Exploring Educational Econometric Software: A Decade of Experiences with Gretl

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Abstract

Training individuals capable of analysing, understanding and explaining the functioning of the economy is a big challenge for Schools of Economics and Business. In this context, Econometrics can be considered as a strategic tool, providing competences referred to the ability to search, process and analyse information, and identify, pose and solve problems. Since the skills in the use of Information and Communication Technologies (ICT) are increasingly important and the educational software plays an outstanding role in the teaching-learning process, in this paper we focus on the adequacy of software packages, proposing the "Four-F" test and examining Gretl (Gnu Regression Econometrics and Time series Library) as a case study. The Four-F test includes the requirements of Freedom, Flexibility, Functionality and Friendliness and, in order to test these hypotheses, we have collected empirical evidence through online students´ surveys. The obtained results provide interesting information, confirming that Gretl is perceived as a free, flexible and friendly software package, and detecting some difficulties related to the most demanding functionality requirements, such as the Gretl console.

Keywords: *Econometrics, Gretl, freedom, flexibility, functionality, friendliness;*

1. Assessing Econometric Software. The Four-F test

The evaluation of instructional software is a main factor in the design and development of computer-based training, since a properly conducted assessment can help to determine the effectiveness, efficiency, usability and acceptability of an instructional program. This is particularly true in the case of Statistics and Econometrics Courses, as it has been shown in several empirical investigations. More specifically, the meta-analyses by Hsu [1], Sosa et al. [2], Larwin & Larvin [3] and Cifti et al. [4] clearly confirm the effectiveness of computer-based tools in Statistics, paying attention to different attributes (such as technology types, student engagement, control over the learning process or feedback) that could account for differences in the effectiveness.

According to previous findings there is significant evidence that students enrolled in computer assisted statistics courses show greater achievement than their peers who receive face-to-face instruction. Nevertheless, once technology has been incorporated to statistics courses, instructors are increasingly interested in knowing which instructional tools foster the most learning.

With the aim of evaluating the suitability of instructional software, we have paid attention to its access, use and understanding, developing an intuitive test named "four-F", whose requirements are illustrated in figure 1. According to our proposal, a suitable software should be accessible, usable and facilitate understanding of statistical and econometric concepts.

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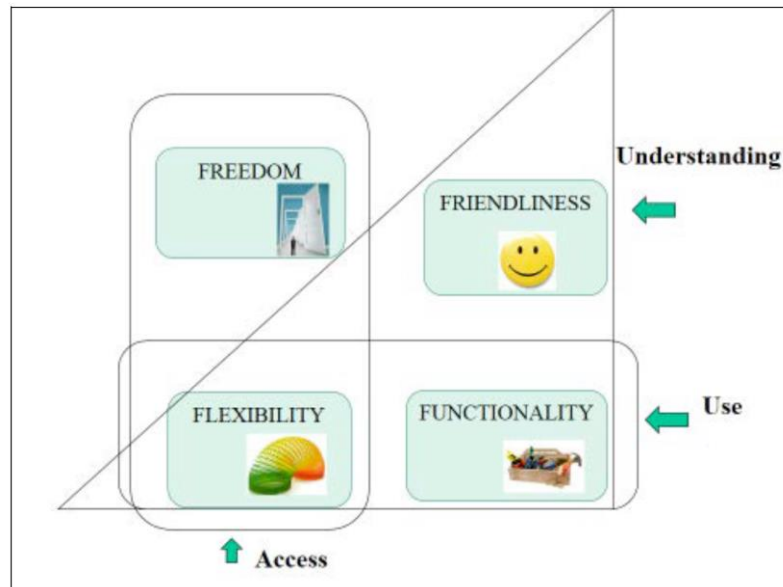[2] University of Oviedo, Spain

Figure 1: The Four-F test

The requirement of Freedom, also understood as openness is mainly related to the access. The inclusive term FOSS (Free Open Source Software) refers to software that is both free (libre) and open source, meaning that it is liberally licensed to grant users the right to use, copy, study, change, and improve its design through the availability of its source code. Thus, the "free" term refers to the freedom to copy and re-use the software, rather than to the price of the software.

According to our opinion, the use of FOSS provides several advantages in the university context, related to both the freedom given to users and the strengths of its peer-to-peer development model. Moreover, some of the most outstanding characteristics of the FOSS (free, democratic, sustainable and technologically competitive, cooperative and competitive relationships,…) appear to be closely related with the main aims of the European Higher Education Area (EHEA) as we have analysed in previous works [5].

The requirement of Functionality refers to the quality of being suited to serve a purpose well. Functionality is mainly related to the use of statistical and econometric software, which should provide a wide range of operations adapted to the needs of its potential users.

Flexibility is closely related to the software usability and can be understood as the ability to be easily modified. Thus, flexibility should be understood in a broad sense including menu options, functions, languages and many other software attributes.

Finally, the quality of being friendly refers the software capability to facilitate understanding of statistical and econometric concepts. Therefore, this requirement is particularly important for instructional purposes, and especially with regard to the less advanced users

2. Learning Econometrics with Gretl: A decade of experiences

Gretl (acronym for Gnu Regression, Econometrics and Time Series Library) is an open-source software package developed by A. Cottrell and R. Luchetti [6], mainly focusing on statistical methods for econometric analysis. Some of the main advantages of Gretl have been described among others by Baiocchi & Distaso [7], Mixon & Smith [8], López & Pérez [9], Falat & Panciková [10]. Moreover, our experience with Gretl has shown that it is a suitable tool for teaching and learning econometrics in a wide variety of courses ranging from undergraduates to doctoral studentes, and including different teaching methodologies (face to face, online and blended-learning).

After a decade of experiences, we have collected some objective evidence referred to the previously described requirements, as we summarise in figure 2.

Requirement	Evidences in Gretl
Freedom	Open-source statistical software
	Developed in Linux. Available on Microsoft Windows and Mac OS X
Functionality	Command Line Interface and Gretl Console
	Integrated powerful scripting language
	Import data from several file formats
	Interaction with R
	Output models as LaTeX files, in tabular or equation format
	Command loop structure for simulations and iterative estimation procedures
Flexibility	Available in English French, Italian, Spanish, Polish, German, Basque, Catalan, Galician, Portuguese, Russian, Turkish, Czech, Traditional Chinese, Albanian, Bulgarian and Greek
	Wide variety of supported data formats
	Tailored for a wide variety of potential users
Friendliness	Intuitive and Friendly interface
	Large database available

Figure 2: Objective Evidence on Gretl

Although some of these requirements, such a those related to freedom and flexibility, can be easily checked on objective information, most of them should be tested according to users' subjective opinions, that can be easily collected through online surveys. With this regard, main attention should be paid to the survey design, including specific items referred to the different software options (functionality), their flexibility and their contribution to understanding (friendliness).

Therefore, we have implemented online student´s surveys including three blocks of questions, respectively referred to the user`s personal characteristics, their level of agreement with specific aspects and their perception of Gretl´s ease of use and its comparison with alternative software. Furthermore, since some of the considered requirements are related to both functionality and friendliness, the items referred to the most intuitive facilities (icons and graphs) have been assigned to friendliness hypothesis while the remaining ones have been related to functionality.

Regarding the methodology, the commonly used Likert scales [11] allow to measure respondents' attitudes by asking the extent to which they agree or disagree with a particular question or statement and, if the typical five point scale is considered (1- strongly disagree, 2-disagree, 3- not sure/undecided, 4-agree, 5-strongly agree), the collected information allows the setting and testing of hypotheses related to the population proportion (H0: $p>0.5$) and/or the population mean (H0: $\mu>3$), leading to the corresponding critical levels (p-values) and conclusions.

3. Testing the Four-F test: Empirical evidence

In order to approach the perception of a wide variety of students, encompassing different academic levels and ways of working with Gretl, this online survey has been implemented in several university courses related to Economic Statistics, Econometrics and Forecasting. A description of the questionnaire including the items related to each hypothes can be found in López & Pérez [12].

The empirical evidence, based on a sample of 225 students and summarised in figure 3, shows that Gretl clearly fullfils the requirements of flexibility and friendliness, while the conclusions referred to functionality differ depending on the considered items.

Regarding Flexibility, most students declare to use Gretl from different locations (home, school, work, …) and for several purposes (clases, autonomous work, team projects, …), thus failing to reject the null hypotesis $p>0.5$. Furthermore, as figure 3 shows, the functionality and friendliness requirements have been anlysed through different ítems, running the corresponding statistical tests for both the population proportion (H0:$p>0.5$) and the population mean (H0:$\mu>3$). The obtained results show that students strongly agree with the most intuitive Gretl facilities (icons and graphs), also confirming Gretl´s ease of use and considering this software better than another alternatives. These results are particularly important since, according to several studies, perceived usefulness and perceived ease of use positively influence learning.

Hypothesis	Item	Critical level (p-value)	
		$H_0: p > 0.5$	$H_0: \mu > 3$
FREE-FLEXIBLE	Use from different locations	1	
	Use for different purposes	1	
FUNCTIONAL	Agreement with workfile options	0.01	0
	Agreement with output facilities	1	1
	Agreement with Gretl console	0	0
	Agreement with Gretl functions	0.4	0.42
	Agreement with Gretl User´s guide and help facilities	0.5	0
FRIENDLY	Agreement with Gretl icons	0.98	0.99
	Agreement with graphs	1	1
	Ease of use	0.2	0.08
	Preference to alternative software	1	1

Figure 3: Evidence from online students´ surveys

With regard to functionality, students show a quite strong desagreement with the workfile options and Gretl´s console, leading to the rejection of the corresponding hypotheses. However, they agree with another functionality ítems such as Gretl´s output facilities, functions and –at least partially- User´s guide (in this last item most students agree to some extent, although the average score does not reach the required 3 points).

In general terms, the obtained results suggest that students consider Gretl a flexible and friendly teaching tool, while they face some functionality difficulties, mainly related to the most demanding options, such as using the console or working with datafiles (importing, compacting, sampling,…).

In order to analyse the robustness of these conclusions we have considered subsamples of students with different levels of expertise, confirming the previous conclusions. However, we have found that the level of Gretl users expertise significantly affect their agreement with the funcionalitiy ítems, leading to a slight increase in the p-values.

4. Conclusions

In a context where educational software plays an increasingly outstanding role, this paper has tried to provide further evidence about some attributes that could significantly foster learning. With this aim we have focused on software access, usability and understanding facilitation, and we have developed the "Four-F" test, including the hypotheses of Freedom, Flexibility, Functionality and Friendliness.

This test has been implemented on the free-open source software Gretl, using both objective information and subjective users´ opinions collected from online students´ surveys.

The empirical evidence allows us identifying Gretl´s main weak and strong points. According to the obtained results, this software fullfils the requirements of freedom, flexibility and friendliness, while some difficulties are found with regard to its functionality.

The online surveys show that the most positive scores correspond to flexibility, perceived usefulness and ease of use, factors which are expected to positively influence learning. On the other hand, according to students´ perceptions the levels of desagreement are referred to the most demanding Gretl options (such as the console or workfile manipulation), and therefore further efforts should be made in order to facilitate their knowledge, also emphasizing their many advantages.

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