Teaching and Learning Econometrics with Gretl
Summarizing Some Experiences

Rigoberto Pérez, Ana Jesús López*

University of Oviedo, Department of Applied Economics,
Campus del Cristo, s/n, 33006, Oviedo, Spain
rigo@uniovi.es, anaj@uniovi.es

Abstract. The European Higher Education Area (EHEA) provides the opportunity of exploring new ways of teaching and learning, emphasizing the role of students in the learning process. In the case of Econometrics (which will play an outstanding role in Economics and Business degrees), our experience has shown that doing Econometrics is a suitable way of learning Econometrics and also that Gretl is a powerful teaching tool, providing our students a wide variety of competences and skills.

This paper summarizes our experiences with Gretl during the last years, including both presential and online learning and combining teachers and students points of view.

Keywords: Econometrics, Competences, Skills, Gretl, AulaNet, Virtual Campus, European Higher Education Area (EHEA)

1   Econometrics in the European Higher Education Area

More than seventy years ago Joseph Schumpeter published his famous work "*The common sense in Econometrics*", where he claimed that every economist is an econometrician since data should be used as a complement of economic theories. Since then, the role of Econometrics in Economics and Business degrees has gradually increased, including not only the study of the main techniques for the estimation and testing of econometric models but also a more realistic approach, which is often based on the use of econometric software.

This more practically-oriented study has become especially important in the present context, since European Universities are currently facing the challenges of the so called "*Bologna process*"[1] which aims to increase the mobility and

---

* Corresponding author

[1] The Bologna declaration was signed in 1999 by the ministers of education from 29 European countries, with the aim to develop the European higher education area (EHEA) by making academic degree standards and quality assurance standards more comparable and compatible throughout Europe. Since then and after several governmental meetings [Prague (2001), Berlin (2003), Bergen (2005), London (2007)] this process has further developed into a major reform encompassing 45 countries.

employability of European higher education graduates thus ensuring competitiveness of European higher education on the world scale. In the case of Spanish universities, the Bologna process has to face several difficulties since the structure of university degrees in Spain is quite different from the Anglo-Saxon model adopted as a reference[2]

The European dimension of education and the contribution of education in setting the European Information and Knowledge Society have been stressed in the Lisbon Summit (2000) with the strategic goal of "making out of the European Union the world´s most competitive and dynamic knowledge-based economy, capable of sustainable economic growth and with more and better jobs and greater social cohesion". Since Economic and Business degrees are narrowly related to these objectives, in this paper we focus on Econometrics as a strategic tool in these fields, also showing the potential of Gretl in the teaching-learning process and summarizing some recent experiences.

1.1   Competences and skills

A concrete approach to implement the Bologna Process is offered by the project "Tuning Educational Structures in Europe", which provides a methodology to re-design, develop, implement and evaluate studies. Furthermore Tuning serves as a platform for developing reference points at subject area level, which are relevant for making programmes of study comparable and compatible.

According to this approach, reference points are expressed in terms of learning outcomes and competences. Learning outcomes are statements of what a learner is expected to know, understand and be able to demonstrate after a learning experience, while competences represent a dynamic combination of cognitive and meta-cognitive skills, knowledge and understanding, interpersonal, intellectual and practical skills, and ethical values.

Competences can be distinguished in subject specific and generic ones, which can be classified into three types: instrumental competences (cognitive abilities, methodological abilities, technological abilities and linguistic abilities), interpersonal competences (individual abilities like social skills) and systemic competences (combination of understanding, sensibility and knowledge).

In order to identify the most important generic competences, a large scale consultation was organized among graduates, employers and academics. The questionnaire included 30 competences and a total of 101 university depart-

---

[2] The Spanish system has two kinds of degrees, respectively leading to a medium-level technical profession (three year Diplomatura) and to higher-level professions or academic disciplines (four or five year Licenciatura or Ingeniería). Nevertheless, the Diplomatura has never been the exact equivalent of a BA/BSc, nor the Licenciatura that of a MA/MSC.

ments took place in the consultation, leading to the results[3] summarized in table 1.

Referring to the generic competences, it is necessary to adapt the students´ knowledge and capacities to the labour market requirements, trying to attenuate the traditional existing distance between the perceptions of academics, employers and graduates.

If we focus on the Economics and Business degrees, which is one of the seven areas considered in the Tuning project, the consultation involved 921 graduates, 153 employers and 153 academics, representing a 17% of the total sample.

Although the available information is quite scarce, according to the provisional guidelines these studies should train individuals capable of analyzing and interpreting the functioning of the economy, with the intention of improving the well-being of the society with the achievement of equity and efficiency and in general to approach the analysis of the most relevant economic and social problems.

More specifically, these degrees should provide competences as "*to use analytical instruments in the decision-making processes*" or "*to handle information technologies*", aspects in which Econometrics is expected to play an outstanding role. In fact, the competences related to Econometrics represent a significant proportion of the total list, including some of the items heading the previously described rankings.

In this context, and following the main guidelines of the Bologna process, during the last academic years we have adopted a "*learning by doing*" approach leading to a more realistic methodology, characterized by an intensive use of e-learning and Gretl.

1.2   The role of Gretl in the teaching-learning process

The e-learning, understood as "*the use of new multimedia technologies and the Internet to improve the quality of learning*" has become increasingly popular during the last years. In the University of Oviedo the virtual campus AulaNet was created in 1999, providing a wide variety of online learning facilities for our students and also joining the Shared Virtual Campus of the G9 Group of Universities[4].

---

[3] The academics were asked to rank seventeen items previously selected from the thirty item list given to graduates and employers. Therefore thirteen items are not present in the academics ranking.

[4] The G9 Group includes nine Spanish public universities: Cantabria, Castilla-La Mancha, Extremadura, Illes Balears, La Rioja, Pública de Navarra, Oviedo, País Vasco and Zaragoza.

Table 1. Rankings of generic competences according to Graduates, Employers and Academics

	Graduates	Employers	Academics
INSTRUMENTAL COMPETENCES			
Capacity for analysis and synthesis	1	3	2
Capacity for organization and planning	10	13	
Basic General Knowledge	20	21	1
Grounding in basic knowledge of the profession	19	23	8
Oral and written communication in your native language	12	11	9
Knowledge of a second language	24	26	15
Elementary computing skills	6	17	16
Information management skills	5	8	
Problem solving	2	4	
Decision- making	15	15	12
INTERPERSONAL COMPETENCES			
Critical and self-critical abilities	17	16	6
Teamwork	14	6	
Interpersonal skills	9	8	14
Ability to work in an interdisciplinary team	21	18	10
Ability to communicate with experts in other fields	18	20	
Appreciation of diversity and multiculturality	29	28	17
Ability to work in an international context	26	27	
Ethical commitment	28	22	13
SYSTEMIC COMPETENCES			
Capacity for applying knowledge in practice	6	2	5
Research skills	25	29	11
Capacity to learn	3	1	3
Capacity to adapt to new situations	8	7	7
Capacity for generating new ideas (creativity)	16	10	4
Leadership	27	25	
Understanding of cultures and customs of other countries	30	30	
Ability to work autonomously	4	12	
Project design and management	23	24	
Initiative and entrepreneurial spirit	22	19	
Concern for quality	11	5	
Will to succeed	13	14	

Since then, the virtual campus AulaNet has experienced some changes, moving from the initial self-developed platform to WebCT and then to Moodle, and providing an increasing number of learning resources, which have been proved to be very useful for communication, teamwork and evaluation.

Furthermore, in the case of Econometrics, our experience shows that the election of suitable software is a main point in order to provide students the required competences and skills. The need of a user-friendly, flexible, open-source and accurate software lead us to Gretl, whose main advantages for teachers and students are described in the next sections.

The outstanding role played by Gretl in the Econometrics teaching-learning process is shown in table 2, which summarizes the main competences related to different learning resources.

Table 2. Teaching-Learning methods in Econometrics and related competences

Teaching-Learning Methods	Competences
Theoretical Sessions	Basic General Knowledge, Capacity for analysis and synthesis, Capacity to learn
Practical Sessions with Gretl	Capacity for applying knowledge in practice, Elementary computing skills, Knowledge of a second language
Team Work with Gretl Database building, Model Specification, Estimation, Testing Analysis, Forecasting , Oral exposition, Final Report	Teamwork, Information management skills, Creativity (capacity for generating new ideas), Problem solving, Decision-making, Capacity to adapt to new situations, Oral and written communication, Concern for quality, Research skills
Self-assessment, Online survey	Ability to work autonomously, Critical and self-critical abilities, Ethical commitment

2   Teaching Econometrics with Gretl

From the teachers´ perspective the use of Gretl offers several advantages, since this open source software provides an easy intuitive interface, allowing different ways of working from interactive point-and-click to batch processing.

This flexibility is one of the most outstanding characteristics of Gretl, offering teachers a good opportunity to re-think contents, methods and evaluation procedures. Therefore, during the last years we have carried out some interesting experiences with Gretl both in presential and online learning.

As it is summarized in table 3 these experiences refer to three different subjects whose characteristics are quite different, but nevertheless we can confirm

that in all the cases the implementation of practical sessions with Gretl has been a successful experience for students and teachers.

Table 3. Description of teaching-learning experiences with Gretl

	Econometrics	**Time Series**	**Forecasting**
Subject Description	Compulsory subject Third year, Degree in Economics, Univ. Oviedo	Optional subject, Third-fourth year, Degree in Economics, Univ. Oviedo	Free-election subject, all years and degrees, G9 Shared Virtual Campus
Teaching-Learning Method	Presential, Blended learning [Theoretical and practical sessions, oral expositions, teamwork]	Presential, Blended learning [Theoretical and practical sessions, oral expositions, personal project]	
Number of students	120	14	Online learning [multimedia facilities, online practical sessions, forum, chat, mail, self-assessment]
Gretl sessions	1 hour/week	2 hours/week	Online sessions
Evaluation	50% Final Exam 30% Teamwork with Gretl 20% Continuous assessment	40% Project with Gretl 20% Oral exposition 20% Continuous assessment 20% Final test	40% Gretl Practices 40% Tests 20% Online participation

It is interesting to stress the role played by Gretl in the whole teaching-learning process, including contents, methods and evaluation. Furthermore, with the aim of achieving coherence, Gretl use has been designed according to the specific syllabus, teaching conditions and student profiles for each of the considered subjects.

Thus, in the case of Econometrics Gretl provides a wide variety of menu options including least squares estimators, maximum likelihood, generalized method of moments, single-equation and system methods, also offering a "*console*" option where users can type commands which are recorded as a batch file.

Our teaching strategy has been designed taking advantage of the flexible character of Gretl. Therefore we combine the quick point-and-click menu options with the use of some commands and console facilities in order to re-build specific results, improving the autonomous work and the comprehension of the main econometric concepts and techniques.

For instance, after obtaining a least squares estimation, students are suggested to obtain the results through matrix computing; some residual tests can be re-build through auxiliar regressions, two stages least squares can be recovered by running the instrumental variables regression and then substituting the estimated results, . . .

Nevertheless, the most powerful teaching tool of this subject is the teamwork which provides the students the opportunity to work with real information allowing them to get familiar with the main problems of the econometric modeling. This work is developed with Gretl in 3-4 student groups, also including the presentation of an oral exposition and a final report.

According to our experience, one of the most useful characteristics of Gretl is the session concept, which provides an iconic space containing several objects as data sets, model tables, scalars, graphs, . . . thus allowing users to save a complete dossier of the whole developed work.

Regarding Time Series, Gretl facilities include ARIMA and VARMA, VEC, GARCH, unit-root and cointegration tests,. . . Since this is an optional subject with quite few students, they are required to develop along the semester a personal project consisting in the estimation of time series models for real monthly or quarterly economic data.

Finally, the case of Forecasting shows some differential characteristics referred both to the teaching method and the university context. With regard to the first aspect, while Econometrics and Time Series are based on *"Blended Learning"*, understood as *"the combination of different learning styles that can be accomplished through the use of 'blended' virtual and physical resources"*, Forecasting is an online free-election matter included in the Shared Virtual Campus of the G9 Group of Universities.

This second aspect must also be stressed due to the diversity of students, belonging to nine Spanish universities and also to different degrees and courses.

Once again, the flexibility of Gretl has been very helpful in the design of this online subject, whose second year will start next February.

In all the described cases, from the teachers perspective we must stress some additional advantages related to Gretl educational and research resources: the access to datasets associated with Econometrics texts as those of Ramanathan, Greene, Stock and Watson, Greene or Gujarati, and the existence of an open scientific community.

3 Learning Econometrics with Gretl

The Bologna process leads to a student-oriented approach, which focuses on the usefulness of study programmes for a future position of the graduate in the

society. Therefore, a sensible definition of learning outcomes and the allocation of credits (according to the European Credit Transfer System, ECTS, based on students´ workload) play a decisive role.

The experiences we are summarizing in this work include students´ participation in these new aspects: the competence-based learning and computation on ECTS credits for different subjects.

Since the virtual campus AulaNet allows an easy implementation of online questionnaires, during the last academic years students have been asked to provide information about their personal effort, the perceived difficulty of the educational contents and the acquired competences and skills. A scheme of the Econometrics survey is shown in table 4.

Table 4. Online survey for Econometrics Students

Sections	Quantitative aspects	Qualitative aspects
Personal Work	Hours of study	Perceived difficulty for each item
Team Work	Hours for different stages: database building, model estimation, hypotheses testing, forecasting, exposition, final report	Perceived difficulty for the team work Satisfaction with Gretl facilities Comparison of personal and team effort Quality of the work compared with others
Quality of the work compared with others Assessmen		Perceived difficulty of assessment questions Satisfaction with the assessment system
General vision		Level of satisfaction with the subject Opinion about professional skills Comments and suggestions

Although the rate of response was quite low (50%), the obtained information shows some interesting facts. A first consideration is the heterogeneity of students (which should be considered when designing and implementing the learning methodology), reflected in the high dispersion of times of personal work, leading to non-representative means.

On the other side a considerable homogeneity is found in the perceived levels of difficulty (approached by the percentages of students whose answers to the proposed questions are "*difficult*" or "*very difficult*") and also in the level

of agreement with the achieved competences and skills (approached by the percentage of students answering "*Total agree*" or "*Agree*"). Besides, since these surveys have been carried out along four academic courses we have also confirmed the stability of the obtained results.

Table 5. Results of the Econometrics online survey

Course Contents	Level of difficulty	Level of agreement
Econometric Models	0.5%	90,0%
Single Regression Model	17,4%	70,6%
Multiple Regression Model	65,2%	76,9%
Qualitative Variables	43,5%	61,5%
Testing Hypotheses	73,9%	80,0%
Simultaneous Equation Models	50,0%	72,7%
Practical Sessions with Gretl	10,5%	70,0%
Teamwork with Gretl	73,3%	94,1%
Continuous Assessment	17,9%	70,8%
Final Exam	8,3%	100%

Regarding students´ opinions about learning outcomes, they mainly emphasize competences as problem solving, capacity for applying knowledge in practice, computing skills and information management skills. Teamwork is also appreciated as a valuable although rather hard competence.

The application of the described methodology and evaluation system has improved the academic indicators of Econometrics as shown in table 6.

Table 6. Econometrics Academic Indicators

Academic Year	Proportion of presented students (%)	Rate of Success (Proportion of passed students, %)
2004-05	77%	77%
2005-06	68%	80%
2006-07	73%	80%
2007-08	79%	88%

4   Concluding remarks

In the framework of the Bologna process the new Economics and Business Degrees must face the challenge of training individuals capable of analyzing and interpreting the functioning of the economy improving the well-being of the society with the achievement of equity and efficiency. With this aim, Econometrics should be considered as a strategic tool whose teaching-learning method should be designed paying special attention to competences as problem solving, decision-making or information management.

Since the election of a suitable software is a key point in the teaching-learning process, during the last years we have experienced the potential of Gretl in three different subjects, leading to satisfactory results for both teachers and learners. More specifically, students surveys show the contribution of these learning methods in the achievement of competences as problem solving, capacity for applying knowledge in practice, computing and information management and teamwork.

To end, we would like to thank the colleagues of the G9 Virtual Campus for sharing valuable experiences during nine years, our students for their collaboration in the online surveys and the Gretl Community for developing and spreading the use of open source econometric software.

Bibliography

[1] Commission of the European Communities: Challenges for the European Information Society beyond 2005, Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, 757 (2004)

[2] Commission of the European Communities.: Progress towards the Lisbon objectives in Education and Training, Commission Staff Working Paper, 419 (2005)

[3] Cottrell, A.; Lucchetti, R.J.: Gretl User´s Guide, Gnu Rregression, Econometrics and Time Series (2008)

[4] Esteban, M.V. et al: Análisis de regresión con Gretl, Departamento de economía Aplicada III, Universidad del País Vasco.

[5] González, J.; Wagenaar, R.: Tuning Educational Structures in Europe. Universities´ contribution to the Bologna Process, http://tuning.unideusto.org/tuningeu (2005)

[6] González, J.; Wagenaar, R.: Universities´contribution to the Bologna Process, http://tinyurl.com/anylvc (2008)

[7] López, A.J.: El papel del E-Learning en el Espacio Europeo de Educación Superior, Congreso Online Educa, Madrid (2004)

[8] López, A.J.; Pérez, R.: An experience on virtual teaching: AulaNet, in Computers and Education: Towards an Interconnected Society, M. Ortega and J. Bravo Ed., Kluwer Academic Publishers, pp. 207—214 (2001)

[9] López, A.J.; Pérez, R.: Networking Universities to bridge the Digital Divide, International Journal of Instructional Technology and Distance Learning, vol.3, n.5, pp. 73–82. (2006)

[10] López, A.J.; Pérez, R.; Mayor, M.: Learning Econometrics by Doing Econometrics. Some pilot experiences, ISI Lisboa (2007)

[11] Pagani, R.; González, J.: El crédito europeo y el sistema educativo español, Informe Técnico ECTS Counsellors and Diploma Supplement Promoters (2002)

[12] Reichert, S.; Tauch, C.: Bologna four years after: Steps toward sustainable reform of higher education in Europe", Trends 2003: Progress towards the European Higher Education Area, European University Association (2003)

[13] Schumpeter, J.: The common sense in Econometrics, Econometrica, Vol. 1, n.1, p. 5–12 (1933)