MARKOV CHAINS METHOD- FORECASTING TOOL OF THE STRUCTURE OF HIGHER EDUCATION GRADUATES BY GROUPS OF SPECIALIZATIONS

Delia, Teselios[1]
Mihaela, Savu[2]

Abstract:
The number of graduates in higher education has seen a downward trend in recent years, with significant declines in economic sciences specialization group. The choice of specialization group by future graduates should be made depending on whether the labor market has the requested specialized jobs, this choice showing, in fact, the supersaturation of certain areas. This paper uses the theory of Markov chains to forecast the share of graduates in higher education by groups of specialties. Knowing future trends allow an appropriate educational strategy based on reality and the requirements of the labor market.

Keywords: *number of higher education graduates, probability, Markov chains theory, labor market*

JEL Code: *C1, I2, J2*

1. Introduction

Our country's economy has led to significant changes in the labor market over the last 25 years. The changes in this market went reflected the occurrence of the Romanian market economy.

"The role of education in providing access to the labor market is reflected by increased employment opportunities for the educated population. People with high levels of education have better opportunities in the labor market, resulting in higher rates of employment. " (Serban, 2012) The average rate of employment among persons of higher education graduates is that of 82.1% in the European Union and 82.5% in Romania.

Unemployment affects to a lesser extent people with higher education, however this phenomenon strongly influences young people. Reducing youth unemployment is a key objective in the developed or developing countries. Moreover, the existence of youth unemployment means loss of human capital. (Zamfir, 2013)

At the European Union level has been established as target for 2020 a rate of 40% of university graduates, age group 30-34 years. In 2014, this indicator showed a value of 37.9% , with a different participation which varied by sex, 42.3% females and 33.6% males. In our country, the rate of university graduates age group 30-34 years was that of 25% in 2014, structured as follows: 27.2% females and 22.9% males.

At the same time the demand for labor causes universities to become more flexible and responsive to labor market needs. (Vasile et all, 2007) In this context, the paper aims to use the theory of Markov chains to predict the structure of higher education graduates and to sense if there are changes in the group structure of specializations.

2. Markov Processes - category of stochastic processes

The general theory of stochastic processes has its origins in the work of mathematicians A. N. Kolmogorov, W. Feller and A.Y. Khinchin in the early 30's, outstanding studies, subsequent, belonging to K.Itô, M.Rosenblatt, I.Karatzas, S.Shreve, A.Skorokhod, G.Ciucu, O.Onicescu, M.Iosifescu, etc. Stochastic processes represent an

[1] PhD Lecturer, "Constantin Brancoveanu" University of Pitesti, Romania, delia_teselios@yahoo.com
[2] PhD Associate Professor, "Constantin Brancoveanu" University of Pitesti, Romania

important branch of probability theory, with applications in both mathematics and physics, economics, finance, biology, medicine, engineering, etc.

Definition 1: A stochastic process is a **parametrized** collection of random variables $\{X_t\}_{t\in T}$ defined on the in the completely additive probability field (Ω, K, P) with values in R^n.

Usually, as a set of T parameters it is considered to be the whole straight line T = (-∞, ∞) or only the positive semiaxis T = (0, ∞) or T = [0, ∞) or a finite segment, usually [0,1]. In all these cases, we say that we are dealing with a process with continuous time. When T is a countable set, we are talking about a stochastic process with discreet time.

An important category of stochastic processes is the Markov processes. The study of these processes has been initiated by the Russian mathematician A.A.Markov (1856-1922), founder of a new branch of probability theory.

In 1923 Norbert Wiener rigorously treated for the first time the continuous Markov processes. The basis of a general theory was provided during the 30s by A.Kolmogorov, the general notion of Markov process being defined by J.L.Doob in the paper "Stochastic Processes" (1953).

"Conceptually, a Markov process is the probabilistic analog of processes in classical mechanics, where future development is completely determined by the present state and it is independent of how developed the present state is". [1]

If we consider as set of parameters T = N in Definition 1, instead of using process we use the term chain.

Definition 2: It is called a Markov chain of random variables, the string of random variables $(f_n)_{n\in N}$ satisfying the conditions: (∀) $0\le t_1\le\ldots\le t_n$, $n\ge 2$ and (∀) $i_1,\ldots,i_n\in I$, with I = set of process conditions, we have:

$$P(f_{t_n}(\xi)=i_n \mid f_{t_{n-1}}(\xi)=i_{n-1},\ldots,f_{t_1}(\xi)=i_1)=P(f_{t_n}(\xi)=i_n \mid f_{t_{n-1}}(\xi)=i_{n-1}) \quad (1)$$

whenever the left part is defined.

The equality (1) it is called Markov's property and it is equivalent to the equality:

$$P(f_n(\xi)=i_n \mid f_{n-1}(\xi)=i_{n-1},\ldots,f_1(\xi)=i_1)=P(f_n(\xi)=i_n \mid f_{n-1}(\xi)=i_{n-1}),(\forall)n\in N^* \quad (2)$$

Definition 3: The probabilities $P(f_t(\xi)=i_t \mid f_{t-1}(\xi)=i_{t-1})$ are called transition probabilities for Markov chain of random variables, and they are denoted by $p(t;i_{t-1},i_t), t=\overline{1,n}$

The significance for $p(t;i_{t-1},i_t)$ is that of the probability of transition from the state i_{t-1} at the t-1 moment to the state i_t at the t moment.

Definition 4: Markov chain of random variables is uniform if:

$$p(t;i_{t-1},i_t)=p_{i_{t-1}i_t} \quad (3)$$

In other words, the likelihood of the occurrence of the i_t state at the t moment subject to the occurrence of i_{t-1} state at moment t-1 does not depend on t explicitly. And therefore

$$P(f_t(\xi)=j \mid f_{t-1}=i)=p_{ij} \quad (4)$$

do not depend on the moments of time corresponding to states, but on the distance in time between states.

Obviously $\sum_{j\in I} p_{ij}=1,\ p_{ij}\ge 0,\ i,j\in I$ (5)

Definition 5: The matrix whose elements are the probabilities of transition it is called transition matrix and it is denoted by $\prod=(p_{ij})_{i,j\in I}$.

Markov processes are subject to practical uses in areas such as: economics (projections of some economic activities), genetics, psychology, etc.

3. Economic Study

Using the theory of Markov chains, we aim to realize a prediction of structure of the number of graduates in higher education for the years 2014 and 2015 by group of specializations.

The starting point is the data provided by the National Institute of Statistics on the number of higher education graduates in the 2010-2013 period, for 10 groups of specializations, as follows:

Table 1. Number of graduates in higher education by groups of specializations

Groups of specializations	Years (Number of persons)			
	2010	2011	2012	2013
G1. INDUSTRY	20138	21190	19878	17820
G2. TRANSPORT AND TELECOMMUNICATIONS	958	1007	797	875
G3. ARCHITECTURE AND CONSTRUCTION	4397	4993	4642	3797
G4. AGRICULTURE	1776	1919	1819	1660
G5 FORESTRY	677	580	577	516
G6. MEDICAL	9729	9434	9437	9250
G7. ECONOMICS	62685	34415	25724	21922
G8. LAW SCIENCE	26404	19215	12521	10388
G9. UNIVERSITY - PEDAGOGY	57589	41604	33492	26893
G10. ARTISTIC	2547	2314	2141	1901
TOTAL	186900	136671	111028	95022

Source: http://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=ro&ind=SCL109H

From (Table 1) one can observe a decrease in the number of higher education graduates during the analyzed period. If in 2010 we had a total of 186900 graduates of higher education, in 2011 registering a total of 136671, and in the last year analyzed (2013) are 95022 graduates of higher education.

The number of graduates in higher education is structured quite similar in the four years analyzed. In 2010, most graduates were registered in the G7 group, followed by G9 and G8 group. In 2011 most graduates were registered at G9 group, followed by those in the G7 and G1. In the next two years 2012 and 2013, ranking the first three groups remains the same as in 2011, only the values being on decline. The trend in the number of graduates in higher education both on the whole and at the level of the 10 groups is declining, with a few exceptions:

- In 2011, the number of graduates in groups G1, G2, G3 and G4 increased compared to the number of the previous year;
- In 2012, group G6 increased the number of graduates compared to the number in the previous year, but with an almost insignificant amount (- 3 graduates).

It should be noted the drastic reduction recorded in the G7 group between 2010 and 2011, when the number of graduates has nearly halved. This is the strongest regression of the analyzed indicator between 2010-2013.

In the first stage we realize a prediction regarding the structure of the number of graduates in higher education for 2014 by group of specializations, the data being used in projections for 2015.

The steps to go through are:

Step 1: Determining the share of graduates by groups of specializations (%)

Table 2. The share of higher education graduates by groups of specializations (%)

Groups of specializations	Years (%)			
	2010	**2011**	**2012**	**2013**
G1. INDUSTRY	10.775	15.504	17.904	18.754
G2. TRANSPORT AND TELECOMMUNICATIONS	0.513	0.737	0.718	0.921
G3. ARCHITECTURE AND CONSTRUCTION	2.353	3.653	4.181	3.996
G4. AGRICULTURE	0.950	1.404	1.638	1.747
G5 FORESTRY	0.362	0.424	0.520	0.543
G6. MEDICAL	5.205	6.903	8.500	9.735
G7. ECONOMICS	33.539	25.181	23.169	23.070
G8. LAW SCIENCE	14.127	14.059	11.277	10.932
G9. UNIVERSITY - PEDAGOGY	30.813	30.441	30.165	28.302
G10. ARTISTIC	1.363	1.693	1.928	2.001
TOTAL	**100**	**100**	**100**	**100**

Source: Made by the authors

(Table 2) provides the opportunity to observe the share of graduates in higher education by groups of specializations. In 2010 the group G7 held a share of 33.5%, followed by 30.8% of the group G9 and the group G8 of 14.1%. In 2011 the first position with 30.4% was that of group G9, followed by the group G7 with 25.1% and the group G1 with 15.5%. In the next two years, the top three remain the same, only the related shares changes. In 2012 group G9 held a share of 30.1%, followed by the group G7 with 23.1% and the group G1 with 17.9%. In 2013 the group G9 held a share of 28.3%, followed by the group G7 with 23% and group G1 with 18.7%.

Step 2: For each pair of consecutive periods of time (t-1/t) = (2010/2011, 2011/2012, 2012/2013, 2013/2014), is calculated the partial matrices of transition.

These are square matrices (10x10) denoted by : $G^{t-1/t} = (g_{ij}^{t-1/t})_{i,j=\overline{1,10}}$.

We denote $A = (a_{ij})_{\substack{i=\overline{1,4} \\ j=\overline{1,10}}}$ the matrix whose elements are the values in (Table 2).

The matrix elements $G^{2010/2011} = (g_{ij}^{2010/2011})_{i,j=\overline{1,10}}$ is determined as follows:

- for $i = j$: $(g_{ij}^{2010/2011})_{i,j=\overline{1,10}} = \min(a_{i1}^{2010}, a_{i2}^{2011})$

The differences $(a_{i1}^{2010} - g_{ii}^{2010/2011}), i = \overline{1,10}$ are called negative deviations (ND) and $(a_{i2}^{2010} - g_{ii}^{2010/2011}), i = \overline{1,10}$ are called positive deviations (PD).

- for $i \neq j$:

$$(g_{ij}^{2010/2011})_{i,j=\overline{1,10}} = (a_{i1}^{2010} - g_{ii}^{2010/2011}) \cdot (a_{i2}^{2010} - g_{ii}^{2010/2011}) / \sum \text{positive deviations}$$

Table 3. Partial matrix of transition from 2010 to 2011

	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	ND
G1.	10.775	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
G2.	0.000	0.513	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
G3.	0.000	0.000	2.353	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
G4.	0.000	0.000	0.000	0.950	0.000	0.000	0.000	0.000	0.000	0.000	

	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	ND
G5.	0.000	0.000	0.000	0.000	0.362	0.000	0.000	0.000	0.000	0.000	
G6.	0.000	0.000	0.000	0.000	0.000	5.205	0.000	0.000	0.000	0.000	
G7.	4.493	0.213	1.236	0.431	0.059	1.612	25.181	0.000	0.000	0.314	**8.358**
G8.	0.037	0.002	0.010	0.004	0.000	0.013	0.000	14.059	0.000	0.003	**0.068**
G9.	0.200	0.009	0.055	0.019	0.003	0.072	0.000	0.000	30.441	0.014	**0.372**
G10.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.363	
PD	**4.730**	**0.224**	**1.301**	**0.454**	**0.062**	**1.697**				**0.330**	8.798

Source: Made by the authors

$\Rightarrow G^{2010/2011}$ is the matrix whose elements are the values in (Table 3).

Therefore, in 2011 compared to 2010, the groups who lost percentages are: group 7 (Economics - 8.358 percentages), group 8 (Law Science -0.068 percentages) and group 9 (University - Pedagogy - 0.372 percentages). Other groups have won percentage, the first being group 1 (Industry) with 4.73 percentage earned by transfer from groups G7 (4.493), G8 (0.037) and G9 (0.20), followed by Group 6 (Medical) with 1.697 percentage.

Proceeding analog, the following transition matrices are obtained:

- $G^{2011/2012}$ whose elements are the values in (Table 4).

Table 4. Partial transition matrix from 2011 to 2012

	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	ND
G1.	15.504	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
G2.	0.009	0.718	0.002	0.001	0.000	0.006	0.000	0.000	0.000	0.001	**0.019**
G3.	0.000	0.000	3.653	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
G4.	0.000	0.000	0.000	1.404	0.000	0.000	0.000	0.000	0.000	0.000	
G5.	0.000	0.000	0.000	0.000	0.424	0.000	0.000	0.000	0.000	0.000	
G6.	0.000	0.000	0.000	0.000	0.000	6.903	0.000	0.000	0.000	0.000	
G7.	0.949	0.000	0.209	0.093	0.038	0.631	23.169	0.000	0.000	0.093	**2.012**
G8.	1.312	0.000	0.288	0.128	0.052	0.873	0.000	11.277	0.000	0.129	**2.782**
G9.	0.130	0.000	0.029	0.013	0.005	0.087	0.000	0.000	30.165	0.013	**0.276**
G10.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.693	
PD	**2.399**		**0.528**	**0.234**	**0.095**	**1.597**				**0.235**	5.089

Source: Made by the authors

The significance of this result is that in the year 2012 compared to 2011, most percentages were gained by Group 1 (Industry) – 2.399, obtained by transfer from groups G2 (0.009), G7 (0.949), G8 (1.312) and G9 (0.13). Group 8 (Law Science) has transferred most percentages (2.782) as follows: G1 group (1.312), G3 (0.288), G4 (0.128), G5 (0.052), G6 (0.873) and G10 (0.129).

- $G^{2012/2013}$ whose elements are the values in (Table 5) .

Table 5. Partial transition matrix from 2012 to 2013

	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	ND
G1.	17.904	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
G2.	0.000	0.718	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
G3.	0.063	0.015	3.996	0.008	0.002	0.092	0.000	0.000	0.000	0.005	**0.185**
G4.	0.000	0.000	0.000	1.638	0.000	0.000	0.000	0.000	0.000	0.000	
G5.	0.000	0.000	0.000	0.000	0.520	0.000	0.000	0.000	0.000	0.000	

	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	ND
G6.	0.000	0.000	0.000	0.000	0.000	8.500	0.000	0.000	0.000	0.000	
G7.	0.034	0.008	0.000	0.004	0.001	0.049	23.070	0.000	0.000	0.003	**0.098**
G8.	0.118	0.028	0.000	0.015	0.003	0.171	0.000	10.932	0.000	0.010	**0.345**
G9.	0.636	0.152	0.000	0.081	0.017	0.923	0.000	0.000	28.302	0.054	**1.864**
G10.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.928	
PD	**0.850**	**0.203**		**0.109**	**0.023**	**1.235**				**0.072**	2.492

Source: Made by the authors

Compared to year 2012, in 2013 there were transferred to the medical field 1.235 percentages, the biggest loss being of 1.864 percentages, recorded by Group 9 (University - Pedagogy).

Step 3: It is calculated the total matrix of transition for 2010-2013 by summing the three partial matrices obtained previously.

Thus, $G^{2010-2013}$ it is the matrix whose elements are the values in (Table 6).

Table 6. Total matrix of transition for the period 2010-2013

	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	TOTAL
G1.	44.183	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	44.183
G2.	0.009	1.948	0.002	0.001	0.000	0.006	0.000	0.000	0.000	0.001	1.967
G3.	0.063	0.015	10.002	0.008	0.002	0.092	0.000	0.000	0.000	0.005	10.187
G4.	0.000	0.000	0.000	3.993	0.000	0.000	0.000	0.000	0.000	0.000	3.993
G5.	0.000	0.000	0.000	0.000	1.306	0.000	0.000	0.000	0.000	0.000	1.306
G6.	0.000	0.000	0.000	0.000	0.000	20.608	0.000	0.000	0.000	0.000	20.608
G7.	5.475	0.221	1.444	0.528	0.098	2.293	71.420	0.000	0.000	0.410	81.889
G8.	1.466	0.030	0.299	0.147	0.056	1.057	0.000	36.269	0.000	0.141	39.464
G9.	0.965	0.161	0.084	0.113	0.025	1.082	0.000	0.000	88.908	0.081	91.419
G10.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.984	4.984
TOTAL	52.162	2.375	11.830	4.789	1.487	25.137	71.420	36.269	88.908	5.622	300.000

Source: Made by the authors

Step 4: It is calculated the predicted structure for the year 2014. Based on matrix $G^{2010-2013}$ it is calculated the probability of transition matrix, by dividing each element of the matrix $G^{2010-2013}$ at the sum of the line on which that item is.

We obtain the matrix denoted by $GP^{2010-2013} = (gp_{ij}^{2010-2013})_{i,j=\overline{1,10}}$, whose elements are the values in (Table 7).

Table 7. Probability of transition matrix

	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10
G1.	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
G2.	0.005	0.990	0.001	0.000	0.000	0.003	0.000	0.000	0.000	0.000
G3.	0.006	0.001	0.982	0.001	0.000	0.009	0.000	0.000	0.000	0.001
G4.	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
G5.	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000
G6.	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000
G7.	0.067	0.003	0.018	0.006	0.001	0.028	0.872	0.000	0.000	0.005

	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10
G8.	0.037	0.001	0.008	0.004	0.001	0.027	0.000	0.919	0.000	0.004
G9.	0.011	0.002	0.001	0.001	0.000	0.012	0.000	0.000	0.973	0.001
G10.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Source: Made by the authors

Being probabilities, the sum of the elements on each line is equal to 1.

The structure predicted for the year 2014 it is calculated as product between matrix transpose $GP^{2010-2013}$ and the vector $\begin{pmatrix} 18.754 \\ 0.921 \\ 3.996 \\ 1.747 \\ 0.543 \\ 9.735 \\ 23.070 \\ 10.932 \\ 28.302 \\ 2.001 \end{pmatrix}$ representing the number of graduates on groups of specializations.

Therefore, the projected structure of the number of graduates in higher education for 2014, by groups of specialization is:

Table 8. Projected structure of the number of graduates in higher education for 2014 (%)

Groups of specializations	2014
G1. INDUSTRY	21.032
G2. TRANSPORT AND TELECOMMUNICATIONS	1.040
G3. ARCHITECTURE AND CONSTRUCTION	4.439
G4. AGRICULTURE	1.973
G5 FORESTRY	0.596
G6. MEDICAL	11.046
G7. ECONOMICS	20.122
G8. LAW SCIENCE	10.047
G9. UNIVERSITY - PEDAGOGY	27.524
G10. ARTISTIC	2.183

Source: Made by the authors

Therefore, for 2014 is anticipated an increase in the number of graduates in higher education for groups of specializations G1-G6 and G10. The other majors groups (G7- G9) will show a decrease in the number of graduates.

Step 5: Based on data obtained in step 4, it is determined the partial matrix of transition for 2013/2014 and the total matrix of transition for the period 2010-2014.

Thus, $G^{2013/2014}$ have as elements the values in (Table 9).

Tabelul 9. Partial matrix of transition from 2013 to 2014

	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	ND
G1.	18.754	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
G2.	0.000	0.921	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	ND
G3.	0.000	0.000	3.996	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
G4.	0.000	0.000	0.000	1.747	0.000	0.000	0.000	0.000	0.000	0.000	
G5.	0.000	0.000	0.000	0.000	0.543	0.000	0.000	0.000	0.000	0.000	
G6.	0.000	0.000	0.000	0.000	0.000	9.735	0.000	0.000	0.000	0.000	
G7.	1.456	0.076	0.283	0.144	0.034	0.838	20.122	0.000	0.000	0.117	**2.948**
G8.	0.437	0.023	0.085	0.043	0.010	0.252	0.000	10.047	0.000	0.035	**0.886**
G9.	0.384	0.020	0.075	0.038	0.009	0.221	0.000	0.000	27.524	0.031	**0.778**
G10.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.001	
PD	**2.278**	**0.119**	**0.443**	**0.226**	**0.052**	**1.312**				**0.183**	4.612

Source: Made by the authors

Therefore, in 2014 compared to 2013, the groups who lost percentages are G7 (2.948), G8 (0.886) and G9 (0.778), achieving transfer of percentage for groups G1-G6 and G10.

The total matrix of transition for the period 2010-2014, $G^{2010-2014}$ has as elements the values in (Table 10).

Table 10. The total matrix of transition for the period 2010-2014

	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	TOTAL
G1.	62.936	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	62.936
G2.	0.009	2.869	0.002	0.001	0.000	0.006	0.000	0.000	0.000	0.001	2.888
G3.	0.063	0.015	13.998	0.008	0.002	0.092	0.000	0.000	0.000	0.005	14.183
G4.	0.000	0.000	0.000	5.740	0.000	0.000	0.000	0.000	0.000	0.000	5.740
G5.	0.000	0.000	0.000	0.000	1.849	0.000	0.000	0.000	0.000	0.000	1.849
G6.	0.000	0.000	0.000	0.000	0.000	30.342	0.000	0.000	0.000	0.000	30.342
G7.	6.932	0.297	1.727	0.672	0.131	3.131	91.542	0.000	0.000	0.526	104.959
G8.	1.903	0.053	0.384	0.190	0.066	1.309	0.000	46.316	0.000	0.176	50.396
G9.	1.350	0.181	0.158	0.151	0.034	1.303	0.000	0.000	116.432	0.112	119.721
G10.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.985	6.985
TOTAL	73.193	3.415	16.269	6.762	2.083	36.183	91.542	46.316	116.432	7.805	400.000

Source: Made by the authors

Step 6: It is calculated the predicted structure for the year 2015. The matrix of transition probabilities $GP^{2010-2014}$ has as elements the values in (Table 11).

Table 11. The matrix of transition probabilities

	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10
G1.	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
G2.	0.003	0.993	0.001	0.000	0.000	0.002	0.000	0.000	0.000	0.000
G3.	0.004	0.001	0.987	0.001	0.000	0.006	0.000	0.000	0.000	0.000
G4.	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
G5.	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000
G6.	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000
G7.	0.066	0.003	0.016	0.006	0.001	0.030	0.872	0.000	0.000	0.005
G8.	0.038	0.001	0.008	0.004	0.001	0.026	0.000	0.919	0.000	0.003
G9.	0.011	0.002	0.001	0.001	0.000	0.011	0.000	0.000	0.973	0.001
G10.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000

Source: Made by the authors

Therefore, the projected structure of the number of graduates in higher education for the year 2015, on groups of specialization is:

Table 12. Projected structure of the number of graduates in higher education for the year 2015 (%)

Groups of specializations	2015
G1. INDUSTRY	25.790
G2. TRANSPORT AND TELECOMMUNICATIONS	1.163
G3. ARCHITECTURE AND CONSTRUCTION	4.812
G4. AGRICULTURE	2.165
G5 FORESTRY	0.626
G6. MEDICAL	12.243
G7. ECONOMICS	17.546
G8. LAW SCIENCE	9.233
G9. UNIVERSITY - PEDAGOGY	26.780
G10. ARTISTIC	2.341

Source: Made by the authors

Therefore, for the year 2015 it is anticipated an increase in the number of graduates in higher education for groups of specializations G1-G6 and G10.

The other groups (G7- G9) will show a decrease in the number of graduates.

4. Conclusions

The downward trend in the number of higher education graduates during the analyzed period is revealed by official figures provided by the National Statistics Institute. A number of factors have led to the reality of the last few years regarding the number of graduates in higher education. Unfortunately, the official figures stop at the year 2013 so that the paper aims to predict the years 2014 and 2015, a period when we should have known real data at present time. However, until the publication of this information by the National Institute of Statistics, the prediction made using Markov chain theory provides us with information regarding the percentage of higher education graduates by groups of specializations.

If between 2011-2013 the top three in terms of the percentage of graduates were occupied by groups G9, G7 and G1, in 2014, the ranking consists of group G9 with 27.5%, followed by group G1 with 21% and group G7 with 20.1%. It is projected an increase in the number of graduates in higher education for groups G1-G6 and G10 and a decrease in the number of graduates for other groups

At the level of the year 2015, the ranking consists of group G9 with 26.7% followed by group G1 with 25.7% and group G7 with 17.5%. The prediction for the year 2015 highlights similar increases to those in 2014.

One can see a shift in preferences for existing specializations in higher education. Supersaturation of the labor market with graduates of the groups G7-G9 is evidenced by choosing other specializations than those which until recently occupied the top places in the ranking of the number of graduates.

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