FOUNDATIONS OF COMPUTING AND DECISION SCIENCES
Vol. 48 (2023) No. 4
ISSN 0867-6356
sciendo DOI: 10.2478/fcds-2023-0019 e-ISSN 2300-3405

Towards automated recommendations for drunk driving penalties in Poland - a case study analysis in selected court

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Abstract. Depending on the legal system, judges may have varying degrees of discretion in determining the type and extent of sentence that can be imposed for a particular offence. Nevertheless, it appears that even in systems traditionally considered discretionary, accepted patterns play a significant role in determining penalties, and judges utilize merely a limited spectrum of potential penalties in repetitive cases. Confirmation of the predictability of sentencing in certain categories of cases facilitates the possibility of automation. Utilising a computer program to assist judges in sentencing proposals based on input is feasible. This program can reflect the standard practice of sentencing penalties and punitive measures in a particular category of cases or rectify it, depending on the adopted sentencing policy. The objective of the article is to present findings from research that investigated whether a specific relation shapes the dimension of penalties and penal measures for cases concerning driving under the influence of alcohol in Poland, in the context of possible automation of the sentencing process. Another aim of this study is to provide an example of a straightforward mathematical recommendation model that tries to reflect both the discovered correlations in the data and the presumed intentions of legislators.

Keywords: automation, sentencing guidelines, digitalization of justice

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1. Introduction

Sentencing in criminal cases is one of the most important tasks of the administration of justice [14]. Different legal systems around the world have different models of sentencing. Depending on the legal system, judges have more or less discretion in determining the type and amount of sentence that can be imposed for a particular offence. They range from numerical guidelines, e.g., in the United States, to soft narrative sentencing guidelines, e.g., in England or Wales, to broad models of judicial discretion [38]. A particular example of systems, where this discretion is reduced are those with so-called sentencing guidelines. These establish a specific relationship between the circumstances of the case and the sentence to be imposed. In general, two types of sentencing guidelines can be distinguished. Firstly, those which are based on and reflect an existing practice and, secondly, those which aim to change the existing practice in the direction dictated by a criminal policy (e.g., reducing the number of prisoners, eliminating the problem of prison overcrowding [2], [61]).

It has been pointed out that sentencing guidelines (in whatever form) have the advantage of providing consistency, standardizing sentences and making them independent of factors that should not influence sentencing, such as the judge's mood on the day or the attractiveness of the offender [48], [3]. People who commit acts in the same circumstances should receive similar, if not identical, sentences [62]. It is also argued that the judge's wide discretion, aimed at an individual assessment of each case, is often an apparent discretion, as judges rule according to specific, contractually accepted tariffs. Despite the wide range of penalties that can be imposed, the vast majority of penalties imposed fall within a narrow range, usually the lower part of the statutory threat, using 1/3 of the statutory range [18], [23]. The effect is the same, i.e., the level of punishment in a given case is the result of the translation of the circumstances of the case into the type and amount of punishment according to standardized relations between these categories whether legally standardized and binding or customary and accepted by judges and prosecutors [27], [19], [17], [30].

This debate is particularly relevant in the context of technological advances and the envisaged possibilities for introducing automated decision-making systems in the administration of justice. While there is no general consensus on the inadmissibility, in the light of current and future legal frameworks [53], [56], [60], [55], of decision-making by machines based on algorithmic systems or artificial intelligence, the issue is different, when it comes to proposals for adjusting the sentence in a given case after a court has assigned criminal responsibility. Such a system supports decision-making, not replaces it. If there are specific sentencing guidelines or schemes, it is possible to transfer these guidelines (rules) to the system and omit the most controversial stage in the use of artificial intelligence systems in the judiciary, i.e., the learning stage. The learning phase raises a number of doubts, including the lack of transparency, the so-called black box [15], discrimination [26], [15], [31] and bias [15]. These doubts, moreover, have largely been confirmed in practice [26].

Although most legal systems in the world, including the one functioning in Poland, do not have standardized sentencing schemes in criminal cases, the idea is not entirely alien, even to systems that traditionally implement a model of broad judicial

discretion. It is worth mentioning, for example, the system of fines for minor offences in Poland, where specific tariffs are in force, both in terms of the amount of the fine and the number of penalty points awarded for a given offence, depending on the circumstances (e.g., the relationship between the speeding thresholds and the penalty). In addition, there are indications in Poland that even in criminal cases (at least in frequent, repetitive cases) judges decide according to generally accepted schemes and tariffs [21], [50]. Confirmation of this thesis could lead to a reconstruction of certain schemes, i.e., an indication of:

1. what are the circumstances of the case that influence the level of punishment and penal measures, and
2. what is the relationship between these circumstances and the level of punishment and penal measures;
3. whether these relationships are consistent with the legal presumptions.

Furthermore, reconstructing these relations would make it possible to define sentencing guidelines either in a way that reflects current practice or in a way that corrects it and to create an algorithm that provides a proposal for sentencing in these categories of cases. This algorithm could streamline the work of the courts, shorten the time taken to resolve cases and reduce, if not eliminate, errors, serving as a solution to one of the greatest sins of criminal procedure in Poland, namely the length of proceedings. In addition, depending on the sentencing policy adopted, sentencing guidelines could achieve other objectives improving consistency or bringing sentences into line with the legislature.

The main goal of the study was to determine, whether the dimension of penalties and penal measures in cases concerning an act under article 178a § 1 of the Penal Code, i.e., driving under the influence of alcohol, is shaped according to some specific relation and, in the case of positive verification, to identify this relation. Another aim of this work is to present an example of a simple mathematical recommendation model that tries to reflect both the identified relations in the data and assumed legislators intentions. The choice of this category of cases was dictated by the fact that driving under the influence of alcohol is one of the most frequently committed offences in Poland [58], [59]. These are frequent, repetitive cases, committed in a similar manner, i.e., with a few individualizing factors. The analysis presented in this paper is a small scale pilot case study, therefore the obtained results concern only one selected court.

2. Materials and Methods

2.1. Data collection

The data used in the presented research come from 50 criminal cases from the repetition K of the act of Article 178a §1 of the Criminal Code from District Court

in Jarocin (court of first instance of central Poland). Since, the penalties are relatively repeatable, such small dataset was believed to be sufficient for planned analyses. These are cases from 2022 and 2023 (both as to the dates of committing the acts and the date of judgment), randomly selected (i.e., based on sampling database identification codes). Examination of the files was possible after obtaining the prior consent of the court president pursuant to Article 156 §1 of the Code of Criminal Procedure. After reviewing the case file, anonymized and non-individualized data were collected:

1. a judge of the case,
2. alcohol concentration (mg/l),
3. age,
4. sex,
5. confession,
6. voluntary submission to penalty,
7. vehicle category,
8. income (PLN net per month)
9. previous conviction for an act against safety of communication,
10. a previous criminal record for an act other than against safety of communication,
11. penalty,
12. the amount of the cash benefit for the Fund for Victims' Aid and Post-Penitentiary Assistance,
13. length of driving ban,
14. possible limitations of the driving ban.

Pursuant to the regulations in force, an offence under Article 178a §1 of the Criminal Code is alternatively punishable by a fine, limitation of liberty or imprisonment for up to 2 years. Pursuant to the wording of Article 33 §1 of the Criminal Code, a fine is imposed in daily rates, specifying the number of rates and the amount of one rate; in general the lowest number of rates is 10, and the highest is 540. In determining the daily rate, the court shall take into account the offender's income, personal and family conditions, property relations and earning capacity; a daily rate may not be lower than PLN 10, nor may it exceed PLN 2,000. The penalty of restriction of liberty lasts a minimum of one month and a maximum of two years; it is imposed in months and years. Furthermore, in the event of a conviction for this offence, it is mandatory to impose penal measures: a prohibition to drive any vehicles or vehicles of a specified type for a period of between 3 and 15 years (Art. 42 §2 of the Criminal Code in conjunction with Article 43 §1 of the Criminal Code) and a cash benefit to the Fund for Victims' Aid and Post-Penitentiary Assistance in the amount of at least PLN 5,000, up to PLN 60,000 (Article 43 §2 of the Penal Code).

2.2. Data analysis

Data from one court in Poland were analyzed in order to determine whether there exist relationships between financial penalty severity and driving ban length with other factors. Since the data contains 50 conviction records, only four factors could be taken into analysis, namely a judge, salary, age, and alcohol concentration (details in section 3.1). The rest of potential factors were not diversified enough to enable meaningful statistical analysis. In 10% of cases a penalty other than a fine was imposed, this was a limitation of liberty penalty. In order to indicate the relationship between the severity of the penalty (not the type) and the circumstances of the case, the conversion factor of 1 month of restriction of liberty penalty = 10 daily rates of fine (Article 45 § 1 of the Executive Penal Code) was adopted, in the absence of the statutory conversion factor of hours/daily rate, 30 hours was set to be equal PLN 40 and 20 hours was set to be PLN 30.

Although, an income and driving ban length are theoretically continuous variables, the observed values were repetitive and not diversed. Since driving ban length can be expressed in only full years and financial penalties were almost exclusively expressed in rounded amounts (e.g., PLN 1500 and PLN 2000) without values in between, these variables looked similar to ranks. Therefore, to determine relationships between penalty severity and driving ban with salary, age, and alcohol concentration Spearman correlation tests were performed. The possible influence of a judge was analyzed by Kruskal-Wallis H test, which compared data grouped by a judge identification number. These analyses are presented in Table 1 and furthered visualized in Figures 1 and 2. This part of the analysis was done in Python with modules numpy [16], scipy [46], matplotlib [20], seaborn [47].

In order to explore in more detail relationships between penalty severity and driving ban with alcohol concentration linear models were created (penalty amount was treated as a regular numeric value with normal distribution, but since only two values dominate in length of driving ban, this variable was transformed and treated as binary). The models were described based on diagnostics plots that are visualized in Figures 3 and 4. This part of the analysis was executed in R environment with the following packages ggplot2 [49], ggfortify [40], lme4 [4], MASS [44].

2.3. Penalty model

Based on the observed data and Polish penal code a mathematical decision model was created to better reflect a potential contribution of alcohol concentration and salary in formulation of a final financial penalty for drunk driving. In this part of the analysis only the cases with provided information on salary were used (n=33). Since there is a linear relationship in the data between alcohol concentration and penalty, similar relation can be expected in the case of relation between salary and penalty (or anticipated based on penal code). The mathematical model was tested, visualized and compared with the data collected in the court using Python (with the use of previously mentioned modules [16], [46], [20] and [47]). Differences between

the model predicted values and the observed ones were shown on dedicated figures, including histogram for absolute error. The model itself was also illustrated as 3D penal landscape.

3. Results

3.1. Analysis of factors related to penalty severity

Since some of the variables in the dataset were identical or not diverse enough only four of them were analyzed, i.e., a judge, salary, age, and alcohol concentration in context of potential relationships with cash penalty amount and driving ban length. The following factors had to be rejected, since they were not diversified enough to show any statistically significant effect: sex (4% of females), admission of being guilty (96% of cases), voluntary submission to punishment (76 % of cases), vehicle category in which the crime was commited (B in 96% of cases and A in 4% of cases), previous conviction history related to communication safety (0% of cases), general conviction history (10% cases), the amount of cash benefit for Victim Assistance and Post-penitentiary Assistance Fund (always PLN 5,000 without exception), exceptions for driving bans (6% of cases).

Spearman correlation tests and linear regression models were used to check relations between variables, i.e., judge, salary, age and alcohol concentration vs. penalty amount or driving ban length. Table 1 shows that there are only three significant correlations. Alcohol concentration correlates positively with both amount of financial penalty ($\rho \approx 0.55$, p-value $< 10^{-4}$) and driving ban length ($\rho \approx 0.72$, p-value $< 10^{-4}$). Financial penalty and driving ban are also correlated but not such strongly like in the case of alcohol concentration ($\rho \approx 0.45$, p-value $= 0.0012$). Based on the results it can be said that alcohol concentration is the only factor that contributes to punishment severity.

Table 1. Spearman correlation results for the analyzed factors.

Variable 1	Variable 2	correlation coefficient (ρ)	p-value
Financial penalty	Alcohol conc.	0.5498	$< 10^{-4}$
Financial penalty	Age of convict	-0.2359	0.0991
Financial penalty	Convict's salary	0.2671	0.1329
Financial penalty	Driving ban	0.4452	0.0012
Driving ban	Alcohol conc.	0.7213	$< 10^{-4}$
Driving ban	Age of convict	-0.028	0.847
Driving ban	Convict's salary	0.3428	0.0508

Relationships with financial penalty were illustrated in Figure 1. As it can be spotted in plot A, alcohol concentration correlates with the administered penalty. Other factors, i.e., age (plot C) and salary (plot D) do not have visible relation with

Table 2. Wald test results for the models showing potential driving ban length prediction basen on alcohol concentration and/or income. All models are binomial, since only two cases (3 or 4 years) were observed in the data. The more z value is away from 0, the more likely is that excluding the analyzed variable will significantly harm the model. Columns named 0.025 and 0.975 show boundaries for 95% confidence interval of coefficients.

Model	Variable	Estimate	Std Error	z	$P > \|z\|$	0.025	0.095
Driving ban vs. Alcohol	Intercept	-6.489	1.872	-3.466	0.0005	-11.0363	-3.4542
	Alcohol	7.857	2.216	3.546	0.0003	4.3032	13.266
Driving ban vs. Income	Intercept	-0.8552	0.7124	-1.201	0.203	-2.4287	0.4507
	Income	0.0004	0.0002	1.614	0.107	$< 10^{-4}$	0.0009
Driving ban vs. Alcohol + Income	Intercept	-7.9186	2.9768	-2.66	0.0078	-15.999	-3.5348
	Alcohol	8.6889	3.2677	2.659	0.0078	3.9048	17.6111
	Income	0.0002	0.0003	0.611	0.5409	-0.0004	0.001

an amount of financial penalty. In addition to that, judges administering sentences do not differ from each other significantly (Kruskal - Wallis H = 2.4774, p-value = 0.2897), what can be seen in stacked histogram showed in part B of Figure 1.

Similar analysis was performed for driving ban length and it revealed the same conclusions as in the case of financial punishment. Figure 2 presents detail plots showing correlations of driving ban length with alcohol concentration (2A), however no such relation is detected for age (part C) and salary (part D). According to one way ANOVA on ranks (Kruskal – Wallis H = 0.9736, p-value = 0.6146), there is no difference between sentences administered by different judges (subfigure 2B).

General linear models (GLMs) were used to find potential patterns in the data, that could be important from model construction perspective and show how the administered penalties agree with the penalty code and lawmakers intentions. First of all, the GLMs may determine whether financial penalty and driving ban length can be modeled by simple linear equations. Secondly, GLMs can provide information about normality. Since potential biases in variance may indicate hidden factors, this analysis might show whether there are unknown variables that influence final punishment.

Table 2 and Table 3 summaries GLMs created for driving ban length (Table 2) and financial penalty amount (Table 3). The results obtained on the basis of these models strongly suggest that only alcohol concentration has impact on final punishment. The results show a potential disagreement with lawmaker intention, that tried to make final penalties to be more dependent on a convict's income. Since only alcohol concentration is related solely to punishment, it will be further analyzed to detect any potential biases. It is worth mentioning that mixed model showing alcohol concentration and income impact on final punishment (driving ban or financial

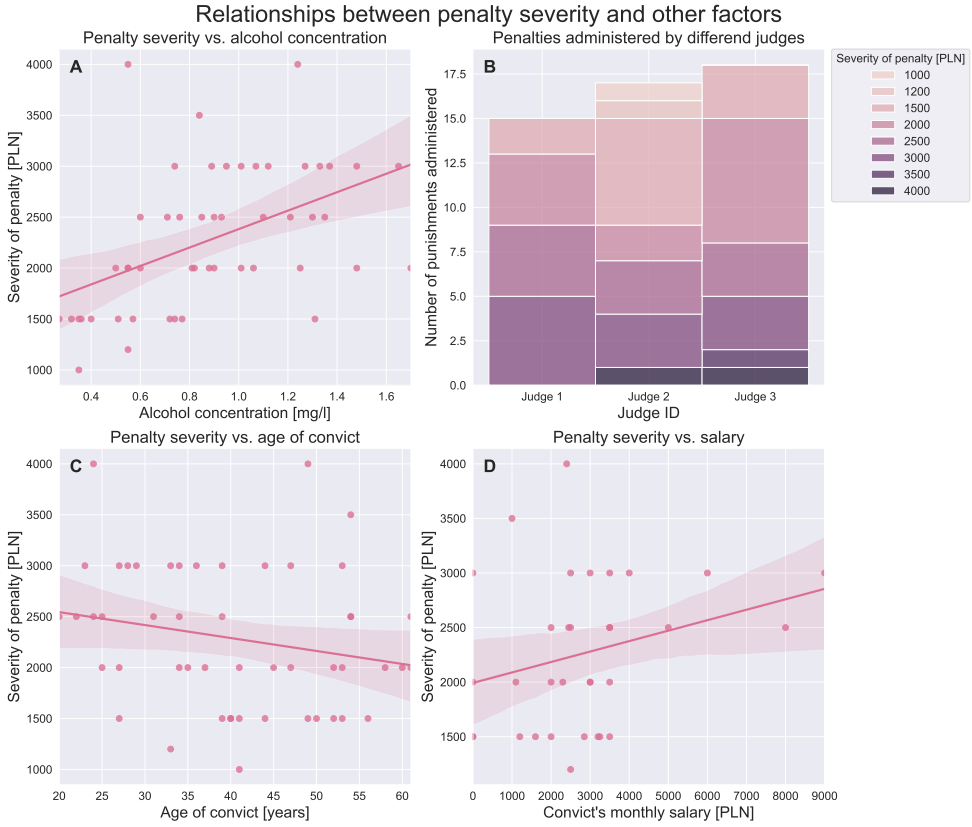


Figure 1. Visualization of relationships between penalty severity and four other factors: (A) - alcohol concentration, (B) – judge giving sentence, (C) – age of convict and (D) – convict's salary. In the case of (A), (C) and (D), that show scatter plots with additional regression line, linear models can be described by the following equations: (A): y = 1477.3603 + 905.3195x; (C): y = 2798.768 - 12.7166x; (D): y = 1992.7516 + 0.09576x. Subplot (B) shows a stacked histogram for amount of cash penalty administered by all three judges working in the selected court.

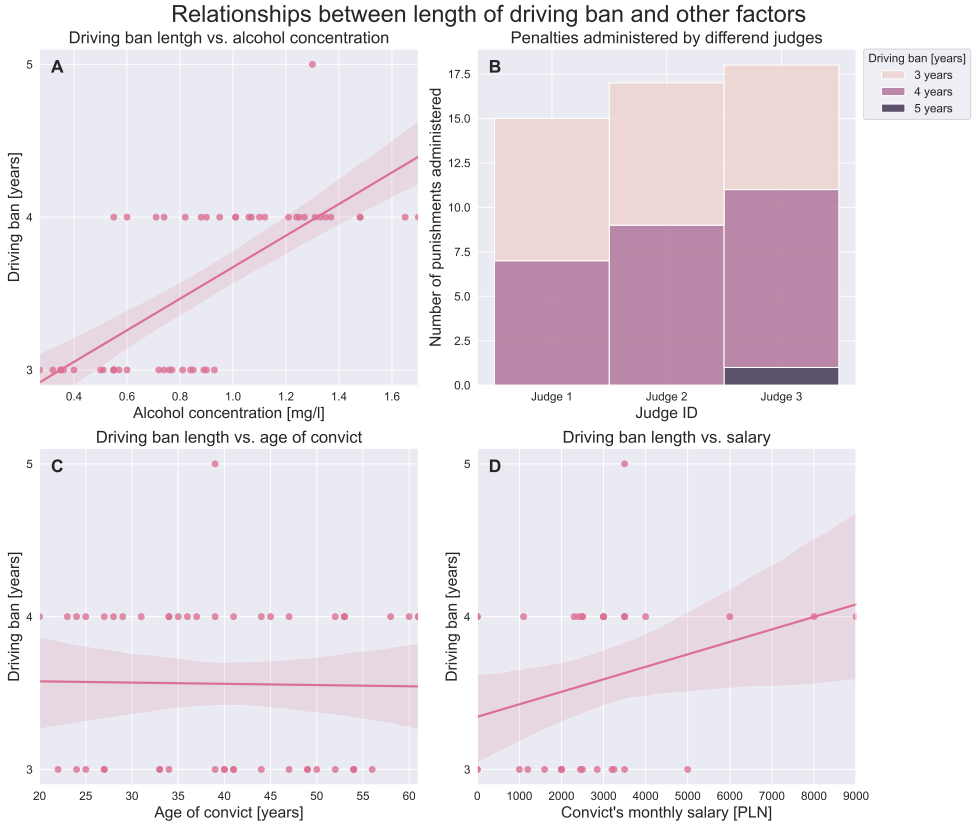


Figure 2. Visualization of relationships between driving ban length and four other factors: (A) - alcohol concentration, (B) – judge giving sentence, (C) – age of convict and (D) – convict's salary. In the case of (A), (C) and (D), that show scatter plots with additional regression line, linear models can be described by the following equations: (A): y = 2.64 + 1.0325x; (C): y = 3.5927 - 0.0008x; (D): y = 3.3446 + 0.00008x. Subplot (B) shows a stacked histogram for driving ban length administered by all three judges working in the selected court.

Table 3. Partial t test results for the Gaussian models showing potential financial penalty prediction based on alcohol concentration and/or income. The more t value is away from 0, the more likely is that excluding the analyzed variable will significantly harm the model. Columns named 0.025 and 0.975 show boundaries for 95% confidence interval of coefficients.

Model	Variable	Estimate	Std Error	t	P > |t|	0.025	0.095
Financial penalty vs. Alcohol	Intercept	1477.4	233.8	6.318	$< 10^{-4}$	1019.08	1935.6
	Alcohol	905.3	243	3.726	0.0005	429.043	1381.6
Financial penalty vs. Income	Intercept	1993.75	207.1	9.621	$< 10^{-4}$	1586.79	2398.7
	Income	0.0958	0.06	1.596	0.121	-0.0218	0.2134
Financial penalty vs. Alcohol + Income	Intercept	1027.49	237.6	4.324	0.0002	561.774	1493.2
	Alcohol	1267.75	240.1	5.276	$< 10^{-4}$	796.2	1737.3
	Income	0.036	0.0454	0.793	0.4338	-0.0529	0.1249

penalty) with respect to judge ID was not tested since there was not enough data to create a reasonable model.

In order to verify relationships of financial penalty and driving ban length with alcohol concentration additional diagnostic plots for linear models were created and presented in Figures 3 and 4. According to Figure 3 data follows normal distribution and the linear model fits relatively well to the observed values. The relationship seems linear (see "Residual vs. Fitted" and "Normal Q-Q" plots). Roots of standardized deviance residuals seem to show that variance in the data is homoscedastic (see Scale-Location plot). According to the three last plots ("Cook's distance", "Residuals vs. Leverage" and "Cook's dist vs. Leverage") there are three outliers in the data (20, 36 and 47), however none of them have significant influence on the model. Based on the diagnostic plots it can be concluded that relationship between the amount of financial penalty and alcohol concentration is relatively strong and significant. In addition to that the relation between these factors has linear nature, showing that financial punishments administered by judges are based on alcohol concentration.

The linear model for driving ban length does not show an ideal relationship of alcohol concentration with ban length (see Figure 4). It is mostly due to the fact that judges must administer bans in full years, therefore no intermediate values are allowed. This created almost a binomial distribution, therefore the model used was also binomial. Restrictions on ban length value created distortions in line on "Residuals vs. Fitted" plot in Figure 4. Although the line seems to be bent, it seems more likely that this is a results of limitations in administering driving bans, rather than a result of a nonlinear relationship. Moreover, "Normal Q-Q" plot shows that residuals are indeed normally distributed which is in general a good indicator of linear relationship. Again, since almost only two lengths of driving bans were administered, the

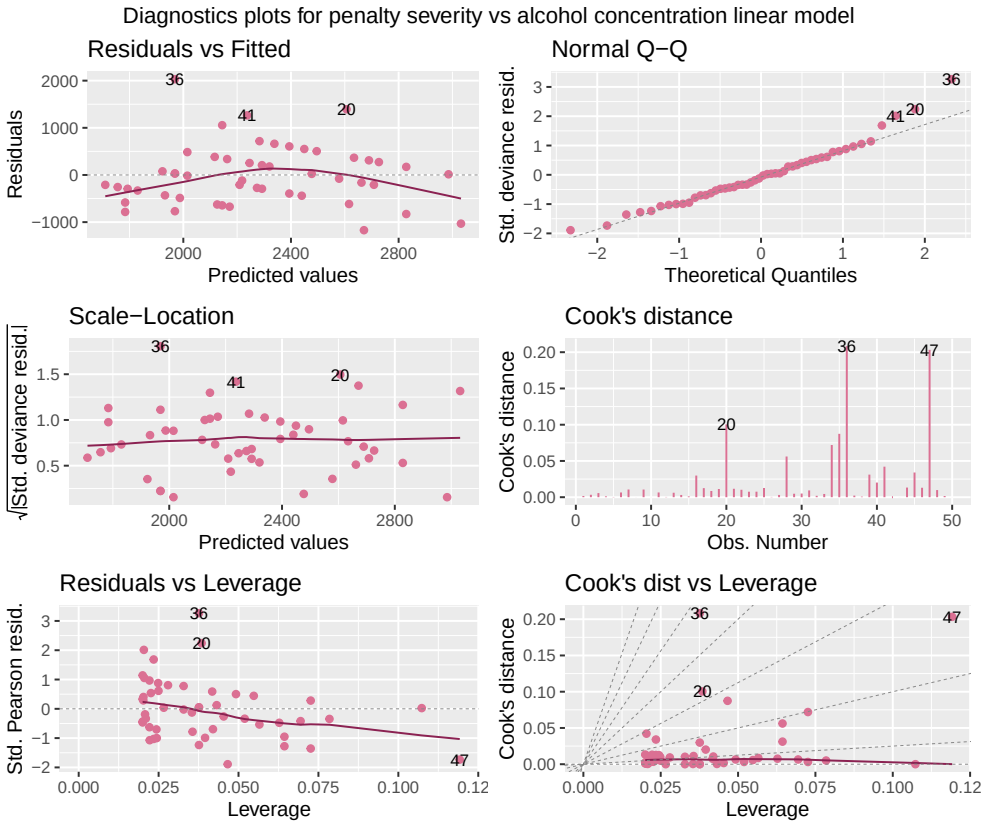


Figure 3. Diagnostics plots for the linear model describing relation between amount of cash penalty and alcohol concentration. There are six plots presented for model diagnostics: "Residual vs Fitted", "Normal Q-Q", "Scale-Locations", "Cook's distance", "Residual vs Leverage" and "Cool's dist vs Leverage". Description and details are in the main text.

assumption that variance is the same among the variables is false ("Scale-Location" plot). However, heteroscedasticity was expected, since exact ban lengths were somehow forced by the lawmakers. There are three outliers (22, 29 and 42), however their influence on the model can be neglected; plots "Cook's distance", "Residuals vs. Leverage" and "Cook's dist vs. Leverage" show that in detail. Based on diagnostics plots visualized in Figure 4 it can be concluded that there is a non-linear relationship between alcohol concentration and driving ban length. However, this relation is distorted, most probably due to a lack of flexibility in administering appropriate length of the ban, that has to be determined in full years.

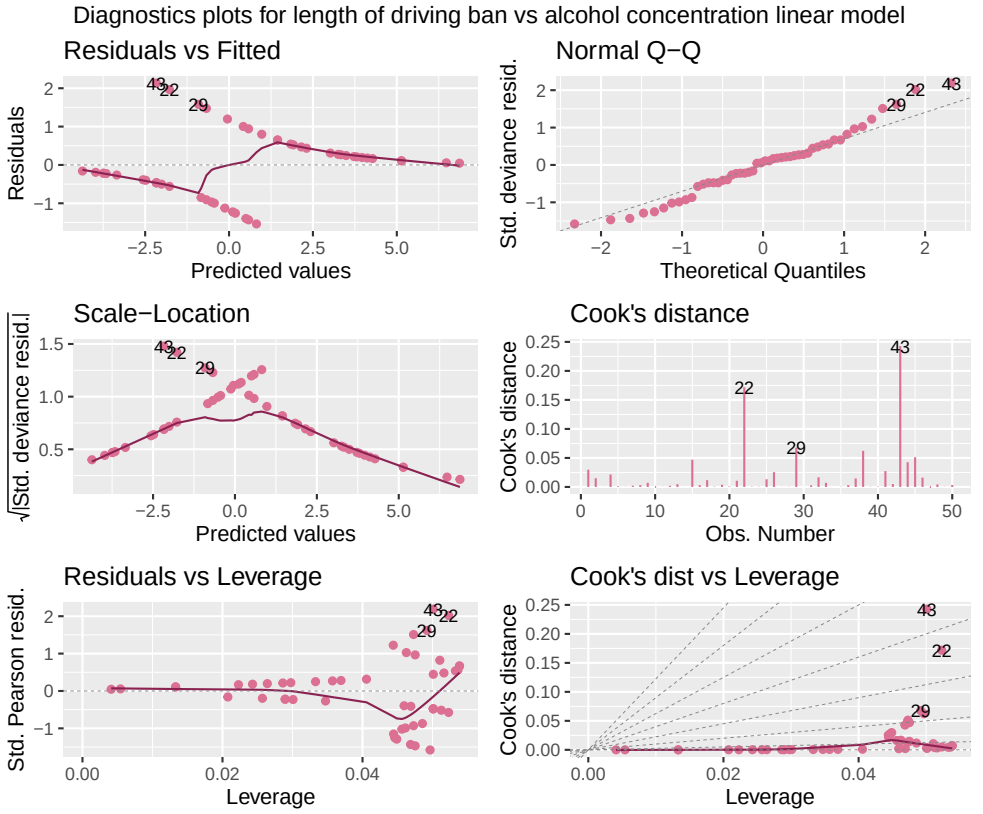


Figure 4. Diagnostics plots for the linear model describing relation between driving ban length and alcohol concentration. There are six plots presented for model diagnostics: "Residual vs Fitted", "Normal Q-Q", "Scale-Locations", "Cook's distance", "Residual vs Leverage" and "Cool's dist vs Leverage". Description and details are in the main text.

3.2. Penalty model evaluation

The financial penalty for drunk driving in Poland is thought to be composed of a number of rates multiplied by a value of rates. The judge, based on information about the case and the accused, determines these two values. According to the Polish penalty code, the minimum number of rates is 10 and the maximal equals to 540. The value of the rate cannot be lower than PLN 10 and cannot be greater than PLN 2,000. Therefore, the penalty shall range between PLN 10x10 (PLN 100) and PLN 540x2000 (PLN 1,080,000). Since the range is very wide and the court possess limited ability to check salary and total wealth of the accused, administering high financial penalties is difficult and rare.

Based on the statistical analysis it can be concluded that only alcohol concentration is taken into account while determining the amount of financial penalty. This situation is in disagreement with the lawmakers thought, that created the mechanism that shall make financial penalty also dependent on accused salary. In practice these fines are accompanied by additional benefit that convict must pay for the Victim Assistance and Post-penitentiary Assistance Fund that cannot be lesser than PLN 5,000. This benefit is high enough to favor lower penalties, since PLN 5,000 is a high amount in comparison to minimal monthly wages PLN 2,700 (net).

The model proposed in this work tries to simplify and reflect the role of convicts' salary and alcohol concentration in recommended amount of financial penalty. The mathematical formulas were constructed based on direct interpretation of Article 178a §1 of the Criminal Code and parameterized with results of the statistical analyses. The model consist of two parts, just like it was proposed by lawmakers, i.e., the number of rates and the value of the rate. The number of rates is dependent on alcohol concentration and the value of the rate is based on the accused salary. Therefore, the final fine will be the result of multiplication of the number of rates and the value of the rate:

$$N = 10 + \frac{\min\{A, 3\}}{3} \cdot 530 \tag{1}$$

$$R = \min\{10 + \frac{S}{k}, 2000\} \tag{2}$$

where N is the number of rates and A is the alcohol concentration expressed in mg/l. R represents the value of one rate and is based on S, that is the amount of monthly salary of the accused in PLN divided by k. Parameter k is a salary scalar, that controls penalty severity in respect to salary. In this model this parameter was set to $k = 500$ (this is a proposition according to which the penalty shall be similar to monthly net salary). The final penalty is a result of multiplication of these two values ($N \cdot R$). In this model it is assumed that maximal concentration of alcohol is 3 mg/l, since it is believed that 3 mg/l and higher amounts of alcohol in blood are associated with severe intoxication, blackouts, loss of consciousness and inability to move. Higher blood alcohol concentration (circa 4 mg/l) is considered to be potentially lethal for a regular person [8].

An example may help in better understanding of the proposed model. For this reason, let us consider a case of a person that earns PLN 4,000 (net) monthly and had 1 mg/l of alcohol detected during a test. According to the model proposed in this paper, $N = 10 + \frac{\min\{1,3\}}{3} \cdot 530 \approx 187$ and $R = \min\{10 + \frac{4000}{500}, 2000\} = 18$, so the final penalty shall be $N \cdot R = 187 \cdot 18 = 3366$ (PLN). In this scenario, the penalty is 84% of monthly salary. Furthermore, for a person with this salary (PLN 4,000 net), the range of penalty lay between: PLN 504 (since minimal alcohol concentration cannot be lower than 0.1 mg/l) and PLN 9,720 (if alcohol concentration is 3 mg/l or greater).

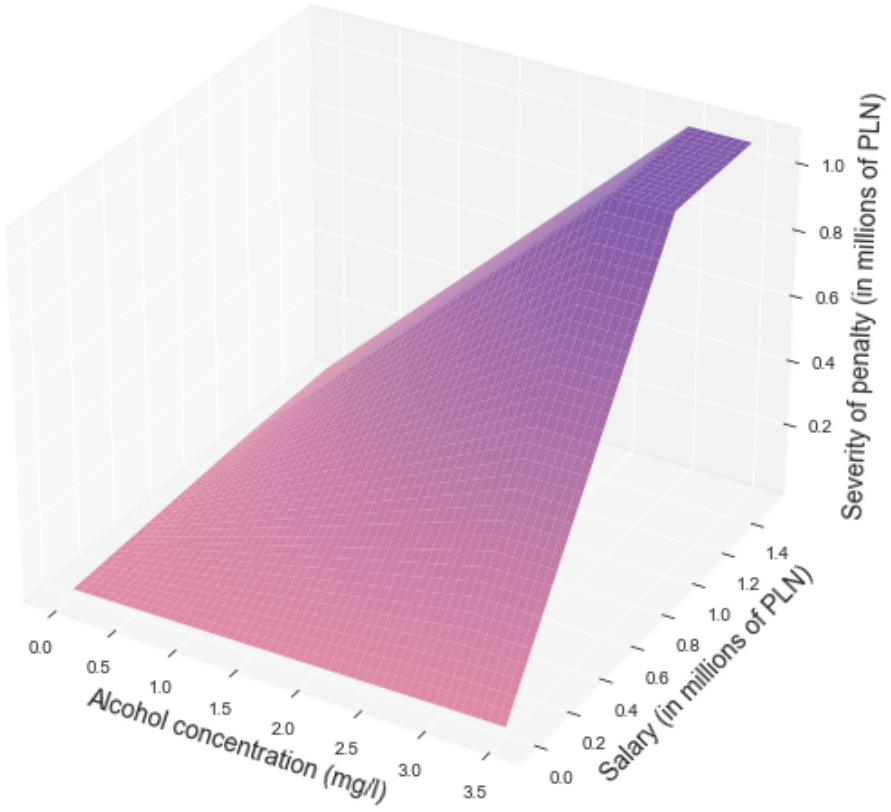


Figure 5. Model recommendations presented in the form of a surface. Since the model assumes maximal salary and maximal alcohol concentration, the shape of the surface is a hill with three slopes (when neither or one of the two maxima are reached) and a flat top (when the number of rates and the value of the rate have the highest possible values, as it is specified in the Article 178a §1 of the Criminal Code).

Figure 5 presents how alcohol concentration and salary contribute to the final

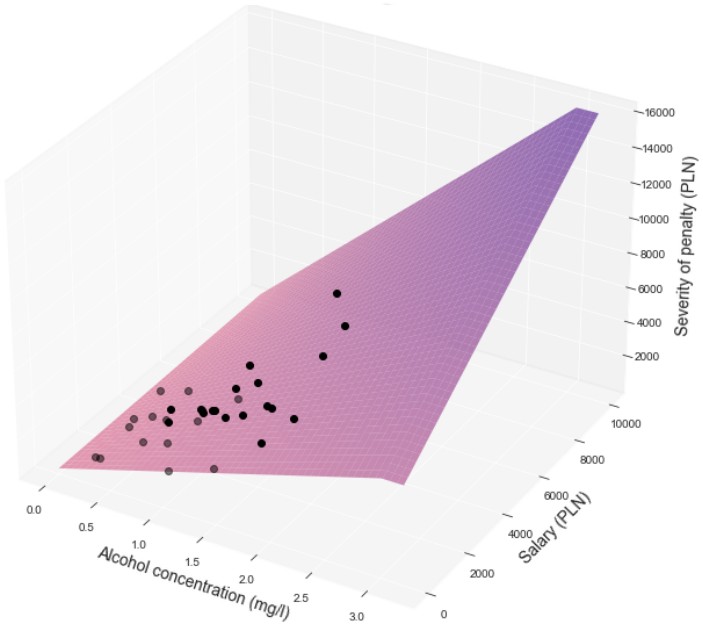


Figure 6. Model recommendation surface with observed amounts of financial penalties administered. As it can be spotted, some dots representing actual sentences are above (the recommended penalty is higher) and the other below (the recommended penalty is lower) the surface.

penalty. Figure 6 shows how the observed values fit into a landscape derived from the model. Figure 7 illustrates differences between the model predicted and the observed values with additional histogram for differences between these values. The model derived and the observed values are similar for low alcohol concentration and low salary. The more value of one or both of these factors increase the higher the error will be (part A and B of Figure 7). Mean absolute error is PLN 842.28, with relatively large standard deviation equal to PLN 791.44. The lowest observed difference between the model and the real data was PLN 18.09, and the largest was PLN 3,317.93. Median error was calculated to be PLN 623.33 and the sum of all (absolute) differences is PLN 27,795.20 (that is 37% of the total amount of penalties administered in the analyzed sample of cases with provided information about salary (n=33), that was PLN 74,700). The total net differences (sum of positive and negative differences) is PLN 14,359.81.

4. Discussion

Linear models confirmed strong correlations between the blood alcohol concentration and financial penalty as well as alcohol concentration and driving ban length. At the same time, according to the obtained results, circumstances other than the blood alcohol concentration and previous criminal record do not have a significant impact on this measure. This is not in line with the legislator's assumption and the rule of making the amount of daily fines dependent on (above all) income. On the basis of the research carried out it can be pointed out that:

1. 90% of the sentences imposed for an offence under Article 178a §1 of the Penal Code are fines,
2. 10% of the sentences imposed for an offence under Article 178a §1 of the Penal Code are restricted liberty sentences,
3. no custodial sentences imposed,
4. there is a linear relation between alcohol concentration and the penalty and driving ban measure,
5. the income of the offender does not have a significant impact on the severity of the sentence.

Although the amount of data collected does not allow for a categorical statement, it is highly probable that the hypothesis of the schematicity of sentencing in repeat cases should be verified positively. This means that it is possible to identify specific relationships between the level of alcohol concentration and previous criminal record, in the amount of the financial penalty and the length of the driving ban imposed. The results of the research, due to limited number of analyzed cases, do not allow this relationship to be indicated at this stage, but confirm the relevance of extending the

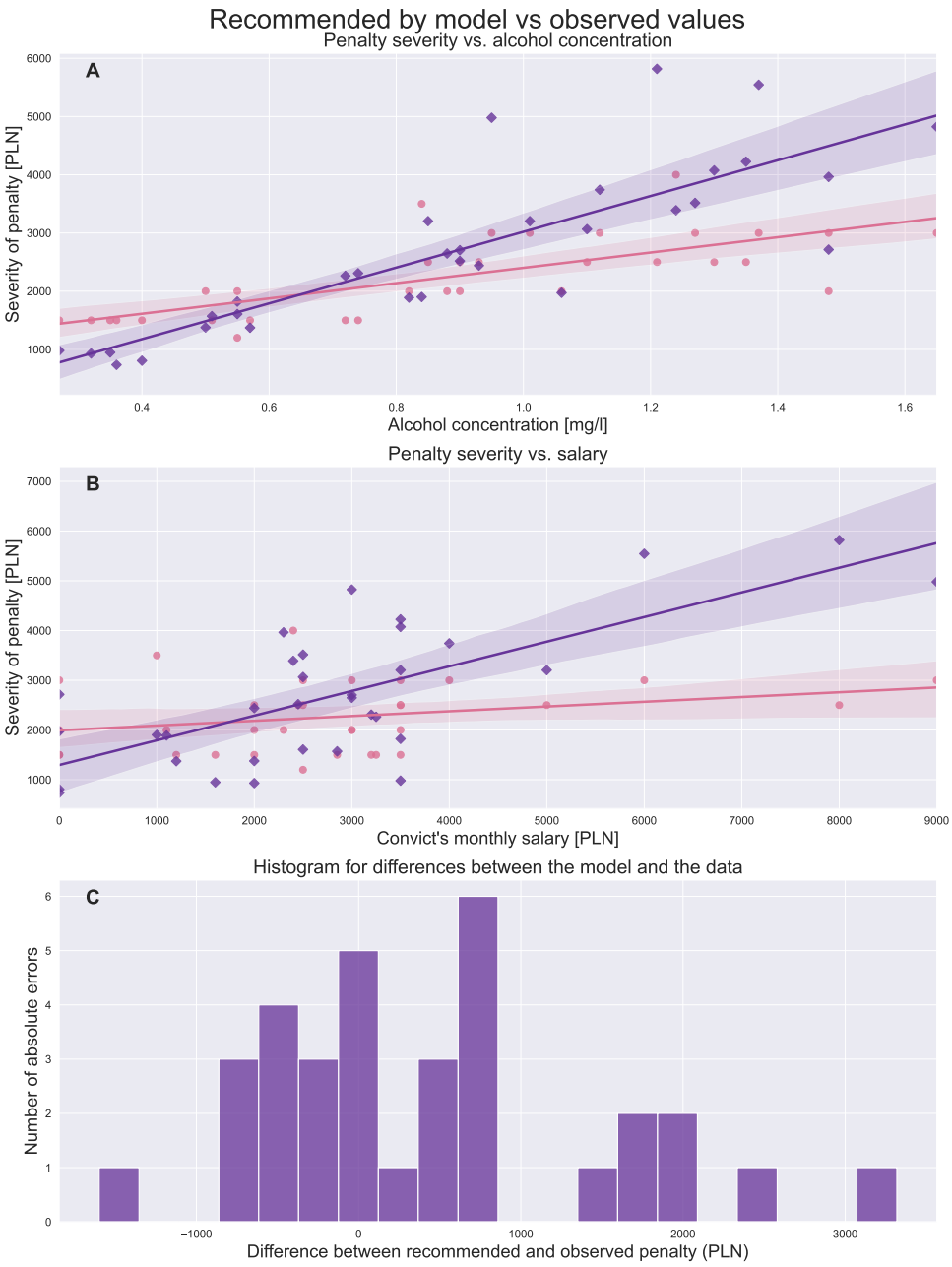


Figure 7. Model recommendation (purple) versus observed amounts (pink) of financial penalties administered. In plots A and B differences between observed and recommended values are illustrated (A: financial penalty vs. alcohol concentration and B: financial penalty vs. salary). Part C presents a histogram for error in PLN. More details can be found in the main text.

research to other courts, in order to confirm the initial verification of the hypothesis and to indicate standardized relationships.

According to the Polish law, drunk drivers are obligated to pay cash benefit for the Fund for Victims' Aid and Post-Penitentiary Assistance. It is worth pointing out that in all the cases examined, the monetary benefit was awarded in the minimum amount, PLN 5,000, hence the examination of the relationship between the circumstances of the case and the amount of the benefit was abandoned. This, however, is not a favorable situation and the benefit should differ (at least slightly) between cases. The situation with monetary benefit shows that there is space for potential improvement in sentencing.

The test results show that in the case of alcohol concentration in excess of 1 mg/l, driving bans are imposed for a period of 4 years, up to an alcohol concentration of 0.8 mg/l for a period of 3 years, and in the range of 0.8-1 mg/l, both bans of 3 and 4 years occur (with few exceptions). This pattern, possibly shows that there is a unofficial threshold for alcohol concentration, i.e.,1 mg/l, above with administered the diving ban is longer.

The studies indicated the nominal amount of the fine, given the lack of any real differentiation between daily rates (there were only daily rates of PLN 10 and PLN 20 and in one case a daily rate of PLN 15). Moreover, the number of rates is also not well diversified (values mostly rounded to 200, 250 or 300). The reason behind it, can be actually simple since it is easier to administer fine equal to PLN 2,000, because is composed of numbers divisible by 10, i.e., $10 \cdot 200$.

The model created in this work was done mainly for demonstration purposes. However, the values recommended by the model fit well the observed data. The key element is that the model adds clear relation between salary and financial penalty. According to the previous statistical analysis this relation was not present in the data. In fact, the simple mathematical model not only clarifies the relationship between multiple factors and the penalty, but also encourages judges to administer more just penalties.

The detection and modeling of specific relations, in turn, allows for the hypothesis that it is possible and reasonable to create a system supporting the work of a judge, proposing the content of a decision on punishment and penal measures on the basis of input data from the case file. Such a system would make it possible to facilitate work in courts in repetitive cases, in which decisions on punishment are the result of generally accepted patterns. It also allows for an elimination of typical human errors, such as an omission of a decision on an obligatory penal measure in a judgment.

The mathematical model presented in this work is based on an assumption that every sentence has to be the same given certain set of precisely defined input parameters. In other words, the authors believe that law have to be deterministic, predictable, clear and simple. Therefore, the model itself is relatively simple and deterministic. A hypothetical probabilistic model based on statistical results does not agree with the presented assumptions, however it is easy to imagine and create. Although, the penalty code allow for some variability of punishments, it is common for legislators and judges to put the effort in elimination of "luck" and noise factors from sentencing practice. Additionally, the model cannot be fully based on data, since

sentencing practice might be simplification or misinterpretation of legislators intentions. Nonetheless, statistical regression models used in this study not only confront, whether judges administer penalties as they were described by lawmakers, but also provide a general information about practicality of law articles. In the case of this study, the data suggested that financial penalty should be close to monthly salary, the relation should be linear and penalties should depend stronger on convict's income. Juxtaposition of theory described in the Criminal Code and observed data may not only help to create better deterministic models for decision support, but also improve the law itself.

The term "sentencing guidelines" typically refers to a set of prescriptive rules or standards that structure judicial discretion in order to predetermine an offender's punishment to some degree [33] [12]. The argument in favor of a system of broad judicial discretion in sentencing is that the individual circumstances of the case can be taken into account. The arguments against centre around the following points:

1. significant differences in sentences imposed in similar cases (sentences can be inconsistent within a (potentially vast) margin of error yet still legal) [25],
2. regionalisms - adopted patterns of jurisprudence in the units concerned that differ from one judicial district to another [18],
3. the pretence of a case-by-case approach abandoned in favor of agreed tariffs [43],
4. the practical impossibility of justifying the choice of a particular sentence level (e.g., 4 instead of 6 months of restriction of liberty) [39] [45] [23],
5. too wide margin of discretion [39] [45] [23].

The arguments in favor of introducing sentencing guidelines, on the other hand, are:

1. desire to achieve consistency (over the past decades, many foreign jurisdictions have undertaken considerable efforts in order to limit unwarranted disparities in their sentencing practice (for a comprehensive overview see [32])),
2. change in punishment policy [2],
3. growing awareness of racial and other disparities [38],
4. a desire to make sentencing outcomes more predictable [38].

The arguments against are:

1. dehumanising the punishment process [10],
2. disregarding the individual circumstances of the case in the adjudication process [9] [37].

It should be pointed out, however, that schematicity of sentencing need not in every case be seen in opposition to judicial discretion. Indeed, it is not an assumption of wide judicial discretion to impose different punishments in cases that are similar in terms of the relevant factors. In reality, the idea of a wide margin of discretion is to leave it open to judges to take into account all the individualizing factors of a case and to vary the level of punishment in situations that call for it. However, if, in repetitive and in the vast majority of cases, these factors requiring differentiation are not present and schematic sentencing should not be considered a flawed system.

In criminal courts a significant percent of cases are repeatable ones, i.e., the cases that are violation of the same article within the same context. An example of such a category of cases, as confirmed by the studies discussed above, are drink-driving cases in which, as a rule, there are no distinguishing circumstances other than the level of alcohol concentration. The imposition of different punishments for persons in the same circumstances is at odds with a generally accepted sense of justice. Above all, the adoption of certain standardized sentencing guidelines, whether applied by judges or by algorithmic systems supporting the work of the judge, makes it possible to eliminate in the sentencing process factors that should not have an impact on sentencing, yet, as research shows, often do. These include factors such as:

- when and what the judge ate;
- time of a day;
- how many other decisions the person has made that day (fatigue factor);
- personal values;
- unconscious or subconscious assumptions or prejudices;
- reliance on intuition;
- an attractiveness of the people involved;
- emotions [41] [7] [6] [35] [29] [24] [1] [5] [28].

Research confirms that sentencing guidelines have increased consistency and fairness of judgments, reduce the influence of non-procedural factors (racial bias, individual characteristics of the adjudicator) [13] [42]. While accepting the possibility of using sentencing schemes, the possibility of automating the process of adjusting the penalty and penal measures in a given case should be pointed out. It has already been stated, that "the sentencing guidelines are essentially an algorithm" [43].

A computer program providing a proposal for the judgment, based on case-law guidelines, would in all likelihood reduce the time it takes to recognize cases in courts. This applies both to the category of repetitive cases, where the algorithm would be applied, as well as to other cases relieving judges of some of their tasks. It allows resources to be diverted to the recognition of more complex cases that require an individual approach. Furthermore, in the case of a delivery of a draft judgment, the risk of omitting to rule on an obligatory measure of punishment or to rule on a penalty or measure at a level contrary to the statutory range decreases, if not disappears. On

the other hand, the reduction in the number of errors relieves both the prosecution units, in terms of preparing appeals aimed at the correction of sentences, and the appellate courts in terms of making such corrections. At the same time, this system is an example of a system supporting the work of the judge, not replacing him or her. Therefore, it does not violate international and constitutional principles of most countries, i.e., the right to have a case heard by an impartial court. Nor is the use of algorithmic or AI-based systems in assisting the work of the judiciary incompatible with the AIA [53], LED [55], GDPR [60], or CoE guide-lines [56]. Both European Union and Council of Europe bodies highlight issues such as the transparency of the operation of AI systems, security of personal data, protection of fundamental rights, oversight and control. There is a clear tendency to close the way to the use of fully automatic systems (e.g., the concept of AI judges), leaving the possibility of using systems that support the work of judges or law enforcement agencies without the possibility of making final decisions or decisions that have an impact in the zone of rights or interests of citizens. Currently, under GDPR and LED, such solutions are limited, but possible.

Polish common courts issue approximately 7.5 million judgments annually [57]. Undoubtedly, algorithmic systems are faster and more efficient than humans in many respects. Such a recommendation system does not get tired and therefore it can work longer and process more cases per day than a human. It is also pointed out that the system is fairer [36]. An algorithmic system is free from the influence of the non-processing factors mentioned above. Furthermore, the use of the presented algorithmic system is free from the accusations made against AI-based justice support systems, i.e., transparency, discrimination [15], poor data quality [22] [54].

5. Conclusions

The model presented in this work proved that it is possible to automate repetitive cases. Data analysis showed that only alcohol concentration is taken into account by judges that administer financial penalties. This situation is in conflict with legislator intentions, that provided a mechanism allowing to establish the amount of penalty according to convict's salary. The proposed recommendation model can not only make sentences more just, but also speed up judges work by calculating penalties with explicit formulas.

Consistency in sentencing is not only a desirable feature of all legal institutions, but also a fundamental principle of justice. It creates transparency and predictability in sentencing practice [34]. Consistency should be perceived as a value and equally to the individual approach it is recognized even in traditionally discretionary systems seeking reform of sentencing and sentencing policy, pointing out that the statutory ranges are too wide [25]. As the results of the research indicate, even in legal systems that promote a wide margin of discretion for the judge, at least in repetitive cases, sentencing takes place on the basis of accepted patterns. This scheme can be translated into algorithmic rules and further into the creation of a computer program providing a draft decision on punishment and penal measures in a given category

of cases. Software like this would support the work of the judge, saving time and minimizing errors. Depending on the punishment policy adopted, algorithmic rules may reflect practice or correct it, with the aim of achieving the legislator's specific objectives.

The goal of the research, however, was not to present *de lege ferenda* conclusions concerning legislative or system changes in the field of penalties. The results of the research make it probable, however, that in a given category of cases sentences are imposed in accordance with the adopted tariffs, ergo it is possible to improve the work of a judge in this area without detriment to the respect for fundamental rights of the participants of the proceedings. Regardless of the adopted conception, a draft decision on a penalty in a given category of criminal cases is not binding for the adjudicator. The judge may reject the proposal, and this would certainly happen in some cases. However, it can be assumed that in the remaining majority of cases, such a proposal would be accepted and, as a consequence, the introduction of this algorithm would improve the work of the courts, reduce the time taken to hear a case and reduce, if not eliminate, the number of errors. It is possible to construct an algorithm proposing a specific penalty and measure of punishment or a range, but significantly reduced in relation to the range drawn by the legislator. The case of the length of the driving ban in cases involving an offence under Article 178a §1 of the Criminal Code with an alcohol concentration of 0.8-1 mg/l can set an example. Within a discretionary framework, this approach assumes that sentences will be "reasonably consistent", reflecting an acceptance that there is no correct sentence but rather a range of correct sentences [25].

Certainly, such an algorithm would not work in all cases. But, in repetitive cases, such as those involving an act under Article 178a §1 of the Criminal Code, it is possible. It is also possible to successively search for these categories of repetitive cases and verify, by means of file research, the schematicity of adjudication and the decodability of the rules. In view of the finding that sentencing practice adopts certain patterns, the argument of eliminating through the use of this algorithm individual case approaches becomes obsolete. Partial automation of the sentencing process may help to solve or minimize one of the biggest systemic problems of the criminal justice system in Poland, the lengthiness of proceedings [51] [52].

Acknowledgments

This research was partially supported by statutory funds of Poznan University of Technology and by statutory funds of Adam Mickiewicz University.

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Received 29.08.2023, Accepted 17.10.2023