INDUZIONI: THE ITALIAN JOURNAL ON TEACHING STATISTICS

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The publication of Induzioni in 1990 was actively supported by the Italian Society of Statistics. It was founded with the intention of gathering together material and ideas for teaching Demography, Probability and Statistics in schools. This paper highlights the relationships among the topic, educational level and curriculum area of articles in the journal by applying multivariate correspondence analysis to a set of categorical data observed in each article. The supplementary variable year of publication helps outline how the editorial policy evolved from 1990 to 1997.

THE ACTIVITY OF ITALIAN UNIVERSITY STATISTICIANS TO PROMOTE STATISTICS IN SCHOOLS

For some time Italian statisticians have been actively involved in promoting a greater understanding and diffusion of a statistical "mentality", with particular focus on the link that this could have with the school environment. This activity has been carried out by the Società Italiana di Statistica (Italian Statistical Society - SIS) and could be said to have commenced with the Round Table Conference on the Teaching of Statistics organised in 1970. It was only some twenty years later that the SIS, under the Presidency of A. Zuliani, recognised the fact that the teaching of statistics at a pre-University level was not prospering, nor had any concrete measures been taken to support the teachers. This led the Society to help found *Induzioni* in 1990 as a tangible proof of the interest of statisticians in teaching their subject in schools.

The Director of *Induzioni* from the outset has been Enzo Lombardo, Professor of Statistics at the Economics Faculty, University of Rome "La Sapienza", who has always been devoted to the problem of teaching statistics and probability at pre-university level.

THE AIMS OF THE JOURNAL AND AN EXPLANATION OF ITS TITLE

In Italy, Stochastics (Probability and Statistics) has been included since 1979 in the mathematics curriculum for junior high schools, and in that of elementary schools since 1985. The situation at high school level remains somewhat confused. Apart from a number of courses in technical schools where it is part of the official curriculum, stochastics throughout the "classical and scientific Lyceum" is only included at an *experimental* level in the mathematics curriculum.

Nonetheless, albeit only as an experiment, the introduction of stochastics in high schools caught most mathematics teachers by surprise. Even statisticians themselves began to take stock of the fact that theirs was only an on/off interest in teaching statistics and that no channel of communication existed to make known their work in the field or to establish ongoing contact with school teachers.

Induzioni was founded with the aim of filling in this gap and to help develop an awareness of statistics both as a technique and method for the quantitative study of collective phenomena, as well as a quantitative culture needed in daily life. This intention is explicit in the full title of the journal which is worth translating - *Inductions*: Demography, probability and statistics in the school. The word *Inductions* is expressly plural so as to comprise all its possible meanings: a more technical one of a philosophical or statistical nature; a physical one referring to a change in an acquired state; and a more all-embracing, older one - to induce, to favour (in this instance, promoting the circulation at a school level of opportunities or starting points of work, information regarding statistics in the broadest sense of the word). This is highlighted in the subtitle, where the explicit reference to demography, probability and statistics serves to recall the different origins and historical roots of this subject which, by integrating different cultural approaches, is by nature interdisciplinary and universal and thus of major cultural importance.

Even the illustration on the cover - a white poplar (*Populus alba*) - is intentionally evocative, well-wishing. Once the poplar is cut it produces numerous shoots at the base of the tree. Indeed, the metaphor could be even more profound: to grow well poplars need a fertile, sunny, terrain; and they are colonising plants which nevertheless leave room for other species. Statistics, too, which calls for precision and carefulness to arouse the curiosity and interest of the student, once captured, triggers a mental opening which is useful in better understanding the type of subject requiring a quantitative approach.

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When deciding on the contents of the journal no stone was left unturned, and some well-known foreign journals in the field were consulted: *Teaching Statistics* and the "Teacher's Corner" in *The American Statistician*, as well as a number of Italian mathematical journals.

The articles published in *Induzioni* are divided according to issue. Logical, epistemological and historical aspects of statistics and probability generally open each issue. Often what are dealt with are fundamental texts of major figures from the past, which are no longer easily available, ranging from Galileo to Quetelet to Graunt, from Gini to Pompilj to De Finetti. The intention here is to show how statistics was born from practical cognitive problems, that the techniques involved are not abstract formulae but based on logical constructions linked to a quantitative study of reality. "Experiences and materials" was the theme for one issue with articles providing inspiration for teachers from elementary to high school. Thanks to an agreement reached with *Teaching Statistics*, each number includes translations of two or three articles whose content is useful and of interest in the Italian context. Also, international events - such as ICOTS conferences and IASE sessions during ISI conferences - have provided the occasion to identify articles in interesting topics which have been to date little studied in Italy, and thus furnish examples for possible future research and provide readers with a more complete range of topics. As the readership of the journal has increased, along with an increase in teacher training in statistics, so too has the input from teachers themselves. Simultaneously, the University and the Italian National Statistical Institute (ISTAT) have begun to pay more attention to the needs of schools and have proposed the use of case studies which would be useful in kindling the interest of the student by using official data, referring to everyday life, which is the aim of "Statistics and daily life". *Induzioni* also publishes discussions and novelties contained in Ministerial programmes regarding the topic "probability and statistics" within the mathematics curriculum.

Moreover the journal publishes Italian research studies on teaching, which is a little thin on the ground. Currently these tend to concentrate on the learning of probability (particularly at elementary school level), quantitative research on the statistical contents of secondary school text books, on the inclination towards the teaching of statistics and probability in high school, and the use of the computer in teaching statistics in high schools and universities. The journal also gives a glimpse of major initiatives in Italy in the field of teaching, of important international meetings and conferences and provides reviews of books which favour the spread of a statistical culture in schools.

HOW EDITORIAL POLICY HAS EVOLVED

Any journal expresses a line of thought which evolves and changes over time. *Induzioni* is now eight years old, and has published 14 issues containing 182 articles.

Statistical analysis is useful in highlighting the distinctive features of the journal and tracing how it has evolved. For this purpose a multivariate correspondence analysis (MCA) was applied. This is a useful descriptive technique in that the underlying features of articles in the journal are by no means due to chance: the editorial board, composed of seven different persons, chooses from among the articles submitted, assuring as far as possible a wide variety of contents, ideas, teaching levels.

More specifically, taking the article as the unit of observation and analysis, the following categorical variables were considered:

> *year of publication* (1990 to 1997)
> *author's nationality* (Italian or foreign)
> *topic*
> *statistics curriculum area*
> *educational level*.

The variable *topic* has the following categories: official curricula; historical topics and foundations; didactic proposals such as materials, case studies, teachware; research on textbooks, teaching software and teachers' inclination to teach statistics and probability; research on students; other. For the variable *statistics curriculum area*, a rough classification was made for each article: descriptive statistics, classical probability, Bayesian paradigms, inference and applied statistics. The variable *educational level* was divided into elementary (6-10), pre-university (11-18) and university (19-), thus allowing international comparisons to be made. Performing an MCA by the "proc corresp mca observed" of the SAS to the Burt table, obtained cross-tabulating the 14 categories for the 3 variables - *topic*, *statistics curriculum area* and *education level* - the first factorial plane explains 26% of the total inertia. Figure 1 helps interpret the phenomenon in question, assessing the reciprocal position of the category points of the same variable, following the study of the quality of the representation of the category points and the indices of the coordinates that contribute most to the inertia for the points. The variable *educational level* helps interpret the first dimension, with university (Univ) (positive axis) being opposite to school, elementary (Elem) and pre-university (PreUniv) (negative axis). Taking the second dimension, *statistics curriculum area* items covering probability (positive axis) are opposed to those dealing with statistics (negative axis), with applied statistics (ApplStat) constituting a sort of hinge between the two. For the variable *topic*, a

critical examination of ministerial curricula (Curr) and historical topics and foundations (HistFoun) (second positive axis) are opposite to didactic proposals (DidProp) and research. Of particular interest is a study of the associations among the categories of different variables.

Figure 1. Induzioni article attributes
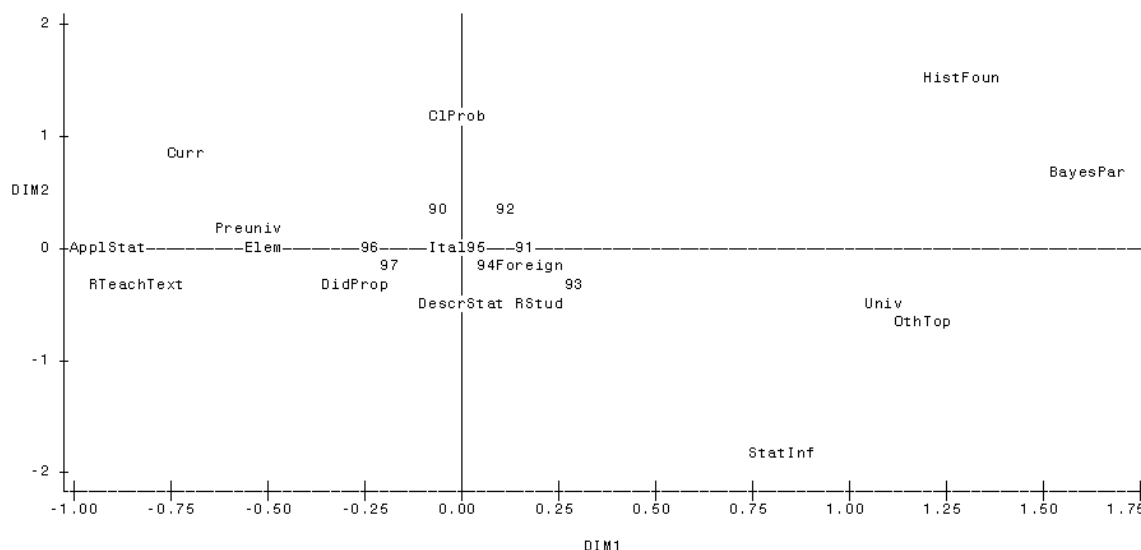
At school level (Elem, PreUniv) the *statistics curriculum area* items most dealt with in articles in *Induzioni* are descriptive statistics (DescrStat), classical probability (ClProb) and applied statistics (ApplStat), while with regard to the variable *topic*, teaching suggestions (DidProp) clearly predominate. Articles covering research at this level tend to cover teaching aids, books and software, and the teacher's inclination to teach statistics and probability (RTeachText).

For the variable *statistics curriculum area*, Bayesian paradigms (BayesPar) and inference statistics (StatInf) are the least covered parts, alongside historical or institutional type topics (HistFoun). Articles of this nature are mostly at university level. The category point regarding research on students (RStud) is of particular note. This label indicates surveys on various topics: how statistics and probability are learnt, students assessment, the students knowledge of pre-requisites of mathematics for beginners' courses. This type of research is found on the positive side of the first axis (that explained by University), as we find here studies performed by university statistics teachers on their students, particularly in the overcrowded Economics Faculty common in Italy.

The introduction of supplementary variables *author's nationality* and *year of publication* enriches the survey. Italian articles (Ital) are placed at the centre of gravity, as these are in the majority and cover all types of topics, every level, and all sections of the programme. Foreign articles (Foreign) are nearer that on research into students (RStud), but not far from didactic proposals (DidProp), particularly for descriptive statistics (DescrStat). A graphical representation of the *year of publication* of articles (90 to 97) shows a gradual shift from an initial situation in 1990 where those containing teaching suggestions of classical probability for school level predominate to 1993 where proposals on descriptive statistics and research on the students have begun to emerge. The year 1993 was a year of innovation, with a new point of focus in the journal - "Statistics and daily life" - which centres on statistics applied to the economy, demography and social aspects. Between 1993 and 1997 this strengthened focus on statistics (as opposed to probability) has continued with a large number of proposals made regarding the teaching of descriptive statistics and applied statistics for schools.

CONCLUSIONS

The analysis performed shows how *Induzioni* is particularly directed towards the publication of articles mainly targeted at a pre-university teaching level, and contains a wealth of proposals regarding teaching descriptive statistics, classical probability and applied statistics. The journal also contains research into the teaching of statistics and probability, particularly favouring pre-university level, and focuses on text books, software and teachers attitudes to probability and statistics. Research on students tends to be at a university level.

The editorial policy would appear to be well-balanced. Initially this was based on studies regarding probability, which was more developed in Italy in 1990, then on statistics and applied statistics, which the founding of the journal may have helped encourage. *Induzioni*, in the last analysis, acts as a bridge between the schools and university. It is a witness to the efforts of a small group of Italian academic statisticians who, aware of the importance of the visibility of their subject within the educational system - and not just in the academic world, research centres and big industry - who have generously and enthusiastically sought to commit themselves assiduously and constantly to the difficult task of promoting a statistical culture in society.