Teaching Statistics in the Tertiary Institutes of Technology in France

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1. What is a Tertiary Institute of Technology (Institut Universitaire de Technologie; IUT)

The IUTs provide a short-term professional tertiary training. In two years, they produce superior technicians and managerial staff prepared for positions of technical management and training in the production sectors.

Within a university framework, an IUT provides a form of training characterised by (a) general scientific grounding, and (b) training in specific areas, taught in collaboration with specialists in their own fields.

This training at an IUT leads to a "Diplome Universitaire de Technologie" or DUT (Diploma) which contains details of the specialist area which was studied during the two years.

This Diploma is recognised nationally, and its standard is guaranteed by a National Commission on Education which develops and puts into place the programmes of teaching and schedules of study in each field. This Commission consists of representatives from the government (the National Ministry of Education), the professional sector (employers, unions, etc.), and the teaching profession, together with two former students who have recently received the DUT.

There are currently 70 IUTs responsible for the provision of training oriented towards both the commercial and industrial sectors. Specialist areas called Teaching Departments (départments d'enseignement) are set up. Several provide more specialised options in the second years, which results in 36 specialist areas being taught in the IUTs.

At present, the training provided by the 70 IUTs is divided into 340 recognised programmes, 215 in specialist areas within the industrial sector, and 125 in specialist areas within the commercial sector.

For the purposes of this paper we shall restrict ourselves to those 12 specialist areas which include some statistical training in their programmes, concentrating particularly on those which aim to train future statisticians.

TABLE 1
Specialist areas, availability and options

Specialist Area	Number of Institutions where Available	Options Within the Area
Applied Biology	21	Agronomy, Biological and Biochemical Analysis, Food and Biology Industries, Dietetics, Environmental Engineering
Chemistry	14	-
Civil Engineering	16	Civil Engineering and Building Engineering (climatics and material of building)
Business Management and Administration	46	Applied Management for Small and Medium Organisations (GAPO), Financial Book-keeping, Personnel
Hygiene and Security	5	Public Hygiene and Security Industrial Hygiene, Security and Conditions of Work
Computer Science	31	-
Industrial Maintenance	9	-
Measurement/Physics	18	Instrumental Techniques, Physic-chemical Measuring and Monitoring
Marketing Techniques	42	-
Transport Logistics	9	-
Statistics and Data Processing (STID)	5	-
Production Organisation and Management	4	-

2. Conditions of admission and organisation of study

Admission is possible in two ways, (a) by qualification, for holders of the "baccalauréat" (University Entrance qualifications) after scrutiny of the applicant's academic records by a Board of Examiners, and (b) through a special entrance examination for candidates who do not meet the requirements for (a) but who hold certain other qualifications.

Training is spread over the two years at the rate of 30-33 hours per week, divided into lectures, tutorials in groups of 24, and practical work in groups of 12.

The first year is devoted to a harmonisation of knowledge, and to the acquisition of basic knowledge in each discipline. The second year aims to familiarise the students with concrete problems by means of case studies and by a final training period in a business or in the public service, lasting 10 to 12 weeks and taking place in the third term.

The teaching is done by members of the tertiary teaching profession and by secondary school teachers in association with professionals in the private and public sectors.

Assessment is effected throughout the year through work evaluation in tutorial sessions; individual written or oral tests; reports produced from group work; and a report from the training period in the second year. Progression from the first to the second year, and the issue of the Diploma (DUT), is determined by a Board of Examiners.

3. Programmes in statistics in the teaching departments other than STID

Obviously these differ according to the specialist area but, with the exception of the STID department, statistics is included in the general mathematics programme. The tutors are generally (except in STID) either mathematics tutors (university or secondary teachers all too rarely trained in statistics) or engineers or researchers with some practical experience, or even tutors in the specialist area who have a good knowledge of its practical value in their field, but do not always have an adequate mathematical grounding.

(i) *Applied Biology*

1st year (common to all options): frequency distributions, random variables, basic vocabulary; graphic representation, parameters; binomial, Poisson, and Gaussian distributions; sampling, estimation of mean and variance, χ^2 test; comparison of means and percentages.

Total schedule in mathematics and statistics: Lectures 18 hours, tutorials 40 hours.

2nd year: Option (a) Applications in Agronomy: χ^2 goodness of fit test; covariance, one-way analysis of variance, test of linear regression; experimental design and two-way analysis of variance; block designs; coefficients of correlation; non-parametric tests. Option (b) Environmental Engineering (in the form of 20 hours of tutorials): statistics applied to biology, study of concrete problems linked to the environment; data processing; techniques and statistics in epidemiology.

(ii) *Chemistry*

Mathematics and statistics together total 32 course hours and 50 tutorial hours in the first year, 24 course hours and 40 tutorial hours in the second year. Programme: laws of probability, random numbers, application of statistical techniques to the processing of experimental results, sampling.

(iii) *Civil Engineering*
In the second year, statistics occupies 8 hours of lectures and 17 hours of tutorials, out of a total applied mathematics schedule of 17 hours of lectures and 35 hours of either tutorials or practical work. The programme consists essentially of the study of characteristic parameters.

(iv) *Business Management and Administration*
Presentation of univariate statistical series, measures of centrality, dispersion, concentration; bivariate statistical series: adjusting, correlation, regression; time series: trends, prediction; indices.
The mathematics programme consists of general mathematics, financial mathematics, and applied statistics. There are 120 hours in the first year and 60 hours in the second year.

(v) *Hygiene and Security*
Descriptive statistics (one-dimensional variables, variables of one dimension); theoretical laws: binomial, Poisson, Normal; evaluation of sampling, distributions of samples, the case of small samples; χ^2 test; two-dimensional statistics: regression, correlation, fitting a straight line, and an exponential; time series: trends, seasonal variations.
The teaching of statistics is included in that of mathematics and physics in a schedule of 90 hours of lectures, 100 hours of tutorials, and 90 hours of practical work.

(vi) *Computer Science*
Statistics is included in applied mathematics. The programme essentially consists of the study of random phenomena, together with as much theory and probability as is necessary for this purpose.
Overall schedule reserved for mathematics: 112 hours of lectures of which 64 are in the first year, and 224 hours of tutorials of which 48 are in the first year.

(vii) *Industrial Maintenance*
The programme is integrated into those of mathematics and probability: descriptive statistics, presentation of data, characteristics of position and dispersion; sampling. Computers are used as a tool wherever possible.

(viii) *Marketing Techniques*
Problems of economic optimisation; statistical series: characteristics, graphic representation, indices; financial problems; analysis of statistical series; estimation; elements of operations research (linear programming, PERT system).
Mathematics and statistics are taught only in tutorials totalling 64 hours in the first year and 32 hours in the second year.

4. The STID department (Statistics and Data Processing)

This type of department was set up nearly 25 years ago under the name "Statistique - Etudes Economiques et Techniques de Gestion" (Statistics - Economic Studies and Management Techniques). With the evolution of new application areas such as methods of data processing, in 1985 it underwent an important modernisation in both content and aim. Taking into account the facts that economic studies and management techniques were no longer the only fields using statistical methods, and that there had

been considerable evolution in information processing techniques, it was possible to put into place a form of training with programmes better adapted to the underlying training objectives.

Currently, the STID departments aim to train Advanced Technicians, who will assist those responsible for services in:

(i) studies and surveys;
(ii) administration and databases;
(iii) quality control and, more generally, quality management;
(iv) bio-statistics, agricultural statistics, agro-statistics;
(v) development and maintenance of specialised software;
(vi) scientific analysis and programming;
(vii) economic and social studies;
(viii) management oriented towards future requirements, forecasting marketing;
(ix) capture and processing of experimental data, etc.

An outline of the programmes, including schedules and percentages in relation to the total schedule, is as follows.

(i) *Basic Statistics:* Basic models and techniques, collection and presentation of data; descriptive statistics; data analysis; inferential statistics; domains of application; industrial statistics; bio-statistics; agro-statistics; quality control. 504 hours (or 28%) of which 192 are in the first year (64 hours of lectures, 128 hours of tutorials) and 312 are in the second year (78 hours of lectures, 234 hours of tutorials).
(ii) *Software for Statistics or for Management and Operations Research:* 116 hours (or 7%) of which 64 are in the first year and 52 are in the second year; tutorials only.

5. Problems posed by the teaching of statistics

From the 74 responses of a survey conducted over 177 teaching departments providing a programme of statistics, excluding STID, the following conclusions can be drawn.

(i) A primary difficulty comes from the heterogeneity of the candidates' scholastic backgrounds. Because the level in mathematics can vary considerably from one section of the baccalauréat to another, one has to start from the level of the group. Moreover the level of statistical knowledge acquired from the baccalauréat is virtually nil.
(ii) The section of the programme on "utilisation" is generally better perceived than the section on "proof". Commonly, interest in statistics does not appear until the end of the second year, after doing a case study or after the final training period (whence the urgent necessity of including concrete case studies which allow an interest in the theory to develop; this last observation is relevant for all levels of education).

(iii) For all these "departments", because the statistics programme is included in the programme of mathematics, the lecturers generally have a mathematical background. It is therefore difficult to find lecturers with a good grounding in statistics, regardless of whether they come from the secondary or tertiary teaching professions.
As for lecturers from the professional sectors, people who are practitioners of the methods being taught in the programme and who have a sound theoretical background are extremely difficult to persuade to come and lecture part-time at the universities. The renumeration available from the national education system in France for these so-called "supplementary" hours just cannot stand comparison with that offered in the private sector, nor even to that offered from public institutions dependent on other government ministries (the disparity easily reaches a proportion of 1:4).

In the STID departments themselves, as in the others, the heterogeneity in the secondary mathematical grounding of the student, depending on which baccalauréat course they have followed, causes a problem. To gauge students' own evaluation of their teaching, an anonymous survey was conducted at the IUT in Vannes in 1987, over the 73 students leaving the STID department. Their initial qualifications were as follows, the last group causing the majority of problems.

Bac. Course E	Bac. D	Bac. B & others
16.5%	39.7%	6.8%

The next table summarises their responses to a question on their adjustment to the teaching level.

	1st year	2nd year
Easy	21.9%	26.8%
Not too difficult	56.2%	56.3%
Difficult	19.2%	15.5%
Very difficult	2.7%	1.4%

As with the other departments, and for the same reasons, recruiting lecturers from the professional sectors poses major problems. In the STID departments, perhaps more than the others, the problems caused by the materials required and by the need to search out and organise the final training periods in a business, require heads of department to show themselves veritable business managers, and this is not a common characteristic of French university teachers! In fact these qualities, which are often developed at the expense of theoretical research, are still not properly recognised for career advancement in the universities.

6. Pursuit of further study

The normal conclusion of the course is entry into working life. However, the best students can apply for study at a university or certain engineering schools, on the recommendation of the IUT.

Taking as an example the STID departments, holders of certain diplomas can enrol for a Master's Degree in Computer Sciences applied to Management (MIAGE), for a Master's Degree in Management and Economic Science, or at "ENSAE" - the National School of Statistics and Economic Administration, or "ISUP" - Statistical Institute of Paris.

They can also acquire the title of "Engineer" through the continuing education programme from the "Conservative National des Arts et Métiers" (CNAM - National Conservatoire of Industrial Arts and Crafts) or specialise further within the continuing education programmes in the universities.

Of the 78 students who obtained their DUTs from Vannes in 1986, 38 went on to pursue further study, 8 enrolled in MIAGE, all passing to the second year, four with distinction; 10 enrolled in an Applied Master's Degree in Social Sciences, all receiving the degree, one with lower 2nd Class Honours and one with Upper 2nd Class Honours.

7. Conclusion

Despite the difficulties which face department heads in the IUTs, the results obtained can be seen as very positive. Even in these present times, when unemployment is the scourge of our society, in several specialist areas, and in particular in the STID, a finishing student can quickly find employment, often in the business house where he or she undertook their final stage of study and where, although hired for their knowledge of computer science, they revealed to their employer their keen interest in statistical methods.