STATISTICAL ANALYSIS OF CRIME PATTERNS IN KATSINA METROPOLIS

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ABSTRACT

The study investigates the most effective deployment of security personnel in high-crime areas using secondary data from Katsina Police Headquarters, the data comprises twelve types of crimes from various police stations in the Katsina metropolis from 2016 to 2022. The data was analysed using the Friedman test. The Friedman result was found to be statistically significant, indicating substantial differences in crimes across the types of crime. Automobile theft and assault are the most occurring crimes with the highest mean ranks, while kidnapping and unnatural offences are the least frequent crimes in the areas. The study reveals that 33 out of every 1000 people commit at least one crime in the Katsina metropolis, with the most common crimes being automobile theft, assault, and housebreaking. The study suggests that the government should increase the deployment of security personnel in the GRA, Sabon Gari, and Central police stations during festive months like December, January, and June.

Keywords: Crimes, Police stations, Friedman, Katsina Metropolis, Security.

1. Introduction

Crime is any activity being carried out by an individual or group of persons within a time and space, which does not follow the guiding principles of the rule of law (Bello *et al.*, 2013).

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Crime, including murder, assault, fraud, and rape, is a law-abiding offence that is deeply ingrained in society. Its intention and behaviour are influenced by social, economic, biological, and psychological factors. Despite past low rates, the rise in crime rates is attributed to socioeconomic issues (Bailey *et al.*, 2017). The alarming increase in crime and criminality around the world has prompted governments and concerned citizens to step up their daily efforts to combat the threat (Perwej *et al.*, 2021).

Bianchi (2006) opined that criminal activity varies greatly depending on the peculiarities of various human communities or discrepancies in their legal systems. For instance, gay acts and abortion are illegal in Nigeria but permitted in several other nations (Musa, 2020). However, efforts to categorize and combine the various forms of crimes that are present in all human civilizations have produced a wide range of offenses, including crimes against people, crimes against property, and crimes against the law (Roncek, 2004). Crime as a social problem can restrict people's freedom in community participation. It can generate considerable fear within the community superseding national security, employment, cost of living, poverty, and health (Hughes *et al.*, 2002). Victims of crime may suffer long-lasting psychological trauma (United Nations Human Settlements Programme [UNHSP], 2007).

Katsina (2012) states that as insecurity is currently a problem in many nations, it may be said to be global in scope because very few nations do not experience it. Since the return of democratic rule to Nigeria in 1999, there has been a noticeable increase in insecurity there. Despite Nigeria's seeming failure, the tendencies that have led to this can be reversed if the international community and the government take very proactive and long-term action (Katsina, 2012). This implies that it is the responsibility of policymakers to stop this trend through development and social fairness. Therefore, solving Nigeria's security issue also means addressing its development dilemma. The work of Gulumbe and Yusuf (2012) on the analysis of crime data for the period of 2006 – 2008 in Katsina State using Principal Component Analysis (PCA), revealed that Musawa had the lowest crime rate, while Katsina had the highest; Danmusa had the highest crime rate, followed by Jibia. PCA was also used by Bello *et al.* (2014) to ascertain the spatial pattern of criminal victimization in the Katsina Senatorial Zone, Katsina State. The findings showed that theft of manufactured goods and

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victimization by thuggery are more common in the urban centre of Katsina and the nearby LGAs. The Katsina Senatorial Zone in Katsina State is the subject of this study.

Usman *et al.* (2021) used geostatistical techniques to predict spatial variability in crime rates in Katsina State. Results showed increased rates in Dantamba, Sheme, Dofar-Mato, Gunya, Dankar, Rubau, Sawai, Wurma, BirinyaTsakatsa, Dankamtsa, Gardawa, and Katsalle Villages. Atsa'am *et al.* (2021) utilized an artificial neural network to create a classification model that predicts whether a person is involved in drug peddling. The model establishes the standard for the execution of a comprehensive system to be utilized at airports, seaports, police stations, and by security personnel involved in drug-related issues. Precise categorization of suspects and offenders would expedite and ensure the exact application of the relevant parts of drug legislation to specific offences, facilitating appropriate actions such as prosecution or rehabilitation.

Crime mapping can play an important role in the policing and crime reduction processes, from the first stage of data collection through to the monitoring and evaluation of any targeted response. It can also act as an important mechanism in a more pivotal preliminary stage, that of preventing crime by helping in the design of initiatives that are successful in tackling a crime problem (Chainey & Ratcliffe, 2013). Katsina metropolis has witnessed several kinds of crime ranging from house and shop breaking, car and property theft, robbery, rape, assault, grievous hurt, threat to life and property, unlawful possession, forgery, vandalization, capable homicide, violation of traffic rules, disturbance of public peace, conspiracy, trespassing. Election violence and terrorism are other types of crime already suffered in the Katsina metropolis. Gulumbe and Yusuf (2012) reported that the Katsina State's crime rate was highest in Katsina LGA, while the lowest rate was in Musawa LGA Robberies were more common in Danmusa LGA, rapes in Jibia LGA, and serious injuries and wounds in Dandume LGA. Also, the work of Bello *et al.* (2014) where their study focuses on the Katsina senatorial zone opined that thuggery victimization, and theft of manufactured products are more prevalent in the urban Centre- Katsina, and the surrounding LGAs.

Based on the results of Abdullahi (2018), five (5) different types of crime were common in the study area which are automobile theft, grievous hurt, robbery, rape, and murder. His research

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reveals that unemployment, poverty, and peer group influence are the major causes of crime in the Katsina metropolis. Ladan and Iguda (2019) observed that insecurity has increased since the return to democratic governance in 1999, and several factors are responsible for creating the present insecurity in the State. The Governments at both the Federal and State levels have made several efforts to tackle the insecurity to bring back peace and security in the State. However, these efforts have not fully succeeded due to certain limitations. There is, therefore, the need for active and decisive strategies to tackle the insecurity facing the State.

The purpose of this research is to identify the crime hotspots in Katsina metropolis and determine the most effective way to deploy security personnel to areas with the highest crime rates due to fast urbanization and growth. This will in turn assist policymakers and government officials in strategizing ways of mitigating crime in areas characterized by high crime rates.

2. Materials and Methods

Nigeria's northwest geopolitical zone includes the state of Katsina. Jigawa, Kaduna, Zamfara, and Kano states are bordered by Katsina State. Adopted as the "Home of Hospitality," Nigeria's state capital and the town of Daura have been designated "ancient seats of Islamic culture and learning."

2.1 Source of Data

The data was collected from Katsina State Police Command Headquarters comprising monthly records on crimes for the period 2016 – 2022. Data preprocessing steps were conducted to ensure data quality which included data transcription from the police headquarters' record; data entry using Microsoft Excel; data cleaning to ensure data accuracy and reliability; and data transformation by transforming the data to make it suitable for the analysis were done using IBM SPSS Version 23.

2.2 Methods

The type of data analysis carried out after data cleaning preprocessing is descriptive, in which the major study variables will be described through frequency distribution data visualization; and inferential statistics. A Non-parametric two-way Analysis of Variance (ANOVA)

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statistical test called Friedman was used to detect differences in types of crimes committed across multiple test attempts. Friedman is particularly useful when the assumptions of repeated measures ANOVA are not met, such as when data are ordinal or non-normally distributed. In our case, it helps assess the effectiveness of security personnel deployment in various high-crime areas over time. The Friedman test is designed to compare ranks across related groups; therefore, it requires that one has repeated measures (in this case, crime counts across different types of crimes). The Friedman test formula is given as:

$$Q = k(k-1)\sum\left(\frac{X_{.j} - N}{k}\right)^2 \sum X_{i.}\left(k - X_{i.}\right)$$

Equivalently,

$$Q = \frac{12}{Nk(k+1)}\sum R_i^2 - 3N(k+1)$$

Where: k is the number of columns (types of crime); n is the number of rows/blocks (station); N is the grand total; and R is the sum of the ranks.

3. Results

Crime Rate of Katsina Metropolis

United Nations [UN] (2023) estimated the population of Katsina metropolis as 524,000, which was a 3.76% increase against 2022. The total number of crimes committed in Katsina metropolis for the coverage period as obtained from the dataset was 17429. According to (Nolan, 2004), the crime rate (CR) is calculated by dividing the number of crimes committed in an area by the total population, the formula is given below:

$$C_R = \frac{TC}{P} \times 1000\%$$

Where: C_R is the rate of crimes per 1000 people; TC is the total number of crimes committed in an area; and P is the total population.

Therefore,

$$C_R = \frac{17429}{524,000} \times 1000\%$$

$$= 33.26\%$$

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Table 1: Distribution of Crime Rates in Each Station

Crimes	Barhim	CPS	Dutsin	GRA	K/Sauri	Makera	Market	S/Gari	Sardauna	Sarki	Grand Total	Rank
Assault	147	485	149	657	124	441	140	523	147	122	2935	2nd
Automobile Theft	164	657	149	637	166	436	143	594	156	180	3282	1st
Conspiracy	34	235	55	171	63	93	39	147	32	57	926	7th
Fraud	31	184	43	187	55	102	35	155	38	41	871	8th
Grevious Hurt	80	430	124	474	114	291	78	356	79	119	2145	5th
Homicide	13	45	9	96	5	32	14	56	15	7	292	10th
House Breaking	146	322	73	486	78	276	148	572	148	69	2318	3rd
Kidnapping	4	26	5	41	7	24	2	10	3	5	127	12th
Murder	17	198	58	105	56	53	16	65	16	49	633	9th
Rape	46	407	103	304	99	190	39	174	48	100	1510	6th
Store breaking	73	438	86	599	87	386	72	323	82	89	2235	4th
Unnatural Offence	3	29	8	58	6	18	6	16	5	6	155	11th
Grand Total	**758**	**3456**	**862**	**3815**	**860**	**2342**	**732**	**2991**	**769**	**844**	**17429**	

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Table 1 shows the number of different crimes committed in each of the stations. In totality, the Government Reserved Area (GRA) police station was identified as the hotspot and has the highest variety of crimes with 3815 (21.89%) recorded, Central Police Station (CPS) recorded the next highest number of crimes with 3456 (19.83%), and Sabon Gari police station completed the top three stations with the highest crime record with 2991 (17.16%) crimes. However, automobile theft, assault, housebreaking, and store breaking were the most common crimes committed in the Katsina metropolis. Figure 1 revealed the months at which the crimes were mostly rampant December, January, June, March, May, October, February, and November.

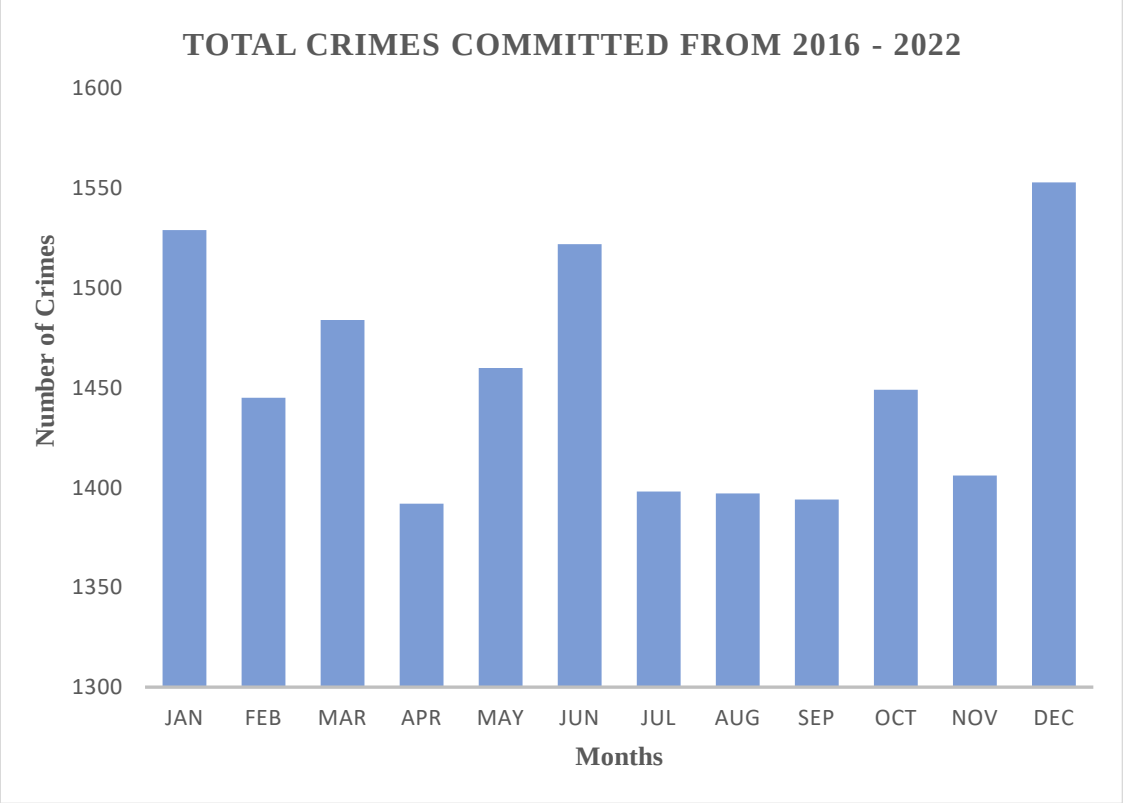

Fig. 1: Bar Chart Showing the Monthly Distribution of Crimes Committed.

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Table 2: Proportion of Rampant Crimes During the Month at Each Hotspot

Months	Assault			Housebreaking			Automobile Theft		
	CPS	**GRA**	**S/Gari**	**CPS**	**GRA**	**S/Gari**	**CPS**	**GRA**	**S/Gari**
January	9.69	8.98	10.13	8.90	9.35	9.27	6.70	6.75	6.40
February	8.87	9.44	8.22	8.68	9.85	7.17	7.00	7.69	9.09
March	9.28	8.52	9.18	7.53	8.35	8.22	7.61	8.48	8.08
April	8.25	7.15	7.65	7.76	7.51	7.87	7.00	7.69	10.27
May	7.01	7.00	9.75	7.08	7.85	8.74	8.98	9.26	5.72
June	9.48	7.76	12.05	7.53	5.84	8.39	9.59	8.95	10.61
July	8.04	9.28	7.65	8.45	8.35	9.27	9.13	7.38	6.73
August	7.63	8.37	5.74	8.90	9.02	7.34	9.89	9.42	9.93
September	7.22	6.70	6.31	8.68	8.18	7.69	9.44	9.26	9.76
October	7.01	9.28	9.18	8.68	8.35	9.62	9.44	8.63	5.89
November	9.28	7.76	5.74	9.13	9.02	7.87	6.24	8.79	7.24
December	8.25	9.74	8.41	8.68	8.35	8.57	8.98	7.69	10.27

Table 2 revealed the proportion of the top three crimes identified as the rampant ones across the three hotspot stations observed as the pronounced places where crimes are mostly committed in the Katsina metropolis. It was discovered that Sabon Gari station is mostly characterized by housebreaking and automobile theft, GRA, and Central police station associated with the assault.

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Table 3: Friedman Test Result

Types of Crime	Mean	Mean Rank	Standard deviation	Range (min., max.)	Chi-Square (P-value)
Assault	24.4583	10.6833	17.2031	(3, 64)	
Automobile	27.3500	11.2250	18.7579	(7, 65)	
Conspiracy	7.7167	5.7292	5.9298	(1, 25)	
Fraud	7.2583	5.3375	5.4826	(1, 20)	
Grevious	17.8750	8.9792	13.8695	(3, 58)	
Homicide	2.4333	2.7708	3.0230	(0, 14)	1132.1944
House Keeping	19.3167	8.9292	14.7517	(3, 55)	($p < 0.05$)
Kidnapping	1.0583	1.8250	1.3176	(0, 6)	
Murder	5.2750	4.2750	4.6472	(0, 20)	
Rape	12.5833	7.5875	10.2544	(2, 48)	
Store Breaking	18.6250	8.6958	16.0200	(2, 59)	
Unnatural Offences	1.2917	1.9625	1.7935	(0, 9)	

Table 3 above presents the results of the Friedman test analysis, the results from the Friedman test provide critical insights into the distribution and prevalence of various types of crimes within the studied dataset. The Chi-Square statistic was obtained as 1132.1944 with a p-value less than 0.05, suggesting that at least one type of crime has a mean count that is significantly different from the others, that is, there exists a significant difference in the mean crime counts across the twelve types of crime analyzed. The mean ranks reflect the relative severity or frequency of each crime type, such that, Automobile and Assault crimes ranked highest, indicating they are more prevalent compared to other crime types. This finding underscores the need for targeted policing strategies and resource allocation to address these specific crimes effectively in the community. In contrast, crimes such as Homicide, Kidnapping, and

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Unnatural Offences show significantly lower mean counts. While these crimes may be less frequent, their impact can be severe when they do occur. Therefore, law enforcement agencies must maintain readiness to respond to these incidents despite their lower frequency.

A Post Hoc test was conducted to determine which type of crimes differ from each other in the metropolis. There exists a significant difference between the following crimes: Assault vs. automobile theft; Conspiracy Vs (Fraud, Murder); Fraud Vs Murder; Grievous hurt Vs (Housebreaking, Store breaking); Homicide Vs (Housebreaking, Murder, Unnatural offence); Housebreaking vs. Store breaking; and Kidnapping vs. Unnatural offence. This indicates that these pairs of treatment means were completely distinct and, therefore, did not come from a common population.

4. Discussion

In all, 17,429 crime cases were found in the research area by the analysis. According to the study, there is a significant influence of criminal activity on the population; the crime rate in the study area was found to be 33.26% for every 1,000 individuals. As a proportion of all incidents, automobile theft was shown to be the most common criminal activity. Government Reserved Area (GRA) Police Station, Central Police Station (CPS), and Sabon Gari Police Station were found to have the greatest total crime statistics, however, allocating resources and developing strategic plans requires this information. Specific crime types that were documented at various locations were the focus of the study. Assault, automobile theft, store breaking, grievous hurt, and Rape, for instance, were more common at GRA. Particular attention was also given to the months when these crimes occurred most frequently. The findings suggest that security personnel deployment should be strategically focused on high-crime areas, particularly those associated with Assault and Automobile crimes. This targeted approach can enhance public safety by concentrating resources where they are most needed.

The spatial distribution of crimes among different police divisions was illustrated by the figures and tables included in the study. Targeted intervention is necessary in locations where overall crime concentrations are regularly greater, such as Sabon Gari, GRA, and Central Police Station (CPS). Information about the temporal fluctuations in crime incidence was obtained from the study. In the second quarter of the year, for example, automobile theft was found to

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have climbed after initially declining in the first quarter. To come up with time-specific strategies, this temporal pattern is crucial. At a 5% level of significance, the Friedman test showed significant differences between the group means of crime types. These findings have more trust because of this statistical rigour. The study underlined the necessity of modifying police tactics and acting appropriately, particularly in regions with persistently high crime rates. It drew attention to possible weaknesses in the efficacy of ongoing programs.

To sum up, the thorough examination of Katsina State's crime statistics yields important insights for stakeholders, legislators, and law enforcement organizations. The results provide practical advice for enhancing resource allocation and security protocols in addition to illuminating the frequency and distribution of crimes. Authorities can adjust their strategies to handle the difficulties that each region of Katsina State faces by knowing the dynamics of criminal activity. Understanding which types of crime are most prevalent can inform training programs for officers, community outreach initiatives, and public safety campaigns.

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Ethics approval and consent to participate

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Authors' Contributions

- Ibrahim Dangani Abubakar: Conceptualization, data curation, formal analysis, writing—original draft, and editing.
- Lawal Olumuyiwa Mashood: Conceptualization, methodology, formal analysis, supervision, writing—review, and visualization.
- Oluwafemi Samson Balogun: Writing—review and editing, and project administration.

References

Abdullahi, A.B. (2018). Analysis of crime in Katsina metropolitan area, Katsina State. *Doctoral dissertation, Department of Geography and Environmental Studies, Ahmadu Bello University, Zaria*.

Atsa'am, D.D., Balogun, O.O, Agjei, R.O., Devine, S.N.O., Akingbade, T.J. and Omotehinwa, T.O. (2022). A model for predicting the class of illicit drug suspects and offenders. *Journal of Drug Issues*, 52(2): 168-181.

Bailey, Z.D., Krieger, N., Agénor, M., Graves, J., Linos, N. and Bassett, M.T. (2017). Structural Racism and Health Inequities in the USA: Evidence and Interventions. *Lancet*, 389(10077):1453–63. https://doi.org/10.1016/s0140-6736(17)30569-x.

Bello, I.E., Ikhuoria, I.A., Agbaje, G.I. and Ogedegbe, S.O. (2013). Managing Urban Crimes with Geoinformatics: A Case Study of Benin City, Nigeria. *Computer Engineering and Intelligent Systems*, 4(13):121- 134.

Bello, Y., Batsari, Y.U. and Charanchi, A.S. (2014). Principal Component Analysis of Crime Victimizations in Katsina Senatorial Zone. *International Journal of Science and Technology, 3*(4):192-202.

Bianchi, A. (2006). Assessing the Effectiveness of the UN Security Council's Anti-Terrorism Measures: The Quest for Legitimacy and Cohesion. *European Journal of International Law*, 17(5):881–919. https://doi.org/10.1093/ejil/chl032.

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

Gulumbe, S.U. and Yusuf, B. (2012). Analysis of crime data using principal component analysis: A case study of Katsina State. *CBN Journal of Applied Statistics (JAS), 3*(2):3.

ISSN NUMBER: 1116-249X

Hughes, G., McLaughlin, E. and Muncie, J. (2002). *Crime prevention and community safety: new directions*. Sage.

Katsina, A.M. (2012). Nigeria's security challenges and the crisis of development:Towards a new framework for analysis. *International Journal of Developing Societies, 1*(3): 107-116.

Ladan, S.I. and Iguda, A. (2019). Analysis of contemporary insecurity in Katsina State, Nigeria. *Direct Research Journal of Social Science and Educational Studies, 6*(7): 95-102.

Musa, A. (2020). Sex Education in Nigeria: Attitude of Secondary School Adolescents and the Role of Parents and Stakeholders. *Open Journal of Educational Development*, 1(1): 1–30. https://doi.org/10.52417/ojed.v1i1.60.

Nolan, J.J. (2004). Establishing the statistical relationship between population size and UCR crime rate: Its impact and implications. *Journal of Criminal Justice, 32*(6): 547-555.

Perwej, D.Y., Abbas, S.Q., Dixit, J.P., Akhtar, N. and Jaiswal, A.K. (2021). A Systematic Literature Review on the Cyber Security. *International Journal of Scientific Research and Management*, 9(12):669–710. https://doi.org/10.18535/ijsrm/v9i12.ec04.

Roncek, D. (2004). Research on crimes in small areas: traps and tricks. In *Proceedings of the 7th Annual International Crime Mapping Research Conference*.

United Nations [UN] (2023). World population prospects: Katsina, Nigeria metro area population 1950-2023. Retrieved on December 28, 2023; Available at: https://macrotrends.net/cities/22006/katsina/population.

United Nations Human Settlements Programme [UNHSP] (2007). *Enhancing urban safety and security: global report on human settlements 2007*. Earthscan.

Usman, U., Suleiman, S., Yar'adua, S.I. and Ismail, A.A. (2021). Spatial Analysis on the Crimes Rate Using Regression Kriging Model: A Case Study of Katsina State. *European Journal of Advances in Engineering and Technology, 8*(10), 64-69.

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