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Spatial Behaviour of Robbery Offenders in the City of Zagreb

Abstract

In recent decades, increasing attention has been given to the visualisation and analysis of the spatial component of crime in combination with other features that jointly constitute the entirety of a criminal event. This study examined a sample of 165 robbery offences from 2018 linked to known offenders, for which journey-to-crime distances were calculated. These distances were used to calibrate five distance-decay functions: linear, negative exponential, normal, lognormal, and truncated negative exponential. Based on the calibrated parameters of the distance-decay functions, the function that best describes the distribution of journey-to-crime distances was identified. The calculated journey-to-crime distances show a decreasing trend with distance, with over 60% falling within 6 km of the travelled path. Calibration results for the five most commonly used distance-decay functions showed that the truncated negative exponential function best describes the distribution of criminal journeys. Furthermore, the study examined the incidence of criminal offences in relation to travelled distance and time of commission, showing an upward trend towards shorter distances during the night and morning hours, whilst during the day, there was greater variation in distance travelled. The study demonstrated that men in the 21-30 age group dominated robbery offences and showed the greatest variation in distance travelled, and that generally male offenders exhibited greater variations in both distances travelled and times of commission compared to female offenders.

Keywords: *robbery, characteristics of perpetrators and crimes, distance decay functions.*

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1. INTRODUCTION

The spatial component of crime is an essential variable for understanding the phenomenon of crime. Environmental criminology, which explains the spatial patterns of crime, is involved in empirical research that is proverbially applied in criminal investigations worldwide. Today's systems for processing spatial data, such as geographic information systems (GIS), and their increasingly widespread application have opened up the possibility of analysing and visualising spatial data within criminal analyses, both in practical application and in empirical research. Criminal analyses based on geocoded data provide insights into spatial patterns of crime, thus enabling an interactive and dynamic study of criminal offence data in time and space (Ceccato 2008). Environmental criminology explains spatial patterns of crime, and its empirical research is proverbially applied in criminal investigations worldwide. Environmental criminology is a common term for several criminological theories that explain the spatial patterns of offenders' movement and the influence of the environment on the choice of location for committing a crime, with regard to awareness space, rational choice, and the offender's routine activities.

Environmental criminology investigates movement in relation to different characteristics of the perpetrator, type of victim, and cultural specifics (Goodwill et al. 2013). According to Andresen (2009), the theories it investigates in a scientific sense are: routine activity theory, rational choice theory, the geometric theory of crime, and crime pattern theory. Routine activity theory was developed by Cohen and Felson (1979). The basic concept lies in the fact that a criminal act occurs in the convergence of space and time of a motivated offender with an appropriate, attractive target of attack in the absence of adequate social control (police, security guards, etc.) that could deter a potential perpetrator from committing a criminal offence as a component of their everyday, usual legal activities (Kannan and Singh 2021). Each individual creates their awareness space, which is familiar and known to them and in which they feel safe. It encompasses the environment along daily routes where the perpetrator and victim intersect in time and space (Anselin 2000).

Rational choice theory explains the decision-making process of an individual and is used to model social and lucrative behaviour. In criminology, it explains the logic of perpetrators' decision-making when selecting the place of crime commission, stemming from the fact that the effort invested justifies the final reward (Brantingham and Brantingham 1995). Most perpetrators will not unjustifiably travel long distances and will seek the easiest way to commit a criminal offence. The theory also assumes a buffer zone around the perpetrator's residence, within which they refrain from committing crimes out of fear of recognition and arrest. Crime is not randomly and uniformly distributed in space (Trotta 2014; Di Bella et al. 2015). The geometric theory of crime explains criminal patterns by modelling them with the following geometric components: paths, nodes, activity areas, and the perpetrator's awareness area, enabling subsequent crime analysis using spatial information systems. A node is a place where an individual usually stops for certain legal and illegal activities for a certain period. Nodes mainly include the location of residence, office, favourite entertainment spot, cafés, shops, and family and friends' residences. Paths are routes that individuals use to move between nodes (Bernasco 2010).

According to the Brantinghams (1995), urban environments that create criminal opportunities and fear of victimisation are a by-product of the built environment of our everyday life, such as houses and neighbourhoods, shops, businesses, sports, and entertainment

facilities, and the like. Furthermore, the urban environment can be divided into several types that should be taken into account: places that are crime generators, places that attract crime (so-called attractors), and neutral places. Generators are places that attract a large number of people for reasons unrelated to crime, such as shopping centres, city centres, sports stadiums, and public transport stations. Such places are part of the activity space of many people, and the paths of perpetrators and victims intersect in time and space at these locations. Unlike generators, attractors are known places for their criminal opportunity for a certain type of crime, which attract motivated perpetrators, such as bars, places with a high concentration of prostitution, drug abuse, and the like. Neutral places are those that do not create criminal opportunities and where crime occurs only occasionally and randomly. This theory assumes the existence of hot and cold spots. Hot spots are areas of high crime concentration, while cold spots are areas with few or no random criminal events.

2. GEOGRAPHICAL PROFILING

The methodology of geographical profiling is based on the theories of environmental criminology and includes the establishment of a geographical profiling model for the area of research. It was defined by Rossmo (2000: 216): "Geographic profiling is an investigative support technique that analyses the locations connected to a series of crimes to determine the most probable area of offender residence".

Therefore, the main task of geographical profiling, based on the locations of a connected series of crimes, is to determine where the most likely residence or anchor point of a serial offender is located for more economical distribution of police forces and prioritisation of suspects, and it represents a practical application of various geographical, criminological and psychological principles (Goodwill et al. 2013). According to Kent and Leitner (2009), this methodology uses two types of spatial models: spatial distribution models, based on various statistical formulations, and spatial interaction models, based on various distance-decay functions (O'Leary 2010).

2.1. Criminal journey and the distance decay effect

The length of the criminal journey is one of the important variables that characterise the geography of crime, and the existence of a distance-decay effect in such a journey is well known (Rossmo & Wheeler, 2024; Andresen, Frank, and Felson, 2014; O'Leary, 2011; Bernasco, 2006). The function has its maximum near the perpetrator's residence, but outside the buffer zone located in its immediate vicinity. As the distance from the residence increases, the probability of a criminal event decreases.

A distance-decay function can analytically represent the probability of a criminal offence occurring at a specific location. The distance-decay function is the relationship between the probability of a crime and the distance of the crime scene from the perpetrator's residence (Canter et al. 2000). According to Levine (2013), the Journey-to-Crime (JTC) routine is defined by a grid over the research area. Locations of a defined series of criminal events that are linked to the same perpetrator are entered, and the distance from each given location to the

centroid of each grid cell is calculated. A calibrated distance decay function is applied to the calculated distances to determine the probability of residence for each grid cell. By summing the residence probabilities from different locations of criminal events and selecting the highest value, the area with the highest probability of the perpetrator's residence is identified. Fig. 1 shows the logic of the routine.

Fig. 1 Logic of the JTC routine (Levine 2013)

In the practical part, the routine consists of two components. The first is the calibration of the optimal distance-decay function using a large number of crime journeys from solved cases. The second part is implementing the parameters of the selected function into the model and calculating the routine.

Five commonly used distance decay functions, also implemented within the *CrimeStat* software package, are as follows [15]:

- Linear function: $f(d) = A + Bd$;
- Negative exponential function: $f(d) = Ae^{-\beta d}$;
- Normal function: $f(d) = A(2\pi S^2)^{-1/2} exp\left[-\left(d - \bar{d}\right)^2 / 2S^2\right]$;
- Lognormal function: $f(d) = A(2\pi d^2 S^2)^{-1/2} exp\left[-\left(\ln d - \bar{d}\right)^2 / 2S^2\right]$;
- Truncated negative exponential function

$$f(d) = A(2\pi d^2 S^2)^{-1/2} exp\left[-\left(\ln d - \bar{d}\right)^2 / 2S^2\right];$$

$$f(d) = Bd \quad \text{za} \quad d < C$$

and

$$f(d) = Ae^{-\beta d} \quad \text{za} \quad \mathrm{d} \geq \mathrm{C}$$

In the following text under the calibration chapter, the graphs of each calibrated function are presented separately, along with descriptions of the reference values used in their calibration.

3. GEOGRAPHICAL PROFILING OF ROBBERY OFFENDERS IN THE CITY OF ZAGREB

The research aimed to examine the spatial movement patterns of robbery offenders in the City of Zagreb in 2018[1]. Data were collected from official sources of the Criminal Intelligence Analytics Service of the Criminal Police Directorate of the Ministry of Interior of the Republic of Croatia.

According to the statistics of the Zagreb Police Administration for the period from 2010 to 2018, the criminal offence of robbery constitutes a large proportion of total crime on an annual basis, with case clearance rates below 60% (Fig. 2). Among robbers, there is a significant number of (multiple) reoffenders, and given the frequency of this type of criminal offence, it can be asserted that it represents a significant security threat to citizens of the Republic of Croatia.

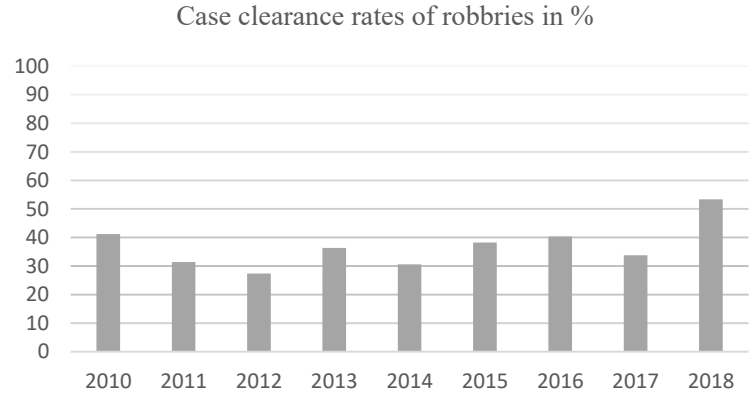

Fig. 2 Percentage of case clearance rates for the Zagreb Police Administration 2010-2018 (https://zagrebacka-policija.gov.hr/statistika/90)

3.1. Calibration of distance decay functions

As a first step, the calibration of the five most commonly used distance-decay functions was conducted to examine which function best describes the spatial movement of offenders and whether the distance-decay effect is observed among perpetrators of robbery offences in the City of Zagreb. For calibrating distance-decay functions, only the lengths of crime journeys are sufficient. The calibration was conducted according to the Gauss-Markov model, which assumes a normal distribution of deviations between estimated and reference values, such that the sum of squared deviations is minimal (Butorac et al. 2021). Only those cases in which both the crime location and the residence location were within the City of Zagreb were included in the adjustment procedure. A total of 165 distances were calculated, accounting for 70% of

[1] This paper is a part of the research project *Geographic profiling of robberies in the area of the City of Zagreb (2018-2025)*, which has been implemented by the University of Applied Sciences in Criminal Investigation and Public Security and the Faculty of Geodesy, University of Zagreb.

the total criminal events in the reference year. The obtained lengths were divided into 3 km classes to calculate the probability of a criminal event occurring based on the length of the criminal journey. The intervals were chosen to be large enough to avoid empty classes, yet not so large as to obscure offenders' preferences regarding their crime journeys. The calculated lengths of criminal journeys for 165 robbery offences show a trend: as distance increases, the probability of an offence decreases. Over 60% of distances are found within intervals up to 6 kilometres, of which 20% are within the interval up to 3 kilometres (Tab. 1).

Tab. 1 Frequency of criminal offence occurrence in relation to the length of the criminal journey

Class (kilometres)	Frequency of occurrence	Percentages
0 – 3	33	20%
3,001 – 6	67	41%
6,001 – 9	23	14%
9,001 – 12	16	10%
12,001 – 15	8	5%
15,001 – 18	2	1%
18,001 – 21	15	9%
21,001 – 24	1	1%

The normalised values served as input parameters in the adjustment algorithm for each function. The quality of the estimate is measured by the standard deviation, and the criterion for selecting the optimal mathematical model is the distance-decay function with minimal deviations from the reference values. The standard deviations are listed in Tab. 2, whilst Fig. 3-7 illustrate the course of calibrated functions in relation to the distribution of frequency of criminal offence occurrence. By comparing the calibrated functions and their standard deviations in relation to the distribution of criminal offences, it can be concluded that the function which best describes the distribution of criminal offence occurrence is the truncated negative exponential function.

The truncated negative function combines the linear and negative exponential functions. During calibration, the maximum value of the function (i.e., the peak of the function) is set, whereby the linear function describes values up to the peak (values that are closer to the residence), and the negative exponential function describes parts of the distribution from the peak towards the maximum distance (values that decrease with distance).

Tab. 2 Standard deviations obtained from the calibration of distance decay functions

FUNCTION	STANDARD DEVIATION
Linear	0.096
Negatively exponential	0.094
Normal	0.228
Lognormal	0.206
Truncated negative exponential	0.043

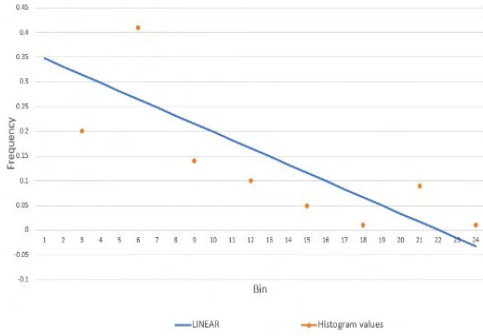

Fig. 3 Calibrated linear function

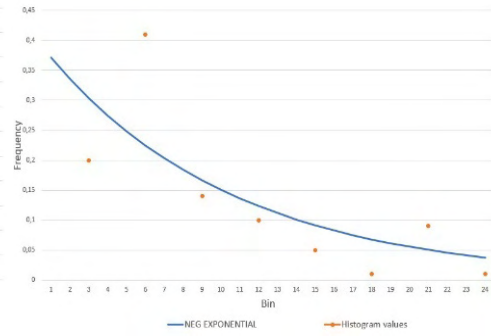

Fig. 4 Calibrated negative exponential function

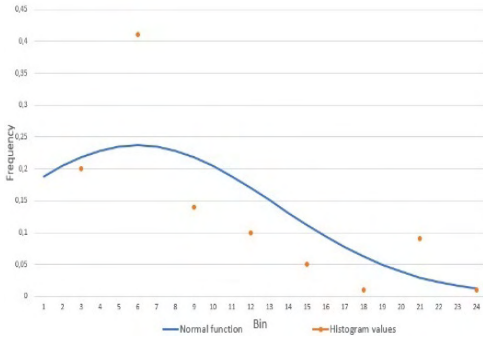

Fig. 5. Calibrated normal function

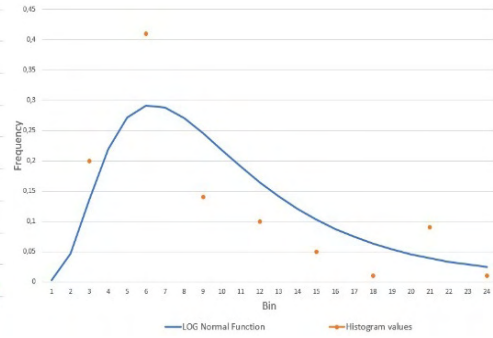

Fig. 6. Calibrated log-normal function

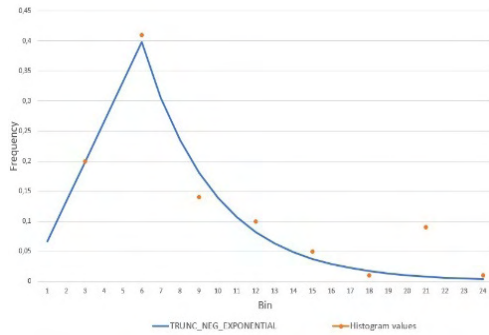

Fig. 7. Calibrated truncated negative exponential function

4. CERTAIN VARIABLES IN RELATION TO THE LENGTH OF CRIMINAL CAREER AND TIME OF COMMISSION

The variables under consideration are socio-demographic variables: age of perpetrator (Age), level of educational qualification (academic level), modus operandi variables: target of attack (Target), subject of criminal offence (Subject), method of commission (Method), means employed (Means), as well as time of commission (Time) and distance.

The temporal component, classified by the hour of the commission of the criminal offence, is divided into categories within a 24-hour period. There are 6 categories in total, each encompassing 4 hours. For each category, the number of criminal offences that occurred within the time frame of that category was determined. Fig. 8 illustrates the frequency of robbery commission in the period from 00 to 24 hours. Fig. 9 clearly depicts the incidence of robberies in relation to the lengths of criminal journeys and time categories. It is observed that perpetrators generally travel distances of 3 to 6 kilometres from their place of residence/stay during night and morning hours, whilst during the day and at times when there are the most incidents, there is greater variation in the length of criminal journey, which can be associated with the mobility of perpetrators (public transport) and other usual, legal activities they perform during the day (work, school, recreational activities, etc.).

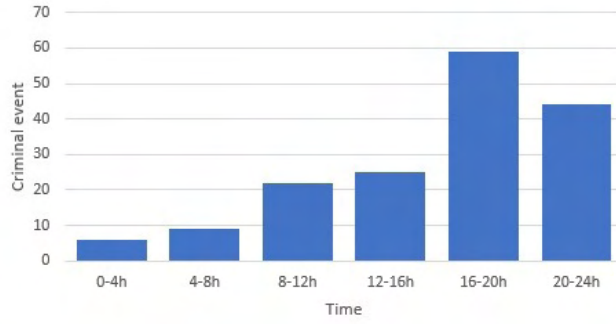

Fig. 8 Number of criminal offences according to the time of commission

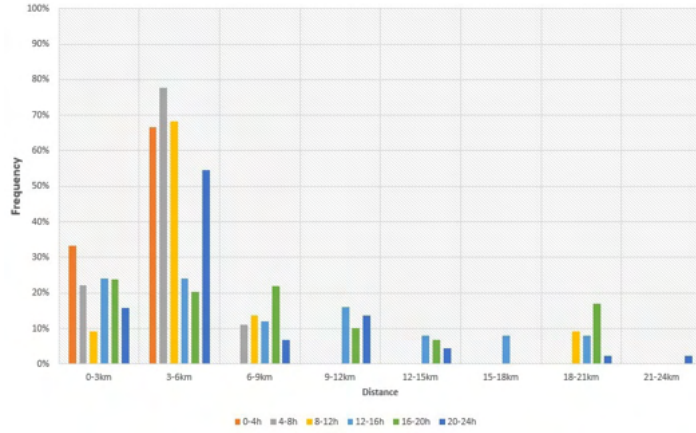

Fig. 9 Frequency of criminal offence occurrence at specific distances in relation to the time of commission

Socio-demographic variables (age, gender, educational qualification of the perpetrator) and modus operandi variables (target of attack, subject of criminal offence, method of commission and means used), as well as time of commission, were examined separately with respect to distances travelled. For each variable, a histogram of the frequency of criminal offences was created according to categories of criminal journey lengths, time categories, and a histogram of the number of criminal offences according to variable categorisation.

4.1. Socio-demographic variables

Age groups of perpetrators were adopted from the official age taxonomy. The number of criminal offences was determined according to specific age groups (Fig. 10). A histogram was created showing the frequency of criminal offence occurrence at specific distances with respect to age group (Fig. 11). According to the data obtained, the highest number of robbery offences in 2018 were committed by perpetrators in the 21-30 age group, of which the majority of criminal offences were committed at distances of 3 to 6 km, whilst this group also demonstrated the greatest variation in criminal journey length. According to time categories with respect to the age of perpetrators (Fig. 12), it can be observed that in the morning and night hours (although fewer in number), perpetrators from younger age groups still predominate, even though the highest number of criminal offences occurs during afternoon and evening hours, where no age threshold is particularly prominent.

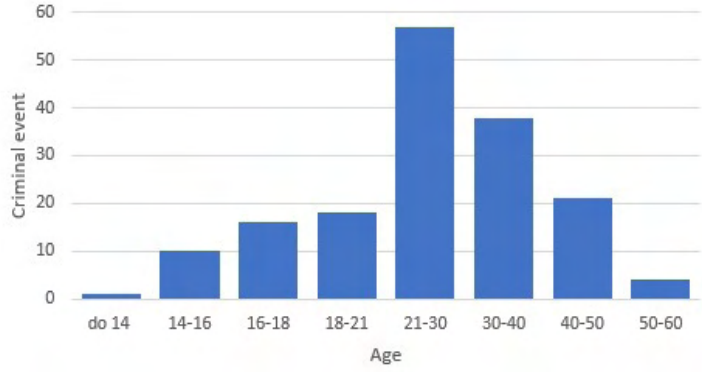

Fig. 10 Number of criminal offences according to age group

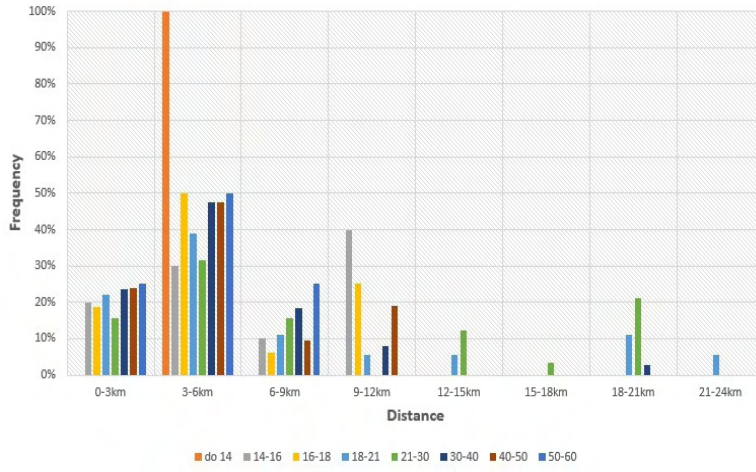

Fig. 11 Frequency of criminal offence occurrence at specific distances in relation to age group

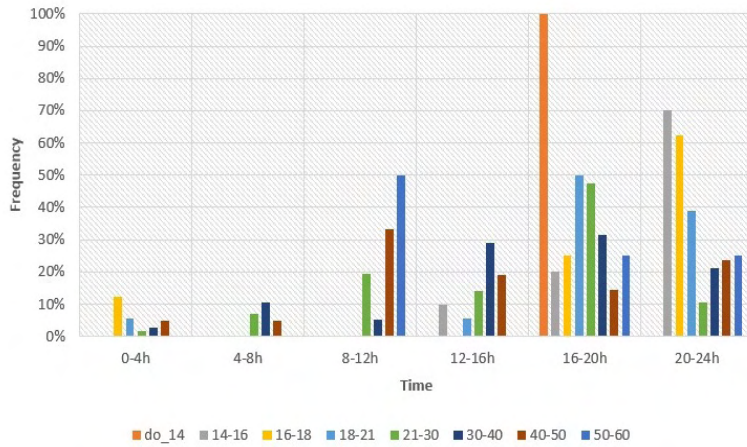

Fig. 12 Frequency of criminal offence occurrence during specific time periods in relation to age group

Of the total 165 criminal offences analysed, the proportion of male perpetrators is 90%. This finding aligns with international trends indicating that the majority of robbers are male (Wüllenweber & Burrell, 2023; Rennison & Melde, 2013). Although the sample of women is small, it was observed that they travel shorter distances than men. Only two female individuals travelled greater distances to commit a criminal offence.

The results are shown in Figs. 13 and 14. Fig. 15 depicts the frequency of criminal offence occurrence with respect to the temporal component, from which it can be concluded that female individuals commit criminal offences during afternoon and evening hours, whilst not a single female individual from the tested sample committed a criminal offence during morning hours or during the night.

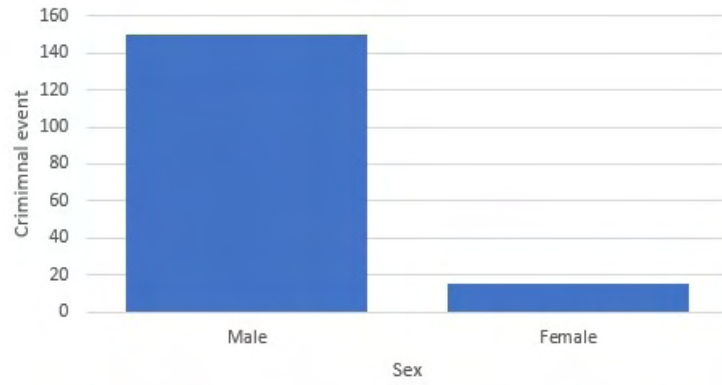

Fig. 13 Number of criminal offences according to the sex of the perpetrator

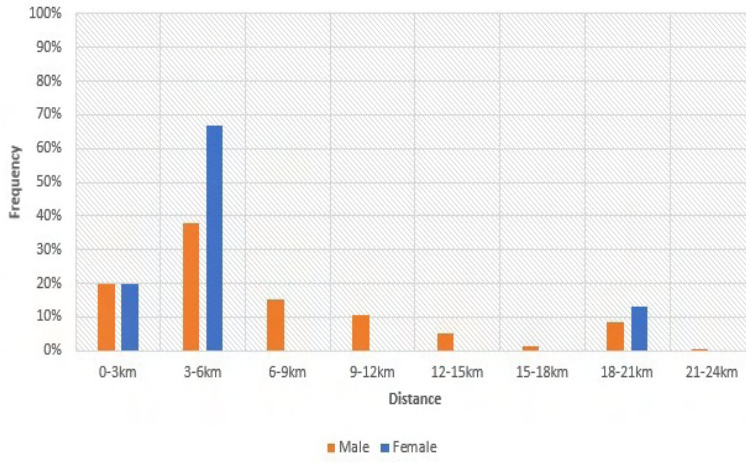

Fig. 14 Frequency of criminal offence occurrence at a specified distance in relation to the sex of the perpetrator

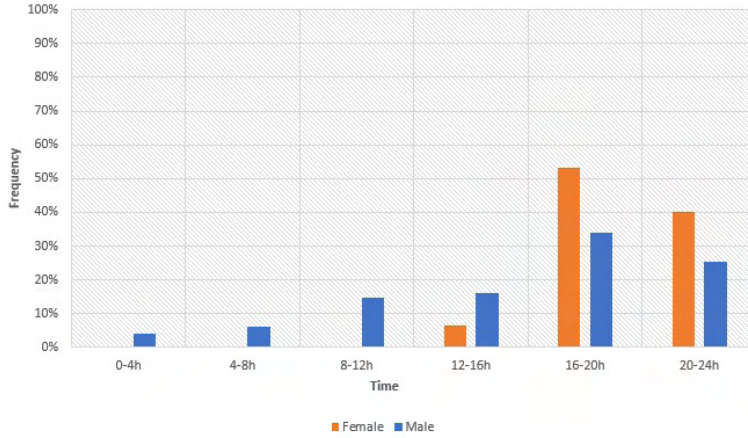

Fig. 15 Frequency of criminal offence occurrence at a specified distance in relation to the sex of the perpetrator

The level of education evidently depends significantly on the motivation for committing this type of crime. Even though research across seven European countries indicates that lower levels of education are associated with a greater likelihood of committing robbery (Babić & Zorić, 2021), the majority of perpetrators have secondary education, whilst the numbers of perpetrators without qualifications and those with lower qualifications are approximately equal (Fig 16). The respective findings generally correspond to the shares of observed educational levels in the general population (Croatian Bureau of Statistics, 2021). Nonetheless, it should be taken into consideration that individuals compare the benefits and disadvantages of their current social and financial status, internal ethical constraints, and the benefits and risks of potentially committing a crime.

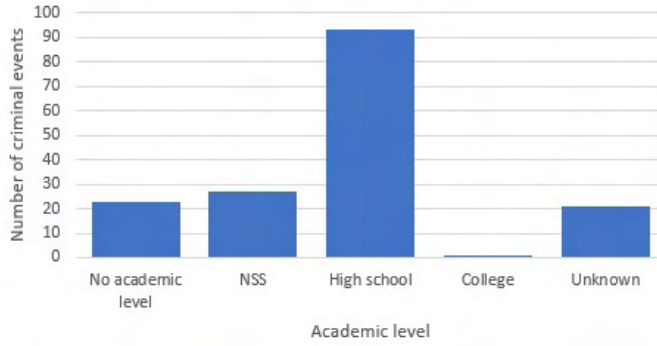

Fig. 16 Number of criminal offences according to the level of educational qualification

Regarding the length of the criminal journey, most perpetrators with lower or secondary education, or without qualifications, follow the distance-decay effect. In the statistical sample, there is just one highly educated offender, hence it is not possible to make a meaningful interpretation. A data deficiency is also observed, as information on educational level is

missing for some perpetrators. Fig. 17 and 18 display the results. It is evident that persons with lower qualifications and persons without qualifications predominate in committing robberies during nighttime hours.

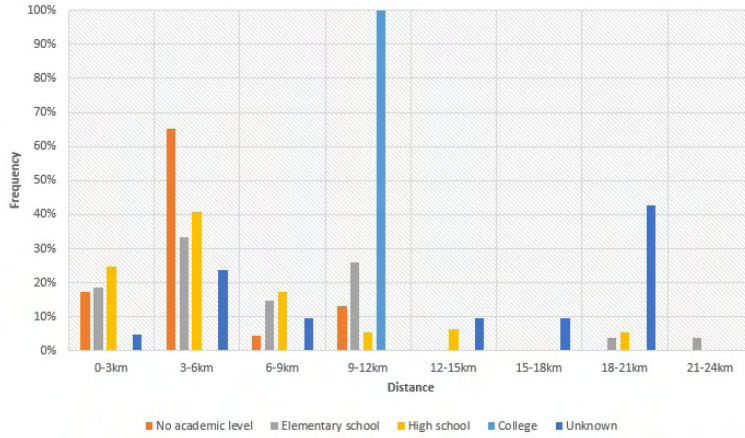

Fig. 17 Frequency of criminal offence occurrence at a specified distance in relation to the level of educational qualification

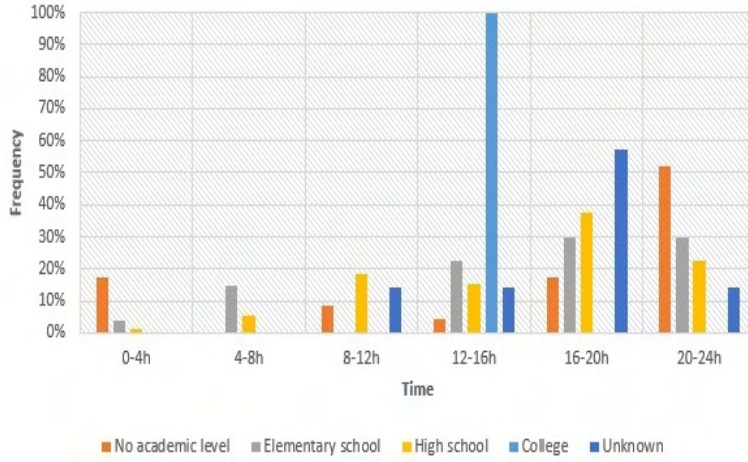

Fig. 18 Frequency of criminal offence occurrence in a specified time period in relation to the level of educational qualification

4.2. Modus operandi variables

The most frequent target of attack in robberies is a natural person. Among legal entities, the most common targets of attack are shops, pharmacies, kiosks and tobacconists, followed by post offices and betting shops. Gas stations and banks are less frequent targets of attack, whilst cafés and currency exchange offices are the rarest (Fig. 19). These data could presumably be

associated with a certain degree of security (such as surveillance cameras, security guards, the number of people fluctuating and the like), which presents an obstacle to the commission of criminal offences. It could also be linked to the perpetrator's psychological profile and to the question of whether the crime was planned, which may determine the actual length of the criminal journey.

However, such data were not available for this research. The results are presented in Fig. 20. At nighttime hours, banks are most prevalent as targets, whilst men are the most common targets of attack across nearly all time periods (Fig. 21).

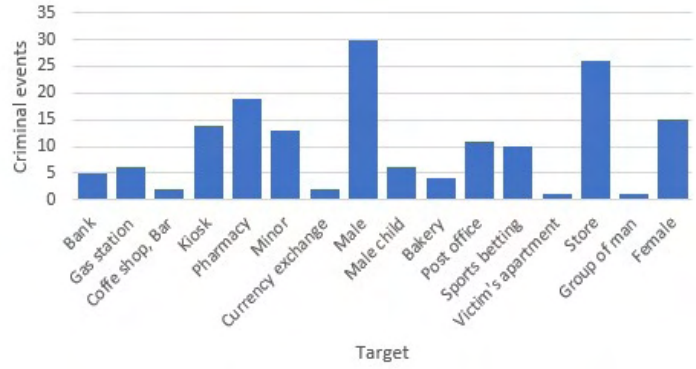

Fig. 19 Number of criminal offences according to the target of attack

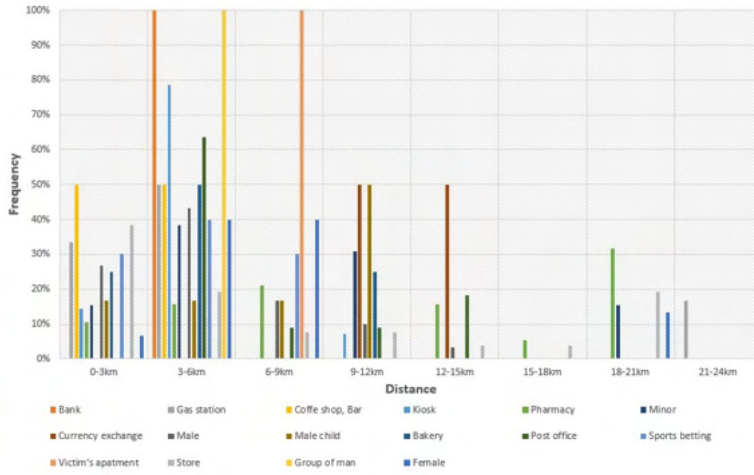

Fig. 20 Frequency of criminal offence occurrence at a specified distance in relation to the target of attack

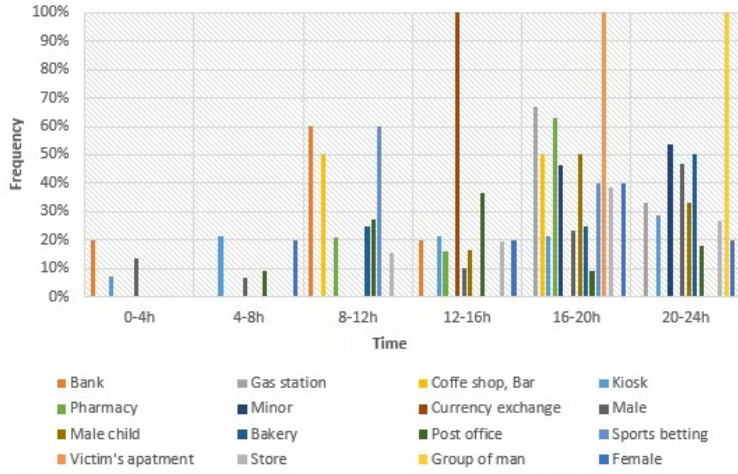

Fig. 21. Frequency of criminal offence occurrence in a specified time period in relation to the target of attack

Indisputably, the unlawful appropriation of money is the primary motive for the commission of the criminal offence of robbery, as the object of the criminal offence in the greatest number of robberies in 2018. The need for this could also be associated with the level of education and personal income of the individual, difficult living conditions, the psychological profile of the perpetrator, his lifestyle habits and needs (e.g. addicts). The results are presented in Figs. 22 and 23. It is observed that the frequency of occurrence of the most common object of the criminal offence is not grouped in any particular time period, which, from this sample, could be defined as significant. Other objects of this criminal offence are distributed evenly throughout the day, except for wallets, which are stolen more often at night (Fig. 24).

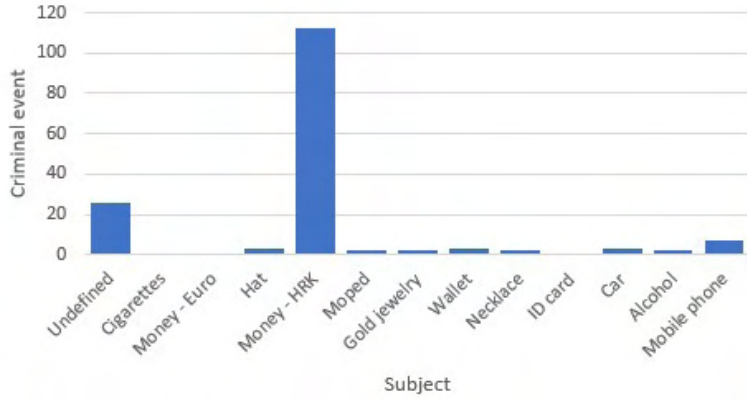

Fig. 22 Number of criminal offences according to the object of the criminal offence

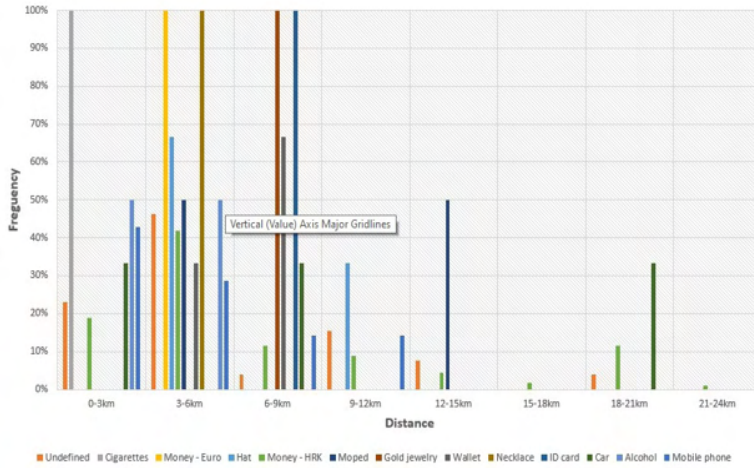

Fig. 23 Frequency of criminal offence occurrence at a specified distance in relation to the object of the criminal offence

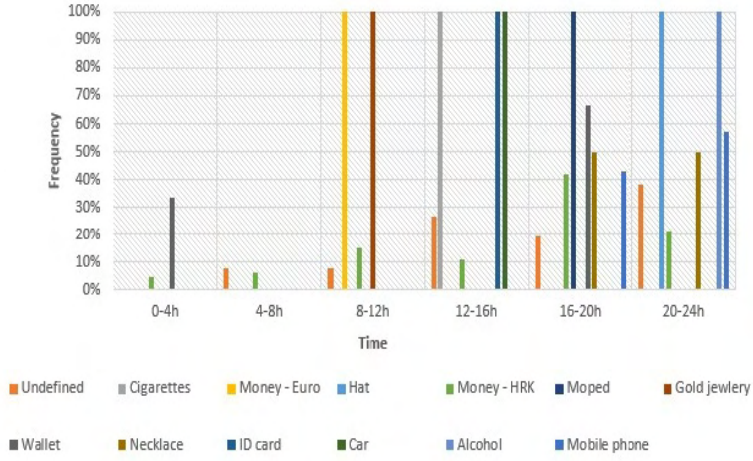

Fig. 24 Frequency of criminal offence occurrence in a specified time period in relation to the object of the criminal offence

In terms of method of commission, threats of attack with weapons and dangerous implements are the most common (Fig. 25). Regarding the length of the criminal path in this sample, for greater distances the predominant method of committing the offence is threatening attack using some type of weapon or implement, whilst the use of physical force is most dominant at intervals of 0-3 km and 6-9 km (Fig. 26). At the interval of 3-6 km, perpetrators use all methods of commission. It could also be established that the largest number of robberies were committed using serious threats, fighting or weapons in the afternoon and evening hours from 16-24 and 20-24 hours, whilst during the morning and night from 00-12 hours, there is evidently significantly less use of various means for committing the offence (Fig. 27).

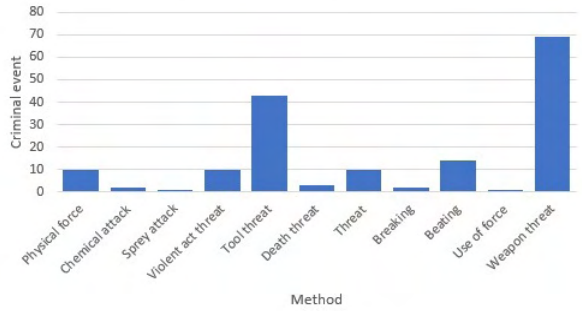

Fig. 25 Number of criminal offences according to the method of commission

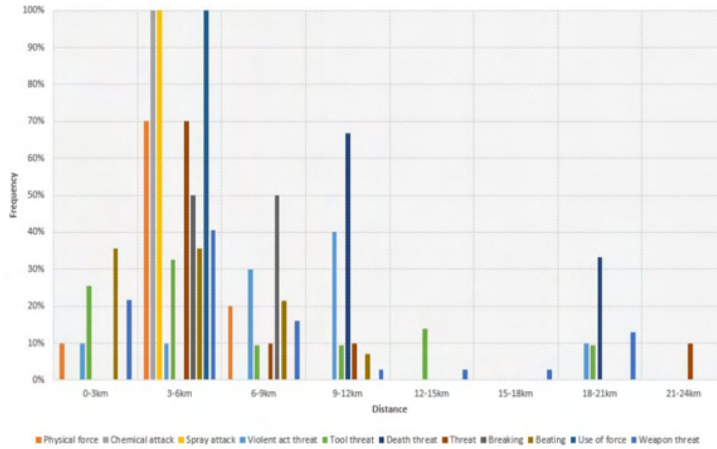

Fig. 26 Frequency of criminal offence occurrence at a specific distance with regard to the method of commission

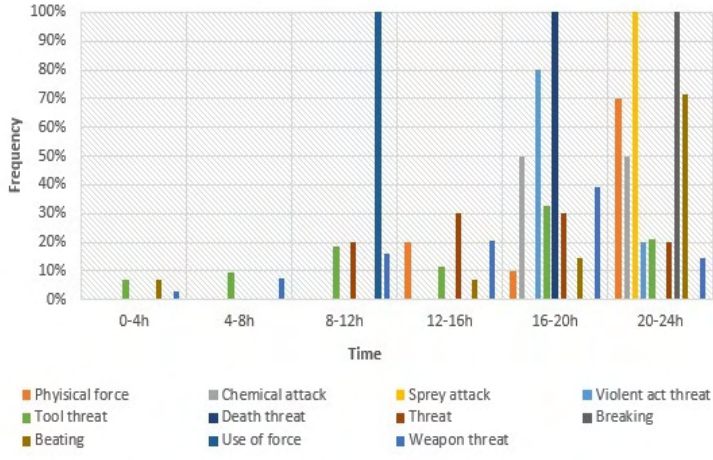

Fig. 27 Frequency of criminal offence occurrence in a specific time period with regard to the method of commission

It can be established that the most common choice of weapon is a pistol, more precisely, a starter pistol predominates. The results are presented in Figs. 28 and 29. No significant changes are observed in the most commonly used implements with respect to time periods during the day (Fig. 30). Similarly, considering the distribution of the total number of criminal offences across time categories, the use of other implements is equally distributed.

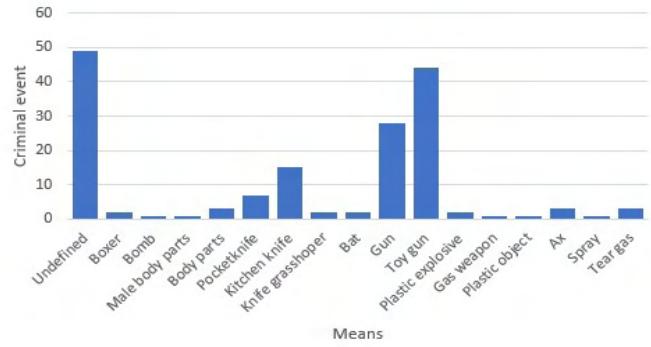

Fig. 28 Number of criminal offences according to the weapon used

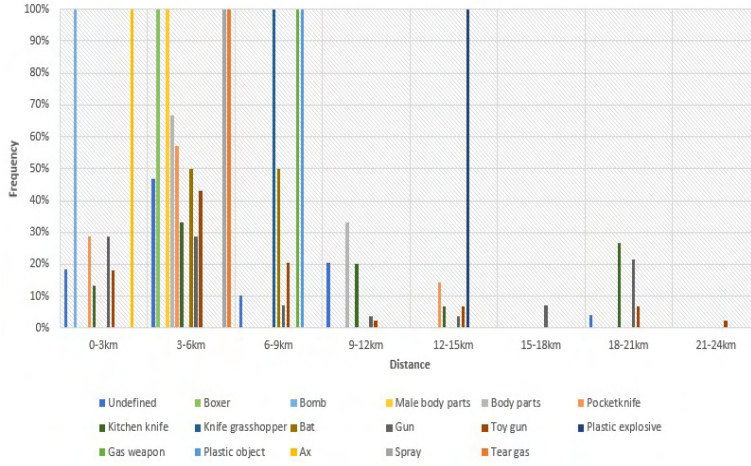

Fig. 29 Frequency of criminal offence occurrence at a specific distance with regard to the weapon used

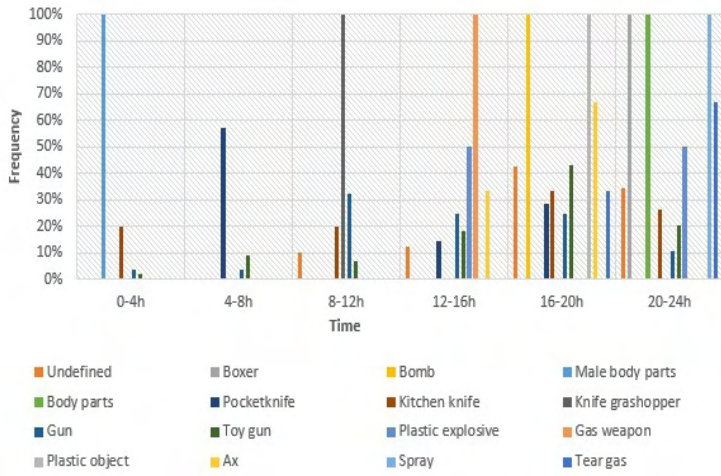

Fig. 30 Frequency of criminal offence occurrence in specific time categories with regard to the weapon used

5. DISCUSSION AND CONCLUSION

In the Republic of Croatia, there is a lack of empirical research on the geography of crime, and, in line with global trends, a need for such research has emerged. This paper examines the incidence of robberies and the connection between the characteristics of perpetrators and robbery offences with the time of commission and the distance travelled by perpetrators.

In the first step, perpetrators with a registered residence who committed a criminal offence within the City of Zagreb were selected. Calibration was made based on calculated lengths of criminal paths in 165 robbery cases, which show a trend of decreasing distances as over 60% of distances are in classes up to 6 km of travelled path, which is consistent with the rational choice theory premise that most perpetrators will not travel great distances to commit a crime unless the final reward justifies the cost of travel and fear of arrest (Brantingham and Brantingham 1995). The calibration results for the five most commonly used distance-decay functions showed that the truncated negative exponential function best describes the distribution of criminal paths.

The paper further examined the incidence of criminal offences in relation to travelled distance and time of commission, and, in this regard, an upward trend in shorter distances of criminal paths during the night and morning hours was observed, whilst during the day, there is greater variation in the distance travelled. This finding can be related to the greater mobility of perpetrators, especially those who use public transport, as well as to other usual, legal activities they engage in during the day (school, work, recreation, etc.). Other variables may indicate certain trends. For example, the largest proportion of robbery offences was committed predominantly by younger men aged 21-30 years, who show the most variation in distance travelled. It was shown that there is a significantly larger proportion of male persons who commit this criminal offence and have greater variations in distances travelled and time

of commission, whilst female persons show shorter distances, with afternoon and evening hours as the time of commission. Regarding the level of education, most criminal offences were committed by persons with secondary education, where a grouping of perpetrators with shorter distances in the afternoon and evening hours is observed. Only one person had a high level of education, and this individual recorded somewhat greater distance travelled and a later commission time in the early afternoon hours.

It is important to emphasise that the dataset used is limited (deficient) for obtaining reliable statistical indicators that could help in a more exact determination of connections between individual variables. Therefore, the analysis should certainly include a larger dataset with more credibly defined variables and solved cases over a longer time span (e.g., 10 years) to detect patterns of robbery in the subject area of research. The established patterns would serve to model the spatial movement of perpetrators, taking into account the specificities of the area and other variables that together constitute a criminal offence.

Consequently, one recommendation to improve police activities is to conduct further empirical research to develop technological and practical solutions to support criminal investigations. For the purpose of introducing these working methods into everyday police work, it is crucial to maintain precise, high-quality records of criminal events, perpetrators and victims, and other variables of criminal offences that affect the occurrence of criminal offences. When conducting investigations, it is necessary to uniformly collect information from the crime scene, as this data is the starting point for all analyses. Also, for monitoring crime-related statistical factors, it would be desirable to collect, in addition to data from the scene, thorough data on perpetrators and victims through questionnaires, which would provide broader knowledge of the event itself and could later be included in various analyses. This would enable police to deploy officers to anticipated strike zones rather than conduct random patrols, potentially preventing future crimes before they occur.

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Sažetak

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Prostorno ponašanje počinitelja razbojništva na području Zagreba

Posljednjih desetljeća pridaje se sve veća pozornost vizualizaciji i analiziranju prostorne komponente kriminaliteta u kombinaciji s ostalim značajkama koje čine cjelinu kriminalnog događaja. U radu je ispitan uzorak od 165 kaznenih djela razbojništva iz 2018. povezanih s poznatim počiniteljima za koje su izračunane duljine kriminalnog puta, a korištene su za kalibraciju pet funkcija smanjivanja udaljenosti: linearnu, negativno eksponencijalnu, normalnu, lognormalnu i krnju negativno eksponencijalnu funkciju. Na temelju izjednačenih parametara funkcija opadanja udaljenosti određena je funkcija koja najbolje opisuje razdiobu duljina kriminalnih putova. Izračunane duljine pokazuju trend smanjivanja udaljenosti jer je više od 60% udaljenosti u razredima do 6 km prijeđenog puta. Rezultati kalibracije pet najčešće korištenih funkcija smanjivanja udaljenosti pokazali su da razdiobu kriminalnih putova najbolje opisuje krnja negativna eksponencijalna funkcija. Nadalje je u radu ispitana incidencija kaznenih djela u odnosu na prijeđene udaljenosti i vrijeme počinjenja te se pokazao uzlazni trend kraćih udaljenosti u noćnim i jutarnjim satima, dok je danju veća varijacija u prijeđenoj udaljenosti. Pokazalo se da u počinjenju kaznenog djela razbojništva dominiraju muškarci u dobnoj skupini od 21 do 30 godina, među kojima je najviše varijacija u prijeđenoj udaljenosti, te da muški počinitelji općenito imaju veće varijacije u prijeđenim udaljenostima i vremenu počinjenja od onih ženskih.

Ključne riječi: razbojništvo, obilježja počinitelja i kaznenog djela, funkcije smanjivanja udaljenosti.

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