A MULTIDIMENSIONAL STATISTICAL ANALYSIS OF A SET OF TEN ACADEMIC PROGRAMS

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Abstract

The article is a multidimensional analysis focused on statistical data, followed by the development and administration of both classic and online questionnaires, tackling and analyzing the programs of interest along the path of the current recipient of the programme (i.e. the student), and also addressing the labour market beneficiary of the graduate's knowledge arising from the programme (i.e. the employing firms and institutions). The article naturally conduces to specifying regional and county-based dimensions compared to the regional and local (or county-based) market of the area where the seat of the university is, and also to identifying associations and correlations of use in modelling the educational supply within the selection pool, by making use of a package of IT software (Eviews); finally, there are a number of remarks and anticipations necessary for a general delimitation of the need to adapt the training programmes and curricula analyzed to the actual regional and county market.

Keywords: education and academic programme, multidimensional analysis, questionnaire, descriptive statistics, association and statistical correlation.

Introduction

The article is structured based on a multidimensional (or multivariate) analysis focused on statistical data from official regional documents (the prevalent ones are the regional statistics of the National Institute of Statistics – INS and EUROSTAT, regional indicators and forecasts of the National Commission of Prognosis – CNP), followed by the development and administration of questionnaires, in both the classic variant and online, starting from programs of interest (i.e. the person in charge of adaptating the studies programs), then following the path of the current recipient of the programme (i.e. the student), and also of the labour market beneficiary of the graduate's knowledge arising from the programme (i.e. the employing firms and institutions), to eventually allow a multi-dimensional associative and projective diagnosis focused on the construction and selection of variables in the first stages, to form a comprehensive database, leading, by means of capitalizing on a software package (Eviews) to the coherent descriptive statistical analysis of the variables related to the beneficiaries of academic education, and to identifying associations and useful correlations for modelling educational supply in the selection pool, accompanied by some general remarks and anticipatory hints necessary for the general delimitation of the need to adapt the training programmes and curricula analyzed to the actual regional and county market.

1. From a three-dimensional statistical vision to a multidimensional education-related approach

In the three-dimensional view (space, time, structure) that is specific to statistical thinking, a phenomenological complex approach starts territorially, which requires a rigorously tailored, customized geographical dimension. Academic education market, which practically continues to undergo diversification, but is also limited by a constant trend towards adjusting to the labour market, essentially remains captive to both a set of specific limitations, and a number of objective gaps, the former mainly caused by demographic boundaries (birth reduced by specific mortality per age groups, and dropping out of school) and the thresholds of relative wealth (income per capita or nominal net income allowing to graduate university), and the latter – by the labour market correlated with the duration of the studies themselves, which would translate into a lag of at least three years, under the Bologna education process, for undergraduate (BA) study programs.

If one chose to start from these issues alone, the population dimension, the welfare dimension and the labour market dimension would prove essential in analysing an educational process in a minimal manner, but when it comes to diverse programs such as those included in the present study, bringing together different areas, ranging from basic sciences to engineering sciences, from social sciences to medical science, so the dimensions that need to be examined are much more numerous, if we add to the aforementioned ones the dimension of crime and justice, the dimension related to health and the institutions that contribute to ensuring it, the dimension associated to the automotive industry and the dimension specific to automotive transports, etc. Today's meaning of a European region has a strong operational character, marking a territory / an area "with more or less defined limits, which serves as the administrative unit to a level below that of the nation-state". (EUROSTAT). The dynamism of the concept of region is remarkable as far as Romania is concerned, too, which thus highlights its "the potential to contribute to the gradual establishment of a binding, uniform and common concept of the region and regionalization in the EU", as is found in the essential statistical criterion of discrimination between macro-regions and counties (as the case is).

Regionalization in figures in the EU–28, and distinctly in Romania

Table no. 1

The level of regional classification (according to NUTS – the statistical classification of territorial units)	The defining regional criterion at EU-28 level		Total number	
	Minimum population	Maximum population	EU - 28	Romania
Level 1 – macro (NUTS1)	3 000 000	7 000 000	98	4
Level 2 – regions (NUTS2)	800 000	3 000 000	272	8
Level 3–sub-regional components (NUTS3)	150 000	800 000	1315	42

Source: Statistics Explained, available online at http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Regional_yearbook_ introduction, accessed 1.08.2014 and completed with data concerning EU-28 and Romania.

NUTS classification is used not only to define regional borders, but also to determine geographic eligibility for structural funds and investment in the EU, with

(NUTS2) regions ranked and divided into three groups: a) less developed regions (GDP the per capita <75% of the EU-28, where seven of the eight Romanian regions can be found, including South-Muntenia); b) transition regions (GDP per capita ranges between [75% – 90%] of the EU-28 average); c) more developed regions (GDP per capita > 90% of the EU-28 average, including the Bucharest–Ilfov region). The ratio of GDP per capita between Bucharest-Ilfov and South Muntenia is 3 to 1. The South-Muntenia region is not yet a constitutional administrative structure, yet it includes seven counties (Argeş, Călăraşi, Dâmboviţa, Ialomiţa, Giurgiu, Prahova and Teleorman) 16 municipalities, 32 cities and towns and 519 rural communes with 2,019 villages. The mountains represent 9.5% of the total area, the hills – 19.8%, and the plains and meadows – 70.7%. The southern area, through the counties of Ialomiţa, Călăraşi, Giurgiu and Teleorman, is dominated by lowlands as a characteristic form of relief, while the northern area, including the counties of Argeş, Dâmboviţa and Prahova, is more balanced and diversified in point of altitude and relief forms: along the plain and hills, it includes the highest mountain ranges of the country (the Făgăraş and Bucegi Mountains). South-Muntenia covers 14.45% of Romania's area (or 34,453 km^2), thus coming in third place after the North-East and South-East regions, and has a population density of 93.8 inhabitants per km^2 (11.5% higher than the national average density).

South-Muntenia is the only region in Romania which fully encompasses another region (i.e. the Bucharest-Ilfov region), developing in terms of territory as a "peripheral network" around the capital city, and so the region embedded becomes a "node" or a "network centre". The coexistence model of the two regions is not regional and gravitational, but rather belonging to the certain and intense type of dependence of the peripheral network with respect to the network node, defined as a metropolis or capital city, so it cannot determine real factors of proportionality between these two regions, which are extreme in point of polarization, from the rural-urban criterion, which still make up a common space ensemble, called Romania's macroregion 3. This original symbiosis of two completely different regions, distinctly and intensely dominated, one by territorial rurality, and respectively, by urbanity, generates a particular geographic area characterized by: a) obvious gaps in the South-Muntenia region in relation to the Romanian capital city; b) deconcentration and ruralization of the South-Muntenia region in relation to the urban core of the metropolis; c) unfavourable labour migration balance of the network for South-Muntenia in relation to the capital's embedded and densified urban node; d) absorption of the school population in the South-Muntenia region, which is placed above the minimum threshold of wealth, into the Romanian capital, which allows greater access to academic education and rapid placement on a labour market which is more dynamic and extended, specific to the network node that is represented by the metropolis.

Of course, one can mention a number of advantages of this symbiosis by embedding, which actually have to do with everything related to the nature of a peripheral network of the South-Muntenia region, apparent in the transport network, institutional and transfer infrastructure, with emphasis on the capital-to-peripheral network direction; however, the educational, health and cultural as well as economic

disadvantages remain essential, especially those related to access to employment and wage levels, which polarize and increase the attractiveness of the metropolis (the Bucharest-Ilfov region), in relation to the peripheral network (the South-Muntenia region). If we apply a statistical criterion of representativeness, known as "criterion 60/60", accepted in researches in the area of product classification or nominal typologies, which can be adapted here to the educational services supplied by the ten undergraduate academic programs analyzed, the multidimensional analysis of the particularities of region South-Muntenia (NUTS2) can be effectively complemented and even substituted, in some phenomena that want concrete data, by the (additional) analysis of the area of the Argeş county (NUTS3), which gives even more than 60% (i.e. cca. 80%) of the students and provides jobs to the largest part of the graduates (over 60%) compared with the University of Piteşti and the extraction pool of its service recipients, along with the labour market that it covers with its graduates.

As far as the second dimension, i.e. time, is concerned, we opted for a double chronological period, as the available final data was given, with a predominantly chronological aim, for the period 1999–2012: existing regional data, and separately in the county of Argeş, and structurally and chronologically, for the post-accession period 2007-2012, in a distinctive manner (except demographics, the 2013 regional data for the remaining dimensions was not available at the time the article was written), which led to a permanent two-pronged approach, the former being a purely chronological approach, and the former being simultaneously a post-accession, and a regionally structural one.

The structural dimension of education, detailed by concrete aspects of the school population and the structure of educational institutions, reveals a number of characteristic trends with significant impact in the statistical analysis. Some contradictory and negative aspects are revealed by the fact that the regional educational network has been maximally contracted from a quantitative standpoint, at the base of the system, i.e. primary and secondary education, which has reached 25% of the initial number of schools at the regional level, and 20% at the Argeş county (though, essentially, the expansion in the number of faculties and high schools can be a positive factor) and simultaneously degraded in point of quality, from the high rate abandonment of school, and continuing with the labour market inadequacy of many forms of the traditional education and training programs. Argeş and Prahova are at the top percentage with both the number of faculties (over 60%) and that of schools (43.4%) in the South-Muntenia region.

Additionally, two other dimensions, the demographic one, the welfare-related one, and the one describing labour market by analyzing labour force, were selected as essential in analyzing an educational process in a minimal manner. The demographic dimension stands for the essential educational pool. The population of the whole region and that of the county of Argeş have been decreasing at annual rates of -0.54% and -0.45%, respectively, and thus a figure of only 92.27%, and 93.67% respectively, of the resident population was reached as of 1 July 1999 (as the national average is even higher, -0.7%, and the remaining number of the population is only 89.14% for the same period) and increase, in an atypical manner, the regional rural structural dominant, from 58.24% to 58.71% (South-Muntenia permanently possesses the highest percentage of

rural population compared to all other regions of the country), and the county rural dominant, from 51.93% to 52.56% (the national percentage of rural population is on a steeper increase, though at much lower levels, i.e. from 45.2% to 46.1%). The analysis focused on structural information highlights the fact that the diminution pace of the total post-accession population was maintained, defining an irreversible process in the absence of appropriate demographic policies (-0.5% regionally, and -0.37% respectively at the level of the county of Argeş) in parallel with the continuation of the atypical process of increase in the rural population (from 58.44% to 58.71% at the regional level, and from 52.08% to 52.56% at the county level).

The severe decrease in the birth rate, increased regional mortality, and consequently an expansion of the negative balance of natural movement as a result of all these trends, had, has and will continue to have, on a medium- and even long term, a major adverse impact on the selection pool of the University of Piteşti, regional- and county-wise, and also on the ten undergraduate (BA) academic programs analyzed. Structurally, the counties in the South- Muntenia region (with the relative exception of Giurgiu, which tends to have an approximately constant evolution in mortality and natality) show the same trend of decreasing birth rates and increasing mortality and the volume of the negative balance of natural movement (which became a constant state in Romania, after the 1992 census), below the national average by about half a percent, and much diminished during the post-accession to the EU. The negative balance of natural movement at a regional level, between 1999 and 2012, will be double, while the negative balance corresponding to the Argeş will treble, which emphasizes the negative impact and increases the vulnerability of selecting students from the county pool used by the University of Piteşti for the 10 undergraduate academic programs analyzed. The dimension of welfare focuses its development especially in economic performance such as GDP per capita and net earnings. GDP per capita sees an upward real trend, which practically doubles its level in 10 years, up to the global recession, only to resume an upward trend, after 2011, which is only confirmed by provisional data. The dynamics of monthly net average earnings per total, reconsidered in comparable 2012 prices, underlines an inertial wage growth until 2009, followed by a substantial reduction at a level, which is maintained till the end of 2012. A ranking by activities and an analysis structured by counties within the South-Muntenia region practical identify higher net nominal earnings, especially in industry and transport, and lower earnings, in education and health, and place the Argeş county first, especially in the last three years, surpassing Prahova county, which long exhibited peak values. The regional forecast anticipates regional GDP growth of 2.5% to 3% for 2014-2017, but the labour market adjustment of the undergraduate academic educational programs analyzed will not be possible without ensuring a modern management focused on stimulating educational, economic and social policies.

The labour market and labour force dimension, summarized in phenomena related to the process of employment. The dynamics of the labour force and employment remains contradictory, both regionally and county-wise: whereas resources increased between 1999 and 2012, employment falls by a significant percentage (-13.45% and, respectively, -14.29%), the reduction per county being more pronounced in Argeş. In terms of business

sectors and activity, employment shows different trends: primary and secondary sector activities contract with regional percentage values ranging between -10% and -20%, and county-wise between -20% and -30%, and tertiary sector activities evolved either upwards, increasing employment by about 50%, and 80%, respectively (in constructions), or by 50% and 20% (in transport and storage), or they stagnated initially or increase occupancy, and finally the dynamics goes down during the recession and post-recession period (education, health and social assistance), the only exception being health and social care in the Argeş county, where employment growth and labour employed was 66% over the period.

The analysis of the average number of employees reflects the same trends that characterize the dimension of employment within the regional and county-wise, and in addition it warns that employment processes in transport and constructions are heavily affected by seasonal employment, so increased employment and continued employment of labour in these activities are only apparent, due to developments of individual business people or self-emplyed persons, and not reflected by the dynamics of the average number of employees. The Argeş and Prahova counties have the majority of the unemployed university graduates in all South-Muntenia regions; their share within this area decreased, over the post-accession period, from 58.95% in 2007 to 55.72% in 2012, to return to 58.08% in 2013. The employment rate determined as a percentage ratio between employed population and labour resources, reinforces the idea that there were significant structural shifts in the negative demographic employment, practically continuing the overall downward trend in the share of the categories of employed population, compared to the labour resources of the South-Muntenia region, from 73.1% to 61.15%, and respectively of the Argeş county, from 77.6% to 64.6%, in the period under scrutiny. The unemployment rate, measured as a percentage ratio between the unemployed and the working population, evolves in an oscillating manner, yet it decreases overall both region-wise, from 10.4% to 6.9%, and in the Argeş county, from 7.0% to 6.1% (the 9.5% peak was reached in 2009, in full recession). The rate, or economic dependency ratio, and the employed population, reveals, over the last 15 years, a completely unfavourable trend, on the rise in the South-Muntenia region from 102.4% to 142.1%; the largest expansion of the ratio characterizes rural areas – from 83.8% to 145.7%.

2. A brief description of the statistical multidimensional (multivariate) analysis in methodological terms

The statistical research is complex and combines a multidimensional statistical analysis and an associative and projective diagnosis in order to model the educational supply in the selection pool (centered on the analysis of correlations in an extensive database that includes 244 variables, in order to identify, and subsequently model and forecast the evolution of the study programs in relation to their characteristic regional and county dimensions), as well as the development of three separate questionnaires for the program managers, students and employing companies and institutions on the labour market. The three questionnaires represent an articulate and well-structured approach, as it is from the first one that the other two naturally develop, following two distinct paths, described by a set of questions such as:

(i) Mention the first 7 to at most 10 occupations after graduation (including the COR code) in a hierarchical structure, according to the number of graduates in the last three years;

(ii) Mention the first 10 types of firms and companies, institutions or organizations employing the graduates, including freelancers, in the last three years (the ranking will be done in keeping with the number of graduates employed, and for the first five positions, also estimate the number of the graduates employed over the last three years);

(iii) Which are the main competing programmes in the region and in the county, and which universities are they based in?

To improve and heighten the degree of adequacy and adjustment of the educational supply, the stress falls, in questionnaires 2 and 3, intended for the students, and, respectively, for companies and institutions, on questions that aim to assess (on a Lickert scale, by an average score ranging between 1 and 5), followed by ranking and extending the skills and competences in the programmes analysed by means of key questions for the students, such as:

(I) *Would you like to be given a course taught by team of two professors of the University?*

(II) *Could you select two additional competences that you consider necessary in practising your future profession*, and, for the employers, questions like: *(i) Which are, in your opinion, the first three competences necessary for a graduate to achieve professional integration? (ii) To what extent do you think the above employees meet the requirements of their work places? (iii) Write three recommendations meant to improve academic education and profesional training of students, and the degree of graduate adaptability on the labour market.*

The study was designed for sample meant to provide freely expressed answers and opinions, being conducted through volunteer service, which resulted in a volume of 400 students for questionnaire 2, and 100 companies and institutions for questionnaire 33.

3. The results of questionnaires per programme and the derived variables

The descriptive statistical analysis essentially focused on the questionnaires of type 1 (type 2 and 3 were needed especially for the second study in the Nova–Curricula project) and aimed at the 40 endogenous, dependent or explained variables, referring to the essential quantitative features for the associative and projective diagnosis and subsequent modeling, which describes the total number of enrolled students, the number of graduates or alumni, the estimated total number of employees and the estimated total number of employees in jobs with higher education within each of the ten programs analyzed, separately. To do the statistical analysis, the descriptive variables were analyzed using the software package Eviews, and the results of that analysis are described in four sets of ten variables each (one for each program –SER01- SER10- detailed in the tables numbered from 2 to 6 inclusive):

Descriptive statistical analysis of the variable total number of students enrolled

Table no. 2

	SER01	SER02	SER03	SER04	SER05	SER06	SER07	SER08	SER09	SER10
Mean	108.8000	84.36364	18.40000	15.80000	55.33333	67.71429	134.2000	90.83333	140.1346	57.00000
Median	95.00000	60.00000	17.00000	23.00000	54.00000	74.50000	128.5000	67.50000	145.2500	40.00000
Maximum	185.0000	189.0000	30.00000	29.00000	60.00000	100.0000	199.0000	233.0000	186.0000	100.0000
Minimum	80.00000	28.00000	0.000000	0.000000	52.00000	30.00000	85.00000	24.00000	36.00000	23.00000
Std. Dev.	28.79534	49.19608	7.471852	14.58424	4.163332	21.68100	43.04726	63.44193	44.12749	28.02040
Skewness	1.353611	0.877386	-0.691758	-0.343339	0.528005	-0.560412	0.228171	1.165646	-1.179112	0.220798
Kurtosis	4.166514	2.793448	3.543482	1.197899	1.500000	2.337355	1.502472	3.119215	3.609188	1.366658
Jarque-Bera	5.431128	1.430865	1.380930	0.774811	0.420645	0.988950	1.021183	2.724569	3.213344	1.789259
Probability	0.066168	0.488981	0.501343	0.678816	0.810323	0.609891	0.600141	0.256075	0.200554	0.408759
Sum	1632.000	928.0000	276.0000	79.00000	166.0000	948.0000	1342.000	1090.000	1821.750	855.0000
Sum Sq. Dev.	11608.40	24202.55	781.6000	850.8000	34.66667	6110.857	16677.60	44273.67	23366.83	10992.00
Existing program-years with data ≠ 0	15 15	11 11	15 14	5 3	3 3	14 14	10 10	12 12	13 13	15 15

Software used: Eviews.Series from SER10 to SER01 refer to data on the total number of students enrolled in ten programmes

All data series are normally distributed in keeping with the values of the Jarque–Bera test (the data are not affected by any measurement errors), but five strongly polarized and heterogeneous series are identified, i.e. SER02, SER03, SER04, SER08 and SER10, which correspond to a set of programmes, the first three engineering and mathematical programmes, and the last two connected with health education and history, which also present larger vulnerabilities in terms of the number of students according to the number of students enrolled or according to a level rather oscillating in its limits, an alternative level which is described by a very high dispersion, and a coefficient of uniformity in amounts greater than 35%, i.e. heterogeneous populations of data, or having a high degree of risk over time.

Descriptive statistical analysis of the variable total number of graduates

Table no. 3

	SER11	SER12	SER13	SER14	SER15	SER16	SER17	SER18	SER19	SER20
Mean	87.93333	63.14286	16.60000	14.00000	34.00000	52.54545	97.60000	89.00000	120.3333	41.61538
Median	87.00000	80.00000	16.00000	17.00000	34.00000	56.00000	84.50000	69.00000	125.0000	47.00000
Maximum	139.0000	101.0000	37.00000	28.00000	34.00000	70.00000	163.0000	197.0000	178.0000	76.00000
Minimum	56.00000	26.00000	0.000000	0.000000	34.00000	25.00000	49.00000	0.000000	84.00000	10.00000
Std. Dev.	21.91042	29.82409	8.492013	13.39776	NA	14.59701	43.47720	63.69197	30.24070	20.13098
Skewness	0.728816	-0.223617	0.411512	-0.161087	NA	-0.786935	0.301070	0.376700	0.545471	0.103883
Kurtosis	3.141157	1.483946	3.951624	1.260562	NA	2.411262	1.461459	1.904298	2.402482	1.817740
Jarque-Bera	1.340386	0.728711	0.989348	0.651967	NA	1.294187	1.137367	0.736739	0.580193	0.780491
Probability	0.511610	0.694644	0.609770	0.721817	NA	0.523565	0.566270	0.691861	0.748191	0.676891
Sum	1319.000	442.0000	249.0000	70.00000	34.00000	578.0000	976.0000	890.0000	1083.000	541.0000
Sum Sq. Dev.	6720.933	5336.857	1009.600	718.0000	0.000000	2130.727	17012.40	36510.00	7316.000	4863.077
Existing programme –years with data≠0	15 15	11 7	15 14	5 3	3 1	14 11	10 10	12 10	13 10	15 13

Software used: Eviews. Series SER20 to SER11 refer to data on the total number of graduates enrolled in 10 programmes.

Very much as in the previous descriptive analysis, we can notice that all data series for the graduates are normally distributed, in accordance with the values of the Jarque–Bera test (the data are not affected by any measurement errors), but the number of heterogeneous series is extended, that is, because of missing data, to the previous programmes are added SER15, a newly created programme, and SER17 (the psychology program), which are heterogeneous and strongly polarized, having a very high dispersion and a uniformity coefficient of values higher than 35%, i.e. a high degree of risk in the short and medium terms, with regard to the population of graduates.

Descriptive statistical analysis of the variable total number of employees estimated

Table no. 4

	SER21	SER22	SER23	SER24	SER25	SER26	SER27	SER28	SER29	SER30
Mean	80.33333	57.14286	15.66667	0.000000	0.000000	29.40000	56.66667	68.00000	77.22222	40.25000
Median	80.00000	70.00000	16.00000	0.000000	0.000000	31.00000	50.00000	53.00000	74.00000	42.00000
Maximum	130.0000	95.00000	37.00000	0.000000	0.000000	35.00000	95.00000	145.0000	106.0000	73.00000
Minimum	50.00000	20.00000	0.000000	0.000000	0.000000	22.00000	30.00000	24.00000	56.00000	19.00000
Std. Dev.	21.58593	28.70208	9.551863	0.000000	0.000000	4.718757	22.36068	42.89522	16.85065	17.72069
Skewness	0.669676	-0.16536	0.194524	NA	NA	-0.565281	0.362674	0.727756	0.465847	0.287960
Kurtosis	3.005828	1.530462	3.195421	NA	NA	1.940419	1.992656	2.181786	2.079348	1.941100
Jarque-Bera	1.121187	0.661768	0.118467	NA	NA	1.000367	0.577826	0.929330	0.643370	0.726476
Probability	0.570870	0.718289	0.942487	NA	NA	0.606419	0.749077	0.628345	0.724926	0.695421
Sum	1205.000	400.0000	235.0000	0.000000	0.000000	294.0000	510.0000	544.0000	695.0000	483.0000
Sum Sq. Dev.	6523.333	4942.857	1277.333	0.000000	0.000000	200.4000	4000.000	12880.00	2271.556	3454.250
Existing programme-years with data ≠ 0	15 15	11 7	15 13	5 3	3 3	14 10	10 9	12 8	13 9	15 12

Software used: Eviews. SER21 to SER30 refer to the data concerning the estimated total number of graduates who will be employed from the graduates of the 10 programmes.

By analogy, all the data series of graduates estimated as being employed are normally distributed in keeping with the values of the Jarque–Bera test (the data are not affected by any measurement errors), but only three homogeneous series identified, i.e. series 21, 26 and 29.

Descriptive statistical analysis of total number of estimated employees with higher education jobs

Table no. 5

	SER31	SER32	SER33	SER34	SER35	SER36	SER37	SER38	SER39	SER40
Mean	60.66667	40.71429	15.66667	0.000000	0.000000	19.70000	14.77778	49.12500	49.66667	28.25000
Median	60.00000	50.00000	16.00000	0.000000	0.000000	19.00000	15.00000	28.00000	47.00000	29.50000
Maximum	100.0000	70.00000	37.00000	0.000000	0.000000	29.00000	27.00000	121.0000	72.00000	52.00000
Minimum	35.00000	15.00000	0.000000	0.000000	0.000000	12.00000	3.000000	17.00000	38.00000	14.00000
Std. Dev.	16.78293	21.10067	9.551863	0.000000	0.000000	5.186521	7.980880	38.77937	11.12430	12.15898
Skewness	0.736806	-0.107345	0.194524	NA	NA	0.296469	-0.270257	0.906634	0.808742	0.406361
Kurtosis	3.313635	1.647566	3.195421	NA	NA	2.267775	2.189626	2.306428	2.784751	2.110034
Jarque-Bera	1.418688	0.546924	0.118467	NA	NA	0.369887	0.355823	1.256329	0.998469	0.726279
Probability	0.491967	0.760741	0.942487	NA	NA	0.831151	0.837016	0.533570	0.606995	0.695489
Sum	910.0000	285.0000	235.0000	0.000000	0.000000	197.0000	133.0000	393.0000	447.0000	339.0000
Sum Sq. Dev.	3943.333	2671.429	1277.333	0.000000	0.000000	242.1000	509.5556	10526.88	990.0000	1626.250
Existing programme-years with data ≠ 0	15 15	11 7	15 13	5 3	3 3	14 7	10 9	12 8	13 9	15 12

Software used: Eviews. SER21 to SER30 refer to the data concerning the estimated total number of graduates who will be employed from the graduates of the 10 programmes.

As can be seen from the values of the correlation matrices of table 7, the data for programme IX are the most highly correlated:

Matrici de corelaţie la nivel de program între variabilele endogene esenţiale pentru cele trei programe *normal distribuite şi omogene la nivelul celor patru variabile analizate*

Table no. 6

Program I	SER01	SE11	SER21	SER31
SER01	1.000000	0.126097	0.134566	0.184310
SER11	0.126097	1.000000	0.996819	0.980104
SER21	0.134566	0.996819	1.000000	0.985176
SER31	0.184310	0.980104	0.985176	1.000000

Table no. 7

Program VI	SER06	SER16	SER26	SER36
SER06	1.000000	0.434676	0.463052	0.498072
SER16	0.434676	1.000000	0.941506	0.919349
SER26	0.463052	0.941506	1.000000	0.960176
SER36	0.498072	0.919349	0.960176	1.000000

Program IX	SER09	SER19	SER29	SER39
SER09	1.000000	0.844907	0.824722	0.817472
SER19	0.844907	1.000000	0.917952	0.919821
SER29	0.824722	0.917952	1.000000	0.994027
SER39	0.817472	0.919821	0.994027	1.000000

Software used: Eviews.

The programme IX is followed by program VI, at the limit of the correlation between enrolled students and graduates, with the labour market by estimated employment (including higher education jobs), while program I correlates the labour market with the graduates, not with the students enrolled, which can be translated either as a more intense process of student selection during the undergraduate programme, or as a process of abandonment after the more severe first year.

Conclusion

The article statistically presents and resizes, in a descriptive and mathematical manner, a set of favourable and normal aspects regarding the evolution of the ten programmes analyzed, originally exploiting correlation matrices for the purpose of diagnosis and design of the populations of students enrolled, and, derived from it, the populations of graduates. About half of the programmes are heterogeneous and strongly polarized over time, according to the databases for the last 15 years, but only three of them incur major developmental risks and vulnerabilities or abnormalities: Mathematics, Physics and Engineering, and History. The dynamics of the graduates, along with the evolution of those who were employed in jobs requiring higher education, identifies, after the multidimensional analyses and the descriptive statistical analysis, along with the analysis of association through correlation matrices, other three programmes, i.e. I, VI, and IX, as the only programmes (out of ten) that are completely free of risk in the descriptive statistics of the data, despite the shrinking school population in the selection pool of the university analyzed.

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References

1. Nijkamp, P., 1986. *Infrastructure and Regional Development: A multidimensional Policy Analisys,* Empirical Economics, vol 11, pp.1-21.
2. Paelinck, J. H., Nijkamp, P., 1975. *Operational Theory and Method in Regional Economics*, Lexington books, Westmead, pp. 13-19.
3. Radermacher, W., '*Foreword*', in Eurostat Regional Yearbook, 2013, pg. 3, available online at http://epp.eurostat.ec.europa.eu/ statistics_ explained/index. php/Regional_ yearbook_ foreword accessed on January 5th, 2015.
4. Săvoiu, G, 2012. *GDP Indicator for Statistical Comparisons at National/Regional and International*, Romanian Statistical Review, vol. 60 (12), pp. 54-62.

5. Săvoiu G., 2006. *Populaţia lumii între explozie şi implozie demografică*, Ed. International University Press, Bucureşti.
6. Eurostat, General Presentation of Regional Statistics, 2014. p.1 disponibil online la http:// epp.eurostat.ec.europa.eu/statistics_explained/index.php/Regional_yearbook_introduc tion accesat în 24 iulie 2014.
7. *** Comisia Europeană, Europa 2020, *O strategie europeană pentru o creştere inteligentă, ecologică şi favorabilă incluziunii*, Bruxelles, 3.3.2010 COM (2010), 2020 available at: http://www.mae.ro/sites/default/files/file/Europa2021/Strategia_Europa_2020.pdf accessed on August 8th, 2014.
8. *** *Statistica teritorială, repere economice şi sociale regionale*, 2014, Ed. INS, Bucureşti available at: http://www.insse.ro/cms/files/IDDT%202012/index_IDDT.htm accessed on July, 27th, 2014.