Author Contribution Statement

[1] **Pedro TADEU** (iD)
Prof. Dr.
Polytechnic University of Guarda (IPG)
Portugal, Superior School of Education, Communication and Sport (ESECD), Centre for Studies in Education and Innovation (CI&DEI, Portugal

Conceptualization, literature review, organization

Abstract

This article examines the role of statistical analysis in criminology, thoroughly investigating its diverse influence and uses. The introduction provides a comprehensive analysis of the convergence of statistics and criminology, highlighting the significance of statistical methodologies in comprehending and mitigating criminal conduct and augmenting the efficacy of the criminal justice system via statistical techniques. The following section examines statistical analysis's impact on comprehending crime trends, facilitating policy development, and constructing effective crime prevention tactics. Real-world case studies show statistical analysis's practical use and beneficial effects in criminological practice. Notwithstanding the many benefits, it is indispensable to acknowledge and examine the possible obstacles and constraints associated with using statistical analysis in criminology. These include but are not limited to difficulties about data quality, ethical considerations, and resource constraints. Considering the abovementioned factors, we propose prospective resolutions and alternative measures to address these obstacles effectively. In anticipation of forthcoming developments, we draw attention to emerging patterns and advancements in the field, including big data analytics, machine learning, and artificial intelligence, which have the potential to augment the capabilities and efficacy of statistical analysis within the realm of criminology. The conclusion effectively integrates the main topics examined, affirming the crucial significance of statistical analysis in the progression of criminological research, policy formulation, and practical implementation. Furthermore, it highlights the contribution of statistical analysis towards establishing safer communities and a fairer criminal justice system.

To cite this article:

Copyright © IEJES

Exploring the Role of Statistical Analysis in Criminology from an Educational Point of View [*]

Pedro TADEU [1] iD

Abstract

This article examines the role of statistical analysis in criminology, thoroughly investigating its diverse influence and uses. The introduction provides a comprehensive analysis of the convergence of statistics and criminology, highlighting the significance of statistical methodologies in comprehending and mitigating criminal conduct and augmenting the efficacy of the criminal justice system via statistical techniques. The following section examines statistical analysis's impact on comprehending crime trends, facilitating policy development, and constructing effective crime prevention tactics. Real-world case studies show statistical analysis's practical use and beneficial effects in criminological practice. Notwithstanding the many benefits, it is indispensable to acknowledge and examine the possible obstacles and constraints associated with using statistical analysis in criminology. These include but are not limited to difficulties about data quality, ethical considerations, and resource constraints. Considering the abovementioned factors, we propose prospective resolutions and alternative measures to address these obstacles effectively. In anticipation of forthcoming developments, we draw attention to emerging patterns and advancements in the field, including big data analytics, machine learning, and artificial intelligence, which have the potential to augment the capabilities and efficacy of statistical analysis within the realm of criminology. The conclusion effectively integrates the main topics examined, affirming the crucial significance of statistical analysis in the progression of criminological research, policy formulation, and practical implementation. Furthermore, it highlights the contribution of statistical analysis towards establishing safer communities and a fairer criminal justice system.

Keywords: Statistical analysis, criminology, predictive policing, big data analytics, machine learning

1. INTRODUCTION

In the present-day context, there is a growing emphasis on the convergence of statistics and criminology, which has become a central area of interest for both scholarly and applied research, with books like the one from Emma Wincup entitled Criminological Research: Understanding Qualitative Methods (Caccavale, 2015). This intersection is distinguished by statistical approaches to assess, evaluate, and forecast criminal conduct and the operational dynamics of criminal justice systems. Using statistical analysis in criminological research offers a strong foundation for comprehending the intricacies of criminal behaviour, society's reactions to crime, and the efficacy of crime prevention tactics. This enables the empirical evaluation of criminological theories and the formulation of evidence-based policies and practices designed to reduce criminal conduct and improve the criminal justice system's effectiveness.

The significance of using statistical analysis in criminology cannot be overemphasised. Statistical methodologies and approaches allow criminologists to discern patterns and trends within criminal behaviour, appraise the influence of diverse variables on crime rates, and measure the

efficacy of initiatives within criminal justice. Quantitative data can be analysed using statistical methods to ensure that conclusions and policy recommendations are based on empirical evidence. Establishing an empirical basis is of extreme importance in formulating crime control policies that are both successful and equitable. This foundation enables the identification of effective measures for preventing and treating criminal behaviour, ultimately improving public safety and promoting justice (Wincup, 2017).

The following sections examine the use of statistical approaches in criminological study and practice. The first part will comprehensively expose the many statistical analyses often used in criminology. These analyses include descriptive, inferential, and multivariate techniques. Subsequently, research into the pragmatic ramifications of statistical analysis with crime prevention, criminal justice policy, and practice. It also examines the difficulties and constraints of using statistical analysis in criminological research. It will provide an analysis of possible remedies and projections for improving the incorporation of statistical techniques in criminology, particularly in conjunction with the newest advancements like artificial intelligence. The last part of this paper will consolidate the main ideas covered, recapping the significant contribution of statistical analysis in furthering our understanding of criminology and its implications for policy and practice.

1.1. The Significance of Statistical Analysis in Criminology

In criminology, statistical analysis emerges as a significant tool, offering a lens through which crime patterns and trends can be comprehensively understood (Bachman et al., 2021). It aids in the dissection of extensive and complex crime data, allowing for the identification of underlying patterns, correlations, and trends that might be imperceptible through a mere qualitative overview. This is the role that Statistics can bring into very quickly, as it does in many other research areas of knowledge (Sharma, 2017). By employing various statistical techniques, criminologists can analyse crime rates, the prevalence of different types of crimes in various regions, and the demographic characteristics associated with criminal behaviour (Truman, 2015). This specific insight into crime data is instrumental in understanding the multifaceted nature of criminal activities and the various factors that influence them.

Statistical analysis not only aids in understanding crime patterns and trends but also plays a crucial role in policy formulation and developing effective crime prevention strategies (MacDonald, 2018). It provides a data-driven foundation for policy decisions, ensuring that the strategies and interventions implemented are based on empirical evidence rather than assumptions or circumstantial evidence. For instance, by analysing crime data, policymakers can identify high-crime areas and allocate resources more effectively to enhance security and prevent crime in those regions. Additionally, statistical analysis can help evaluate the effectiveness of existing crime prevention strategies and policies, enabling continuous improvement and refinement (Perry et al., 2013).

In policy formulation, statistical analysis facilitates the identification of the root causes and contributing factors of crime, allowing for the development of targeted and tailored interventions. It enables the assessment of various social, economic, and environmental factors that influence criminal behaviour, providing a basis for comprehensive and holistic crime prevention strategies (Perry et al., 2013). By understanding the factors contributing to crime, policymakers and law enforcement agencies can develop initiatives that address these issues, ultimately leading to more effective crime prevention and reduced criminal activities.

Moreover, statistical analysis enhances accountability and transparency in the criminal justice system (Truman, 2015). It allows for objectively evaluating law enforcement practices, policies, and interventions, ensuring that they meet the standards of fairness, effectiveness, and equity. By employing statistical analysis, law enforcement agencies can continuously monitor and assess their

225

operations, identify areas for improvement, and implement changes to enhance their effectiveness and the quality of service provided to communities.

The significance of statistical analysis in criminology is multiple. It provides invaluable visions into crime patterns and trends, facilitates data-driven policy formulation, develops effective crime prevention strategies, and enhances responsibility and transparency in the criminal justice system. By harnessing the power of statistical analysis, criminologists, policymakers, and law enforcement agencies can work collaboratively to understand, prevent, and address criminal behaviour, creating safer and more secure communities.

1.2. Types of Statistical Methods Used in Criminology

Within criminology, statistical methodologies are important in facilitating a thorough comprehension of crime patterns, trends, and associated phenomena. The following section explores the three main disciplines of statistics often used in criminology: Descriptive, Inferential, and Multivariate Statistics.

Every category fulfils a distinct function in aiding criminologists in analysing and interpreting crime data, formulating forecasts about criminal conduct, and comprehending the intricate connections among diverse crime-related aspects. The statistical studies provide valuable insights that play a crucial role in defining crime prevention and intervention tactics, contributing to improving public safety and justice.

A. Descriptive Statistics

• Descriptive statistics play a crucial role in summarising and describing the main features of a dataset, providing a concise overview of the data's central tendencies and dispersion. In criminology, descriptive statistics clearly show the overall crime trends and patterns within a specific area or time frame (Black, 2016).

• Use in Criminology: Descriptive statistics help review large volumes of crime data to present understandable and interpretable information (Caccavale, 2015). It aids in identifying the average crime rates, the distribution of crimes across different regions, and the variation in crime rates over time.

• Examples:

- Measures of central tendency, such as the mean, median, and mode, are used to identify offenders' average or most common crime rates or ages (Black, 2016);

- Measures of dispersion like the range, variance, and standard deviation provide insights into the spread and variability of crime data, offering a deeper understanding of the diversity and distribution of criminal activities (Black, 2016).

B. Inferential Statistics

• Inferential statistics are essential for making inferences or predictions about a larger population based on a smaller sample. It allows criminologists to make educated guesses and predictions about crime trends and patterns in the larger population by analysing a sample dataset (Brandl, 2017).

• Use in Criminology: Inferential statistics enable criminologists to test hypotheses and predict future crime trends, the effectiveness of crime prevention strategies, and the potential impact of various factors on criminal behaviour (Brandl, 2017).

• Examples:

- Hypothesis testing assesses the relationship between different variables, such as the impact of socioeconomic factors on crime rates;

- Regression analysis helps understand the relationship between dependent and independent variables, such as the effect of law enforcement strategies on crime reduction (Brandl, 2017);

- Probability estimates predict the likelihood of specific criminal behaviours or trends.

C. Multivariate Statistics

• Multivariate statistics are used to analyse more than two variables simultaneously to understand their relationships. It provides a more comprehensive analysis, allowing criminologists to analyse multiple factors and their interactions concerning criminal behaviour (Li, 2018);

• Use in Criminology: Multivariate statistics enable the analysis of complex datasets with multiple variables, providing a more holistic understanding of the factors influencing criminal behaviour and the effectiveness of various interventions (Li, 2018).

• Examples:

- Factor analysis is used to identify underlying relationships between observed variables, helping identify critical factors influencing criminal behaviour;

- Cluster analysis helps group similar data points, aiding in identifying patterns and trends in criminal activities (Li, 2018);

- Multivariate regression allows for the analysis of the impact of multiple independent variables on a dependent variable, providing a more comprehensive understanding of the factors influencing crime rates and criminal behaviour.

1.3. Some Case Studies/Examples

In this section, we present some real-world examples of statistical analysis being effectively used in criminology, demonstrating its practical application and impact on policy and practice. These case studies underscore statistical methods' significance in analysing crime data, formulating evidence-based policies, and developing effective crime prevention strategies (Braga & Weisburd, 2012).

A. Predictive Policing in Los Angeles

• One notable example is predictive policing in Los Angeles, California. The Los Angeles Police Department (LAPD) implemented PredPol, which uses statistical algorithms to analyse historical crime data and predict potential future crime hotspots (Mohler et al., 2015). Officers are then directed to increase patrols in these areas.

• Outcomes and Impact: The implementation of PredPol led to a noticeable reduction in crime rates in the areas where the program was deployed (Mohler et al., 2015). It allowed the LAPD to allocate their resources more efficiently, focusing on areas with a higher likelihood of criminal activity. The program's success underscored the importance of using statistical analysis for informed decision-making in law enforcement, leading to more effective crime prevention and improved public safety (Mohler et al., 2015).

B. New York City's CompStat Program

• Another exemplary case is the CompStat program in New York City, a performance management system that utilises statistical data to inform policing strategies and tactics (Willis et al., 2004).

• Outcomes and Impact: The CompStat program significantly decreased significant crimes in New York City by enabling the efficient allocation of police resources based on crime trends and patterns identified through statistical analysis (Willis et al., 2004). The program has been recognised for its effectiveness in reducing crime and enhancing public safety, and various other cities across the United States have adopted it (Willis et al., 2004).

C. The Use of Regression Analysis in Evaluating Crime Prevention Programs

• Regression analysis has been used to evaluate the effectiveness of various crime prevention programs and interventions (Gill et al., 2014). For instance, a study employed regression analysis to assess the impact of a community policing initiative on crime rates and community satisfaction (Gill et al., 2014).

• Outcomes and Impact: The study found that the community policing initiative reduced crime rates and increased community satisfaction, highlighting the program's effectiveness (Gill et al., 2014).

227

Regression analysis provided objective and empirical evidence of the program's success, informing future policy decisions and contributing to the development of more effective crime prevention strategies (Gill et al., 2014).

D. Cluster Analysis in Understanding Gang Activities

• Cluster analysis has been employed to analyse gang activities, helping law enforcement agencies to identify patterns and trends in gang-related crimes and develop targeted interventions (Knox, 2006).

• Outcomes and Impact: Cluster analysis enabled the identification of specific areas with high levels of gang activity, allowing for the implementation of targeted interventions and allocating resources to address gang-related crimes effectively (Knox, 2006). The analysis informed the development of evidence-based gang prevention and intervention strategies, reducing gang-related crimes and enhancing community safety (Knox, 2006).

Within criminology, statistical methodologies facilitate a thorough comprehension of crime patterns, trends, and associated phenomena. The following section explores the three main disciplines of statistics often used in criminology: Descriptive, Inferential, and Multivariate Statistics.

2. Challenges and Limitations

While statistical analysis in criminology offers numerous benefits, it also has challenges and limitations. To successfully use statistical techniques in criminological study and practice, it is essential to have a solid understanding of these groups of difficulties (Lum & Isaac, 2016; Ratcliffe, 2004). Knowing and understanding the difficulties could help us move forward with solutions.

A. Data Quality and Availability

• One of the significant challenges criminologists and law enforcement agencies face is the quality and availability of data related to crime. The integrity of any statistical analysis hinges on the foundation of robust, accurate, and comprehensive data; this is valid not only in this area but in many others nowadays. However, on many occasions, the data collected can be fragmented, inconsistently recorded across different jurisdictions, or may not capture all incidents due to underreporting. This inconsistency and lack of comprehensive data can lead to skewed analyses, potentially resulting in misinformed policies or strategies. Moreover, the dynamic nature of crime means that data needs to be continuously updated to reflect current trends, further emphasising the importance of its quality and timely availability for all that use it. Accurate statistical analysis relies on comprehensive, reliable, and timely data. Nevertheless, criminologists often face issues related to incomplete, outdated, or inaccurately reported data (Lum & Isaac, 2016).

• Possible Solutions: Enhancing data collection methods and ensuring consistent and accurate reporting can help overcome this challenge (Lum & Isaac, 2016). Collaboration between law enforcement agencies, governmental bodies, and research institutions can facilitate the availability of high-quality data for statistical analysis (Ratcliffe, 2004). This collaboration needs to be promoted by the formal entities responsible for these command chains by different programs. The creation of social networks between the entities is a good example.

B. Ethical Concerns

• Ethical concerns arise when employing statistical analysis, especially in the context of predictive policing and profiling (Richardson et al., 2019). As law enforcement agencies increasingly turn to data-driven approaches to forecast potential criminal activities, the algorithms and models they use can inadvertently inherit and amplify existing biases in the data. Such biases might stem from historical policing practices, societal prejudices, or disparities in data collection. When these biases are not addressed, the resulting predictions can disproportionately target and impact marginalised communities, further deepening the divide and mistrust between these communities and law enforcement (Richardson et al., 2019). When data is skewed or biased, the results from analysing such

228

data do not truly represent the actual scenario or population. This can lead to erroneous conclusions, misleading predictions, and potentially flawed policies or decisions based on those conclusions. In essence, the integrity and reliability of any mathematical or statistical model are only as good as the data it is built upon. If the foundational data is biased, the entire analysis structure can be compromised, leading to a cascade of errors in interpretation and application. This not only raises concerns about the fairness and justice of predictive policing but also questions the ethical implications of relying heavily on data that might be inherently biased.

• Possible Solutions: Ensuring transparency, accountability, and ethical considerations in developing and implementing statistical models can help mitigate these concerns (Richardson et al., 2019). Regular audits and assessments of the models and their outcomes can ensure fairness and equity (Ferguson, 2017).

C. Misinterpretation and Misuse

• The complexity of statistical methods can lead to misinterpretation and misuse (Berk & Bleich, 2013). Incorrect application or interpretation of statistical analysis can result in flawed conclusions and ineffective policies (Berk & Bleich, 2013).

• Possible Solutions: Providing adequate training and education for criminologists and other professionals involved in statistical analysis can help prevent misinterpretation and misuse (Berk & Bleich, 2013). Collaboration with statisticians and data scientists can ensure the correct application of statistical methods (Weisburd & Piquero, 2008).

D. Resource Constraints

• Resource constraints always pose significant challenges, whatever the area. For instance, limited funding can restrict the acquisition of advanced analytical tools, like software and training programs essential for sophisticated data analysis. Moreover, a lack of qualified human resources means there might not be enough skilled personnel to conduct in-depth analyses, interpret results, or implement findings in real-world scenarios. The absence of updated technological infrastructure can further impede the processing of large datasets, real-time analysis, and the integration of various data sources. These constraints limit the depth and extent of analysis, leading to delays, oversights, and potential inaccuracies. In a field as critical as criminology, where data-driven insights can shape policies, strategies, and public safety measures, such limitations can have far-reaching consequences. (Perry et al., 2013).

• Possible Solutions: Allocating dedicated resources for statistical analysis and leveraging technological advancements can enhance the capacity for practical data analysis (Perry et al., 2013). Seeking grants and funding for statistical analysis projects can provide the necessary resources for successful implementation (Chainey & Ratcliffe, 2013). The last solution is used with quite good results in the academic field: institutions like universities have specific offices only to apply to different types of programs to raise funds to be used inside the university by their researchers.

E. Overreliance on Quantitative Data

• There is always the duality of quantitative and qualitative analysis, as well as what is the best and how they could be used in our studies and analysis. Qualitative data has become more critical in recent years, complementing quantitative data in academic field studies. So, the same situation could happen in the criminology area. While quantitative data provides a structured and measurable view of crime trends, rates, and patterns, it often lacks the depth and nuance that qualitative insights could bring. Qualitative data, derived from interviews, observations, and personal accounts, offers a deeper dive into the motivations, experiences, and socio-cultural contexts surrounding criminal behaviour. By focusing solely on the numerical aspects, there is a risk of missing out on the rich tapestry of human experiences and societal factors contributing to the crime. This can result in data-driven policies and interventions that may not be as effective in addressing the root causes or the broader implications of criminal activities. Hence, a balanced approach that integrates quantitative and qualitative data is

essential for a holistic understanding of the complexities of crime and its societal impact (Copes & Miller, 2015).

• Possible Solutions: Balancing quantitative analysis with qualitative research can provide a more holistic and comprehensive understanding of crime and criminal behaviour (Copes & Miller, 2015). Integrating quantitative and qualitative research insights can inform more effective and equitable policies and interventions (Palys & Atchison, 2008). For this, institutions need human resources capable of guiding qualitative data studies. In this case, one of the most obvious solutions is that these institutions establish cooperation bonds with academia, allowing capable social sciences researchers to conduct qualitative analysis.

3. The Future of Statistical Analysis in Criminology

As we look towards the future, emerging trends and technologies are set to revolutionise the role of statistical analysis in criminology. These advancements enhance data analysis capacity, improve statistical models' accuracy and reliability, and provide more comprehensive and nuanced insights into crime patterns, trends, and prevention strategies (Braga & Weisburd, 2012; Ratcliffe, 2016; Perry et al., 2013).

A. Big Data Analytics

• One of the most significant advancements in recent years is the rise of big data analytics (Ratcliffe, 2016). Of course, obscure situations always arise from this type of technology and data collection from everyday citizens. Still, at this point, we want to engage in the positive things that could come. This technological evolution has transformed how data is collected, stored, and analysed, paving the path for more sophisticated and comprehensive approaches to understanding diverse, complex phenomena. The increasing availability of large datasets related to crime and criminal behaviour, often called 'crime big data', has opened up new roads for criminologists and researchers. These datasets, ranging from detailed crime reports to vast social media interactions, offer a richer and more specific view of criminal activities and their underlying patterns. With the power of big data analytics, it is now possible to examine these massive datasets in real time, extracting meaningful insights that were previously hidden or too bulky to retrieve. Such capabilities provide unprecedented opportunities for statistical analysis, allowing for more in-depth examinations of crime trends, the identification of emerging threats, and the development of more targeted and effective intervention strategies.

• Use in Criminology: Big data analytics can process and analyse vast volumes of data at high speeds, enabling real-time analysis and reporting (Ratcliffe, 2016). It allows criminologists to analyse more complex and extensive datasets, uncover more profound insights, and identify subtle patterns and trends that may be overlooked in smaller datasets.

• Examples: Analysis of social media data to identify potential threats or criminal activities (Ratcliffe, 2016). Something that is used quite often these days. Real-time analysis of crime reports and data to enhance situational awareness and inform immediate response strategies (Ratcliffe, 2016).

B. Machine Learning

• The so-called Machine learning, a subset of artificial intelligence, stands at the vanguard of technological advancements with transformative implications for various fields, including criminology (Perry et al., 2013). As computational algorithms designed to learn and make decisions from data without being explicitly programmed, machine learning models offer a dynamic approach to data analysis. This could be very useful in the field of criminology; their adaptive nature allows them to evolve and improve over time as they are exposed to more data. This capability mainly benefits our case, where the crime landscape constantly shifts and evolves. By connecting the power of machine learning, criminologists can research vast datasets deeper, uncovering intricate patterns and relationships that might elude traditional analytical methods. Furthermore, the predictive capabilities

of machine learning can be connected to forecasting potential criminal activities or identifying areas at higher risk, enabling proactive measures later for prevention. Since the volume and complexity of crime-related data continue to grow, integrating machine learning techniques promises to elevate the precision, efficiency, and scope of statistical analyses in criminological research (Perry et al., 2013).

• Use in Criminology: Machine learning algorithms can analyse large datasets, identify patterns, and make predictions with minimal human intervention (Braga & Weisburd, 2012). It enhances the accuracy and efficiency of statistical analysis, enabling more precise predictions and insights.

• Examples: Predictive policing uses machine learning algorithms to analyse historical crime data and predict future crime hotspots (Perry et al., 2013). Analysis of text data (such as police reports) using Natural Language Processing (NLP) to extract relevant information and insights (Mohler et al., 2015).

C. Artificial Intelligence (AI)

• Artificial Intelligence (AI) is undeniably the trend of the modern era (Kaplan & Haenlein, 2019), rapidly linking its intricate web across various sectors and industries. From healthcare to finance, transportation to entertainment, AI's influence is universal, reshaping traditional paradigms and introducing innovative solutions to age-old challenges. Understandably, we stand on the point of another technological revolution; it is evident that AI is not just a fleeting trend but a transformative tool to redefine the contours of our daily lives. Its ability to process vast amounts of data, learn from patterns, and make autonomous decisions positions AI as a game-changer in problem-solving and decision-making processes. Moreover, the continuous advancements in AI research and development promise even more sophisticated and tailored applications in the future. As society becomes increasingly interconnected and data-driven, AI's role becomes dominant, acting as the cornerstone of the vast digital ecosystem. As we said before, this could open black boxes revealing unforeseen changes, but it is from the change that comes the progress (Rogers, 2003). Given its profound impact and potential, it is safe to say that AI will not only play an essential role in shaping the trajectory of humankind in the coming years but will also be instrumental in shaping the future landscape of global innovation and progress. It will offer advanced tools and techniques for data analysis, pattern recognition, and prediction for the criminology area (Braga & Weisburd, 2012).

• Use in Criminology: AI can process and analyse complex and multi-dimensional datasets, providing comprehensive and nuanced insights into criminal behaviour, crime patterns, and the effectiveness of various interventions (Braga & Weisburd, 2012).

• Examples: AI algorithms are used for facial recognition and analysis of surveillance data to identify suspects and analyse criminal activities (Knox, 2006). AI-powered analysis of various data sources (such as demographic, economic, and crime data) to inform policy formulation and crime prevention strategies (Chainey & Ratcliffe, 2013)

4. CONCLUSION

We reach a point of understanding that the use of statistical analysis in criminology has caused a significant change in multiple ways. This article highlights different ways statistical procedures are used to analyse crime data, support the development of evidence-based policies, and improve crime prevention efforts. The available techniques, ranging from descriptive statistics that reveal crime patterns to advanced machine-learning algorithms that forecast future criminal behaviours, are all becoming more complex and efficient (Weisburd et al., 2014; Braga & Weisburd, 2012).

Real-world case studies clearly show the practical use of statistical analysis; for example, the predictive policing in Los Angeles and New York City's CompStat have shown measurable decreases in crime rates and improved public safety. These evidence-based approaches enhance operational

efficiency and foster community trust by promoting openness and accountability (Mohler et al., 2015; Willis et al., 2004).

Despite the good examples we provided, the effectiveness of statistical analysis depends on its precise and ethical implementation. Since the digital era brings more particularities, big data analytics, machine learning, and artificial intelligence can bring significant changes and present new ethical and practical dilemmas to society (Lum & Isaac, 2016; Perry et al., 2013). Eventually, while using rigorous statistical analysis, criminology can potentially lay the ground for safer communities and a more equitable society (Ferguson, 2017; Richardson et al., 2019).

The advancement of big data analytics enables the immediate processing and analysis of extensive information, resulting in a more profound understanding of patterns in criminal activity and permitting prompt responses. Real-time analysis of social media data may effectively detect developing threats and illegal activity, improving situational awareness for law enforcement organisations (Ratcliffe, 2016). Due to its capacity to acquire knowledge and adjust its behaviour based on experience, machine learning provides sophisticated predictive skills, allowing for more precise predictions of areas with high crime rates and probable criminal activities (Perry et al., 2013). AI, which includes a wide range of applications, has great potential to transform the industry, providing detailed insights and more efficient tactics for preventing crime in different ways (Braga & Weisburd, 2012; Kaplan & Haenlein, 2019).

Ethical issues will remain a central concern, particularly given the growing dependence on data-driven methodologies. So, when using these technologies, it is essential to prioritise openness, accountability, and justice while conducting regular audits, adhering to ethical principles, and implementing inclusive policies may effectively reduce any biases and guarantee that these improvements have a positive impact on society (O'Neil, 2016; Richardson et al., 2019).

Combining statistics and criminology may lead to a safer and more just society, but it is also crucial that ethical concerns are at the front of investigations.

Ethics Committee Decision

Due to the scope and method of the study, ethics committee permission was not required.

5. REFERENCES

Black, J. A. (2016). Descriptive statistics in criminal justice research. *Journal of Criminal Justice Education*. https://doi.org/10.1080/10511253.2016.1159880

Braga, A. A., & Weisburd, D. L. (2012). The effects of focused deterrence strategies on crime: A systematic review and meta-analysis of the empirical evidence. *Journal of Research in Crime and Delinquency*, *49*(3), 323–358.

Brandl, S. G. (2017). *Inferential statistics hypothesis testing and crime analysis. Crime analysis and crime mapping*. SAGE Publications.

Ciccarelli, S., & Lazzari, R. (2015). La devianza giovanile autorilevata. Primi resultati della ricerca ISRD3 a Napoli. *Rassegna Italiana di Criminologia*, 3, 159-173. https://issuu.com/pensamultimedia/docs/rassegna_italiana_di_criminologia_3_2015

Chainey, S., & Ratcliffe, J. (2013). *GIS and crime mapping*. John Wiley & Sons.

Copes, H., & Miller, J. (2015). *The routledge handbook of qualitative criminology*. Routledge.

Ferguson, A. G. (2017). *The rise of big data policing: Surveillance, race, and the future of law enforcement*. NYU Press.

232

Gill, C., Weisburd, D., Telep, C. W., Vitter, Z., & Bennett, T. (2014). Community-oriented policing to reduce crime, disorder, and fear, and increase satisfaction and legitimacy among citizens: A systematic review. *Journal of Experimental Criminology, 10*(4), 399-428.

Kaplan, A., & Haenlein, M. (2019). Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence. *Business Horizons*, *62*(1), 15-25.

Knox, G. W. (2006). Findings from the k-12 survey project: A special report of the ngcrc on gang problems in schools. *Journal of Gang Research*, *14*(1), 1–52.

Li, Q. (2018). Multivariate statistical methods in criminology. *Quantitative Criminology*, 50-51. https://doi.org/10.1007/978-3-319-95341-9_4

Lum, C., & Isaac, W. (2016). The myth of accuracy in criminal justice data: Predictive policing and the overemphasis on data-driven approaches. *Criminology & Public Policy*, *15*(3), 681-696.

MacDonald, J. (2018). Statistical analysis and the study of crime. *Crime and Justice*. https://doi.org/10.1086/696677

Mohler, G., Short, M. B., Malinowski, S., Johnson, M., Tita, G. E., Bertozzi, A. L., & Brantingham, P. J. (2015). Randomized controlled field trials of predictive policing. *Journal of the American Statistical Association*, *110*(512), 1399-1411.

O'Neil, C. (2016). *Weapons of math destruction: How big data increases inequality and threatens democracy*. Crown.

Palys, T., & Atchison, C. (2008). *Research decisions: Quantitative and qualitative perspectives.* Nelson Education.

Perry, W. L., McInnis, B., Price, C. C., Smith, S. C., & Hollywood, J. S. (2013). *Predictive policing: the role of crime forecasting in law enforcement operations.* RAND Corporation. https://www.rand.org/pubs/research_reports/RR233.html

Ratcliffe, J. H. (2004). The hotspot matrix: A framework for the spatio-temporal targeting of crime reduction. *Police Practice and Research*, *5*(1), 5-23.

Ratcliffe, J. H. (2016). *Intelligence-led policing*. Routledge.

Richardson, R., Schultz, J., & Crawford, K. (2019). Dirty data, bad predictions: How civil rights violations impact police data, predictive policing systems, and justice. *New York University Law Review Online*, Forthcoming.

Rogers, E. M. (2003). *Diffusion of innovations (5th ed.)*. Free Press.

Sharma, A. (2017). Role of statistics in different fields. *Research Journal of Science and Technology*, *9*(1), 118-122. https://doi.org/10.5958/2349-2988.2017.00018.3

Truman, J. L. (2015). The use of statistics in criminal justice research. *Journal of Quantitative Criminology*. https://doi.org/10.1007/s10940-015-9264-6

Walker, J. T., & Maddan, S. (2015). *Statistics in criminology and criminal justice: Analysis and interpretation*. Jones & Bartlett Learning.

Weisburd, D., & Piquero, A. R. (2008). How well do criminologists explain crime? Statistical modelling in published studies. *Crime and Justice*, *37*(1), 453-502.

Weisburd, D., Wilson, D. B., Wooditch, A., & Britt, C. (2014). *Advanced statistics in criminology and criminal justice.* Springer. https://doi.org/10.1007/978-3-319-95341-9

Willis, J. J., Mastrofski, S. D., & Weisburd, D. (2004). Compstat in practice: an in-depth analysis of three cities. *Police Foundation*.

Wincup, E. (2017). *Criminological research: Understanding qualitative methods (2nd ed.).* Sage Publications Ltd. https://doi.org/10.4135/9781473982802

233