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Use of Statistical Correlation Analysis in the Study of Road Accidents

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Abstract: This paper performs a statistical analysis of the dependency relationships between processes and phenomena and focuses on highlighting the main causes of accidents. As the number of vehicles increased, so did the number of accidents. When we talk about the road transport system, we must not exclude the fact that there will always be road accidents due to unpredictable causes (vehicle failures) or foreseeable (infrastructure, reckless driving). All these causes can be amplified by a series of conditions such as day or night, road category, but also by the manner and nature of accidents (between vehicles, between vehicle and pedestrian, etc.). Using the analysis of the Pearson correlation between the codings, the nature, the mode and the place of accidents in Romania, it was highlighted that the most prone to accidents at night are new vehicles and "used" vehicles are responsible for accidents in localities.

Keywords: statistics; accidents; traffic conditions

1. Introduction

Road traffic represents the general movement of vehicles and people, focused on land areas specially designed for this purpose, namely roads. The phenomenon of

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road traffic or road traffic is manifested just as clearly over long distances, in large territories, as well as in small areas (cities and other types of settlements). As a result of the continuous improvement of vehicles, today we have reached high rates and very high proportions of road traffic evolution.

Driving involves a continuous and permanent adaptation to a myriad of different traffic situations. A road accident should not be reduced to a simple element, as a multitude of interrelated causes have contributed to its occurrence. Therefore, reducing the risk of an accident can not only be achieved by eliminating a root cause, but must take into account the full potential of the aspects that favored the occurrence of the event.

2. Methods and Materials

The statistical study of the dependency relationships between processes and phenomena focuses on identifying the relationship that exists between two or more characteristics. The importance of knowing the connection between a phenomenon or process and the causes that generate and determine it is special because only in this way the real possibility of its control and influence is created. In this context, it becomes necessary to use methods, techniques and tools that can indicate the existence or absence of a link between the various variables in accidentology. Thus, statistics provide such methods, techniques and tools, some simple, others extremely laborious and complex. In our country, such concerns are not yet coordinated by a specialized institution and that is why we face too many road accidents.

The association of variables is usually studied under the name of correlation. Two major directions can be distinguished in this study:

- calculating an association (correlation) indicator;
- estimating a functional model to represent the association between variables.

The correlation coefficient between two variables can be calculated by the CORREL function (Array1, Array2), where Array1, Array2 are, respectively, the areas that contain the values of the two variables (they must obviously have the same number of values).

Correlation analysis is the procedure that calculates the linear correlation coefficients, also known as the Pearson correlation coefficients denoted by r whose interpretation is:

- $r \in [0; 0.2]$ → very weak correlation, non-existent;
- $r \in [0.2; 0.4]$ → weak correlation;
- $r \in [0.4; 0.6]$ → reasonable correlation;
- $r \in [0.6; 0.8]$ → high correlation;
- $r \in [0.8; 1]$ → very high correlation - very close relationship between variables.

Statistics on road accidents in the EU show that half of all deaths were among car occupants, while pedestrians, motorcyclists and other vulnerable categories of public road users each make up 15-20% of those who -they lost their lives in such traffic events. Unsafe operating conditions could be defined as:

- the presence in the fleet of a large number of vehicles;
- the presence in the fleet of vehicles with an advanced age that leads to the decrease of their performances;
- the quality level of the infrastructure does not rise to the performance standards of new vehicles.

According to the data obtained from the National Institute of Statistics (INS) in Romania, the evolution of car registration in the period 2007 - 2019 is presented in figure 1. noting that in the period 2007 - 2011 the trend was decreasing 2012 - 2019 the trend was to increase both new and used vehicles, figure 1. It can also be seen that lately the trend has been to put used cars into circulation that no longer exactly correspond to the initial performance, which is why they become potential sources of accidents.

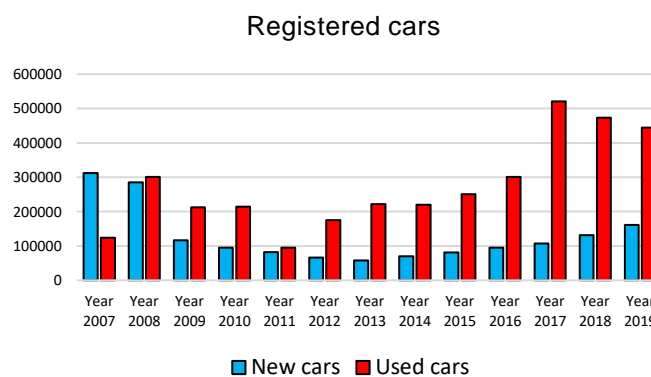


Figure 1. Cars Registered in Romania during 2007-2019

The evolution of the number of road accidents in the period 2007 - 2019 is presented in figure 2 in which a weak upward trend can be observed in the period 2013 - 2019. The total number of accidents in the analyzed period varied from the minimum value of 24662 in 2007 to 31146 in 2019, according to INS., figure 2.

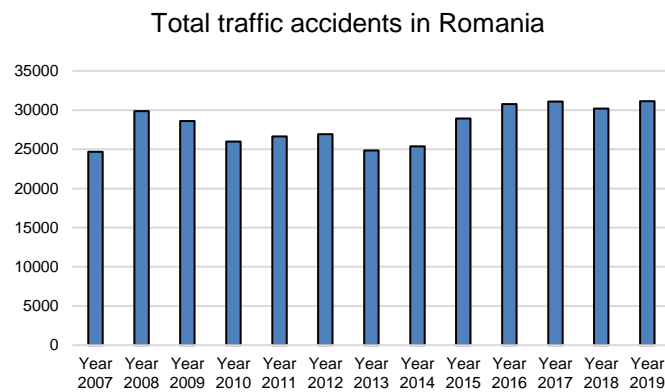


Figure 2. Total Number of Road Accidents in Romania during 2007-2019

The association between the evolution of the number of cars and the evolution of the number of accidents in Romania was made using the statistical functions offered by the Microsoft Excel application. From the graph shown in Figure 3 it can be stated that:

- the number of used cars registered in the period 2007 - 2019 are in a strong direct correlation, with the number of accidents produced in the same period produced on highways and in daylight;
- there is also a high correlation between used cars and accidents occurring outside the localities, in localities and in which only one vehicle was involved;
- the number of new cars are more present in the statistics of accidents produced at night compared to those used.

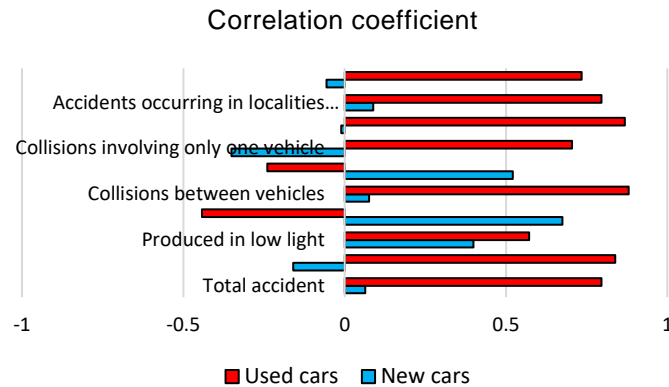


Figure 3. Graph of the Correlation Analysis between the Number of Vehicles and the Number of Road Accidents Produced in Romania in the Period 2007-2019

Figure 4 shows the evolution of road accidents in the period 2007 - 2019, according to the INS, according to the lighting conditions at the time of their occurrence. Most accidents occur during the day due to the high density of vehicles in circulation. Accidents caused during low light rank second only to the number of road events due to poor or lack of public lighting systems as well as deficiencies in the lighting system of vehicles. The fewest accidents occur during the night.

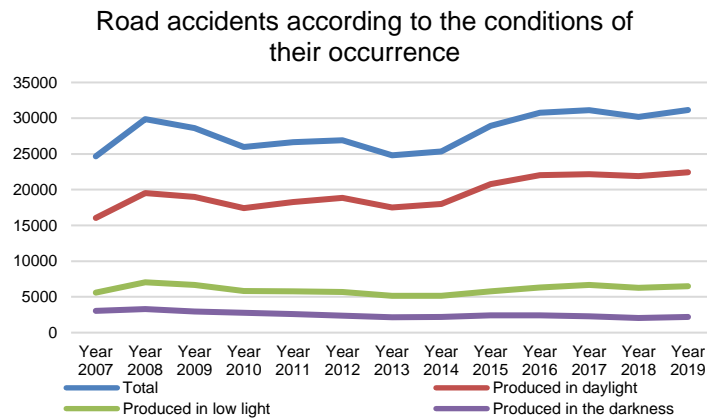


Figure 4. Number of Road Accidents in Romania Depending on Road Brightness in 2007-2019

Regarding the involvement in road events only of motor vehicles, or of motor vehicles and pedestrians, most accidents occur when only motor vehicles are

involved. Collisions involving a single vehicle occupy the last place, but in the analyzed period, their number increased from 5956 in 2007 to 7158 in 2019, figure 5.

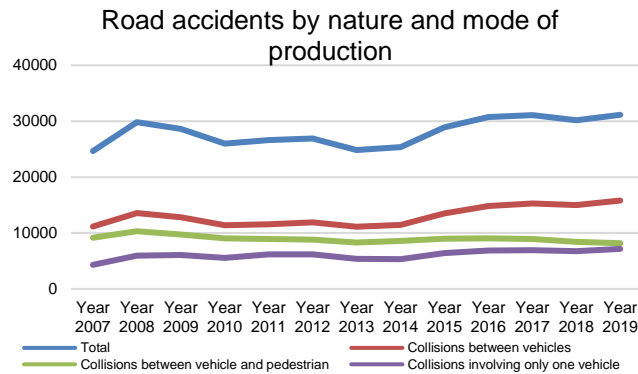


Figure 5. Number of Road Accidents in Romania Depending on the Nature and Mode of Production in the Period 2007-2019

According to the data of the National Institute of Statistics in the period 2007 - 2019 most serious road accidents occurred within the localities, figure 6. Although on the roads outside the localities there are fewer serious road events, accidents in these areas have the highest rate of mortality: 34.4%.

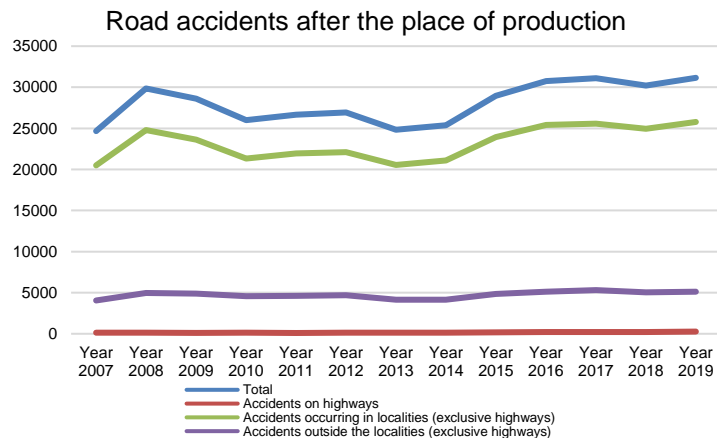


Figure 6. The Number of Road Accidents Produced in Romania Depending on the Nature and Manner of Production in the Period 2007-2019

We analyzed from the point of view of the connection between the age of the cars (new - up to 2 years and occasionally over 5 years) and the conditions of their

production, the nature and the way they were produced, as well as the place of their production.

With regard to new cars, it can be said that there is a good correlation with accidents at night and also with accidents between vehicle and pedestrian, figure 7. The other factors do not show a link between new cars and accidents from which it can be concluded that they are safer, braking and driving performance make them safe, unwanted events based on subjective human factors (driver experience, age, terrifying or alcohol consumption, etc.).

The same cannot be said of used cars involved in road accidents. These are closely linked to motorway accidents and to each other precisely due to the low performance of both the braking and driving system, figure 8. This justifies motorway accidents when high speeds develop and can no longer be avoid the accident. There is also a strong correlation with day-to-day accidents because these vehicles are put into service by people who travel to and from work, people who do not opt for a new car due to their average standard of living. of them.

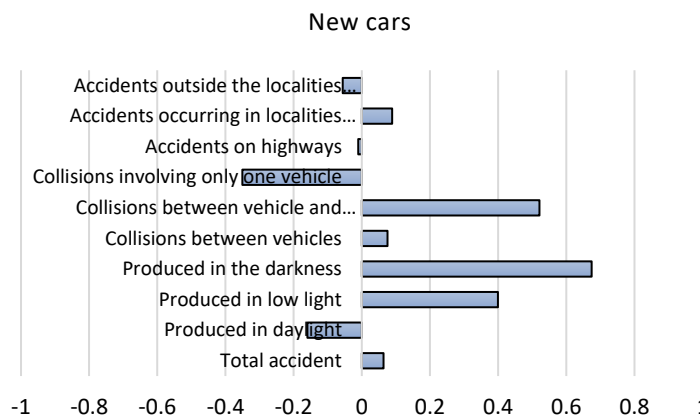


Figure 7. Correlation between the Nature, Manner and Conditions of Accidents with New Cars in the Period 2007-2019

A good correlation is also registered with the accidents produced in the localities and those in which only one car is involved. It can be said that the congestion of used vehicles in the urban area is the result of living standards.

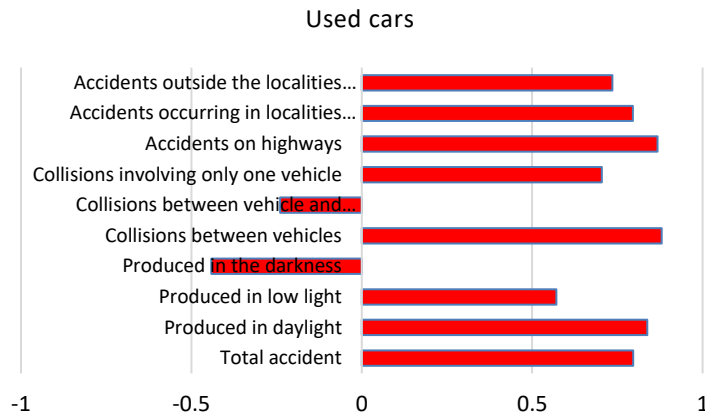


Figure 8. Correlation between the Nature, Mode and Conditions of Accidents with used Cars in the Period 2007-2019

3. Conclusions

Following this statistical analysis, it can be concluded that out of the total number of registered cars, those used are the most involved in accidents, and the most common of these are in accidents between vehicles and those produced on highways. New vehicles do not have a good correlation with accidents during this period except for those caused at night.

Failure to drive on roads outside the localities is the second most common cause of serious accidents, after not adapting the speed to road conditions, maintaining a very high value of mortality (41%). The fewest accidents occur on highways, however, with an increase from 120 in 2007 to 265 in 2019.

By comparatively analyzing the graphs in Figures 7 and 8, the following conclusions can be drawn:

- the most prone cars to accidents on highways are those used
- also most of the accidents caused inside and outside the localities are also the vehicles over 5 years old purchased on occasion
- at night most accidents involving new cars occur
- collisions with a pedestrian are more common in new cars precisely because their performance makes drivers drive fast in localities;

➤ accidents involving only vehicles are related to their age, the older they are the more prone to collisions with each other.

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