ANALYSIS OF CRIME RATES IN THE DEVELOPING REGIONS OF ROMANIA

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Abstract
Based on data about the crime rate provided by the 2010 Statistical Yearbook of Romania we have evaluated the statistical significance of the differences of crime rates in the Romanian development regions. To achieve this goal has been used the dispersion analysis (ANOVA) based on Fisher-Snedecor test (unifactorial model). The hypothesis that at least two media are different with a probability of 95% was checked, so we can say that there are significant differences on the crime rates in the Romanian regions. The results showed that as a region is more developed economically the crime rate is lower.
Keywords: crime rate, developing regions, convicted person, statistical analysis.

1. INTRODUCTION

In Romania, between 1990-1998 and 2005-2009, a strong increase of the criminality rate was found (over 420% in 1998 compared to 1990 and that over 40% in 2009 compared to 2005). Although between 1999-2005 a modest rebound of the crime has been registered, the general picture of the criminality rate shows a high level. This phenomenon is directed linked to the economic development of various statistical regions. In this context, the influence of certain economic and social factors is important to bee analyzed.

Similar analyses were run in U.S.A. (Luc, 2009 and Matcha, 2011). and France (Chantraine, 2004), on racial and immigrants communities. A a strong link between the criminality rate and the economic and social elements was also identified.

To perform the statistical analysis of crime rates by regions, we used the region structure defined in National Human Development Report Romania - 1999 (Table 1).

TABLE 1 - COMPOSITION OF THE DEVELOPING REGIONS

No. crt.	Region	Counties
1.	North-East	Bacău, Botoşani, Iaşi, Neamţ, Suceava, Vaslui
2.	South-East	Brăila, Buzău, Constanţa, Galaţi, Tulcea, Vrancea
3.	South	Argeş, Călăraşi, Dâmboviţa, Giurgiu, Ialomiţa, Prahova, Teleorman
4.	South-West	Dolj, Gorj, Mehedinţi, Olt, Vâlcea
5.	West	Arad, Caraş-Severin, Hunedoara, Timiş
6.	North-West	Bihor, Bistriţa-Năsăud, Cluj, Maramureş, Sălaj, Satu Mare
7.	Centre	Alba, Braşov, Covasna, Harghita, Mureş, Sibiu
8.	Bucharest	Municipiul Bucureşti, Ilfov

A. The statistical significance of changes in crime rates by regions

Our purpose is to test the statistical significance of differences between crime rates in the Romanian regions of development. For this reason has been used the dispersion analysis (ANOVA) test based on Fisher-Snedecor (unifactorial model). Although the graphics representations can offer an intuitive image concerning the equality of averages of many populations, the graphic procedure does not provide sufficient arguments to take decisions in this regard because adds a dose of subjectivity. In contrast with this method, a statistical hypothesis testing model removes subjectivity and adds scientific rigor to the analysis (Matcha, 2011).

Following data taken from 2010 Statistical Yearbook of Romania were processed: the crime rate, the number persons definitively convicted and the nominal net average earnings (Table 2).

TABLE 2 - EVOLUTION OF EARNINGS IN THE PERIOD 1990-2009, THE NUMBER PERSONS DEFINITIVELY CONVICTED AND THE CRIME RATE

Year	Earnings (RON)	Persons definitively convicted	Crime rate (number of crimes per 100,000 population)
1990	0,3381	37112	422
1991	0,746	60883	601
1992	2,014	69143	635
1993	5,9717	83247	965
1994	14,1951	95795	1043
1995	21,1373	101705	1310
1996	32,1169	104029	1423
1997	63,2086	111926	1601
1998	104,2274	106221	1774
1999	152,2878	87576	1619
2000	284	75407	1577
2001	422	82912	1519
2002	532	81814	1432
2003	664	76739	1274
2004	818	69397	1069
2005	968	65682	963
2006	1146	56705	1078
2007	1396	46127	1307
2008	1761	36795	1345
2009	1300	34226	1356

Hypotheses to be tested are:

$$H_0 : \mu_1 = \mu_2 = \mu_3$$

The null hypothesis argues that there are not significant differences between the average rates of crime statistics at the region level and the alternative hypothesis argues that at least two averages are different.

H1: at least two averages are different.

The test used is expressed as the ratio of average crime rates dispersions in two different regions.

$$F = \frac{s_1^2}{s_2^2}, \text{ where}:$$

$$s_1^2 = \frac{\sum_i (\bar{r}_{\inf r}^i - \overline{R}_{\inf r})^2 n_{i_o}}{r-1} = 71686976162 \quad \text{Values resulted from the use of Microsoft Excel and are}$$

presented in Table 3.

$$s_2^2 = \frac{\sum_i \sum_j (r_{unfr}^{ij} - \bar{r}_{\inf}^i)^2}{n-r} = 10737566613$$

$$F = \frac{s_1^2}{s_2^2} = \frac{71686976162}{10737566613} = 190.27 > F_{0.05;2.39} = 3.0698$$

F Value represents the Fischer test value.

TABLE 3 - DATA PROVIDED BY ANOVA APPLICATION

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance		
Average salary	20	9687.243	484.362145	315247.2459		
Number of convicted persons	20	1483441	74172.05	564686460.47		
Crime rate	20	24313	1215.65	133377.1868		

ANOVA

Source of Variation	SS	df	MS	F	P-value	Fcrit
Between Groups	71686976162	2	35843488081	190.2739135	0	3.158843
Within Groups	10737566613	57	188378362			
Total	**82424542775**	**59**				

It is noted that for a 5% significance level (α = 0.05) and thus for a probability of 95%, the null hypothesis is rejected and the alternative one is accepted. Therefore we can say that there are significant differences in crime rates of the population in different regions of the country. The regions with the highest crime rates of the population are: the South West region (1634 crimes per 100,000 inhabitants) and the West region (1605 crimes per 100,000 inhabitants). The regions with the lowest crime rates are the North East region (1231 crimes per 100,000 people) and North West region (1148 crimes per 100,000 inhabitants).

TABLE 4 - DISTRIBUTION OF THE PEOPLE CONVICTED , THE AVERAGE NET NOMINAL WAGE EARNING AND THE CRIME RATES ON THE ROMANIAN COUNTIES FOR 2009.

No. Crt.	County	Convicted Population (persons)	Average salary (RON / person)	Crime rate- crimes per 100,000 persons
1	Alba	689	1506	1978
2	Arad	1325	1521	1521
3	Argeş	748	1713	1179
4	Bacău	1524	1685	1452
5	Bihor	885	1351	1046
6	Bistriţa-Năsăud	507	1442	1083
7	Botoşani	928	1390	1020
8	Braşov	848	1639	1242
9	Brăila	842	1494	1171
10	Buzău	711	1479	1217
11	Caraş-Severin	433	1397	1158
12	Călăraşi	582	1408	1678
13	Cluj	1480	1772	1237
14	Constanţa	1118	1736	1341
15	Covasna	295	1290	934
16	Dâmboviţa	774	1573	1066
17	Dolj	776	1644	1458
18	Galaţi	1544	1636	972
19	Giurgiu	218	1557	1406
20	Gorj	599	2032	1937
21	Harghita	754	1322	1408
22	Hunedoara	1215	1546	2336
23	Ialomiţa	568	1444	1511
24	Iaşi	1166	1680	1146
25	Ilfov	213	2126	1450
26	Maramureş	1074	1508	1687
27	Mehedinţi	324	1695	1363
28	Mureş	1146	1359	1090
29	Neamţ	1329	1394	1406
30	Olt	711	1608	1872
31	Prahova	1116	1772	1085
32	Satu Mare	825	1375	1259
33	Sălaj	364	1421	1181
34	Sibiu	752	1659	1237
35	Suceava	1205	1452	1165
36	Teleorman	465	1469	1181
37	Timiş	946	1767	1370
38	Tulcea	479	1491	1330
39	Vaslui	1201	1398	1128
40	Vâlcea	513	1549	1581
41	Vrancea	953	1413	1469
42	Mun. Bucureşti	2650	2507	1450
43	**Total**	**36795**	**1761**	**1345**

Source: 2010 Statistical Yearbook, National Institute of Statistics

The folowing results were obtained: Crime rate-average is 1345 crimes per hundred thousand people across the country; an quadratic average deviation of 293 persons per thousand square, and the coefficient of variation 5.69%. These data are significant and show that the crime rates on counties is homogenous, with a small variation.

TABLE 5 - DISTRIBUTION AROUND THE REGIONS OF THE NUMBER OF CONVICTED PEOPLES, THE CRIME RATE AND THE NET AVERAGE EARNINGS (FOR 2009)

Region	Convicted Peoples	Net average earning	Crime rate
	Persons	RON/pers	Crimes per 100,000 population
North-Est	7353	1119	1148
South-Est	5647	1150	1447
South	4471	1155	1231
South-West	2963	1190	1234
West	3919	1220	1234
North-West	5207	1810	1450
Centre	4412	1260	1634
Bucharest-Ilfov	2863	2507	1605
Total	36795	--	1345

Source: 2010 Statistical Yearbook, National Institute of Statistics

TABLE 6 - APPLICATION ANOVA - RESULTS

Crime rate (Crime per 100.000 persons)	
Mean	1345.404762
Standard Error	45.27995328
Median	1294.5
Mode	1237
Standard deviation	293.447636
Sample Variance	86111.5151
Kurtosis	2.149760506
Skewness	1.315755625
Range	1402
Minimum	934
Maximum	2336
Sum	56801
Count	42

TABLE 7 - APPLICATION ANOVA – RESULTS.

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	10752287	2	5376144	46,75409	0,000000	3,069894
Within Groups	14143484	123	114987,7			
Total	24895772	125				

B. Multi-criteria ranking on statistical regions

For the multi-criteria ranking of Romanian regions we have chosen five criteria (based on 2009 data): GDP / capita (in current prices), crime rate (crimes per 100,000 inhabitants), the adult literacy rate (%), life expectancy (years) and rate of enrolment at all levels of education. Some of these indicators has been taken into account to calculate the human development index. Table 7 presents these data.

TABLE 8 - DISTRIBUTION IN THE ROMANIAN REGIONS OF GDP / CAPITA, CRIME RATE, LEVEL OF ADULT LITERACY, LIFE EXPECTANCY, RATE OF ENROLMENT

Region	GDP/Capita	Crime Rate	Level of Adult Literacy	Life Rate expectancy	Rate of enrolment
North-East	14772,6	1148	96,9	69	59,6
South-East	19813,7	1447	95	68,8	59,9
South	19927,3	1231	95,6	69	57,6
South-West	18530,9	1234	97,8	69,1	61,8
West	25979,6	1234	97,8	68,1	65,1
North-West	21284,3	1450	97,2	68,3	63
Centre	22820,1	1634	98,5	69,7	61,2
Bucharest-Ilfov	58060,6	1605	98,9	69,5	82,3

Source: Ministry of Education and the National Institute of Statistics

We performed a statistical ranking of the Romanian regions taking into account the five mentioned criteria, using a ranking method and the relative distance to the maximal performance.

a) **The ranking method**

The method supposes to assign ranks to each territorial-administrative unit, on successive steps, taking into account the value of each ranking criterion. The unit with the maximum quality or performance will receive rank 1, the next one will receive rank 2, etc. The rank n, equal to the number of investigated units, is given to the unit with the minimum quality or performance. The score will be achieved by summing the ranks assigned to each unit. The administrative-territorial unit with the lowest score is considered the best performing in terms of all criteria and obtains a final rank 1. As the score increases, the final rank equally increases.

On the basis of the five criteria and following the application of the ranking method we have showed that the region ranked the best is Bucharest (rank 1), followed by the Centre region (rank 2) and West region (rank 3). The most disadvantaged regions in this ranking are: the North-East region (the last position - rank 8), the South region (rank 7) and the South East (rank 6) (Table 9).

TABLE 9 – THE REGION RANKING

Region	GDP/Capita	Crime Rate	Level of Adult Literacy	Life Rate expectancy	Rate of enrolment	Score	Final Rank
North-East	8	1	6	4.5	7	27	8
South-East	6	5	5	6	6	28	6
South	5	2	8	4.5	8	28	7
South-West	7	3	7	3	4	24	5
West	2	4	3	8	2	19	3
North-West	4	5	4	7	3	23	4
Centre	3	7	2	1	5	18	2
Bucharest-Ilfov	1	6	1	2	1	11	1

This method is easy to be used, but the major disadvantage is represented by a lost of the information quality due to the different distances between successive units is systematically replaced by the difference 1 between successive ranks.

b) The method of assessing the relative distance to the maximum performance

Applying this method we could obtain a clearer hierarchy of the administrative units. The method involves (Voineagu, 2007) the determination of the relative distance of each unit to the one that records the maximum level, for each ranking criterion (Table 10). This distance is expressed by relative value to maximum performance unit (chosen as comparison base).

TABLE 10 - DETERMINATION OF RELATIVE DISTANCE TO THE MAXIMUM PERFORMANCE

Region	Ranks given to					Average distance	Final Rank	Relative dist. to max. Level
	GDP/ Capita	Crime Rate	Level of Adult Literacy	Life Rate expectancy	Rate of enrolment			
North-East	0,254	0,930	0,980	0,990	0,724	0,698	8	66,3
South-East	0,341	1,173	0,961	0,987	0,728	0,773	6	73,4
South	0,343	0,998	0,967	0,990	0,700	0,745	7	70,7
South-West	0,.319	1,000	0,989	0,991	0,751	0,749	5	71,1
West	0,447	1,000	0,989	0,977	0,791	0,807	2	76,6
North-West	0,367	1,175	0,983	0,980	0,765	0,795	4	75,5
Centre	0,393	1,324	0,996	1,000	0,744	0,826	3	78,5
Bucharest-Ilfov	1,000	1,301	1,000	0,997	1,000	1,053	1	100

Following this method, the region on the most advantageous position is still Bucharest, followed by Center region and West region. The last regions are North-East and South. The results are similar to those achieved in the previous method.

In conclusion, the results showed that as a region is more developed economically the crime rate is lower. Moreover, we can say that in the context of accelerating restructuration and privatization, the increasing openness of the economy will significantly determine the degree of development of a region and the decrease of the crime rate.

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