THE TEACHING OF STATISTICS AND PROBABILITY
IN THE ITALIAN JUNIOR HIGH SCHOOL

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1. The Italian Junior High School curriculum in statistics

In 1979, the Italian Ministry of Education issued a new curriculum for the Junior High School. Among other innovations, the curriculum introduced the teaching of statistics and probability.

In Italy, it is worth nothing, education is compulsory until the age of 14, and most types of Senior High School do not explicitly consider statistics and probability in their curriculum.

It is, then, easy to image the enthusiastic endorsement of Italian statisticians for such an event, and the interest of those teachers and institutions who had long advocated the need for introducing elementary statistics and probability at the secondary school level.

The Italian Statistical Society (SIS) had indicated (SIS, 1970; Facolta . . . , 1979) that in schools before University the teaching of statistics ought to be pervasive, i.e., integrated within content disciplines, and formalized step by step, in order to let students acquire statistics as a tool for (scientific) problem solving.

The new curriculum raised obvious worries, too. First of all, it was assumed that teaches were able to cope with new subjects. They were expected to teach pupils "to collect, set up, and correlate data", "to test the correspondence between experimental outcomes and stated hypotheses" and also to highlight the differences between the observed reality and the inherent mathematical laws.

Secondly, statistics and probability were added to an already huge curriculum, since there is only one teacher for science and mathematics in Junior High School.

Some teachers protested against, while others simply tolerated, the imposed curriculum. This may be why, two years after the first one, the Ministry enacted a new decree in order to consider statistics and probability as matter for the final written examination.

In 1982, three years after the first decree, an exploratory survey for evaluating the reactions of teachers to the described situation and the prospects for the so-called "mathematics of uncertainty and probability" was carried out in the Venetian district. A large survey was carried out in the remaining Italian districts in 1983.

A mail questionnaire was sent to a random sample (1/9 of the "population" in both surveys) of Math and Science teachers (Fabbris, 1982) and, after two reminders, 73% responded.

Examining the obtained responses, a profile of the teachers is sketched (par. 2) and some answers to questions we had in mind while we began the research are given: "Is statistics taught?" (par. 3), "Which parts of statistics and probability are taught?" (par. 4), "Why some teachers put off the teaching of statistics?" (par. 5).

In the last two paragraphs, comments on prospects for the teaching of statistics are presented together with suggestions that, if put into practice, might improve the situation described.

2. A profile of Mathematics and Science teachers

The typical Math and Science teacher is a young (64% enrolled as teachers after 1970) married woman. Male teachers are about one-third of the total. Less than 10% of all responses is above 50.

The absolute majority (53%) of teachers graduated i Biology or Natural Science; another 25% in Mathematics and/or Physics, or Chemistry; an unimportant fraction (less than 1%) in Statistics.

As far as their curriculum studiorum is concerned, it has to be underlined that just 35.1% of respondents took at least one exam in statistics or probability while they attended their undergraduate studies and 5.4% went to post-graduate courses on similar topics.

It may seem amazing that the average number of exams on statistics and probability taken by younger teachers is significantly lower than that of the elder.

3. Is statistics taught?

The teaches who dealt with statistics and probability in the school year 1982/83 are an estimated 65.9% of the whole set of 45,800 teachers on active service.

Basically, the teaching of statistics begins during the last form when students are believed to be mature enough to grasp difficult arguments. Relatively few teachers impart elements of statistics and probability since the first (10.1%) or the second form (22.9%).

Many factors condition the decision to deal with such a subject. The basic ones seem to be a positive attitude of teachers toward their role and the feeling of belonging to a socially relevant institution.

The teachers showing psychological drawbacks are the youngest, unsure of the tenure of their job, and those at the end of their flat career, diffident toward imposed novelties and, maybe, resistant to change their way of

teaching. The distance from the average behaviour is large for teachers without tenure; among them, less than 40% taught statistics and probability during the surveyed years.

Another factor is commonly supposed to be training in the subject matter and refreshment of the cultural bases of professional skill. Instead, as far as the teaching of statistics and probability is concerned, there is no statistical difference between the percentage of teachers who taught it even if they did not attend any specific course (65%) and that, though higher (73%), of those who stood for at least one exam or attended a postgraduate course on statistics and probability.

The largest percentage of teachers of Math and Science who dealt with statistics (85%) is found among those who attended a specific course after graduation. This puts again into relief the attitudinal variables as determinants of the decision to teach statistics.

It may arouse curiosity that the percentage of teachers graduated in statistics who dealt with one of the subject matters is below the average.

Another factor generally influencing the involvement of teachers is school environment. Actually, schools in urban areas show a larger acceptance of the official curriculum. Moreover, the presence of full-time activities in a school is positively correlated to the teaching of statistics.

No clear relation appears, on the other hand, between the teaching of the subject and the class size, and no relation at all is found between the presence of activities for integration of disciplines and the teaching of the subject.

It is not evident, then, which aspects of school environment stimulate the teaching of statistics beyond the previously acquired inclination of teachers.

4. Which parts of statistics and probability are taught?

The items used to collect the information on the specific parts of statistics and probability dealt with are very general. Only broad sectors as "data collection and analysis", "hypothesis testing and use of logical connections, "random events and probability" were asked about.

The most popular is the broad field of descriptive statistics (52% of respondents treated it), followed by probability (41%) and by the logic and practice of hypothesis testing (26%).

Those who treat data collection and analysis basically avoid every reference to statistical inference and, at most, they introduce a vague concept of probability through combinatorial analysis.

On the opposite side, more than half of those who treat combinatorial analysis neglect statistics.

That minority of teachers who try to acquaint their pupils mainly with the foundations of statistical inference, join this subject with either descriptive statistics or combinatorial analysis, yet without an effective integration of the subjects dealt with.

Definitely, only about 25% of those who responded positively to the question on teaching statistics combine together various subjects of statistics and probability and get close to the likely essence of the official curriculum.

Interest and matter for application of statistical and probabilistic techniques are found in other disciplines: "technical education" (20% of all teachers), history and geography (16%), but also "Arts and music" (3%).

The textbook is considered an aid appropriate to the teaching of statistics and probability only by one-third of teachers, without remarkable differences between those who used it as a guide for teaching the subject and the other ones who did not. The deficiencies teachers point out are more and more severe as their level of involvement on teaching statistics decreases.

Even if it is difficult to detect the truthfulness of responses like these, textbooks are really defective. Criticisms come from statisticians, pedagogists, and teachers because the chapter on statistics and probability (usually, just one at the end of the book) either do not tie together with the rest, or linger upon formalisms without applications to the real world. Teachers who try to merge statistics and probability in a broader cultural set-up complain that they don't find the wanted links between subjects.

5. Why some teachers put off the teaching of statistics?

To various degrees, all teachers, whether they started statistics or not, worry about the possibility for pupils to effectively learn statistics and probability at Junior High School and many of them suggest postponing it.

For teachers who did not start the treatment of the subject this argument lets us understand that they gave it up altogether and did not put it off, since not to teach statistics is presented as a conscious choice. This is the position of about 20% of the teachers who did not deal with the subject.

Very frankly, one out of four teachers who put off the subject admits not to know enough about it. On the other side, at least 10% of those who started would like to attend a refresher course to get a deeper knowledge of it.

If we remember that almost two out of three teachers, whether they already taught statistics or not, never attended a course in it, it is easy to guess that the observed frequencies underestimate the true level of teachers' need to bring themselves up to date.

Several teachers taught themselves parts of the subjects. Textbook adequacy is, then, vital both for teaching and for learning.

6. Prospects

The prospects for the immediate future are deduced from Table 1, where the recent behaviour and the intention for the year following that of the surveys are put together.

Table 1: Percentage distribution of Mathematics and Science teachers, according to whether they taught statistics and probability and to what they intended to do the year following that of the survey.

	FOLLOWING YEAR				
PAST YEAR	Will teach	Won't teach	Don't know	No longer a teacher	TOTAL
Taught statistics and probability (n=2467)	85.3	0.1	12.9	1.7	100.0
Did not teach (n=1307)	39.8	10.8	46.9	2.5	100.0
Total (n=3774)	69.6	3.8	24.6	2.0	100.0

If we trust the obtained responses, we expect that teachers treating statistics and probability will become more and more numerous as time goes by.

A part of those who already decided to teach statistics and probability will no longer stick with the subject. On the contrary, among the teachers who put the subject off, only a small fraction will persist in refusing to teach it, while many of them have indicated their intention of teaching it in the near future.

On the whole, excluding the ones who expect to retire, the number of teaches in the category of interest would increase at least 3.7%.

Reflecting on the data presented in Table 1, three main categories of teachers can be picked out:

(i) a substantial and expanding group that taught statistics and/or probability during the third form and intends to go on with it, adapting his/her teaching program to possible interactions with colleagues of other disciplines and to the actual curriculum of the pupils;

(ii) a set (about 25% of all teachers) with a less positive attitude toward school, and often worried about his/her job tenure, that considers the teaching of statistics and probability dependent on optimal school and

class conditions. Year by year, the largest part of this group goes on looking for better conditions;

(iii) a small group (about 4%) of irreducible or disappointed teachers who do not intend to deal with the subject in the future. It is not possible to know why these people took up such a negative, even provocative, position against the new curriculum.

7. Further comments and some suggestions

Job tenure has come up as a factor that interacts with the teaching of statistics. We just mention it, but the solution to such a general problem pertains to global policy and has to be linked with other political decisions.

Bearing in mind that the purpose of teaching statistics and probability is for developing in all pupils a "forma mentis for experimental research", we feel that the basic, minimal contents of statistics to be taught in the compulsory school should be spelled out in detail in a syllabus.

Such a syllabus would leave the teacher ample leeway for treating in a deeper way the preferred subjects, choosing the teaching methods, and finding the content areas through which to convey the subjects.

We wish to stress the importance of statistics (over probability) for educational purposes in the compulsory school. Whenever the teacher has to select a topic, he/she should put combinatorial analysis and calculus of probability at the bottom of the list.

The teaching aids we have in mind are textbooks and other materials. As far as teaching materials produced by teachers and pedagogic centres are concerned, it is to be said that the few such initiatives are not yet a sure reference for interested people. Only a national institute, composed of prominent mathematicians, statisticians and pedagogists can promote the development of teaching aids and turn the locally produced materials to good account.

The way statistics and probability are dealt with in textbooks is not yet satisfactory. The problem is not so easy to solve. Would it be a good solution that official commissions created by SIS, or by the associations of mathematicians, or by the Ministry of Education, evaluate textbook adequacy for the new curriculum (or for a hypothetical syllabus)?

Acquiring qualifications for teaching statistics seems to be a problem for all teachers on active service, and a target for many of them. Nevertheless, the data discussed above; the inadequacy of local institutes deputed to train teachers on active service (IRRSAE); the indifference of academic authorities about High School education; all of these factors lead us to anticipate problems for any initiative to improve teachers' qualifications. However, it is the only path to take.

References

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