THE TEACHING OF STATISTICS IN PORTUGAL – PROBLEMS AND SOME SUGGESTIONS TOWARDS ITS SOLUTION

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1. Probability and Statistics for Non-Mathematicians in Portugal

The teaching of probability and statistics to non-mathematically trained individuals is important in secondary schools, as well as at a latter stage in engineering, economics, social sciences, medicine, agriculture and fishing, market and opinion research, insurance, finance, biometry and demography.

Since 1978, such teaching has been of interest to me as Professor of Statistics at the IST of the Technological University of Lisbon. Let me try to outline the means which I believe are required to develop and implement appropriate programs to teach probability and statistics in these areas.

In Portugal, there is a shortage of statistical experts, and limited financial resources so that both must be efficiently used. There is also the more basic problem of educators' attitudes towards the teaching of probability and statistics. In most Portuguese universities such teaching is relatively recent, less than twenty years old. Probability and statistics as autonomous disciplines are still not generally accepted in our country, as is clearly revealed by the following facts. 1) Most engineering schools have only two semesters of probability and statistics in their degree curricula (five years program) For instance, the IST provides only one semester of probability and statistics all together. 2) In the Portuguese National Statistical Institute, little or no statistical research is being carried out. 3) The great majority of our secondary school teachers of mathematics have had just one course in probability, and only very few have followed a course in statistics for their mathematics degree at the University.

What this indicates is that the task of teaching probability and statistics in the areas mentioned above will require a very careful approach. This will require a long time to implement, because we shall have to start from the beginning, namely with the training of qualified faculty to teach these subjects. Luckily we have already made a start; in the last decade the number of qualified statisticians (with an M.Sc. or Ph.D. degree in statistics or even a first degree in statistics from Portugal or abroad) has increased many times over. An educated guess, based on the list of Portuguese and Brasilian statisticians that I published in 1981, still tells me that in the whole of Portugal, there are probably fewer than fifty statisticians. This number is clearly not enough even to staff the faculty needs at the university level.

In the article Ramalhoto (1985) I concentrated mainly on the teaching of probability and statistics in secondary schools. I gave an overview of the situation concerning statistical concepts taught, preparation of teachers and proposed action to be taken to improve the quality of teaching. Up to a point I consider the teaching of probability and statistics in secondary schools as a paradigm of the problems that have to be faced in the other areas listed above. However they also have their own specific problems and do not require the involvement of as many individuals as the teaching of probability and statistics in secondary schools. That is one of the reasons why they might progress more rapidly. In fact, as far as I know, it is fair to say that in Portugal no progress has been made in the teaching of probability and statistics in secondary schools but the same is not true in the case of other areas, as for instance engineering.

In what follows I shall concentrate on the teaching of probability and statistics at the Department of Mathematics of the IST.

2. Probability and Statistics at IST

Let me introduce some general information on the IST and on the Department of Mathematics itself. The IST has more than six thousand students and more than 100 full and associate professors. Most of its professors are Ph.D.s from leading universities in U.S.A., England, Germany and France. The Institute until the very early eighties provided just undergraduate and Ph.D. degrees in civil, electrical, mechanical, chemical and mining engineering. After 1981 it started providing (post-graduate) M.Sc. degrees in various branches of engineering and now provides also undergraduate and M.Sc. degrees in physics and applied mathematics.

2.1. The Department of Mathematics

The Department of Mathematics has three Sections: Algebra and Analysis; Statistics and Applications; Applied Mathematics and Computation. The second is the smallest of all. The Department has restricted its activity, almost completely, to offering basic mathematics courses to majors on engineering. In fact, just, recently, the Department has been able to diversify its activities by creating an undergraduate degree in applied mathematics and computation an M.Sc. degree on applied mathematics and also by offering graduate courses on mathematics and statistics to majors on engineering (M.Sc.degrees).

In what follows I shall concentrate mainly on the teaching of probability and statistics, which is the subject of this article.

2.2. The Teaching of Probability and Statistics

The difficulties to recruit the right faculty staff and to make them to work with us towards a Ph.D. degree in probability and statistics has been enormously. Some of the main reasons are: i) the universities in the country with applied mathematics don't generate enough staff even for themselves; ii) most of the junior staff available, acceptable to us, are engineering graduates from the IST, who on average work for the Depart-

ment of Mathematics just until they are able to get a position in their own Engineering Department. Possibly another reason is that till 1982 the Department of Mathematics offered just one-semester basic course on probability and statistics, compulsory to all undergraduate engineering degrees of the IST. This course is located at the second year of the five years degree, and has an attendance of about four hundred students per semester.

In 1982 we started providing graduate statistics courses to majors on engineering which have been extremely important to us. The value of probabilistic and statistical ideas and methods to the Engineers seems to become better understood and joint teaching and research groups now look easier to organize. For instance, the creation of optional courses in probability and statistics to majors on engineering to be offered to fourth and fifth year students seems to be more realistic now after having established these links with the other Departments at the post-graduate level.

In 1983 the Department of Mathematics initiated its two years M.Sc. degree on applied mathematics with three areas of concentration: analysis, probability and statistics and numerical analysis. To our mind this would be a very important step towards a higher level of teaching, the reinforcement of the research capabilities of our Department, and above all it would rapidly improve the quality of our junior staff. This degree has been on for about three years and we are still learning how to adjust its courses in a way that all the three Sections of the Department may benefit from it.

The main hopes now are on the five years undergraduate degree on applied mathematics and computation (which is the result of a couple of years of hard work from some colleagues of mine). We have just started this degree with a class of thirty selected students. This degree has three concentrations: applied analysis, computation, probability and statistics. The courses provided on probability and statistics are: i) compulsory to all concentrations - introduction to probability and statistics (2nd semester); probability (3rd semester); statistics (4th semester): ii) compulsory to probability and statistics – statistical inference (5th semester); computional statistics (5th semester); decision theory (6th semester); stochastic process I (7th semester); time series (8th semester); stochastic process II (9th semester); sampling (IOth semester). The main objective of this degree is to supply statisticians and applied mathematicians with skills and experiences that include a large spectrum of mathematical, probabilistic. statistical, and computational knowledge, practical problem solving and consulting practice. Some of these new courses on probability and statistics (the total program or part of it) will be used also to create optional courses in applied probability and statistics to majors on engineering.

2.3 The Other Departments

I share the view that statisticians and scientists/technologists will find more in common to the advantage of both, if their education can be more closely linked. To my mind the IST offers the ideal environment to make it come true. From my own experience, with post-graduate courses, I believe that the creation of joint teaching and research projects are the best way to make it work. Personally, I would very much welcome, for instance, a joint research or teaching project, in collaboration with any other En-

gineering Department, concerning statistical aspects of queueing theory (applied stochastic processes specially queuing theory has been my main areas of research) or some aspects of time series analysis, reliability, etc. Another interesting area of inter-departmental collaboration (artificial-intelligence community and statistics community) could be in the development of statistical computer software in the "expert systems" direction, the so called third-generation software, which accidently is beginning to emerge, see Gale (1985).

2.4. Industry

It would be of some importance to the Department of Mathematics to establish industrial connections. The most important response would be that the department sponsors Mathematics-in-Industry study groups. As I see it some of the general goals for these study groups would be:

- To convince Industry of the merits of collaboration between Mathematics and Industry;

- To stimulate greater awareness in Portuguese Industry of the needs for a role of Mathematics;

- To provide a fresh source of research problems and educational material for mathematicians:

- To lead to better employment prospects for mathematics graduates;

- To adjust some of the undergraduate and the postgraduate courses to the needs of Industry;

- To assist industries with problems requiring mathematical input and analysis;

- To prepare a workshop on the issue "Preparing Statisticians and Applied Mathematicians for Careers in Industry - What Can University and Industry Do Cooperatively to Develop Appropriate Programs?

- To hold "Career Days" at the IST with invited members from Industry (this could be a joint adventure of the whole Technological University of Lisbon);

- To develop industry internship programs;

- To provide a "Careers in Industrial Statistics and Applied Mathematics" brochures.

I think that it is fair to say that most of those study groups would be faced with work which largely requires the techniques based on thorough understanding of data rather than the development of new methodology. For sure, in most cases, the statistical role at a specific firm is one of continual involvement in the design of experiments and collection and analysis of data rather than the occasional visits to tackle a specific problem with interesting mathematical and statistical content. But of course, if there is

no research reward attach to it there was already a financial reward in the first place and probably a "case study" which latter on might be incorporated in some lecture notes.

By the way , it is perhaps worthwhile notice that, a popular realization that Portuguese product quality and productivity are crucial for a fairer Portuguese position in the European Community presents an opportunity for the Portuguese statistical community to make stronger contributions to sound industrial practice than it has in the past. Therefore an example of a possible activity of one of these study groups could be to set up courses in modules of eight or ten hours each on, for instance, statistical quality control, design of experiments, graphical data analysis, statistical computer packages, statistical decision theory, life data analysis, opened to anybody in industry and well adjusted to its needs.

References

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