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To appear in: Technical Sciences

Received 19 March 2024;
Accepted 26 May 2024;
Available online 27 May 2024.

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Evaluation of factors affecting the number of traffic accidents

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Abstract

Year after year, the number of traffic accidents is decreasing. This value in recent years has been influenced mainly by the pandemic. However, the value is still very high. For this reason, every effort should be made to reduce the number of traffic accidents. The purpose of this article is to evaluate the factors affecting the number of traffic accidents according to weather conditions. For this purpose, a random selection was made of 10 measurement points in Poland, for which the following parameters were analyzed: traffic volume on the road and the number of accidents at the analyzed points. Based on the study, it can be concluded that the number of road accidents is most influenced by factors such as good weather conditions, as well as cloudy and rainy days. In addition, based on the study, the weights of factors affecting the number of traffic accidents are as follows: good weather 0.5406; rain 0.1529; cloudy 0.3065.

Keywords: road accident, weather conditions, measures

1. Introduction

Road accidents are a serious social problem in every country. The causes of road accidents depend on various factors, such as weather conditions, alcohol, speed, etc. According to the World Health Organization [1], more than 1.35 million people die in road accidents each year, and millions more suffer serious injuries and long-term negative health consequences. Accidents also lead to economic losses. The number of road accidents worldwide is decreasing year by year. This value in recent years has been influenced mainly by the pandemic. However, the value is still very high (Figure 1). Every day in Poland there are an average of 62 road accidents, in which 6 people are killed and 72 injured. These accidents are associated with increased medical costs, the need for repairs to vehicles and road infrastructure, negative impacts on the environment, such as through leakage of operating fluids. For this reason, all measures should be taken to prevent traffic accidents in order to reduce their number. One such measure is to learn about the factors that affect the number of traffic accidents by eliminating them in the future [2,3]. The article consists of Literature review, Materials and methods and Results, and concludes with a summary.

2. Literature review

Zhai et al. [4] and Holland et al. [5] in their study showed that pedestrians are most at risk of traffic accidents because they are less protected than vehicle passengers. In addition, they suffer serious injuries among all traffic participants. Other studies have shown that factors such as alcohol consumption, age or gender of drivers, lighting, road condition, pedestrian behavior, accident
scene, vehicle, speed and adverse weather affect pedestrian injury rates [6-9]. Adverse weather conditions and inadequate lighting, especially of pedestrian crossings, often lead to more serious injuries on the roads [10]. However, this depends on the area studied. For example, an article [10], showed that in most cases, weather conditions have little effect on traffic accidents. We can also encounter this research topic in the paper [11], in which the authors introduced a model of the probability of traffic accidents depending on the time of day and the current weather. The relationship between weather conditions and traffic accidents has also been analyzed in works [12-14].

![Figure 1 Number of road accidents in Poland according to weather conditions from 2001 to 2021](image)

Numerous publications have addressed the Road traffic safety issue. Road traffic risk indicators were discovered by Pałega [15]. Provincial-level RTS components were analyzed by Wachnicka [16]. Rafalski examined RTS in Poland, focusing on big trucks in particular [17]. Moreover, publications [18,19] addressed the causes of traffic accidents. Gad-Mowlena and Los examined the many risky behaviors shown by experienced drivers and evaluated the effects of remedies implemented in large automobiles on rear-end collisions [20,21]. Publications [22,23] and books [24,25] also include general information about Road traffic safety.

In addition to reducing traffic accidents, prevailing weather conditions also affect traffic volumes and driver behavior, such as their reaction time to the prevailing traffic situation [26-28]. In his work, Eisenberg [29] studied the relationship between precipitation and traffic accidents in the United States, where he showed that more traffic accidents occur during negative weather conditions. A similar topic was addressed by Brodsky and Hakkert [30], who found that accident rates increased by 100% during rainy conditions, while in Denmark the increase was negligible at around 10%. Fridstrom et al. [27], on the other hand, found that in Norway and Sweden, rainfall had no effect on the change in traffic accidents. On the other hand, in Poland, the highest number of traffic accidents occurs during good weather conditions. Moreover, as the temperature increases and during good weather conditions, the number of road accidents increases [3, 28, 31].

For the purposes of the work, it was assumed that [32]:

- good weather conditions are:
  - air temperature > 3°C,
  - no precipitation,
  - wind < 5.5 m/s,
  - visibility > 10 km,
  - pressure difference over the day < 8 hPa,
- bad weather conditions (if one of the following factors is met) are:
- slippery pavement (temperature < 3°C and occurrence of precipitation),
- heavy rain (temperature > 0°C, precipitation > 3 mm),
- snowstorm (temperature < 0°C, precipitation > 3 mm),
- strong wind (wind > 10 ms/s),
- dense fog (visibility < 300 m).

In their study, Masello et al. [10] presented a different approach to analyzing traffic accidents. They studied the impact of driver assistance systems on improving road safety. The study was conducted in a variety of traffic situations under different weather conditions.

Weather conditions also affect the relationship between three elements of traffic (the so-called safety triangle), namely: the human being (and his psychomotor state, fatigue, stress, concentration), the vehicle (its technical condition, traffic speed, load) and the environment (road infrastructure).

Based on the presented analysis of the literature on the probability of a traffic accident depending on the prevailing weather conditions, various conclusions can be drawn. For this reason, the article determines the weights of the influence of selected weather factors on the probability of a traffic accident. For this purpose, a random selection of 10 measurement points in Poland was made, for which the following data were analyzed: traffic volume and the number of accidents depending on the weather conditions under which the accident occurred.

3. Materials and methods

In order to answer the stated goal, the article adopts the following algorithm for proceeding:

1. Randomly selected measuring points.
2. The following parameters were determined for the aforementioned points:
   a. The markings of the road on which the measuring point is located.
   b. Traffic speed at the analyzed point.
3. Determined the total number of traffic accidents depending on the prevailing weather conditions during the incident at the analyzed points from the years: 2007, 2010, 2015, 2021.
4. The number of traffic accidents depending on the volume of motor vehicles passing through the analyzed points in the year, as well as the number of traffic accidents that occurred at these points depending on the prevailing weather conditions, was recalculated. For this purpose, the total number of vehicles passing through the given measurement point was determined, and the % share of the analyzed measurement point was determined taking into account the traffic volume.
5. The total number of accidents at the analyzed points in 2007, 2010, 2015 and 2021 was determined.
6. The number of traffic accidents was recalculated taking into account the % share of traffic volume.
7. The values of the weights of the number of accidents in the analyzed points for the prevailing weather conditions were determined.

3.1 Selection and location of sites

In order to determine the weights of the impact of selected atmospheric factors on the probability of a traffic accident, a random selection of 10 points in Poland was made. For these points, the
following data were analyzed: traffic volume and number of accidents depending on the weather conditions prevailing during the accident (Figs. 2, 3). The points were selected on both national (DK 6 and DK11) and provincial (DW167, DW179, DW 203 and DW206) roads. In all assumed measurement points, the permissible speed of vehicle traffic was 50 km/h.

**Table 1 Coordinates of measurement points [33]**

<table>
<thead>
<tr>
<th>No.</th>
<th>Measurement Point</th>
<th>Road signage</th>
<th>Longitude of the point</th>
<th>Latitude of the point</th>
</tr>
</thead>
<tbody>
<tr>
<td>point1</td>
<td>Piła - Wojska Polskiego</td>
<td>DW 179</td>
<td>16.732301</td>
<td>53.151436</td>
</tr>
<tr>
<td>point2</td>
<td>Piła - Poznańska</td>
<td>DK 11</td>
<td>16.752994</td>
<td>53.126343</td>
</tr>
<tr>
<td>point3</td>
<td>Piła - Al. Piastów</td>
<td>DK 11</td>
<td>16.737967</td>
<td>53.150107</td>
</tr>
<tr>
<td>point4</td>
<td>Piła - Niepodległości</td>
<td>DK 11</td>
<td>16.737933</td>
<td>53.163308</td>
</tr>
<tr>
<td>point5</td>
<td>Manowo</td>
<td>DK 11</td>
<td>16.287356</td>
<td>54.132729</td>
</tr>
<tr>
<td>point6</td>
<td>Mścice</td>
<td>DK 11</td>
<td>16.080240</td>
<td>54.219427</td>
</tr>
<tr>
<td>point7</td>
<td>Sianów</td>
<td>DK 6</td>
<td>16.302716</td>
<td>54.230299</td>
</tr>
<tr>
<td>point8</td>
<td>Strzekęcino</td>
<td>DW 167</td>
<td>16.165485</td>
<td>54.099837</td>
</tr>
<tr>
<td>point9</td>
<td>Sucha Koszalińska</td>
<td>DW 203</td>
<td>16.266325</td>
<td>54.260465</td>
</tr>
<tr>
<td>point10</td>
<td>Szczeglino</td>
<td>DW 206</td>
<td>16.384696</td>
<td>54.180654</td>
</tr>
</tbody>
</table>

**Figure 2 Measurement points within the city of Pila [34]**
2.2 Weather conditions Acronyms

The probability of a traffic accident depends on a number of factors affecting this value. The article evaluates the impact of traffic volume at the analyzed points and the following atmospheric conditions under which a traffic accident occurred:

- good weather conditions
- rainfall,
- snowfall,
- strong wind,
- cloudy,
- blinding sun,
- fog.

Due to the lack of annual data, from the General Directorate of National Roads and Highways (GDDiK) on average annual traffic volumes, data from the following years were used: 2007, 2010, 2015 and 2021, as shown in (Table 2). In addition, the total number of traffic accidents according to weather conditions at the analyzed points from the day are presented for the selected points: 2007, 2010, 2015 and 2021 (Table 3). Average daily annual traffic (SDRR) was defined as the number of motor vehicles passing through a given measurement point in 24 consecutive hours, on average in one year.
Table 2 Vehicle traffic intensity at analyzed measurement points [33]

<table>
<thead>
<tr>
<th></th>
<th>Average annual vehicle traffic volume [vehicles/day]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2007</td>
</tr>
<tr>
<td>point1</td>
<td>6377</td>
</tr>
<tr>
<td>point2</td>
<td>17080</td>
</tr>
<tr>
<td>point3</td>
<td>9971</td>
</tr>
<tr>
<td>point4</td>
<td>10418</td>
</tr>
<tr>
<td>point5</td>
<td>8973</td>
</tr>
<tr>
<td>point6</td>
<td>15099</td>
</tr>
<tr>
<td>point7</td>
<td>10613</td>
</tr>
<tr>
<td>point8</td>
<td>2796</td>
</tr>
<tr>
<td>point9</td>
<td>3584</td>
</tr>
<tr>
<td>point10</td>
<td>2278</td>
</tr>
</tbody>
</table>

Table 3 Total number of traffic accidents according to weather conditions at the analyzed points from the years: 2007, 2010, 2015 and 2021 [3]

<table>
<thead>
<tr>
<th></th>
<th>Total number of traffic accidents</th>
<th>good weather conditions</th>
<th>rainfall</th>
<th>fog</th>
<th>strong wind</th>
<th>on a cloudy day</th>
<th>dazzling sun</th>
<th>snow fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>point1</td>
<td>277</td>
<td>142</td>
<td>40</td>
<td>2</td>
<td>0</td>
<td>77</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>point2</td>
<td>203</td>
<td>112</td>
<td>23</td>
<td>0</td>
<td>2</td>
<td>55</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>point3</td>
<td>152</td>
<td>78</td>
<td>23</td>
<td>1</td>
<td>1</td>
<td>38</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>point4</td>
<td>106</td>
<td>55</td>
<td>22</td>
<td>0</td>
<td>1</td>
<td>22</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>point5</td>
<td>35</td>
<td>21</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>point6</td>
<td>94</td>
<td>59</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>point7</td>
<td>133</td>
<td>64</td>
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<td>1</td>
<td>1</td>
<td>50</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>point8</td>
<td>8</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>point9</td>
<td>12</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>point10</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Taking into account traffic volume and weather conditions, a function describing the probability of a traffic accident was determined, which was assumed in the form:

\[ PWD = f(a^{n1}) \cdot f(b^{n2}) \cdot f(c^{n3}) \cdot f(d^{n4}) \cdot f(e^{n5}) \cdot f(f^{n6}) \cdot f(g^{n7}) \] (1)

where:

- \( PWD \) – The likelihood of a traffic accident,
- \( f(a^{n1}) \) - The likelihood of a traffic accident in good weather conditions,
- \( f(b^{n2}) \) – The likelihood of a traffic accident during rainfall,
- \( f(c^{n3}) \) – The likelihood of traffic accident during fog, smoke,
- \( f(d^{n4}) \) – The likelihood of a traffic accident during high winds,
\( f(e^{n5}) \) – The likelihood of a traffic accident when it is cloudy,
\( f(f^{n6}) \) – The likelihood of a traffic accident when the reason is the blinding sun,
\( f(g^{n7}) \) – The likelihood of traffic accident during snowfall, hail.

The likelihood of a traffic accident depends on a number of factors, which include good weather conditions, rain, snow, hail, fog, smoke, strong wind, blinding sun and cloudy days. Each of these factors, is determined by a number of variables. Considering the above factor, we can represent the components of the above functions in the form:

\[
f(a^{n1}) = f(a^1, a^2, a^3, a^4, a^5, a^6)
\]

where:
- \( f(a^1) \) - air temperature when it is higher than 3\(^\circ\)C,
- \( f(a^2) \) - precipitation does not occur,
- \( f(a^3) \) - wind is less than 5,5 m/s,
- \( f(a^4) \) - visibility higher than 10 km,
- \( f(a^5) \) - the pressure difference during the day is less than 8 hPa,
- \( f(a^6) \) - the psychophysical capacity of the driver.

\[
f(b^{n2}) = f(b^1, b^2, b^3, b^4, b^5, b^6, b^7, b^8, b^9, b^{10}, b^{11})
\]

where:
- \( f(b^1) \) – occurring rainfall of more than 3 mm,
- \( f(b^2) \) – impaired mental and physical capacity of the driver,
- \( f(b^3) \) – headache,
- \( f(b^4) \) – sleep disorder,
- \( f(b^5) \) – irritation,
- \( f(b^6) \) – nervousness,
- \( f(b^7) \) – cardiac arrhythmia,
- \( f(b^8) \) – worsening of depressive symptoms,
- \( f(b^9) \) – sluggishness,
- \( f(b^{10}) \) – fatigue,
- \( f(b^{11}) \) – dyspnea.

\[
f(c^{n3}) = f(c^1, c^2, c^3, c^4, c^5, c^6, c^7, c^8, c^9, c^{10}, c^{11})
\]

where:
- \( f(c^1) \) – fog, smoke present; visibility below 300 m
- \( f(c^2) \) – impaired mental and physical capacity of the driver,
- \( f(c^3) \) – headache,
- \( f(c^4) \) – sleep disorder,
- \( f(c^5) \) – irritation,
- \( f(c^6) \) – nervousness,
- \( f(c^7) \) – cardiac arrhythmia,
- \( f(c^8) \) – worsening of depressive symptoms,
- \( f(c^9) \) – sluggishness,
- \( f(c^{10}) \) – fatigue,
\[ f(c^{11}) = \text{dyspnea.} \]

\[ f(d^{n4}) = f(d^1, d^2, d^3, d^4, d^5, d^6, d^7, d^8, d^9, d^{10}, d^{11}) \] (5)

where:
- \( f(d^1) \) – occurring strong winds above 10 ms/s,
- \( f(d^2) \) – impaired mental and physical capacity of the driver,
- \( f(d^3) \) – headache,
- \( f(d^4) \) – sleep disorder,
- \( f(d^5) \) – irritation,
- \( f(d^6) \) – nervousness,
- \( f(d^7) \) – cardiac arrhythmia,
- \( f(d^8) \) – worsening of depressive symptoms,
- \( f(d^9) \) – sluggishness,
- \( f(d^{10}) \) – fatigue,
- \( f(d^{11}) \) – dyspnea.

\[ f(e^{n5}) = f(e^1, e^2, e^3, e^4, e^5, e^6, e^7, e^8, e^9, e^{10}, e^{11}) \] (6)

where:
- \( f(e^1) \) – cloudy day when cloud cover of the sky is at a minimum 5/8,
- \( f(e^2) \) – impaired mental and physical capacity of the driver,
- \( f(e^3) \) – headache,
- \( f(e^4) \) – sleep disorder,
- \( f(e^5) \) – irritation,
- \( f(e^6) \) – nervousness,
- \( f(e^7) \) – cardiac arrhythmia,
- \( f(e^8) \) – worsening of depressive symptoms,
- \( f(e^9) \) – sluggishness,
- \( f(e^{10}) \) – fatigue,
- \( f(e^{11}) \) – dyspnea.

\[ f(f^{n6}) = f(f^1, f^2) \] (7)

where:
- \( f(f^1) \) – blinding sun occurs,
- \( f(f^2) \) – impaired psychophysical performance of the driver (mood, sense of satisfaction and calmness).

\[ f(g^{n7}) = f(g^1, g^2, g^3, g^4, g^5, g^6, g^7, g^8, g^9, g^{10}, g^{11}) \] (8)

where:
- \( f(g^1) \) – there is snowfall, hail, above 3 mm,
- \( f(g^2) \) – impaired mental and physical capacity of the driver,
- \( f(g^3) \) – headache,
- \( f(g^4) \) – sleep disorder,
- \( f(g^5) \) – irritation,
On the basis of the data presented in Tables 2 and 3, an analysis was made of the number of traffic accidents depending on the volume of motor vehicles passing through the analyzed points during the year, as well as the number of traffic accidents occurring at these points depending on the prevailing weather conditions. For this purpose, the total number of vehicles passing through a given measurement point was determined, and the % share of the analyzed measurement point with traffic volume was determined (Figure 4). In the next step, the total number of accidents at the analyzed points in 2007, 2010, 2015 and 2021 was determined (Table 4). The number of traffic accidents was then recalculated taking into account the % share of traffic volume, and the values of the weights of the number of accidents at the analyzed points were determined for the prevailing weather conditions (Figure 5). Based on the data presented, it can be concluded that the highest number of traffic accidents occurs during good weather conditions, as well as during strong winds and on cloudy days. In the case analyzed, one can also observe the negligible influence of atmospheric factors such as fog, smoke, blinding sun and snow and hail on the number of traffic accidents. For this reason, these factors were ignored in the next stage of the study.

![Figure 4 Participation of each measurement point in the survey](image)

**Table 4** Number of road accidents in analyzed points in 2007, 2010, 2015, 2021 [3]

<table>
<thead>
<tr>
<th>Weather conditions</th>
<th>good weather</th>
<th>rain</th>
<th>fog</th>
<th>wind</th>
<th>cloudy</th>
<th>sun</th>
<th>snow</th>
</tr>
</thead>
<tbody>
<tr>
<td>point 1</td>
<td>142</td>
<td>40</td>
<td>2</td>
<td>0</td>
<td>77</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>point 2</td>
<td>112</td>
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<td>0</td>
<td>2</td>
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<td>8</td>
<td>3</td>
</tr>
<tr>
<td>point 3</td>
<td>78</td>
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<td>1</td>
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<td>7</td>
</tr>
<tr>
<td>point 4</td>
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<td>0</td>
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<td>2</td>
</tr>
<tr>
<td>point 5</td>
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<td>0</td>
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<td>1</td>
</tr>
<tr>
<td></td>
<td>59</td>
<td>8</td>
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<td>0</td>
<td>25</td>
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<td>1</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
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<td>---</td>
<td>---</td>
</tr>
<tr>
<td>point 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>point 7</td>
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<td>1</td>
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<td>3</td>
<td>2</td>
</tr>
<tr>
<td>point 8</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>point 9</td>
<td>6</td>
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<td>0</td>
<td>0</td>
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<td>1</td>
<td>1</td>
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<td>5</td>
<td>289</td>
<td>26</td>
<td>28</td>
</tr>
</tbody>
</table>

**Figure 5** Number of accidents according to weather conditions [3]

On the basis of the data presented in Figure 6, taking into account the provisions of formula (1), the weights of the factors affecting the number of traffic accidents in the dependence in the analyzed weather conditions were determined. The relationship is shown in formula (9).

\[
PWD = a^{0.5066} \cdot b^{0.1433} \cdot c^{0.0045} \cdot d^{0.0037} \cdot e^{0.2872} \cdot f^{0.0238} \cdot g^{0.0308}
\]  

(9)

In addition, Figure 6 shows the negligible impact of the following factors on the number of traffic accidents: fog, smoke, blinding sun, and snow and hail. For this reason, a first simplification was made by eliminating the above-mentioned factors.

In the next step, according to the above procedure, the weights of the factors affecting the number of traffic accidents were determined again. In this case, the simplified form of the relationship is presented in Equation 10. On this basis, the weighted average number of accidents at the analyzed points was determined (Figure 6).

\[
PWD = f(a^n_1) \cdot f(b^n_2) \cdot f(d^n_4) \cdot f(e^n_5)
\]  

(10)
Based on the data shown in Figure 6, taking into account the provisions of equation (10), with the first simplification, the weights of the factors affecting the number of traffic accidents were again determined. In this case, the simplified form of the relationship is shown in equation 11. The relationship is shown in equation (12). Based on this, it can be seen that there is a low probability of a traffic accident during high winds. For this reason, further research introduced another simplification No. 2, in which the previously mentioned factor was not included.

\[ PWD = f(a^{n1}) \cdot f(b^{n2}) \cdot f(e^{n5}) \]  

(11)

\[ PWD = f(a^{0.5385}) \cdot f(b^{0.1523}) \cdot f(d^{0.0039}) \cdot f(e^{0.3053}) \]  

(12)

Taking into account simplification number 2, as well as the data from Tables 2 and 3, an analysis of the number of traffic accidents was carried out according to the redetermination of the weights depending on the prevailing weather conditions. The weighted average number of accidents at the analyzed points was then determined for the prevailing weather conditions (Figure 7).

**Figure 6** Number of accidents according to weather conditions - Simplification 1

**Figure 7** Number of accidents according to weather conditions - simplification 2
Based on the data presented in Figure 7, taking into account the provisions of formula (12), with the second simplification, the weights of the factors affecting the number of traffic accidents were redetermined. The relationship is shown in formula (13).

\[ PWD = f(a^{0.5406}) \times f(b^{0.1529}) \times f(e^{0.3065}) \]  

(13)

4. Results

In order to check the validity of the proposed mathematical model, the total number of traffic accidents was substituted into equation (13) (Table 3), and then the resulting data was compared with the number of traffic accidents recorded at the analyzed points. The following prediction errors, determined from equations (14-17), were used to calculate measures of excellence for the considered relationship. A summary of the errors for the analyzed measurement errors is presented in Table 5.

- **ME** – mean error
  \[ ME = \frac{1}{n} \sum_{i=1}^{n} (Y_i - Y_p), \]  
  (14)

- **MAE** – mean average error
  \[ MAE = \frac{1}{n} \sum_{i=1}^{n} |Y_i - Y_p|, \]  
  (15)

- **MPE** – mean percentage error
  \[ MPE = \frac{1}{n} \sum_{i=1}^{n} \frac{Y_i - Y_p}{Y_i}, \]  
  (16)

- **MAPE** - mean absolute percentage error
  \[ MAPE = \frac{1}{n} \sum_{i=1}^{n} \frac{|Y_i - Y_p|}{Y_i}, \]  
  (17)

where:
- \( n \) - length of the forecast horizon,
- \( Y \) - observed value of traffic accidents,
- \( Y_p \) - the forecast value of traffic accidents.

<table>
<thead>
<tr>
<th>Points</th>
<th>Errors</th>
<th>Good weather conditions</th>
<th>Rainfall</th>
<th>Cloudy</th>
<th>Errors</th>
<th>Good weather conditions</th>
<th>Rainfall</th>
<th>Cloudy</th>
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5. Conclusion
The article evaluates the factors affecting the number of road accidents depending on weather conditions. For this purpose, a random selection was made of 10 measurement points in Poland, for which the following parameters were analyzed: traffic volume on the road and the number of accidents at the analyzed points. Based on the study, it can be concluded that the number of road accidents is most influenced by factors such as good weather conditions, as well as cloudy and rainy days. The analyzed method can be used to predict the number of traffic accidents at a specific place and time.

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