Teaching Applied Quantitative Methodology to First Year Undergraduate Students in Economics

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1.   Background

This paper is about the main features of a new course in applied quantitative methodology introduced into the curriculum of undergraduate studies in economics, in accordance with a law enacted in 1984. This law outlined a scheme of reform aimed at lowering the rate of failure, primarily after the first and second years at university, and better adapting training programmes to professional needs.

Accordingly, several innovations were introduced, relating to the content of the course as well as to pedagogics. We will deal successively with the background of this experiment, its goals, achievements, and organisation.

Free access to the university of one's choice is the rule in France for pupils having passed the special examination (baccalauréat) at the end of secondary school. Such a system brings heterogeneous cultural backgrounds to studies in economics. Almost two-thirds of students have taken, while in high school, introductory classes in economics which focussed on facts and contemporary problems by means of a descriptive approach. The remainder is divided into two groups: about one-fourth of all applicants have acquired a strong background in mathematics; the last group, exhibiting a rather literary profile, shares a rather low level in mathematics with the majority of their fellows.

Hence a large proportion of students feel uncomfortable with mathematics and formal language, which, in their mind, are linked to scientific and exact argument, while they perceive economics as a descriptive subject requiring nothing other than everyday language.

Approximately sixty percent of registered students go on to the second year. An analysis of the causes of failure would go far beyond the scope of this paper. Let us briefly distinguish three categories of students who fail: first, those who choose a field

which matches neither their expectations nor their abilities; second, those who seek applied rather than theoretical training and a quick exit to professional activity - they are usually unable to maintain the required pace; and third, those capable of understanding abstract and theoretical teaching, interested in it, but discouraged by a use of formal language. Our purpose was to diminish the contribution to failure of this last category.

Before the reform, the curriculum comprised the teaching of basic concepts and main currents of economic theory, national accounting, mathematics (functions and linear algebra), statistics (one and two-dimensional including elementary analysis of time series). The programme of statistics was mainly technique and tool-oriented; it was a part of the course in mathematics.

In economic matters, measuring and counting were dealt with incidentally, as needed, as a rather tedious prerequisite to comments on economic or social phenomena.

This situation was considered as presenting an inaccurate picture of methodological problems, particularly with regard to the issue of data quality, and its relationship with the reliability of information and statements derived from the data.

2.   Purposes

Our starting point is that the economist involved in decision-making or advising decision-makers has to rely on the statistician to improve his knowledge and prepare efficient decisions. A good dialogue between the economist and the statistician is a pre-requisite to good quality and useful information. We shall demonstrate how, at the beginning of the process, the statistician helps the economist arrive at a precise defin-ition of the unambiguous, meaningful variates which best enlighten initial questioning; then how, after data has been collected according to normal technical standards, dialogue is again necessary to determine the form under which the data should be summarised, synthesised, and set out so as to best yield meaning.

From this starting point, the course set itself the following specific aims:

(i)   To analyse the whole chain of production of new knowledge starting with the definition of information required, and proceeding with data collection, verific-ation, presentation and processing, ending with the generation of new meaning, this last step completing the circle.

(ii)   To make the students notice the frequent necessity, particularly when using complex and multifaceted real-world data (for example, data from administrative sources), of representing the whole information as a series of special purpose tables or graphics, each element displaying clear-cut meaning. To discuss the frequently-met requirement of dropping some information in order to gain some meaning.

(iii)   To emphasise the problem of reliability of data in relation to the collection process, particularly when the information is obtained through interviews, and cannot be adequately checked by the statistician.

(iv)   To illustrate complementarity rather than opposition between formal and literary languages, this issue comprising different sides: numbers should always be complemented by a comment in standard language; formal language and numbers don't necessarily guarantee accuracy; ambiguous concepts of everyday life can be

turned into more scientific ones, allowing precise evaluation; contradictory opinions all relying on quantitative data about the same phenomena can be elucidated by deepening the analysis of underlying concepts, as well as by carefully examining the reliability of information.

(v) To distinguish short-term and long-term analysis, and the tools applicable to one or the other; to compare diachronic and synchronic approaches, and show how data may lead to different, opposite conclusions according to the approach selected.

(vi) To demonstrate basic tools of quantitative analysis in a practical and logical way.

(vii) To provide some information about the statistical system, the censuses, the main surveys pertaining to economic or social fields, the legal aspects of data collecting (confidentiality, protection of privacy, mandatory response, etc.).

3. Topic content

The fact that we were dealing with first-year students lacking knowledge about economic or social facts, as well as the rather short period available for the course (14 weeks of lectures and 10 weeks of applications prepared at home, and conducted in small groups, see below) brought us to select seven main topics which required no specific background.

Topic 1 : How to extract information from a table: How to extract information from a table giving the level of a variate for several dates and geographical areas (for example, yearly production of oil for different countries or regions). After a short qualitative survey, we show how the computation of index numbers related to one area, with level 100 for the preceding year, or for a given year, and that of index numbers related to one date, with level 100 for a given area (and particularly the structure of a whole), complemented by charts, helps to extract information from the data. We emphasise that in each case the calculation results in some loss of information, with, as a trade-off, greater clarity in what is left. As a result, the meaning of data is better expressed through a set of simpler tables and corresponding charts, each yielding a piece of information. We decribe the different ways of expressing the comparison between levels (by index number, by percentage, etc.), we define the average annual rate of variation over a period and comment on its meaning.

Topic 2 : Synthetic index numbers: Noticing that the variations of prices for a set of goods can be observed, but not the variation of the set of prices, we get the students to consider that a synthetic price index number is a built-up indicator which should meet the two purposes of being mathematically simple and economically meaningful. We show then that the unweighted average of elementary index numbers is the simplest one, but is economically irrelevant. Hence we bring in naturally the Laspeyres and Paasche indexes which can be interpreted as the weighted average of elementary indexes or as the ratio of values computed for different dates with the same set of prices. We discuss the short-term and long-term effect of the different structures of Laspeyres and Paasche price indexes, particularly if chain index numbers are used, as is the case with the consumer price index, for instance. The topic includes the distinction between variation from date to date (sliding variation), fitted to short-term analysis, and yearly average variation (used, for example, in national accounting), the "carry forward"

effect. We deal with volume index numbers, constant currency values. For applications, we draw freely on the national accounts. We mention the main characteristics of the consumer price index (seasonal products, changes in reference goods, split of price increases between quality enhancement effect and inflation effect, etc.).

Topic 3 : Unidimensional statistics: Starting with the goal of best summarising a distribution with a small number of parameters, we set out the different indicators for central tendency (Yule criteria) and for deviation. Different approaches to the issue of inequality of distributions (quartile ratio, Gini's curve and index, etc.) are compared, particularly with respect to sensitivity to changes in distribution. We illustrate the pitfalls of ratios, the numerator of which is not a part of the denominator, or is not of the same nature, and the risks of misinterpretation which this entails (demographic ratios, ratios of self-financing of investment, etc.).

Topic 4 : Classifications:

(a) *Classifications of productive units:* After having set out the formal properties of classifications and a short history of economic classifications used for national accounts and foreign trade, we explain how the chosen combination of criteria belonging to different classes reflects the structure of productive units, thus how such classification can be viewed as yielding a short tour inside the panorama of industries (for example, plastics are classified according to technique, glass is processed from raw materials to consumer goods in the same units, which is quite different from metallurgy, automobile and farm equipment which are described separately even though techniques are close because these two kinds of products are not found in the same factories, etc.), and how the choice of categories made by the statisticians depends on the field covered by the professional organisations.

(b) *Classifications of trades and social categories:* We refer to the ambitious plan conceived after the second world war by the French National Institute for Statistics and Economic Studies (INSEE) aiming at classifying individuals by means of criteria pertaining to different fields of knowledge (economic, social, cultural, political), and yielding a nomenclature which could be referred to by specialists of different fields as well as by non-specialists. We underline how such a social categorisation was deliberately designed as a cognitive tool and a mirror of the representation of social groups, but also how the procedure for grading people, relying on census, compelled the statisticians to take full account of the institutions and the ways in which they structure social identification, so as to guarantee a good quality and reliability of results.

We emphasise that the 1982 transition from the old 1954 classification to a new one, expresses also changes in the relative weight of industries, the strengthening of salaried status, and an improvement in the quality of grading. This follows from a better knowledge of trades analysed on a permanent basis since the second world war (Répertoire des métiers) and a more precise classification linked to the increase in the number of conventional agreements on job scales (conventions collectives) which developed over the last forty years as a result of fitting the classification of trades and social categories to these scales.

Topic 5 : Employment and unemployment: This topic is chosen to illustrate quantification because, besides its importance as a social issue for economists, it does not require prior specialised knowledge (unlike the issue of production, for instance). We deal successively with:

(a) *Counting the unemployed:* We skim through the characteristics of the four main sources of data available: two of them are by-products of the activity of social institutions (one manages unemployment and collects taxes for this purpose, the other matches job offers and demands, registers the unemployed). The third source comes from the general census of the population. The fourth one is a yearly survey conducted by INSEE covering a much broader scope than unemployment. In fact, this survey is the main source on the structure of employment (according to sector of activity, qualification, sex, citizenship, age, length of training, duration of work, etc.) and rates of activity. We then deal with the problems occurring with administrative sources (linked to the implementation of regulations), compare a census with a survey, handled by professional statisticians who, thanks to the limited size of the sample, have the opportunity to ask a broad set of questions through a long interview, some answers allowing one to validate others.

(b) *Methodological problems linked with the continuous range of status* from full employment to inactivity and unemployment, including state-subsidised temporary jobs, and their consequences on evaluating the levels of employment.

(c) *Quantifying different aspects of unemployment:* duration, means of access, qualification, age, activity, etc. How they enable one to distinguish between the profiles of young unemployed (low average durations of unemployment, precarious forms of employment) and old (long duration of unemployent, non-adapted training).

(d) *Comparing two approaches to active populations,* one adding numbers employed and unemployed; the other being derived by applying rates of activity by age to demographic data.

Topic 6 : Time series analysis: We discuss particularly the adequacy of the chosen model to the observed variables. We deal with the two main elementary methods of estimating the trend (least squares and moving averages), stressing their qualities and defects. We give a hint of the method (Census X 11) widely used in statistical organisations.

Through examples (wages, rates of activity for women, rates of marriage, etc.) we get the students to think over the paradoxes of synchronic versus diachronic analysis, to get accustomed to the concepts of cohort, age effect, generation effect.

Topic 7 : Measuring productivity: We start with productivity of labour, then we deal with the productivity of capital and come across the problems of measuring aggregate capital stock. Next is the concept of global productivity and the underlying hypotheses about the way of combining aggregating factors. This heading also includes the issue of surplus accounts. We throw some light on the ways of defining and measuring efficiency and profitability of productive capital.

In addition, we provide some information about the public statistical organisation and selected tools of data collecting (census, large-scale surveys in the fields of employment, unemployment, wages, the structure of industries, etc.).

4. Organisation

Our course is organised according to a three-tiered structure. It comprises, on a weekly basis:

(i)   1.5 hours of lectures (14 weeks) addressed to large groups of 250 to 500 students (1100 students are registered and three similar courses run in parallel). The content covers basic theoretical concepts.

(ii)   1.5 hours of work (14 weeks) in large groups (the same as for lectures) on typical examples or cases, oriented towards the acquisition of tools.

(iii) 1.5 hours of work (10 weeks) in small groups (35 students) under the supervision of a teacher. The students have to prepare at home a selected list of exercises taken in advance from a file distributed at the beginning of the semester. These include various types of tasks:

-      data processing (computation of indexes, ratios, factors, etc.);
-      building of simple tables or graphs;
-      writing short commentaries on sets of data, requiring simple preliminary processing;
-      synthesising information from several small tables and graphs, no more than one page-length; for instance, a panorama of the French demographic situation for the last year, of employment and unemployment, comparison of macroeconomic forecasts for the main countries worked out by the IMF or OECD (monetary variates excluded);
-      comparison of different definitions for economic and social phenomena (implemented by national or international statistical organisations), and comments on their suitability as regards the various points of view from which the issue can be examined;
-      text analyses about methodology.

The file also contains documents to stimulate further thinking, and sets of short exercises with solutions, designed to help understand the course better.

5.   Assessment

This course has not yet been fully assessed, but the following elements appear clearly:

(i)   Students consider that this course is rather demanding, but it is fairly well accepted.

(ii)   As a matter of fact, it exhibits a broad range of performances.

(iii) This course has helped students better understand that acquisition of new knowledge from data inevitably implies that inherent methodological issues must be taken into account.

(iv)   It has contributed to reducing the traditional gap between subjects according to whether they resort more to formal or to literary language.

(v)   The rate of failure has slightly diminished, but this course is only a part of the reform, and we cannot yet estimate its specific contribution.