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# Using R as an alternative teaching tool in the Ecological University of Bucharest

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## ABSTRACT

*In a global world universities want to offer the best education to their students so that they can be competitive on the labour market both in the country where they studied and beyond its borders.*

*The Romanian education system - currently undergoing reform - attaches great importance to the use of traditional efficient teaching tools, along with new alternative ones.*

*The R data analysis system represents such an alternative method that the Ecological University of Bucharest uses in order to stimulate the student's creativity in problem solving.*

**Keywords:** university, economic education, academic tools, teaching, open source R

**JEL Classification:** A22, A23, I21, I25

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## 1. TERTIARY EDUCATION IN ROMANIA. GENERAL DATA

Radical improvement and diversification of educational offer of the entire system of education and training in Romania is recognized as a priority target of strategic importance and a mandatory condition for put into practice the principles of sustainable development in the medium and long term.

“In the Romanian society there is a wide recognition that the education represents the strategic factor for the future development of the country through its essential contribution to multidimensional modeling and predictive human capital”<sup>1</sup>.

In accordance with actual specific legislation, the Romanian educational system includes:

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<sup>1</sup> The Regional Development Strategy 2014-2020, Priority Axis 6. Development of human capital, social inclusion growth

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- Secondary education and
  - Tertiary education.

According to the article 23 of the Law of National Education (Law No. 1 of January 5, 2011 published in Official Monitor No. 18 of 10 January 2011) national system of secondary education includes the following levels:

- a) early education (0-6 years), consisting of the pre-school (0-3 years) and preschool (3-6 years);
- b) primary education, which includes preparatory class and classes I-IV;
- c) secondary education, including:
  - lower secondary education or gymnasium that includes grades V-IX;
  - higher secondary education or high school level, including the high school grades X-XII/XIII;
- d) professional education and with duration between six months and two years;
- e) non-university tertiary education, including post-secondary education.

General compulsory education is composed of primary and lower secondary education.

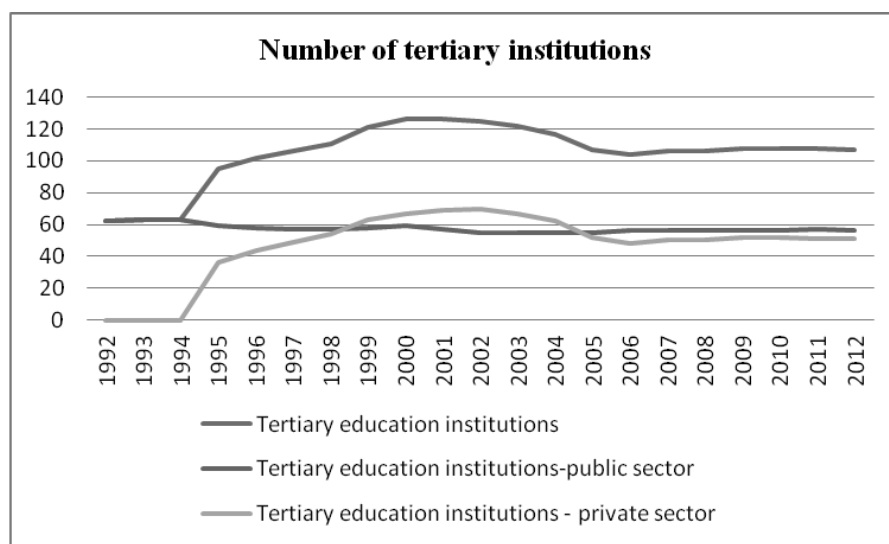
In the 114 of the Education Law it is shown that Tertiary education is organized into universities, academies, institutes, and schools of higher education.

The Tertiary education institutions can be state, private or religious. These institutions have legal personality, there are for nonprofit, public interest and there are apolitical.

Evolution of the number of these institutions in the period 1992-2012 is presented in the following graphic:

### Number of tertiary institutions

Fig. 1



Source: Romanian National Institute of Statistics

It should be noted that although private universities functioned since 1990 (Ecological University of Bucharest functions from April 1990), they were not identified in official statistics than 1994 because of the legislative void in this field in mentioned period.

From the graphic presented one can notice that the number of state tertiary education institutions (56 units - year 2012) is approaching that of private educational institutions (51 units – year 2012) which indicates the need for and this form of private tertiary education in Romania.

Regarding of the number of students enrolled in tertiary education in the period 1990-2012 is an increase of 4.7 times in 2007 compared to 1990 and a decrease to half their number in 2012 compared to 2007 (in 2012 recorded 464 592 students enrolled in tertiary education to 907,353 students in 2007).

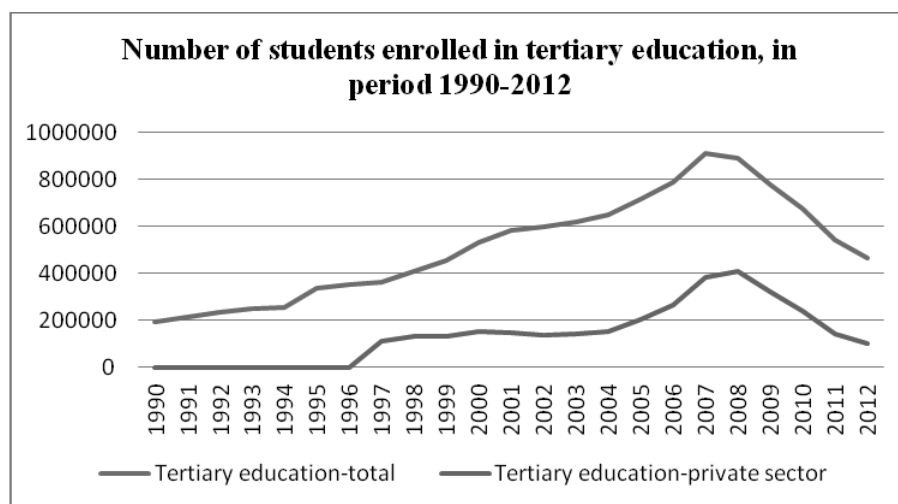
And in the private tertiary education it is noted almost the same trend as that in 2008 the number of students increased by 3.7 times compared to the number registered in 1997 but a drastic decrease in the period 2008-2012 to 75.7% in 2012 reaching the number of students almost to that of students registered in 1997.

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The situation analyzed is represented in Graphic 2.

**Number of students enrolled in tertiary education, between 1990-2012**

Fig. 2



Source: Romanian National Institute of Statistics

Number of graduates in tertiary education followed the same increasing trend in 1990-2007, as the number of students enrolled in the period specified, for that in 2007-2011 the number of those who have graduated a tertiary education institution to decrease by 41.3%.

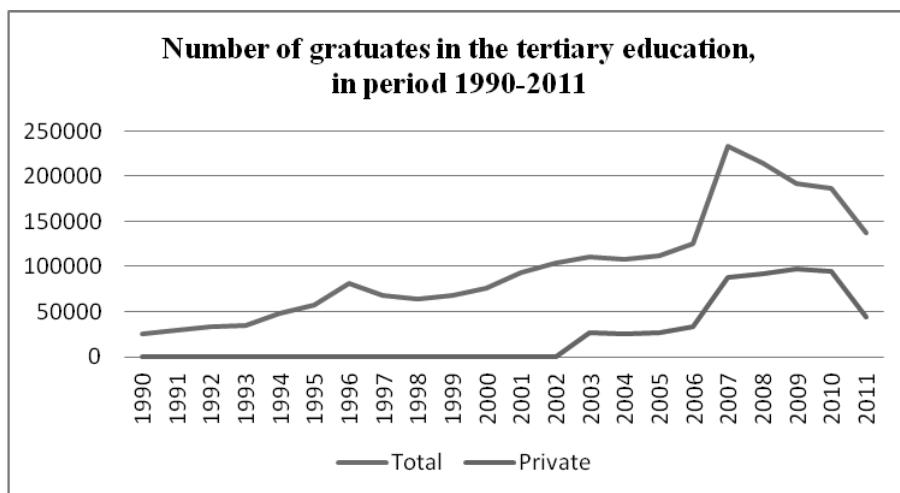
In private tertiary education the number of students who have graduated an institution of tertiary education decreased by 54.8% in 2011 compared to 2009, which means that not all students enrolled have completed their studies, because they did not have the financial resources necessary for fees or they have found jobs where they did not need a degree or they opened their own business without having a degree, or they have left the country for gains significant than they can gain in their country.

The situation above is presented in the graphic below:

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### Number of graduates in the tertiary education, in period 1990-2011

Fig. 3



Source: Romanian National Institute of Statistics

Analysing the number of teaching staff in tertiary education in Romania it shows that in the period 1992 - 2007 the number almost doubled (increase in 2007 was 1,76 times the reference year 1992). From 2007 until 2012 the number of teaching staff decreased by 14% because reducing the number of students from this period but also because of reaching the age of retirement of teachers, limit stipulated in Education Law no. 1/2011. For their number to decline from 2007 to in 2012 by 14% due to reduced in the number of students in the same period but due to reaching the retirement age of teachers in the Law of Education no. 1/2011.

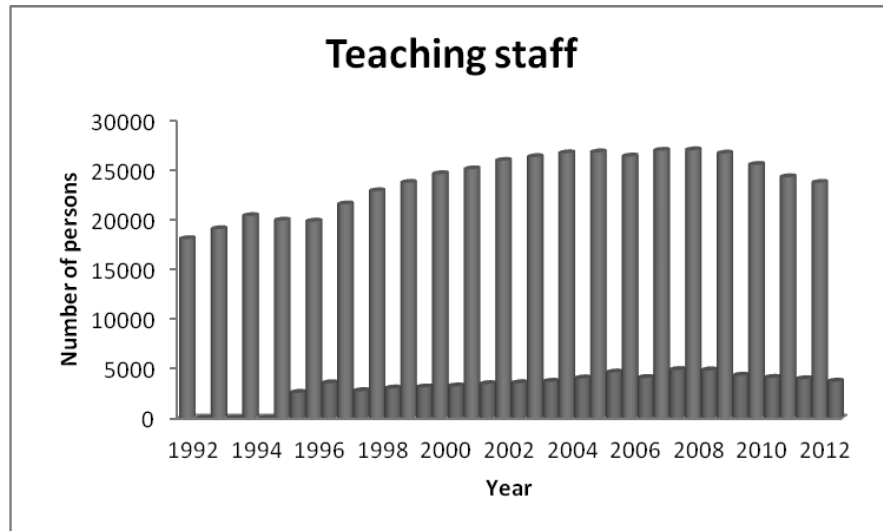
Number of teachers in private education it doubled between 1995-2007 (the increase was 1.88 times in the analyzed period) while in 2012 their number will decrease by 24% compared with the situation existing in 2007 (due to reducing the number of students in period 2007-2012).

This trend is outlined in Graphic 4.

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### Teaching staff between 1992-2012

Fig. 4



Source: Romanian National Institute of Statistics

Most teachers of Romanian universities looking for new methods and tools for teaching courses and seminars to fulfill the needs of current students which increasingly using more and more new technologies.

Should be noted that in reaching this target teachers are sometimes confronted with resistance of some students or colleagues.

Using the tool R in some universities in Romania is part of the desire of teachers to provide quality educational services to students in their personal development, of the professional insertion and meeting the need for socio-economic competence.

In the the following rows we present these universities in Romania which is using the tool R:

**University of Bucharest:**

- Faculty of Sociology and Social Assistance which uses R statusor package for teaching of statistics (applications in R);
- Faculty of Mathematics

**University of Pitești**

- Faculty of Mathematics and Computer Science;

**Technical University of Civil Engineering Bucharest**

- Faculty of Civil, Industrial and Agricultural Buildings;

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**Academy of Economic Studies of Bucharest:**

- Faculty of Cybernetics, Statistics and Informatics

**Ecological University of Bucharest**

- Faculty of Economic Sciences

**Ecological University of Bucharest** has sought, since its establishment in 1990, the education and training of students in their personal development, social integration and their active participation in the functioning and development of a sustainable economy.

Ecological University of Bucharest – first private educational institution in Romania, after 1990

Founded in the April 4th 1990, Ecological University of Bucharest – it is the only university with environmental profile from Romania, it numbers today about 30,000 graduates of the following faculties:

Faculty of Ecology and Environmental Protection;

Faculty of Law and Administrative Sciences;

Faculty of Economic Sciences;

Faculty of Physical Education and Sports;

Faculty of Communication Sciences;

Faculty of Management and Environmental Engineering;

Faculty of Psychology.

In the faculties there are: 11 undergraduate programs; 21 master programs and 25 postgraduate program training and continuing professional development.

“The mission of the Ecological University of Bucharest consists of initial and continuing training of highly qualified specialists for professional activities that are competitive in the labour market, as well as the achievement of the efficient research and development activities.

The university has also the mission to create, exploit and disseminate knowledge through the development of educational and research methods for all members of the University community, so as to ensure an appropriate position in the Romanian and European higher education.”<sup>1</sup>

In the University, **Faculty of Economic Sciences**, by several young and enthusiastic teachers was introduced the tool R - a useful tool with many advantages over traditional software packages.

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1. Self-assessment report 2013, [www.ueb.ro](http://www.ueb.ro)

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### **Faculty of Economic Sciences – short presentation**

Undergraduate studies function with two specializations:

- Finance and Banking
- Business Administration.

There are 4 master degrees and 10 postgraduate programs of training and continuing professional development.

From the 41 disciplines for each undergraduate program and 14 disciplines in each master's program, the software R is used at present time, at disciplines: statistics; economic statistics; financial macroeconomics; financial forecasting; econometrics; financial econometrics; capital markets; capital market - institutions and tools.

### **Applications of R – in courses**

- graphical representation of distribution and time series;
- maps;
- statistical indicators (see Annex).

### **Advantages of R software in University**

- Promoting open-source software among students;
- Exchange information and ideas on R between students from universities around the world;
- Possibility dissemination research results by professors and students;
- Identify opportunities for collaboration between different universities, joint projects;
- Direct involvement of students in the preparation of program subroutines;
- Improves the relationship and communication between students and teachers outside of the study programmes;
- Harmonization of curricula the disciplines in the curricula of the faculties with those of the partner universities;
- Creation of performance skills of the students in the labor market;
- Cost-free for Academic use;
- The existence of two college professors who are part of Team R-omania: associate professor Nicoleta Caragea and associate professor Antonia Ciprian Alexandru, who can supervise the work of teachers and students in this field and provide additional help;
- Offers a larger communication and contacts between universities;
- Promotes the University and Faculty on the nationally and internationally plan.



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### **Disadvantages of R software in University**

- Given it's a new open-source software, the popularity of the program has a slow start;
- At this moment, R is used in a small scale because it is not yet promoted at the highest level in all faculties of Ecological University of Bucharest;
- The possibility of using R in few disciplines.

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2. Wiley, David, 2006. Open source, openness, and higher education. *Innovate* 3 (1), <http://www.innovateonline.info/index.php?view=article&id=354>
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6. National Institute of Statistics, National Center for Statistical Training Courses - Introduction to estimation techniques on small fields with applications in R/ Introduction to SPSS, from 18 to 22 November 2013. Lecturers: Nicoleta Caragea, Ciprian Alexandru, Ana Maria Dobre - experts in R
7. R for Social Network Analysis, <http://www.stanford.edu/~messaging/RforSNA.html>
8. Institutul Național de Statistică, [www.insse.ro](http://www.insse.ro)

## STATISTICAL INDICATORS – STATISTICAL LESSON WITH R

Let it be “Graduates” a database with 80 graduates, their graduate specialization and initial salary.

We want to represent the initial salary distribution and to compute some indicators, such as mean and standard deviation.

```
> head(Graduates)
  Graduate Specialization Initial.salary
1      1      Finanțe           1550
2      2      Management          1310
3      3      Management          1575
4      4      Marketing          1675
5      5      Contabilitate        1585
6      6      Marketing          1590
```

```
> attach(Graduates)
```

```
#graphical representation of Initial salary distribution
```

```
> hist(Initial.salary)
```



```
#computing the mean of Initial salary
```

```
> mean(Initial.salary)
[1] 1626.688
```

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```
#computing the standard deviation of Initial salary
> sd(Initial.salary)
[1] 181.2508

#computing the median of Initial salary
> median(Initial.salary)
[1] 1610

#computing the geometric average of Initial salary
> exp(mean(log(Initial.salary)))
[1] 1616.851
```