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Rethinking the concept of punishment: modeling the level of danger posed by criminals to society

Переосмислення концепції покарання: моделювання рівня небезпеки, який становлять злочинці для суспільства

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Abstract

The rapid increase in crime rates in many countries is evidence of the ineffectiveness of the current punishment system and the need to rethink the existing approach to applying punitive sanctions to criminals, taking into account the threat they pose to others. This study aims to build an analytical model for an objective assessment of the level of danger posed by suspects (convicts/prisoners) to society, based on their socio-demographic characteristics and data on previous criminal activity. To achieve this goal, discriminant canonical analysis is used as a multivariate statistical method for classifying objects. The empirical base consisted of data on 13,010 convicts serving sentences in penitentiary institutions in Ukraine. Key factors that have a significant impact on the distribution of criminals

Анотація

Стрімке зростання рівня злочинності в багатьох країнах є свідченням недієвості наявної системи покарань та необхідності переосмислення існуючого підходу до застосування каральних санкцій до злочинців з врахуванням загрози, яку вони становлять для оточуючих. Це дослідження ставить за мету побудувати аналітичну модель для об'єктивної оцінки рівня небезпеки, яку становлять підозрювані (засуджені/ув'язнені) для суспільства, на основі їхніх соціально-демографічних характеристик та даних про попередню злочинну діяльність. Для досягнення поставленої мети використано дискримінантний канонічний аналіз як багатофакторний статистичний метод класифікації об'єктів за групами. Емпіричну

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into groups (high, moderate, low) according to the level of danger they pose to society have been identified: the age at which a person was first sentenced, early dismissals, suspended convictions, education level, type of employment, the motivation for dismissal. An optimal canonical discriminant model has been constructed that allows for the accurate classification of new cases into the identified groups. The results obtained can be used in the judicial system, probation services, and law enforcement agencies to make informed decisions regarding the measure of punishment, parole, level of supervision, and ensuring public safety. The proposed applied solution can be integrated into an automated analytical system to increase the efficiency of the judicial system.

Keywords: judicial system, fair punishment, public safety, criminal behavior, digitalization, information technology, discriminant analysis, analytical model, court decisions, court.

базу склали дані про 13010 засуджених, які відбувають покарання в установах виконання покарань України. Виявлено ключові фактори, які мають суттєвий вплив на розподіл злочинців на групи (high, moderate, low) за рівнем небезпеки, яку вони становлять для суспільства: the age at which a person was first sentenced, early dismissals, suspended convictions, education level, type of employment, the motivation for dismissal. Побудовано оптимальну канонічну дискримінантну модель, що дозволяє точно класифікувати нові випадки за виділеними групами. Отримані результати можуть бути використані в судовій системі, службами пробації та правоохоронними органами для прийняття обґрунтованих рішень щодо міри покарання, умовно-дострокового звільнення, рівня нагляду й забезпечення безпеки громадян. Запропоноване прикладне рішення може бути інтегровано в автоматизовану аналітичну систему для підвищення ефективності системи судочинства.

Ключові слова: судова система, справедливість покарання, суспільна безпека, злочинна поведінка, цифровізація, інформаційні технології, дискримінантний аналіз, аналітична модель, судові рішення, суд.

Introduction

The crime rate is steadily increasing in many countries, causing serious concern in society and posing new challenges for law enforcement and justice systems (Gruszczyńska & Gruszczyński, 2023). This trend poses a serious threat to public safety and negatively affects economic development (Galinari & Bazon, 2021; Anser et al., 2020; Adela & Aldhaheri, 2024) undermines citizens' sense of security, and causes a decline in trust in law enforcement and the judicial system (Kulachai & Cheurprakobkit, 2023). The current trends require a comprehensive analysis of the reasons for such negative dynamics and the development of effective ways to counteract this phenomenon at the international and national levels. At the same time, the fight against crime requires a comprehensive approach, which includes not only increasing the efficiency of law enforcement agencies but also taking into account the "prison paradox", according to which an increase in the number of prisoners does not have a significant impact on reducing crime and causes additional costs (Stemen, 2017).

Society must be aware that not all criminals are hardened and incorrigible. Often, people commit illegal acts due to a combination of circumstances, recklessness, or the influence of a negative environment. In such cases, it is advisable to distinguish between offenders who do not pose a significant threat to society and hardened criminal elements. Providing prospects for resocialization and correction for the first category reduces the burden on the penitentiary system and opens the way for these people to return to a law-abiding society. The issue of giving a chance for correction to certain categories of offenders is relevant and justified (Letlape & Dube, 2023). Applying rehabilitation programs, psychological support, vocational training, and involvement in socially useful work to them, provided that they sincerely repent and desire to be corrected, may be a more effective approach than simply isolating them. This will save resources and at the same time preserve the chance for a dignified life for those who can realize their mistakes (Legodi & Dube, 2023). At the same time, the approach to hardened, incorrigible criminals should be strict and uncompromising, as they have consciously chosen the illegal path and pose a significant threat to public safety. They should be subject to the strictest measures by the law. Distinguishing between offenders and taking an individual approach to each case, taking into account the level of danger they pose to society, is justified and necessary

in terms of humanity and common sense. Giving a chance for correction to those who can get on the path of correction is not indulgence, but an investment in a safe future for society. An effective crime prevention strategy should combine repressive measures with preventive ones, focusing on eliminating the root causes of the problem and creating an enabling environment for the law-abiding behavior of citizens. For effective crime detection and prevention, it is important to analyze the person of the criminal, and not just the fact of committing the crime (Kamaluddin et al., 2021). Focusing on the criminal and the danger they pose to others, and not just on the crime itself, allows for a better understanding of the causes of illegal behavior, identifying risk factors, the level of threat to society, and developing individual approaches to rehabilitation and resocialization.

An objective assessment of the level of danger that a suspect (convict/prisoner) poses to society is an important element in ensuring the rule of law, justice, a balance of interests, and increasing the efficiency of the judicial system. Such an assessment is based on a comprehensive analysis of various individual characteristics to determine a person's propensity to repeat illegal actions, their social adaptability, and the possibility of successful resocialization after release. The obtained information can help the court impose a punishment that corresponds to the degree of public threat posed by the committed crime and the personality of the offender. This contributes to the realization of the principle of justice as a fundamental principle of the judiciary. Taking into account the danger posed by the convicted person to others makes it possible to individualize the punishment given the specific circumstances of the case and the person of the criminal, which corresponds to the general legal principle. Based on such data, the court can properly balance the objectives of punishment for the committed crime and the prevention of possible new offenses in the future. Knowledge about the level of danger that a convict poses to society will allow the court to properly protect public safety and the rights of victims of crime. This creates the prerequisites for choosing appropriate rehabilitation measures and programs for the successful resocialization of offenders after serving their sentences. Taking into account objective data on the level of threat posed by the accused to others when passing sentences makes the judicial process more understandable and acceptable to society.

These are important guidelines for the court when making decisions regarding punishment, parole, pardon, and ensuring safety in the administration of justice. It is also one of the key factors that the court takes into account when choosing the type and length of punishment. Assessing the level of danger that an offender poses to society allows the court to assess the risks and make a reasoned decision about the possibility of early release or the need to serve the full term of punishment (Kovalchuk et al., 2023a). The court can use information about the level of danger to establish additional restrictions or obligations for the convicted person after their release, for example, a ban on approaching certain places or persons, and to take the necessary safety measures during the trial.

Information about the level of danger that a convicted person poses to society is important for a wide range of institutions, including courts, penitentiary institutions, and institutions for the resocialization of offenders. Penitentiary institutions use this information for the proper distribution of convicts by detention regimes, ensuring the safety of staff and other inmates. Probation officers must have this data to properly organize supervision and social support for convicts after release. Assessing the danger that criminals pose to society helps the police and law enforcement agencies determine priorities, plan crime prevention measures, and ensure proper supervision of released convicts. Such data is used for planning rehabilitation and resocialization programs for convicts. Psychological and psychiatric institutions use this information to determine necessary therapeutic measures, reduce risks, and correct the behavior of convicts. The rapid increase in the amount of data that needs to be considered in the administration of justice is one of the key reasons for the need to automate the determination of the level of danger that a convicted person poses to society. For an objective assessment, a huge number of factors must be taken into account, from biographical data to psychological profiles and details of criminal cases (Onyeneke & Karam, 2022; Kovalchuk et al., 2023b). Manual processing of such a large amount of information is becoming increasingly difficult. In the digital age, a lot of information about a person's behavior, connections, and intentions is contained in their online activity, social networks, etc. Analyzing this "digital footprint" requires specialized tools. In addition, to fully assess the level of danger that criminals pose to society, it is necessary to consolidate and process information from various sources - from police databases to social services. Modern jurisprudence requires a rapid response, so manual processing of large amounts of data can no longer keep up with the needs.

For the effective functioning of the justice system, it is an objective necessity to automate the assessment of the danger that convicts pose to society. Effective tools for implementing this process can be statistical

methods and the latest information technologies. Applied models built on their basis are capable of quickly and qualitatively analyzing large information arrays and identifying patterns and trends in determining the level of danger posed by certain categories of convicts. They can also be applied to new datasets about criminals. Such models are based on statistical data and algorithms, which increases impartiality and eliminates possible human factors. Algorithmization ensures consistency of assessment by applying the same criteria to all cases, unlike human expert analysis, where deviations are possible. Analytical models can provide significant objective knowledge in assessing the level of danger that criminals pose to society, and simplify and accelerate this process. For Ukraine, such studies are innovative. So far, the assessment of the danger that criminals pose to society is carried out manually, which necessitates the urgent need to develop reliable applied solutions.

The purpose of this study is to build an analytical model for assessing the level of danger posed by suspects (convicts/prisoners) to society, based on their socio-demographic characteristics and information about previous criminal activity. The study objectives are formulated to:

- Identify the main factors influencing the distribution of suspects (convicts/prisoners) into groups (high, moderate, low) according to the level of danger they pose to society;
- Assess the magnitude of the influence of each of the identified factors in the distribution of criminals into the selected groups.
- Record the optimal analytical discriminant model for assessing the level of danger posed to society by suspects (convicts/prisoners) who were not included in the initial dataset.

Literature Review

The issue of ensuring fairness in punishment and finding alternatives to incarceration is one of the most pressing and debated topics in academic and legal circles. However, most existing studies have certain limitations, as they focus on a narrow category of crimes or offenders and often have a pronounced territorial specificity – based on the peculiarities of national legislations, principles, and approaches to sentencing, as well as forms of serving sentences in a particular country or region (Wang & Zhang, 2023). O. Arandjelović analyzed incarceration and its admissibility as a punitive instrument of justice. He demonstrated that incarceration does not meet the key criteria for fair punishment and can be adequately mitigated, under the severity of the crime (Arandjelović, 2023). The authors B. Gruszczyńska and M. Gruszczyński evaluated the relationship between crime rates and the number of prisoners in European countries based on a correlation-regression analysis of four types of offenses: assault, rape, robbery, and theft. The researchers found that the level of prison occupancy is directly related to the peculiarities of the state's criminal law policy, in particular, the harshness or liberalism in matters of choosing the measure of punishment and determining the terms of imprisonment for offenders Gruszczyńska & Gruszczyński, 2023). S. Caridade et al., analyzed the individual and social environment associated with criminal activity (Caridade, 2022). K.M. Berezka et al. found that early involvement in the criminal environment is a significant risk factor for committing repeated offenses (Berezka et al., 2022). Many studies on identifying non-obvious signs associated with a person's future criminal activity and decision-making regarding crime prevention specifically concern crimes committed in adolescence. Aazami et al., conducted a literature review on risk factors, protective factors, and interventions related to juvenile delinquency (Khachatryan & Heide, 2023; Lee et al., 2023). In their study, they identified multidimensional factors that influence delinquent behavior in adolescents (Aazami et al., 2023). Researchers L.S. Galinari and M.R. Bazon studied the behavioral and psychosocial characteristics of juvenile offenders in Brazil, based on empirical data collected in the context of Brazilian socio-cultural reality. They developed a four-class model, where different profiles were identified, indicating differences between juvenile offenders both in psychological functioning and types of criminal behavior, as well as in psychosocial risk/protective factors associated with each profile. The results obtained can contribute to improving the assessment necessary for informational support of court decisions (Galinari & Bazon, 2021).

The issue of assessing the level of risk that criminals pose to society, imposing fair punishment, and effective alternatives to incarceration is of universal importance and requires comprehensive interdisciplinary study, taking into account global trends, international experience, and the latest achievements in the fields of psychology, jurisprudence, criminology, the penitentiary system, offender rehabilitation, public safety, and the applied use of statistical methods and information technologies. Only

such comprehensive and systematic research can provide answers to pressing challenges and offer balanced and effective solutions in this area.

Methodological approach and data sources

This article uses a multidisciplinary approach, which involves applying analytical methods and IT tools to process and analyze legal data to obtain new valuable knowledge and support decision-making in the judiciary. One such important decision is determining the level of danger posed by a convict, which ensures a balance between protecting society, implementing the principles of fair justice, and successful reintegration of offenders after serving their sentences.

To create an analytical model for assessing the level of danger posed by criminals to society, discriminant canonical analysis was used (Boedeker & Kearns, 2019). This is a statistical method used to predict the belonging of objects or observations to certain groups or categories based on a set of measured variables. Its main goal is to find a linear combination of independent variables (a discriminant function) that best separates or discriminates between groups. There are several predefined groups or categories to which objects belong. There is a set of independent variables (predictors) that are measured for each object. A discriminant function is constructed, which is a linear combination of independent variables. It maximizes the differences between groups and minimizes the differences within groups. Using the discriminant function, new objects with unknown group membership can be classified into the appropriate group based on their values of the independent variables. Discriminant analysis is a useful tool for identifying the most important variables that distinguish groups and creating classification rules for new observations.

We applied this multivariate statistical method to classify convicts according to the level of danger (high, moderate, low) they pose to society and to identify the most significant predictors for distinguishing these groups. The empirical analysis was performed based on information from the criminal histories of 13,010 convicts serving sentences in penitentiary institutions in Ukraine. The initial dataset contains information about the individual and social characteristics of convicts and their previous criminal activity.

Table 1 presents the variables of the initial dataset, their description, and possible values.

Table 1.
Input data set description

Variable	Description	Value
RR	Recidivism rate	Low; moderate; high
AGE	Age at the time of the study	Integer
AAP	Age at which a person was first sentenced to actual imprisonment	1 – age lower than 18; 2 – age between 18 and 30; 3 – age between 30 and 45; 4 – age higher than 45
AAS	Age at which a person was first sentenced to actual imprisonment or given their first suspended sentence	1 – age lower than 18; 2 – age between 18 and 30; 3 – age between 30 and 45; 4 – age higher than 45
ED	Existence of early dismissals	Integer
SC	Number of suspended convictions	Integer
SEX	Sex	1 – male; 2 – female
MS	Marital status	1 – male; 2 – female
EL	Education level	0 – incomplete secondary; 1 – secondary; 2 – special secondary; 3 – incomplete higher, 4 – higher
PR	Place of residence	1 – rural area; 2 – urban area
TE	Type of employment	0 – unemployed; 1 – part-time4; 2 –full-time
MD	Motivation for dismissal	0 – no; 1 – yes

For empirical research, the software package Statistica was used (TIBCO, 2024).

Results and Discussion

Discriminant analysis was used to predict the level of danger (high, moderate, low) that convicts pose to society. One of the conditions for its applicability is the independence of the variables (predictors) used to distinguish between groups. Table 2 presents the correlation coefficients for all pairs of predictors (Boedeker & Kearns, 2019).

Table 2.
Correlations Matrix, $p < 0.05$

Variable	AGE	SEX	AAP	AAS	PR	TE	EL	SC	MS	ED	MD
AGE	1.00	-0.05	0.37	0.34	-0.03	0.06	0.08	-0.01	0.12	0.15	-0.01
SEX	-0.05	1.00	-0.18	-0.18	-0.03	-0.05	-0.02	0.02	0.02	0.08	-0.07
AAP	0.37	-0.18	1.00	0.87	-0.05	0.13	0.18	-0.13	0.11	-0.21	0.06
AAS	0.34	-0.18	0.87	1.00	-0.05	0.13	0.18	-0.23	0.10	-0.23	0.05
PR	-0.03	-0.03	-0.05	-0.05	1.00	0.11	0.15	0.05	-0.01	0.03	0.04
TE	0.06	-0.05	0.13	0.13	0.11	1.00	0.24	-0.06	0.16	0.02	0.16
EL	0.08	-0.02	0.18	0.18	0.15	0.24	1.00	-0.05	0.11	-0.06	0.08
RC	0.25	0.10	0.36	0.35	0.05	-0.09	-0.10	0.12	-0.03	0.41	-0.08
SC	-0.01	0.02	-0.13	-0.23	0.05	-0.06	-0.05	1.00	-0.01	0.19	0.01
MS	0.12	0.02	0.11	0.10	-0.01	0.16	0.22	-0.01	1.00	0.03	0.12
ED	0.15	0.08	-0.21	-0.23	0.03	0.02	-0.06	0.19	0.03	1.00	0.02
MD	-0.01	-0.07	0.06	0.05	0.04	0.16	0.08	0.01	0.12	0.02	1.00

A dense correlation (0.87) is identified only for one pair of variables – AAS and AAS. This means that the earlier a person was involved in the criminal environment (was sentenced to probation or a real measure of punishment), the earlier they ended up in penitentiary institutions. Usually, for a crime that is not serious and committed by a person for the first time, convicts receive a suspended sentence. Therefore, the dense correlation between AAS and AAS may indicate that such offenders commit repeated offenses.

The purpose of the empirical analysis is to find a linear combination of the studied independent variables that best distinguishes between groups of convicts according to the level of danger they pose to society. The Wilks' Lambda value of $0.154 \in [0; 1]$ and close to 0 (Table 3) means that the discrimination is good. $F_{0.01}(24, 25991) = 1674.093$, which is greater than the critical value of the F-distribution: $F_{0.01}(24, \infty) = 1.73$. We reject the hypothesis that the observations belong to one group. Therefore, the application of discriminant analysis is justified. The classification of convicts according to the levels of danger they pose to society is correct.

Table 3.
Discriminant Function Analysis Summary

N=13010	Wilks' Lambda		Partial Lambda	F-remove (2,12996)	*p* -value	Toler.	1–Toler. (R–Sgr.)
AGE	0.155405		0.992865	46.70	0.000000	0.697508	0.302492
SEX	0.154332		0.999768	1.51	0.221521	0.963353	0.036647
AAP	0.154296		0.999997	0.02	0.979302	0.258612	0.741388
AAS	0.156452		0.986216	90.82	0.000000	0.272661	0.727339
PR	0.154296		0.999996	0.02	0.977029	0.959792	0.040209
TE	0.154431		0.999123	5.70	0.003348	0.897345	0.102655
EL	0.154408		0.999274	4.72	0.008898	0.906854	0.093146
SC	0.330977		0.466183	7440.73	0.000000	0.608070	0.391930
MS	0.154314		0.999881	0.77	0.460899	0.944172	0.055828
ED	0.157246		0.981241	124.23	0.000000	0.942936	0.057064
MD	0.154424		0.999168	5.41	0.004475	0.955719	0.044281

Table 3 presents the estimates of the discriminant function and predictors for constructing the classification function. The predictors AGE, AAS, TE, EL, SC, ED, and MD have high statistical significance ($p < 0.01$). SEX, AAP, PR, and MS ($p > 0.05$) are not significant for the distribution of convicts into groups according to the level of danger they pose to society. Both Wilks' Lambda and Partial Lambda estimates can take values ranging from 0 to 1. Wilks' Lambda = 0 means complete discrimination, and Wilks' Lambda = 1 means no discrimination. The closer the Partial Lambda value is to 1, the smaller the contribution of the corresponding variable to the discrimination model. The closer this value is to 0, the greater the contribution

of the corresponding variable to the discrimination model. The variable SC has the highest weight for discrimination since Wilks' Lambda = 0.33 for this variable is the highest, and its Partial Lambda value = 0.47 is the lowest among all predictors (Table 3). Therefore, the number of suspended convictions has the greatest impact on the distribution of convicts into groups according to the levels of danger they pose to society. The leniency of the judicial system creates a feeling among criminals that criminal activity may go unpunished. This encourages them to commit new crimes and create threats to others.

F-remove is a statistical measure used to assess the importance of individual predictors (independent variables) in a discriminant model. A high F-remove value for a particular predictor indicates that this predictor makes a significant contribution to the discrimination between groups in the discriminant model, i.e., it is important for classifying observations. A low F-remove value indicates that the corresponding predictor has little influence on classification, and it can be safely removed from the model without significant loss of discriminatory ability. The highest value among all variables F-remove = 7440.73 is for SC. This confirms its greatest influence on discrimination.

Table 4 presents the classification matrix for verifying the correctness of the training samples.

Table 4.
Classification Matrix

	Rows: Observed classifications Columns: Predicted classifications			
Group	**Percent Correct**	**High p = 0.13**	**Moderate p = 0.32**	**Low p = 0.54**
High	97.64	1698	41	0
Moderate	98.55	0	3862	57
Low	99.17	0	61	7291
Total	98.45	1698	3964	7348

From the obtained classification matrix, we can conclude that 159 out of 13,010 convicts were incorrectly assigned to the identified groups based on the level of danger they posed to society (Table 4). However, the squared Mahalanobis distances of these objects to the groups they were assigned to are smaller than the distances to the centers of other groups (Table 5). For example, for object 8, the squared Mahalanobis distance to the "high" group it was assigned to is 16.11. It is smaller than the distances to the centers of other groups – 16.17 to the "moderate" group and 34.04 to the "low" group. Therefore, the classification of these objects into the previously identified groups is correct. There is no reason to exclude these objects from the analyzed sample.

Table 5.
Squared Mahalanobis Distances from Group Centroids (fragment)

Case	Observed Classif.	High p = 0.13	Moderate p = 0.32	Low p = 0.54
***8**	High	16.11	16.17	34.04
***18**	High	17.68	18.80	36.81
***48**	High	13.28	13.44	26.77
***71**	High	9.99	10.63	31.57
***252**	Moderate	28.62	6.83	6.90
***296**	Moderate	27.81	6.30	7.16
***307**	Moderate	32.65	11.30	12.30
***360**	Moderate	29.23	5.48	6.05
***327**	High	11.23	11.82	30.40
***775**	High	6.70	8.31	28.34
***1334**	Moderate	38.81	14.01	14. 13
***1782**	Moderate	27.81	6.30	7.16
***2305**	High	15.60	16.40	31.40
***3611**	Moderate	31.18	5.84	6.25
***4608**	Moderate	31.71	9.41	9.98
***4962**	Low	46.87	14.24	14.06
***5464**	Low	51.76	17.26	17.18
***5803**	Moderate	39.40	14.66	14.77
***7802**	Moderate Moderate	30.96	7.18	8.00
***9443**	High	29.23	5.48	6.05
***12993**		23.42	23.51	39.97
***13006**	Moderate	31.71	9.41	9.98

Table 6 presents the estimates of the discriminant function. The Wilks' Lambda value (0.15) indicates the presence of a difference between the groups. In discriminant analysis, Wilks' Lambda is an estimate of the influence of each level of the independent variable on the model and is measured from 0 to 1. Wilks' Lambda equal to 0 means complete discrimination, and equality to 1 means no discrimination (Statistics How To, 2024).

The value of the canonical correlation coefficient R equal to 0.91 indicates the existence of a strong correlation. The calculated value of the Chi-squared test $\chi^2(24) = 24298.30$ for $p < 0.01$ is greater than the critical value $\chi^2(24) = 10.856$. Therefore, there is a strong relationship between the discriminant function and the identified groups of danger that convicts pose to society (Table 6).

Table 6.
Chi-Square Tests with Successive Roots Removed

Roots Removed	Eigen-value	Canonical R	Wilks' Lambda	Chi-Sgr.	Df	*p*-value
0	5.088689	0.914200	0.154296	24298.30	24	0.00

We performed classification based on the classification functions. The method finds a linear combination of predictor variables (the discriminant function) that maximizes the difference between groups and minimizes variation within the group (Boedeker & Kearns, 2019). Table 7 presents the coefficients of the classification function for each class.

Table 7.
Classification Functions; grouping: RR

Variable	High $p = 0.13$	Moderate $p = 0.32$	Low $p = 0.54$
AGE	7.73	6.33	5.14
SEX	17.67	17.56	17.31
AAP	0.95	2.16	3.81
AAS	0.30	0.28	1.36
PR	3.02	2.77	2.63
TE	0.19	0.31	0.52
EL	0.34	0.34	0.45
SC	2.63	1.41	0.49
MS	-1.77	-1.55	-1.51
ED	2.36	1.44	-0.22
MD	8.00	8.22	8.65
Constant	-32.69	-27.10	-26.05

The analytical representation of the optimal (containing only significant predictors) canonical discriminant model is presented as follows:

$$\text{high} = -32.69 + 7.73\times \text{AGE} + 0.30 \times \text{AAS} + 0.19 \times \text{TE} + 0.34 \times \text{EL} + + 2.63 \times \text{SC} + 2.36 \times \text{ED} + 8.00 \times \text{MD};$$

$$\text{moderate} = -27.10 + 6.33 \times \text{AGE} + 0.28 \times \text{AAS} + 0.31 \times \text{TE} + 0.34 \times \text{EL} + 1.41 \times \text{SC} + 1.44\times \text{ED} + 8.22 \times \text{MD};$$

$$\text{low} = -26.05 + 5.14 \times \text{AGE} + 1.36 \times \text{AAS} + 0.52 \times \text{TE} + 0.45 \times \text{EL} + + 0.49 \times \text{SC} - 0.22 \times \text{ED} + 8.65 \times \text{MD},$$

where AGE is the age at the time of the study, AAS is the age at which a person was first sentenced to actual imprisonment or given their first suspended sentence, ED is early dismissals, SC is several suspended convictions, EL is education level, TE is a type of employment, MD is the motivation for dismissal.

Thus, the number of suspended convictions has the maximum impact on assessing the level of danger that criminals pose to society: the coefficients for this variable (2.63, 1.41, 0.49 for the high, moderate, and low

groups, respectively) are the most different for different groups. An increase in the number of suspended convictions increases the level of threat that the offender poses to others. The age of the convict is also a risk factor – criminals with criminal experience pose a greater danger. Resocialization has not yet fully fulfilled its main function – not all criminals become law-abiding citizens. An interesting result is obtained regarding early dismissals: this variable is inversely correlated with the "low" group. This means that parole does not contribute to reducing the level of threat that prisoners pose to others. The level of education has a greater impact when distributing prisoners into the "low" group. Therefore, education correlates with a lower level of danger that a convict poses to society. These results confirm the estimates obtained by other authors (Onyeneke & Karam, 2022; Ades & Mishra, 2021). Employment has a greater impact on the distribution of objects into the "low" group: individuals who have a permanent job pose less danger to others. Similar conclusions were drawn by other researchers (Zungu & Mtshengu, 2023). The motivation for dismissal does not significantly affect the distribution of prisoners into the identified groups, but it is more inherent in individuals who pose less threat to society. This issue has not been studied in the literature, so it requires additional attention and further detailed analysis.

The obtained discriminant model is a system of linear equations (linear combinations of independent variables) that will optimally distribute convicts (suspects) into the corresponding groups (high, moderate, low) according to the level of public danger they pose to society. With the help of these functions, new observations can be classified. They are assigned to those classes whose classification values are maximum.

Fig. 1 shows a scatterplot of canonical values. It visualizes the contribution of each of the discriminant functions to the distribution of criminals into groups according to the level of danger they pose to society.

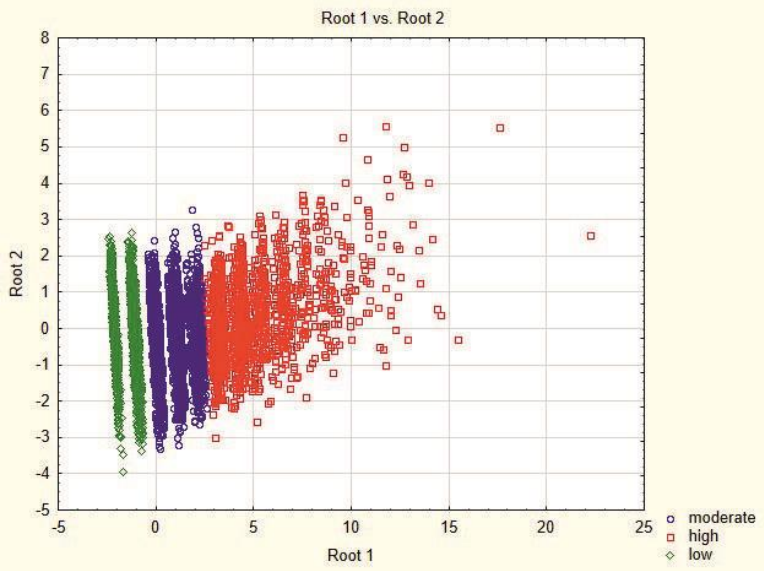

Figure 1. Scatterplot of Canonical Values for Criminal Danger Level Groups.

Each of the 13,010 observations (prisoners) is represented by a point on the graph. The points represent the canonical scores, which are the values of the canonical variables derived from the original data. Points belonging to the same group (high, moderate, low) according to the level of public danger that criminals pose to society are marked with the same color and symbol. Points within the moderate and low groups are clustered compactly. For the high group, which is the smallest among the others, there is the highest dispersion of points, indicating the presence in this group of persons convicted of serious or particularly serious crimes, serving long sentences, and having no suspended sentences or early releases. The distances between the groups are large enough for acceptable discrimination of objects. Therefore, the canonical analysis performed is of high quality.

The constructed canonical discriminant model can be used to assess the level of danger posed by suspects (convicts/prisoners) for new datasets on criminals. The obtained knowledge can be used by the court in determining the measure and term of punishment, establishing the possibility of parole; by the probation service to choose the appropriate level of supervision and control over the released convict; by law

enforcement agencies to take appropriate measures to prevent crime and protect citizens. An objective assessment of the level of danger that a convict poses to society is an important element in ensuring the rule of law, and justice, maintaining a balance between the imposition of punitive sanctions commensurate with the degree of illegal behavior, and ensuring public safety, and increasing the efficiency of the judicial system as a whole.

Conclusions

The traditional justice system typically focuses primarily on the very facts of the crime committed and the circumstances of its commission. However, a more comprehensive approach is needed for effective crime prevention and ensuring a proper balance between public safety, the realization of the principles of justice, and the successful reintegration of offenders into society after serving their sentences. It is necessary to rethink the system of punishments in such a way that it takes into account not only the circumstances of the illegal behavior but also the personal characteristics of the offender, their motivation, the possibility of correction, and, most importantly, the level of threat they pose to others.

The article examines the problem of automating the assessment of the level of danger posed by suspects (convicts/prisoners) to society. An empirical analysis was conducted based on data on 13,010 convicts serving sentences in Ukrainian penitentiary institutions. An analytical model was developed to assess the level of danger posed by criminals to society based on their socio-demographic characteristics and information about previous criminal activity. Significant factors influencing the distribution of criminals into groups (high, moderate, low) according to the level of danger they pose to society were identified: the age at which a person was first sentenced, early dismissals, suspended convictions, education level, type of employment, and the motivation for dismissal. An optimal canonical discriminant model was developed for classifying new cases into the identified groups.

The presented research was conducted within the framework of developing a unified analytical judicial system in Ukraine and is part of the digitalization of justice. The presented applied solution is not without limitations, as it does not take into account all factors that may be associated with the danger posed by a criminal to society. In particular, adverse family circumstances, mental state at the time of the crime, etc. We plan to study this issue in depth in future research. However, the obtained knowledge can be used by courts when imposing sentences, their measures and terms, as well as when considering issues of parole; by the probation service – to determine the appropriate level of supervision and control over former prisoners after release; by law enforcement agencies – to introduce appropriate measures to prevent crime and ensure the safety of citizens. This will ensure the consistency and impartiality of relevant processes in the justice system, improve public safety, and ensure the proper resocialization of offenders.

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