

CLUSTERING OF LEGISLATIVE SECURITY OF CAR UTILIZATION IN ASPECT OF EFFICIENCY OF PERFORMANCE OF NATIONAL ADMINISTRATIVE AGENCIES IN POLAND

Zbigniew Burski

University of Life Sciences in Lublin, Faculty of Production Engineering,
Department of Power Industry and Vehicles

Summary. The paper discusses the issue of clustering of legislative security of car utilization in aspect of efficiency of performance of national administrative agencies in Poland. The issue of security in exploitation of vehicles and working machines is one of the most important system problems in contemporary scientific researches. Government and ownership transitions in the country caused that in the issue of act and passive security in vehicles' utilization there appeared a need to take into account legislative safety in aspect of standardization and control of researches and assigning responsibility in their management. In this thesis there is introduced a regionalization algorithm k-means clustering, based on the assumed indicators of efficiency of performance of national administrative agencies (Police). This algorithm is a subject of multidimensional evaluation of these agencies in aspect of significance of statistic appearance.

Key words: vehicles' exploitation, management of security, standardization of evaluation, cluster analysis.

INTRODUCTION

The issue of security of work and vehicles' exploitation is one of the most important issues of contemporary scientific researches. Safety is a concept difficult to define because of its multi-pronged and often subjective character [Hołyst 2004]. Issues of safety in different disciplines are frequently of the same nature and can be formalized in the same way [Żółtowski 1996, Żółtowski 2003, Niziński i in. 2006]. It concerns especially basic balanced strategies of management which rely on 3 basic systems:

- system of management of quality,
- system of management of environment,
- system of management of safety of exploitation and utilization.

Legislative safety of utilization and exploitation of vehicles and working machines is the basic element of science about management of this safety. Safety system is continuous choice of aims, methods of action and resources – aimed to the object (in the subject of this thesis – a vehicle), in

order to reach desirable state of safety, by standardization of researches and legislative elimination of factors leading to an increase of threat, wastes etc. [Burski i in. 2003a, Burski i in. 2003b, Burski i in. 2005].

System of management of quality is not only normative procedures, but also estimation of pathological phenomena, criteria and estimation of effectiveness of administration and analysis of its improvement.

PURPOSE OF THE THESIS

The purpose of this thesis in aspect of management of safety of vehicles' exploitation is an analysis of effectiveness of performance of control and prosecution agencies in Poland on the basis of indicators characterizing this safety.

Lack of system and complex (rational) apprehension of mutual interaction of factors influencing standardization of vehicles' utilization led to the development of a balanced model of action [Burski i in. 2005]. There was used multidimensional, mathematical statistical analysis – cluster analysis with algorithm of grouping objects of k-means clustering [Burski i in. 2005, Analiza skupień PL 1999].

METHODOLOGY OF RESEARCH AND STATISTICAL CALCULATIONS

1. K-means algorithm, theoretical basis of methodology of research

The concept of cluster analysis includes a few different algorithms of classification, used in exploitation practice [Woźniak 2001]. One of them is grouping objects using method of k-means. It is quite different from other “Methods of Agglomeration and Grouping of Objects and Aims”. It bases on an assumed a priori hypothesis that a number of clusters of analysed objects is known. Using this method it is possible to create k of different, possibly unlike clusters. Programme of algorithm of calculation begins from k-random clusters and there is moving of objects between these clusters. Algorithm minimizes variation inside of clusters and maximizes variation between clusters. It is analogical to “converse” in an analysis of variance. Test of significance in an analysis of variance estimates variation between groups in proportion to variation inside groups, with the assumption that test of significance is calculated for the hypothesis that means in groups differ from one another. In grouping k-means in algorithm there is moving objects from and to groups (clusters) in order to gain the most significant results in an analysis of variance.

2. Object and subject of research

The object of research were statistical data from the Police and GUS concerning stolen cars (recognized as missed) and number of regained cars (including data of vehicles whose search was cancelled ipso jure).

The subject of analysis was one of indicators characterizing effectiveness of work of prosecution agencies in the years of government and property transformation (1995-1998). The quoted statistical data of police headquarters and GUS are accordant to art. 9 ust. 1 of Act from 21.06.1996 about the Agency of Home and Administration Secretary (Dz. U. Nr 106, poz. 491 and Dz. U. from year 1997, nr 70, poz. 443).

In this thesis, as an indicator characterizing effectiveness of work of agencies of national administration was established a value of quotient of increase of regained cars:

$$W.W.O = \frac{Po}{Po-1}, \quad (1)$$

where:

Po – number of searches cancelled in a particular year,

$Po-1$ – number of searches cancelled in a previous year.

RESULTS OF STATISTICAL CALCULATIONS

In Table 1 there are presented results of classification of an indicator of increase of cars “cancelled” in the years 1995-1998 according to the simplified rule: $wwo < 100\% \Rightarrow A$, $wwo > 100\% \Rightarrow B$. On the basis of a preliminary classification there were found two voivodships with a constant tendency to the worst effectiveness in car retrievals (searches cancelled) – these are the Warsaw and the Kielce voivodships. The best results in an analysed indicator on a constant level (*BBB*) were found in 9 voivodships. 8 voivodships had a tendency to improvement and in 25 the effectiveness had decreased.

Table 1. Results of calculations of an increase quotient and classification of cars cancelled (*wwo*) and clustering $k = 4$

Nr	Region	Quotient <i>wwo</i> (%)			Simplified classification			Group nr	Distance
		96/95	97/96	98/97	96/95	97/96	98/97		
1.	Warszawskie	76,1	88,4	85,7	A	A	A	3	0,32
2.	Białskopodlaskie	138,4	162,4	74,4	B	B	A	3	0,28
3.	Białostockie	182,4	113,3	75,5	B	B	A	3	0,41
4.	Bielskie	116,6	87,9	62,9	B	A	A	3	0,29
5.	Bydgoskie	453,4	109,2	106,1	B	B	B	2	0,79
6.	Chełmskie	138,8	139,8	118,7	B	B	B	3	0,20
7.	Ciechanowskie	548,1	98,6	121,9	B	A	B	2	0,42
8.	Częstochowskie	79,4	123,4	110,5	A	B	B	3	0,23
9.	Elbląskie	1040,0	376,9	89,3	B	B	A	1	1,12
10.	Gdańskie	130,3	114,8	107,5	B	A	B	3	0,12
11.	Gorzów Wlkpol.	732,7	96,2	82,4	B	B	A	2	0,99
12.	Jeleniogórskie	120,8	102,4	99,1	B	B	A	3	0,14
13.	Kaliskie	107,9	278,1	40,4	B	B	A	3	0,94
14.	Katowickie	95,6	117,1	110,9	A	B	B	3	0,15
15.	Kieleckie	95,2	91,5	88,2	A	A	A	3	0,23
16.	Konińskie	92,5	133,3	114,2	A	B	B	3	0,18
17.	Koszalińskie	114,8	98,7	80,2	B	A	A	3	0,18
18.	Krakowskie	93,0	117,6	126,6	A	B	B	3	0,22

19.	Krośniewskie	671,4	83,0	110,3	B	A	B	2	0,72
20.	Legnickie	109,0	108,3	103,7	B	B	B	3	0,11
21.	Leszczyńskie	1100,0	132,7	86,3	B	B	A	1	0,68
22.	Lubelskie	135,1	118,9	61,2	B	B	A	3	0,24
23.	Łomżyńskie	131,0	148,7	99,1	B	B	A	3	0,16
24.	Łódzkie	391,9	510,0	141,3	B	B	B	2	2,27
25.	Nowosądeckie	114,2	88,4	78,9	B	A	A	3	0,24
26.	Olsztyńskie	121,4	160,8	98,4	B	B	A	3	0,21
27.	Opolskie	673,3	91,7	116,0	B	A	B	2	0,69
28.	Ostrołęckie	93,4	152,5	111,6	A	B	B	3	0,22
29.	Piłskie	88,9	125,0	120,8	A	B	B	3	0,21
30.	Piotrkowskie	115,8	136,4	81,7	B	B	A	3	0,11
31.	Płockie	181,1	241,3	138,8	B	B	B	3	0,81
32.	Poznańskie	67,9	184,6	120,6	A	B	B	3	0,46
33.	Przemyskie	163,6	143,3	70,5	B	B	A	3	0,33
34.	Radomskie	112,7	104,2	91,8	B	B	A	3	0,13
35.	Rzeszowskie	130,4	108,0	87,0	B	B	A	3	0,14
35.	Siedleckie	107,7	84,1	90,2	B	A	A	3	0,25
37.	Sieradzkie	80,2	103,7	117,9	A	B	B	3	0,27
38.	Skierniewickie	120,6	90,9	138,3	B	A	B	3	0,31
39.	Słupskie	830,8	178,7	108,3	B	B	B	1	0,96
40.	Suwałskie	830,4	132,7	102,0	B	B	B	1	1,01
41.	Szczecińskie	112,1	131,2	100,3	B	B	B	3	0,05
42.	Tarnobrzесьkie	1175,0	117,0	55,8	B	B	A	1	1,13
43.	Tarnowskie	194,2	129,9	83,3	B	B	A	3	0,46
44.	Toruńskie	81,0	91,7	108,5	A	A	B	3	0,29
45.	Wałbrzyskie	106,1	94,6	92,8	B	A	A	3	0,19
46.	Włocławskie	96,6	83,4	131,3	A	A	B	3	0,33
47.	Wrocławskie	142,5	104,4	79,0	B	B	A	3	0,22
48.	Zamojskie	135,9	83,0	997,7	B	A	B	4	0,00
49.	zielonogórskie	106,8	130,5	78,1	B	B	A	3	0,12

Table 2. Results of calculation of between and inner group variance and clustering of voivodehips for $k = 4$

	Between	df	Inner	df	F	Significance
ww096/95	409,3150	3	22,38502	45	274,2783	0,000000
ww097/96	2,5388	3	25,09342	45	1,5176	0,222841
ww098/97	79,5081	3	2,16772	45	550,1719	0,000000

In Fig. 1 there are presented exemplary results of calculation of clustering using the method of k -means for $k = 4$. There was calculated a value of variance between means (inner group) and group, distance classification of adherence of voivodships to 4 clusters (Tab. 2).

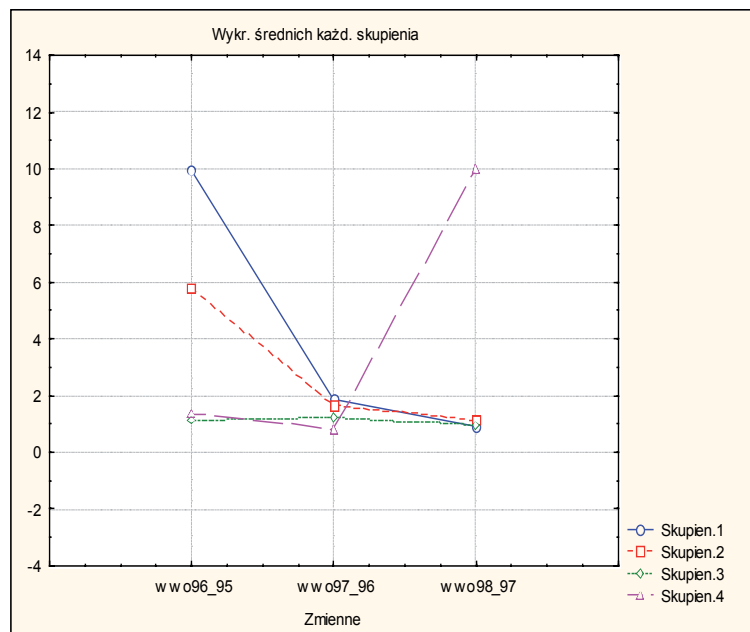


Fig. 1. Diagram of means of a growth quotient of cars cancelled, clusters 1-4 in years 1995-1998

Table 3. Descriptive statistics of clusters 1- 4 (a, b, c, d) of variables of growth quotient of cars cancelled (regained)

a)					b)				
Statystyki opisowe skupienia 2 (dane Skupien. zawiera 6 przypadków)					Statystyki opisowe skupienia 1 (dane Skupien. zawiera 5 przypadków)				
Zmienna	Średnia	Standar. Odchylenie	Warianc.		Zmienna	Średnia	Standar. Odchylenie	Warianc.	
ww o96_95	5,784805	1,362432	1,856221		ww o96_95	9,952408	1,577206	2,487579	
ww o97_96	1,647756	1,693424	2,867683		ww o97_96	1,876196	1,083124	1,173157	
ww o98_97	1,129931	0,194086	0,037669		ww o98_97	0,883214	0,203133	0,041263	

c)					d)				
Statystyki opisowe skupienia 4 (dane Skupien. zawiera 1 przypadek)					Statystyki opisowe skupienia 3 (dane Skupien. zawiera 37 przypadków)				
Zmienna	Średnia	Standar. Odchylenie	Warianc.		Zmienna	Średnia	Standar. Odchylenie	Warianc.	
ww o96_95	1,358974	0,00	0,00		ww o96_95	1,160540	0,295974	0,087600	
ww o97_96	0,830189	0,00	0,00		ww o97_96	1,252208	0,410365	0,168399	
ww o98_97	9,977273	0,00	0,00		ww o98_97	0,967185	0,224495	0,050398	

Statystyki opisowe skupienia: Descriptive statistics of concentration

Zmienna: variable

Średnia: Mean

Standar. odchylenie: Standard deviation

Warianc. : Variance

On the basis of the acquired classification $k = 4$ there was stated that cluster 1 includes 5 regions (voivodships), cluster 2 – 6 regions, cluster 3 – 37 regions, cluster 4 – the Zamość region (Tab. 3).

On the basis of values of means presented in Fig. 1, in two clusters (1 and 2) there is initially a tendency to growth of the number of regained cars (11 regions), which in years 1997-1998 gets stabilized. In cluster 3 there is still the same level of regained cars and in cluster 4 there is the Zamość region, where there was a substantial decrease of effectiveness of prosecution agencies in the years 1997-1998.

CONCLUSIONS

1. Contemporary requirements of EU leading to balanced development of macroregions require not only indicators characterizing their economic growth, but also estimation of pathological phenomena connected with this growth. Such phenomenon is undoubtedly motor crime in scope of safety of utilization and exploitation of means of road transport.

2. A significant factor counteracting motor crime is estimation of work of agencies of national administration, which are legislatively obliged to ensure safety of utilization and exploitation of vehicles. In this thesis there were used two sorts of indicators which enable objective estimation of effectiveness of work of agencies of national administration in a regional aspect. It is an indicator of simplified classification and quotient of growth of cars regained using a method of mathematical statistic k-means.

3. From analysis of gained outcomes of calculations it results that independently from the used method of classification there is a similar number of voivodships of an increased effectiveness of work in aspect of a number of regained cars (8-11). In the analysed period of time in each of the used methods of calculation the worst results of quotient of regained cars was found in the Warsaw and the Kielce voivodships. Application of the method of k-means enabled to deduce the Zamość voivodship with a substantial decrease of effectiveness of work of prosecution and control agencies in the years 1997-1998. It is undoubtedly connected with location of this voivodship – near the border.

4. Researches on optimization of estimation of prosecution and control agencies in a regional aspect are continued, because they should take into account many other factors characterizing a particular region, statistical as well as social-engineering.

REFERENCES

- Analiza skupień PL. 1999. Copyring StatSoft, SKU 3159. Kraków.
- Burski Z., Burski P. 2003. Klasyfikacja kradzieży środków technicznej obsługi rolnictwa jako przestępstwa wg polskiego ustawodawstwa karnego. Wyd. KMiER PAN, Oddział w Lublinie, T. 5, s. 23-29.
- Burski Z., Burski P. 2003 b. Karnoprawna analiza kradzieży pojazdów samochodowych o charakterze rozbójniczym, ze szczególnym uwzględnieniem obszarów wiejskich. Wyd. KMiER PAN, Oddział w Lublinie, T. 5, s. 11-22.
- Burski Z., Burski P. 2005. Zrównoważony model działaniowy zarządzania bezpieczeństwem eksploatacji i standaryzacji badań technicznych pojazdów. Kongres Eksploatacji Urządzeń Technicznych. Wyd. Instytut Technologii Eksploatacji, Radom, s. 57-64.
- Burski Z., Krasowski E. 2007. Problems of Contemporary – Motorization in Poland – Analysis of Costs and Loss of Car Stealing in Middle – Eard Macro Region. Zbirkim Naukowych Prac Nacionalnogo Agrarnogo Universitetu Ukraini, Kyiv, 17 zontnaja.

- Hołyst B. 2004. Kryminalistyka. Wyd. X, PWN, Warszawa.
- Niziński S., Kalator B. 2006. Ocena efektywności funkcjonowania systemów eksploatacji pojazdów i maszyn z wykorzystaniem procesów Morkowa. *Motoryzacja i Energetyka Rolnictwa*. T. 8, Wyd. PAN Oddział w Lublinie, s. 156-168.
- Pływaczewski W. 1996. Zorganizowane kradzieże i przemyt samochodów zagrożeniem dla europejskiego systemu bezpieczeństwa. *Przegląd Policyjny*, nr 2.
- Woźniak A. 2001. Regionalizacja obszarów wiejskich w aspekcie wielowymiarowego kryterium. Próba metodyczna. *Inżynieria Rolnicza*, nr 9, Warszawa, s. 317-328.
- Żółtowski B. 1996. Podstawy diagnostyki maszyn. Wyd. ATR Bydgoszcz.
- Żółtowski B. 2003. Nowe wyzwania w nauce i technice. *Motoryzacja i Energetyka Rolnictwa*. T. 5, Wyd. PAN Oddział w Lublinie, s. 238-252.