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**EVALUATION OF ACCIDENT RATE DYNAMICS INVOLVING  
VULNERABLE ROAD USERS IN THE GOMEL REGION**  
**ОЦЕНКА ДИНАМИКИ АВАРИЙНОСТИ С НЕЗАЩИЩЕННЫМИ УЧАСТНИКАМИ  
ДОРОЖНОГО ДВИЖЕНИЯ ПО ГОМЕЛЬСКОЙ ОБЛАСТИ**

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**Abstract.** *The object of the research is the accident rate among vulnerable road users (pedestrians, cyclists, and animal-drawn transport drivers) on the territory of the Gomel region of the Republic of Belarus. In the paper, we carry out the analysis of the estimated dynamic patterns of the number of victims among vulnerable road users in road traffic accidents. Taking into account the dynamic patterns of accident rates and the identification of factors affecting road traffic accidents will increase the efficiency of measures to eliminate negative trends in the field of road safety and accident reduction.*

**Keywords:** *vulnerable road users, accident rate*

### **Introduction**

The accident reduction problem is urgent and requires the improvement of road safety enhancement methods.

As compared to developed countries, the road accident rate in the Republic of Belarus is characterized by a high fatality risk in road traffic accidents and vehicles dangerous to humans as well as a high severity of consequences, which is 3 to 15 times higher than similar indicators in countries with developed automobilization.

An increase in the number of cars on urban roads leads to an increase in the number of road accidents involving vulnerable road users. Pedestrians, cyclists and animal-drawn transport drivers are the most vulnerable and unprotected on the road [1, 2].

The paper sets out to estimate the dynamic patterns of accident rates in the Gomel region and to identify factors affecting road traffic accidents involving vulnerable road users. It will result in the increased efficiency of road accident reduction measures.



**Statement of basic materials**

To assess the dynamics of accidents and to identify significant influencing factors, a large amount of information is required. The given objective is very ambitious and requires a large number of observations to draw serious conclusions.

As a source of information, we use the database of the State Traffic Inspection (Traffic Police) of the Department of Internal Affairs of the Gomel Oblast Executive Committee of the Gomel Region on road traffic accident victims over the last twelve years from 2009 to 2020. The number of people killed and injured in road traffic accidents involving vulnerable road users is taken as the accident rate. Overall, there are about 4933 records available.

To assess the dynamic patterns in the number of vulnerable road users killed and injured in road traffic accidents, we use the rate tendency and the rate trend. With regard to the performed analysis of road traffic accidents, the tendency shows the direction of movement of the analyzed indicator, i.e. how much the road traffic accident rate will change in one calendar year [3]:

$$t_y = \frac{\sum_{i=1}^n (i - \bar{i})(Y_i - \bar{Y})}{\sum_{i=1}^n (i - \bar{i})^2}, \tag{1}$$

where  $i$  is a period number;  $n$  is the number of periods;  $\bar{i}$  is the mean;  $Y_i$  is the value of the indicator corresponding to the  $i$ -th period;  $\bar{Y}$  is the mean value of the indicator.

The presence of a trend indicates the stability of the dynamic patterns of the indicator.

The results of calculating the tendency and determining the trend of changes in the number of road traffic fatalities and injuries involving vulnerable road users in the Gomel region are shown in Table 1.

**Table 1**

**Analysis of accident rate statistics involving vulnerable road users in the Gomel region**

		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	$t_y$	trend
Pedestrians	deaths	76	60	57	56	52	43	43	40	34	23	26	30	-4,18	yes
	injuries	289	293	263	247	221	216	193	157	161	133	187	162	13,66	yes
Cyclists	deaths	20	13	14	15	8	13	12	8	4	4	10	13	-0,8	no
	injuries	51	51	32	45	44	40	28	35	29	24	26	34	-2,05	no
Animal-drawn transport drivers	deaths	1	1	2	2	0	2	0	0	0	0	0	1	-0,12	no
	injuries	7	9	7	6	3	7	4	6	2	0	3	0	-0,51	no
Total	deaths	97	74	73	73	60	58	55	48	38	27	36	44	-5,1	yes
	injuries	347	353	302	298	268	263	225	198	192	157	216	196	-16,2	yes



Over the researched period, there has been a steady decline in the number of deaths and injuries among vulnerable road users. There is a general trend towards an increase in the number of pedestrians injured in road traffic accidents. They make up the majority of the killed and injured in road accidents with vulnerable road users in the Gomel region.

The dynamic patterns of the societal risk  $R_c$  (the number of deaths in road accidents per 100 thousand population) are presented in Table 2.

Table 2

### Dynamic patterns of the societal risk in the Gomel region

		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	$t_y$	trend
Societal risk $R_c$	Pedestrians	5,28	4,18	3,99	3,93	3,66	3,04	3,04	2,84	2,42	1,65	1,87	2,17	-0,29	yes
	Cyclists	1,39	0,91	0,98	1,05	0,56	0,92	0,85	0,57	0,28	0,29	0,72	0,94	-0,05	no
	Animal-drawn transport drivers	0,07	0,07	0,14	0,14	0,00	0,14	0,00	0,00	0,00	0,00	0,00	0,07	-0,01	no
	Total	6,73	5,16	5,11	5,13	4,23	4,09	3,89	3,40	2,71	1,93	2,59	3,19	-0,35	yes

Over the researched period, there has been a stable decrease in the societal risk for vulnerable road users.

Table 3 shows the regression analysis results of the number of victims in road accidents involving vulnerable road users in the Gomel region in Statistica, the statistical data analysis program.

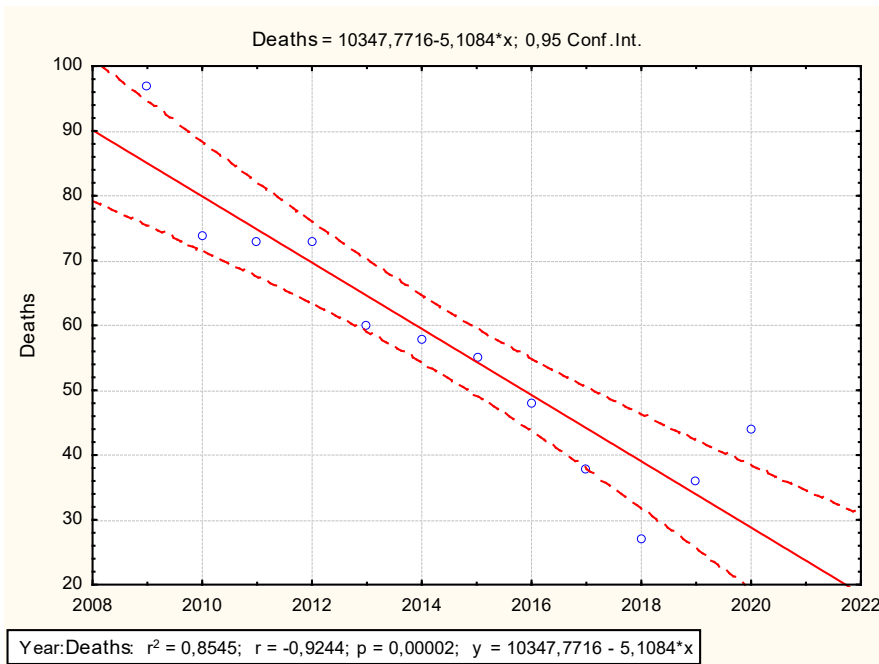
Table 3

### Statistical analysis results of road traffic fatalities and injuries involving vulnerable road users

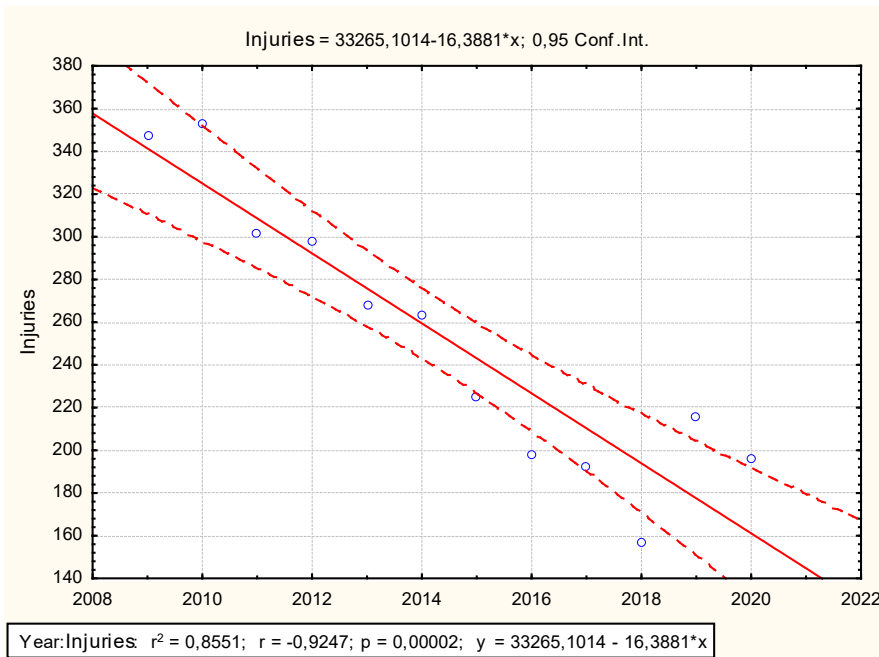
	Relationship	Correlation coefficient $r$	Determination coefficient $R^2$	Fisher's criterion $F$	p- level
Deaths	$y=10347,77-5,11x$	-0,92	85,45	58,74	0,000017
Injuries	$y=33265,1-16.39x$	-0,92	85.51	59,01	0,000017
Societal risk	$y=707.047-0.39x$	-0,92	85.12	57,21	0,000019

The relationships shown in the table are statistically significant at the significance level of 0.05 and above.

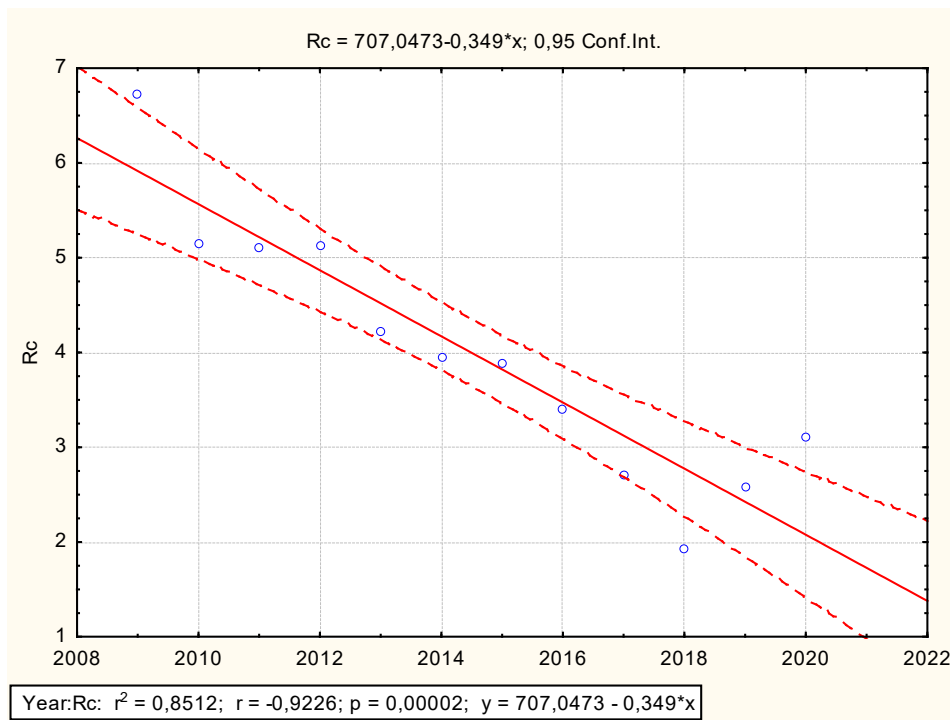
The change in the number of deaths and injuries caused to vulnerable road users in road traffic accidents and social risk is shown in Figures 1 – 3. The prediction of the number of deaths and injuries among vulnerable road users in Statistica is shown in Figure 4.



**Fig. 1 Changes in the number of road traffic fatalities among vulnerable road users**



**Fig. 2 Changes in the number of road traffic injuries among vulnerable road users**



**Fig. 3 Changes in the number of social risk among vulnerable road users**

Variable	B-Weight	Value	B-Weight * Value
Год	-5,10839	2021,000	-10324,1
Intercept			10347,8
Predicted			23,7
-95,0%CL			12,8
+95,0%CL			34,6

Variable	B-Weight	Value	B-Weight * Value
Год	-16,3881	2021,000	-33120,4
Intercept			33265,1
Predicted			144,7
-95,0%CL			109,7
+95,0%CL			179,7

**Fig. 4 Prediction of the number of road traffic fatalities and injuries among vulnerable road users for 2021**

**Conclusions**

The evaluation of the dynamic patterns of accident rates among vulnerable road users in the statistical data analysis program Statistica will increase the efficiency of the development of road accident reduction measures in the Gomel region.

**References:**

1. Fanny, M. Accident risk of road and weather conditions on different road types / M. Fanny, N. Ilkka, I. Satu // Accident Analysis & Prevention. – 2019. – 122. – pp. 116-125.
2. Nikolaoua, P. European Countries’ Road Safety Evaluation by Taking Into Account Multiple Classes of Fatalities / P. Nikolaoua, K. Folla, L. Dimitriou, G. Yannis // Transportation Research Procedia. – 2021. – 52. – pp. 284-291.
3. Azemsha, S.A. Application of scientific methods in improving road safety [monograph] / S.A. Azemsha, A.N. Starovoitov; Ministry of Transport and Communications of the Republic of Belarus, state un-t of transp. – Gomel: BelSUT, 2017. – 191 p.



**Аннотация.** Проблема снижения аварийности на автомобильных дорогах является актуальной и требует усовершенствования методов повышения безопасности дорожного движения. Объектом исследования является аварийность с незащищенными участниками дорожного движения (пешеходами, велосипедистами и водителями гужевого транспорта) на территории Гомельской области республики Беларусь. В качестве источника информации использовалась база данных Госавтоинспекции Управления Внутренних Дел Гомельского Облсполкома по Гомельской области по пострадавшим за двенадцать лет с 2009 года по 2020 год. В качестве показателей аварийности принималось количество погибших и раненых в дорожно-транспортных происшествиях незащищенными участниками дорожного движения. Произведен анализ расчета оценки динамики изменения количества пострадавших незащищенных участников дорожного движения в дорожно-транспортных происшествиях. Учет динамики изменения показателей аварийности и выявление факторов, влияющих на аварийность, позволит повысить эффективность мероприятий по устранению негативных тенденций в сфере обеспечения безопасности дорожного движения и снижения аварийности.

**Keywords:** незащищенные участники дорожного движения, аварийность.

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