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TIME SERIES OF AGRICULTURAL SCIENCES HIGHER EDUCATION IN ROMANIA

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Abstract
In the last two decades in Romania a series of changes on both higher education and economy occurred. These changes had determined variations at the option to follow a profile at first level of higher education. The present study includes data about the evolution of the number of students in higher education at the agronomical profiles in the period 1991 to 2003. In order to analyze the trends referring to the agronomical profiles of Romanian higher education a mathematical model has been developed. The model integrates the following parameters: (1) the mean annual variation ratio (as absolute and relative values), (2) the increasing mean annual ratio (as absolute and relative values), (3) the number of students' estimation for 1989 (as absolute value), (4) the numbers of students prediction for 2008, (5) the correlation coefficient, (6) the linear trend, (7) the number of students estimation for 1989 and (8) for 2008 obtained by the model. The mathematical model has been integrated into an online application, and here are analyzed and discussed. Using the descriptive information of public funds allocated on the last two years to four universities with agricol profile from Romania, a discussion regarding the evolution of the composite index of unitary students on each university was open.

INTRODUCTION

In the last years were established many concepts for higher educations such as: (1) the higher educational system viewed as generator of higher qualified labour force, (2) the higher educational system viewed as a form of preparation for a scientific career, (3) the higher educational system viewed as a solution for growing chance of a person in society. Given these concepts I suggest that is important to understand the evolution from statistical point of view in consideration of the number of students, enrolled and graduates and the evolution the allocations of goods for agronomic profiles. In Romania, the main founding comes from the public budget. The distribution of these funds is made depending on the number of enrolled students and the field of study, and on the standards achieved by each university, which are measured through quality indices. The data regarding the number of students on educational fields are received by C.N.F.I.S. (the National Council for Higher Education Founding) from each university. [1,2]

The aim of the paper is to analyse the trend of agricultural sciences education at national level using time series of enrolled students and graduated students, for a period of twelve years, and repartition of budget funds for two years.

MATERIALS AND METHOD

The present study uses the data on higher education institutions reported to the National Institute of Statistics during 1991-2003 years and to the National Council for Higher Education Founding.

The following table presents the evolution of two numerical characteristics (enrolled students and graduate students) during 1991-2003 periods:

Table 1. Enrolled students (1), Graduate students (2) during 1991-2003 in Romania

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
(1)	8236	9213	9604	9301	9421	10761	12074	14293	18562	21152	24401	20013	20952
(2)	1057	1276	1445	1724	1445	2038	2117	2094	2149	2226	2908	2816	N/A

Starting with our approach, let $a_1, \ldots, a_n$ be a time period, where a_i is an university year, and n is a number of years considered period (A). Let $b_1, \ldots, b_n$ be a time series, where b_i is the value of the considered characteristic (B) corresponding to the time moment a_i. Let $M(\cdot)$ be the average operator. Thus, M(B) is the average of the B characteristic:

$$M(B) = \Sigma b_i/n \quad (1)$$

Analogue,

$$M(A) = \Sigma a_i/n,\ M(AB) = \Sigma a_i b_i/n,\ M(A^2) = \Sigma a_i^2/n, \text{ and so on.} \quad (2)$$

We've calculated the followings:

÷ Averaged Annual Variation (in absolute units), AAVA, and Averaged Annual Variation (in relative units), AAVR:

$$AAVA(B) = \Sigma|b_{i+1}-b_i|/(n-1),\ AAVR(B) = AAVA(B)\cdot 100/M(B) \quad (3)$$

÷ Averaged Annual Growing (in absolute units(, AAGA, and Averaged Annual Growing (in relative units), AAGR:

$$AAGA(B) = (b_n-b_1)/(n-1),\ AAGR(B) = AAGA(B)\cdot 100/M(B) \quad (4)$$

Using (4), backward (BF) and foreward (FF) forecasting at one given year can be done using:

$$BF(B,A,year) = \begin{cases} b_1\left(1+AAGR(B)\right)^{year-a_1}, AAGR(B) \neq -1 \\ b_1\left(1-AAGR(B)\right)^{a_1-year}, \text{otherwise} \end{cases} \quad (5)$$

$$FF(B,A,year) = \begin{cases} b_n\left(1+AAGR(B)\right)^{year-a_n}, AAGR(B) \neq -1 \\ b_n\left(1-AAGR(B)\right)^{a_n-year}, \text{otherwise} \end{cases} \quad (6)$$

÷ Linear regression and correlation between B and A (time correlation analysis) provide also a good tool for analysis. Following formulas were used:

$$r(A,B) = cov(A,B)/disp(A)\cdot disp(B),$$
$$cov(A,B) = M(AB)-M(A)\cdot M(B), \quad (7)$$
$$disp(A) = (M(A^2)-M^2(A))^{1/2}$$

÷ Trend, expressed in both absolute and relative units:

$$Trend(B,A) = cov(A,B)/disp^2(A),\ TR(B,A) = 100\cdot Trend(B,A)/M(B) \quad (8)$$

÷ The estimation based on trend (relation 7) it served for estimation at 1989 and 2008 years with formula:

$$Estimation(B,A,year) = b_i + Trend(B,A)\cdot(year-a_i), \text{ true for any i from 1 to n} \quad (9)$$

The estimation can be done for both backward (BE) and forward (FE).

RESULTS AND DISCUSSIONS

The figure 1 contains number of enrolled students from higher educations in period 1991-2003 from the agriculture specialization and the veterinary medicine specialization.

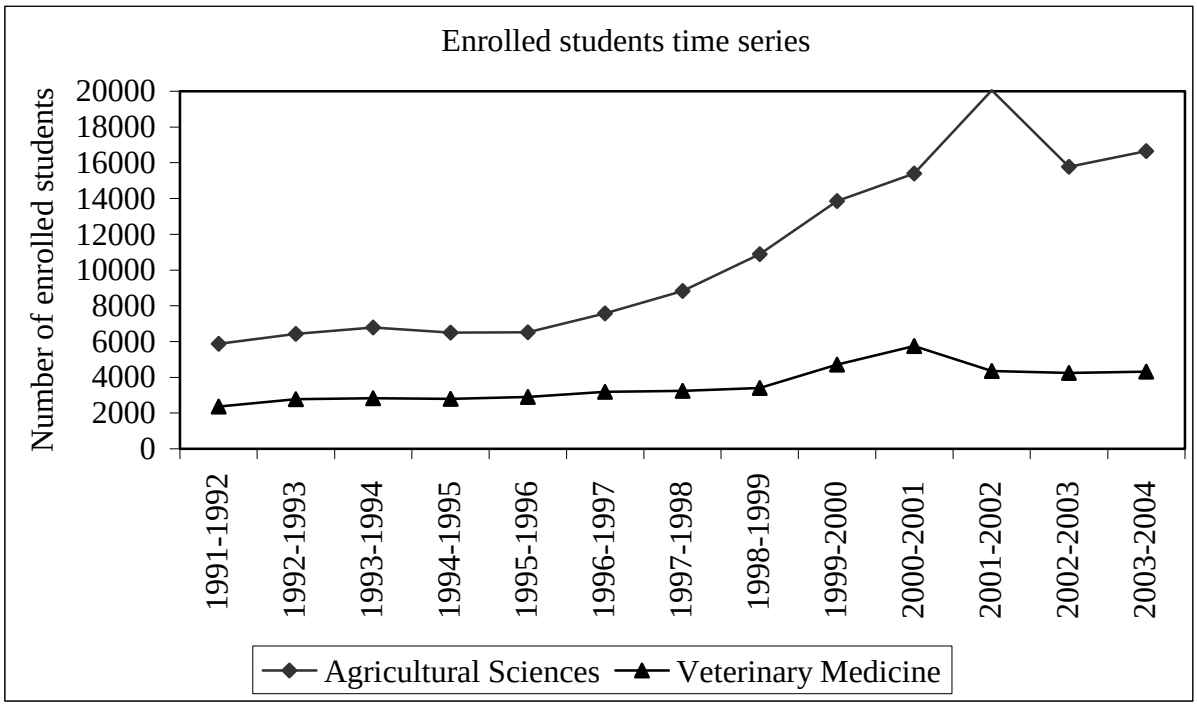

Figure 1. Evolution of enrolled student's number during 1991-2003 period

The following figure contains evolution of graduates' students for the two profiles.

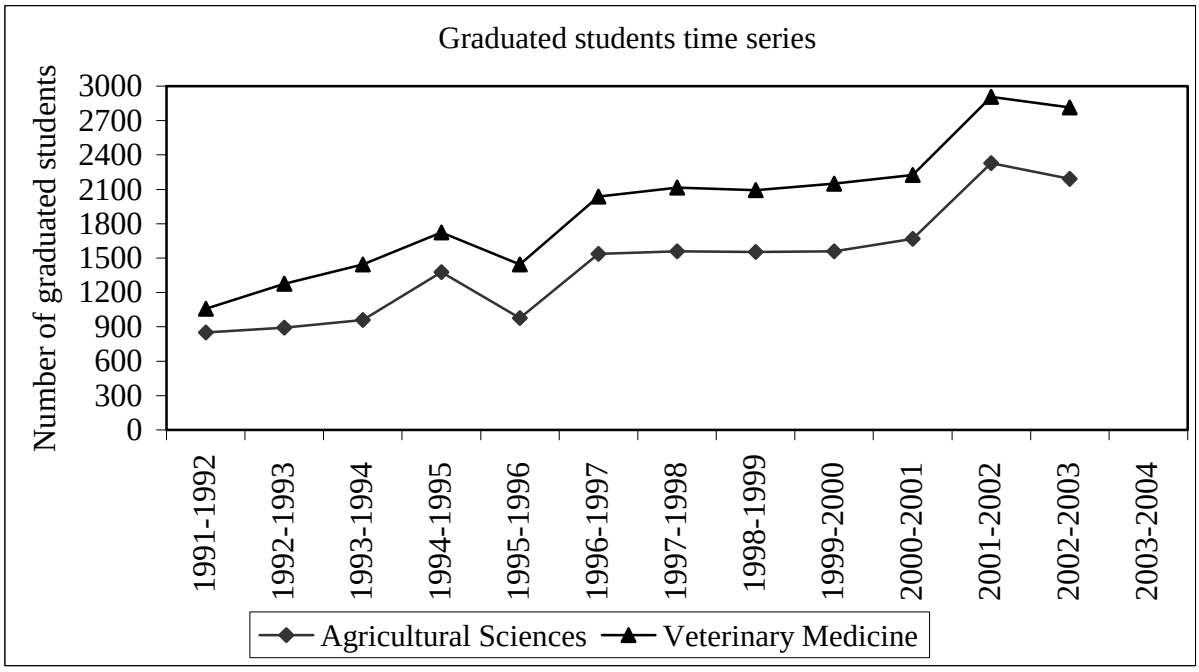

Figure 2. Evolution of graduate's number during in period 1991-2002

Following table (Table 2) contains number parameters described by equations (1-9) for chosen characteristics (number of enrolled students, and graduates).

In Romania the number of students is very important because it is a variable which is used for the calculus of the equivalent unitary student. The allocation funds depends on

unitary student equivalent and quality index. The proportion of these influences varies from one year to another as are given in Table 3.

In the following table (Table 2) analyzed the distribution of the total allocation funds for agronomical profile on four universities from Romania.

Table 2. Evolution parameters for enrolled students and graduated from 1991 to 2003

Parameter	1	2	3	4	5	6
AAVR	12.8	15.4	11.3	14.3	17.4	17.3
AAGR	7.7	8.7	4.6	10.7	10.9	10.4
BF(1989)	6104	4112	2027	374	328	46
FF(2008)	28149	23230	5156	4692	3670	1025
r	0.926	0.921	0.847	0.956	0.940	0.871
Trend	1296.1	1090.7	205.4	168.8	131.6	37.2
TR	9	10	6	49	10	8
BE(1989)	2916	1157	1759	77	321	156
FE(2008)	27541	21879	5662	3684	2821	863

Legend:
Parameter: see Materials and Method
1: Total Enrolled Students (Agricultural sciences and Veterinary medicine)
2: Enrolled Students Agricultural sciences; 3: Enrolled Students Veterinary medicine
4: Total Graduated Students (Agricultural sciences and Veterinary medicine)
5: Graduated Students Agricultural sciences; 6: Graduated Students Veterinary medicine

The funds are allocated beyond the mathematical model that is elaborated by the National Council of Funding of Higher Education's experts.

Table 2. Total allocation funds for agronomical profile on four universities from Romania

University	Proportion from total budget		
	2005-2006	Variation	2006-2007
USAMV Bucureşti	36%	▼	34%
USAMV a Banatului Timişoara	25%	►	25%
USAMV Cluj-Napoca	23%	▲	24%
USAMV "Ion Ionescu de la Brad" Iaşi	16%	▲	17%

Table 3. The allocation funds by equivalent unitary students and quality index

University	Equivalent unitary students distribution			Composite quality index distribution		
	2005-2006	Var	2006-2007	2005-2006	Var	2006-2007
USAMV Bucharest	37%	▼	35%	35%	▼	30%
USAMV Timişoara	24%	►	24%	27%	▲	29%
USAMV Cluj-Napoca	23%	▲	24%	23%	▲	25%
USAMV Iaşi	16%	▲	17%	15%	▲	16%

By studying the evolution of enrolled students in the period 1991-2003, it is noticed an increasing on both profiles until the university year 2001-2002, and a decreasing for the agriculture specialization until 2002-2003. After this year, the number of enrolled students is ascending. For the veterinary medicine specialization, the decreasing appears one year earlier, 2000-2001, and then the number of enrolled students is slowly ascending. The prediction for 2008, for both specializations, is increasing (Entry FE(2008) in Table 1). Taking in consideration the number of graduated students it is noticed a decreasing in 2001-2002 for the agriculture specialization, meanwhile for the veterinary medicine specialization it is registered

an increasing. The decreasing registered, both for the number of enrolled students and for the number of graduated students, could be explained through a series of phenomena that took place in that period, respectively the instable economical situation and the changes resulted by the educational system reform from that period [7,8].

Although in the agronomic sector in Romania noticed stagnation, from an economic point of view, the number of enrolled students has been increasing in the last years.

From the comparison of the universitary year 2005 with 2006 positive changes for almost each of the four universities were ocuured. The USAMV Cluj-Napoca has a growing by one percent at the equivalent unitary number of students and two percents at the quality index. At USAMV Iaşi the growing are one percent for both variables. The USAMV Timişoara is remarked by growing in quality performances, which are reflected in the quality index with two percent. Only USAMV Bucureşti recorded a decline with two percents at the equivalent unitary number of students and with five percents at the quality index.

CONCLUSIONS

By analysing the equivalent unitary students and the quality index from the past two years on national level, can be noticed increasings registered by Cluj-Napoca, Iaşi, and Timişoara Universities. These are been reflected in the increasing of the budgetary allocation for the main founding.

Another remark is given by quality composite index, which increases in contribution to budget funds proportion from 2005-2006 to 2006-2007. As can be seen from Table 3, this change of composite quality index proportion on total budget funds distribution advantages smaller universities. Thus, USAMV Timişoara, USAMV Cluj-Napoca, and USAMV Iaşi are advantaged. The most advantaged universities were which ones it increases in composite quality index the moust. These are USAMV Timişoara and USAMV Cluj-Napoca.

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