografia e Estatística). ENCE also offers a training in statistics at secondary level.

Statistics is a profession regulated by law in Brazil, in the same sense that medicine or law are regulated. This means that statistical activities can be performed only by persons having a B.S. in statistics. Since the

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Table 1 Total enrolment in Brazilian educational institutions in 1984 (in thousands)

Level	Enrolment		N° Institutions	
	total	public %	total	public %
Pre-school	2,084.1	63	27,436	68
1st degree	24,515.4	87	192,759	95
2nd degree	2,944.1	62	8,853	53
University	725.5	66	67	70
Undergrad	687.9			
Grad, MS	31.9			
Grad, PhD	5.8			
Other Higher				
Educ. Instit.	713.5		801	26
Total	30,982.6		229,916	

Source: Ministério da Educação, 1984

Table 2 Total enrolment (1983) and diplomas granted (1982) for ten states (in thousands)

State	Enrolment 1983	Diplomas 1982
S. Paulo	131.3	19.9
R. Janeiro	110.3	14.9
R. G. Sul	99.5	12.6
Minas Gerais	50.9	7.5
Ceará	38.8	4.1
Bahia	30.4	5.1
Pernambuco	30.1	3.8
Paraná	43.0	5.1
Paraíba	26.7	4.1
Goias	17.6	2.4

Source: Ministério da Educação - 1985

undergraduate courses in statistics are recent (except for ENCE and the Statistics School in Bahia, all started around 1970), older statisticians received a special denomination under the law that regulated the profession, issued in 1965. Therefore, by a 'statistician' we mean a B.S. degree holder. There are also the so-called 'technicians in statistics', who hold a secondary level diploma, as mentioned before. These are supposed to

work in statistical tasks, in government statistical offices, business and industry, under the supervision of a (regular) statistician.

There are currently 18 universities offering undergraduate programs in statistics (Appendix II). The federal government establishes a minimal curriculum (this is true for all professional programs). Basically this includes Calculus, Linear Algebra, Data Analysis, Probability, Statistical Inference, Sampling, Design of Experiments and a choice of at least two elective disciplines among Quality Control, Econometrics, Biometrics, Demography and Actuarial Sciences. This curriculum is under revision now and most universities offer a larger choice of disciplines. See Peres and Morettin (1982) for an example. The idea is that the universities have the flexibility of complementing this minimal curriculum according to the needs of the region. The undergraduate programs in statistics are four-year programs. See Appendix I for a summary of the curriculum at the University of São Paulo.

Concerning the flexibility stated above, for example if the principal need for statisticians in a region is for government statistical offices, a curriculum centered in economics seems to be an adequate preparation, with courses in sampling, survey design and methods, data analysis and graphical methods, etc., (The American Statistical Association, 1978). On the other hand, if industry is a major source of employment (for example, the south region of the country), the emphasis should be on regression analysis, design of experiments, quality control, time series, etc. (Marquardt, 1979). To meet these needs, a new minimal curriculum is now being proposed to the federal council of education. See also Peres, Morettin and Narula (1985).

Only a few universities offer graduate studies at the master's level and only one (The University of São Paulo) at the Ph.D level. Graduate level programs in statistics are usually devoted to undergraduates coming from various fields and lead to a M.S degree after about two years of full time studies and a master's dissertation, or to a Ph.D degree after more advanced studies and a research thesis. The main objective of these programs is to produce urgently needed well qualified individuals for teaching and research in the statistical field. The major factor limiting the establishment of graduate programs is the lack of qualified individuals for such responsibilities. Most of the graduate faculty members currently in the statistical departments got a Ph.D degree abroad (mainly USA and some European countries).

We estimate that there are about 1,200 statisticians with a B.S degree, 200 graduates with a M.S level and 80 graduates with a Ph.D level (of these about 80% got their degree abroad) currently working in Brazil. The overall estimated number of statisticians (except graduate level) is 3,000, including those affiliated before 1965 and those with a secondary degree diploma.

Table 3 shows the number of undergraduate courses in statistics, total enrolment in 1983 and diplomas granted in 1982. Appendix II gives the Brazilian institutions of higher education with undergraduate courses in statistics.

Table 3 Undergraduate courses in statistics: number, total enrolment (1983) and diplomas (1982)

Nature	Number of courses	Enrolment 1983	Diplomas 1982
Federal	11	1,923	168
State	3	634	73
Municipal	1	102	—
Private	3	776	61
Total	18	3,435	302

9.4 EMPLOYMENT OPPORTUNITIES

Government statistical offices are the major source of employment for bachelor's level statisticians. Only in industrialized areas, as the south region of the country, do industry and business appear to generate jobs. One reason for this situation is that many large industrial firms are tied to multinational companies, which bring with them from their home countries all the necessary technology, including the statistical expertise (Morettin, Peres, Narula and Mentz, 1985). But many companies have started to think about issues of quality control, forecasting, process control, design of experiments, etc. Also the market research area is attracting some newly graduated statisticians.

The computer area has had a great development recently in Brazil and this opened a new field for statisticians. Some statisticians, after the undergraduate course, may decide to pursue a graduate course, at the master's level initially, in areas like statistics, operations research, computer sciences, economics, etc.

A follow-up study conducted by Bussab (1982) among the undergraduates who finished the course at the University of São Paulo, from 1975 to 1980, revealed that most of them were working in universities, banks, industry and services. Table 4 shows the situation for 133 individuals.

This is not typical for the country as a whole, but it is true that many newly graduated B.S statisticians are attracted to a graduate program in statistics and are hired during this program by some university. This happens, as discussed above, because of the lack of qualified individuals with master's or Ph.D degree.

The universities are the major source of employment for individuals with graduate education. Most of the master level statisticians will go to some university and practically all the Ph.D candidates already belong to a higher education institution or research center in government.

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Table 4 Distribution of 133 statisticians from U.S.P. by areas of occupation

Area of occupation	Year of completion						Total	%
	75	76	77	78	79	80		
University	4	—	3	7	4	8	26	19.5
Banking	—	—	3	3	14	4	24	18.0
Government	—	—	4	4	2	1	11	8.3
Industry	—	3	—	4	4	4	15	11.3
Commerce	—	—	1	1	—	—	2	1.5
Services	1	4	1	4	2	2	14	10.5
Marketing	—	—	3	1	—	2	6	4.5
Other	1	1	—	3	1	1	7	5.3
Unknown	—	1	5	1	7	5	19	14.3
Inactive	2	—	—	2	3	2	9	6.8
Total	8	9	20	30	37	29	133	100.0

9.5 PROFESSIONAL AND CLASS ASSOCIATIONS

Since statistics is a profession regulated by law, there are organisations which control the activities of statisticians as well as the firms that hire them. At regional level there are the Conselhos Regionais de Estatística – CONREs (Regional Councils of Statistics) and these are centralized in a Conselho Federal de Estatística – CONFE (Federal Council of Statistics). Every statistician has to be affiliated to a CONRE in order to exercise the profession. The CONREs also control the firms, checking if other professionals (engineers, economists, etc) are doing the job required of a statistician. But this control is not very effective and there is also a controversy about this regulation.

The statisticians may also affiliate to a class association, called Associação Profissional de Estatísticos do Brasil, which aims to promote the profession, organize short courses, seminars and regional meetings.

Concerning scientific and professional societies with the same character as the ASA in the United States or the RSS in the United Kingdom, there are currently two in Brazil. The older one, called Sociedade Brasileira de Estatística, is closely tied to the Brazilian National Statistical Office, and publishes a journal, 'Revista Brasileira de Estatística', devoted primarily to official statistics. The second association is a new one, created in 1984. It will sponsor the SINAPE (Brazilian Symposium on Probability and Statistics), which has been held biannually since 1974 and, starting 1987, will publish a journal, 'Revista Brasileira de Probabilidade e Estatística' (Brazilian Journal of Probability and Statistics).

9.6 FURTHER COMMENTS

In this report we have tried to describe the overall situation of the training and education of statisticians in Brazil. One recurrent topic of discussion

and concern is the regulation of the statistical profession in the country. It is not clear how this regulation will affect the profession, but some changes have to be considered, for example, to allow graduate level statisticians to be contemplated by the law. It seems that the academic sector is not (or at least is less) affected by this regulation.

Concerning employment opportunities, industry and business do not generate many jobs, at least in most areas. One reason for this is their lack of awareness that a statistician can be useful in the management and decision process. This situation may be partly due to the fact that there is not enough promotion of the statistical profession in Brazil.

Another factor of concern is that there is a gap between statistical education in the universities and its applications in industry, business and governmental statistical offices. It seems that this happens in other countries (see the American Statistical Association, 1978, and Morettin, Peres, Narula and Mentz, 1985). To overcome this situation an innovative curriculum was developed at the Instituto de Matemática e Estatística, Universidade de São Paulo (see Peres, Morettin and Narula, 1985).

Regarding teaching of elementary and high school levels, little is done. Some notions of probability are taught in the Second Degree, and notions of statistics are taught only by those technical schools that form medium level statisticians. It is imperative that those responsible for the school level education in the country should be aware of the increasing importance of the statistical technology in all fields and should be convinced of the importance of its inclusion in the curricula.

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APPENDIX I: *Summary of curriculum at U.S.P.*

Calculus (4 semesters)
Linear Algebra (2 semesters)
Complex Analysis
Physics (2 semesters)
Computer Programming (2 semesters)
Probability (2 semesters)
Statistical Inference (2 semesters)
Sampling Techniques
Design of Experiments (2 semesters)
Introduction to Stochastic Processes
Multivariate Analysis
Time Series Analysis
Regression Analysis
Nonparametric Analysis
Exploratory Data Analysis
Applied Statistics (2 semesters; coupled with 'on the job' training)
Elective disciplines (7 semesters; choice of disciplines in economics, public health, biology, engineering, etc.)

APPENDIX II: *Brazilian Institutions with undergraduate courses in statistics*

Univ. Fed. do Amazonas	Escola Nac. Ciências Estatísticas
Univ. Fed. do Ceará	Univ. Est. do Rio de Janeiro
Univ. Fed. Rio G. Norte	Univ. Fed. do Rio de Janeiro
Univ. Reg. do Nordeste	Univ. Fed. de São Carlos
Univ. Cat. Pernambuco	Universidade de São Paulo
Univ. Fed. Pernambuco	Univ. Est. de Campinas
Univ. Fed. da Bahia	Univ. Fed. Paraná
Esc. Sup. Estat. Bahia	Univ. Fed. Rio G. do Sul
Univ. Fed. Minas Gerais	Universidade de Brasília