

## SPATIO-TEMPORAL ANALYSIS OF CRIMES IN HARYANA: A GEOGRAPHICAL PERSPECTIVE

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### Abstract

The spatio-temporal analysis of crimes offers critical insights into the patterns and dynamics of criminal activities over space and time, enabling more effective law enforcement and policy-making. This study focuses on Haryana, a northern state in India, with the objective of mapping and analyzing the spatial distribution and temporal trends of various types of crimes. The findings reveal significant spatial clusters of crimes, and specific times of heightened criminal activity. These insights have important implications for law enforcement strategies, resource allocation, and policy development. The two main objectives have analysed in the present work i.e trend of crime types and pattern of crime types in Haryana. For this work, the secondary data have been collected from national crime record bureau and tabulated. Murder, dacoity, theft, and robbery crimes have shown significant fluctuations over time, with a noticeable increase in early 2000s and a gradual decline in recent years. Robbery rates have also seen a steady increase, stabilizing around 1.31per cent by 2018. Kidnapping/Abduction Crimes have shown a dramatic increase, particularly from 2010 onwards, peaking in 2016, with a slight decline thereafter. Miscellaneous Crime has consistently held the highest percentage of total crimes, though there has been a gradual decline from the mid-20th century into the early 21st century.

Keywords: Spatio-temporal Analysis, Crime Patterns, Haryana

## Introduction

A basic human right is the ability to live in a world free from violence. It has an immediate impact on both the length and quality of a person's existence, as seen by things like shortened lifespans, pervasive feelings of insecurity, behavioral adjustments to deter crime, and so on. Consequently, one of the "capabilities" that enhances one's quality of life is the ability to defend against violence. Violence weakens the rule of law, which lowers the value placed on property rights, deters investment, and hence hinders economic expansion and the efficient operation of public services (Chauhan & Baraik, 2016). It is the duty of every citizen and human being in general to contribute to the development of a healthy society. For the benefit of humanity, technology must advance. Therefore, the scientific and research community have an obligation to forcefully contribute to reducing the rate of crime.

In collaboration with law enforcement, academics must devise a system for examining criminal incidents from the extensive crime data collection. Combining such technology with



domain expertise would effectively forecast the techniques of operation of criminals and envision the crime together with related data, such as crime categories, likely tactics, and crime location (Wadhwa & Dutt, 2011).

Spatio-temporal analysis integrates spatial data (location) and temporal data (time) to reveal patterns, trends, and correlations that may not be apparent when examining the data separately. Detecting areas with high concentrations of criminal activities. Understanding how crime patterns change over time. Optimizing the deployment of law enforcement resources. Formulating targeted policies for crime prevention and control. Anticipating future crime events based on historical data (Kedia, 2016).

Haryana, a state in northern India, has witnessed significant socio-economic changes over the past few decades. Rapid urbanization, industrialization, and migration have contributed to changes in the crime landscape. A geographical perspective on crime in Haryana involves examining how different regions within the state experience and respond to crime. This includes comparing crime rates and types of crimes in urban and rural areas. Analyzing how different districts within Haryana vary in terms of crime incidence. Investigating the influence of factors such as population density, literacy rates, and economic conditions on crime patterns. Identifying clusters of high and low crime areas using spatial statistical methods.

The spatio-temporal analysis of crimes in Haryana provides valuable insights into the patterns and dynamics of criminal activities in the state. By integrating geographical and temporal data, this approach helps in identifying crime hotspots, understanding trends, and formulating effective strategies for crime prevention and control. As Haryana continues to develop, it is crucial to leverage advanced analytical techniques to ensure the safety and security of its residents. Feminist responses to crimes against women encompass a range of theoretical, activist, and policy-oriented approaches aimed at addressing and combating gender-based violence. These responses highlight the systemic nature of violence against women and advocate for societal changes to achieve gender equality and justice.

India, with its diverse cultural, social, and economic landscape, faces unique challenges when it comes to addressing crime, particularly gender-based crimes. The intersection of crime, gender, and society in India reveals deep-seated issues rooted in patriarchy, socio-economic disparities, and cultural norms (Kaur, 2011).

Crimes against women in India have been a significant concern, drawing attention from policymakers, activists, and researchers. Analyzing official statistics helps to understand the scope, trends, and regional variations of these crimes, facilitating informed responses and interventions (Mukherjee et al. 2001). Crime is a complex social issue influenced by various factors such as economic conditions, social structures, cultural norms, and geographical settings. Understanding the patterns and trends of crime is essential for effective law



enforcement and policy-making. Spatio-temporal analysis of crimes provides a comprehensive approach to study the distribution and dynamics of criminal activities over time and across different geographical locations (Thakur & Parai, 1993). Controlling crime in India is a multifaceted challenge that requires a comprehensive approach involving law enforcement, legal reforms, socio-economic development, community engagement, and technological advancements. The following strategies outline the key components necessary for effective crime control in India (Henderson, 1913).

## Objectives

- To analyze the trends of crimes in Haryana.
- To analyze the spatial patterns of crimes in Haryana at districts level.

# Database & Research Methodology

The research methodology for this study on the spatio-temporal analysis of crimes in Haryana employs a systematic and multi-faceted approach to data collection, processing, analysis, and visualization. Initially, crime data is gathered from secondary sources as the National Crime Records Bureau (NCRB) for the period of 1966-2018. The collected data includes details on crime types, locations, and times. The data undergoes rigorous cleaning to remove duplicates and correct errors. For spatial analysis, Geographic Information Systems (GIS) software, such as ArcGIS has been used to map crime distributions. The data have been classified by using equal interval methods for preparing thematic maps. The graph has been prepared in excel for showing trend of crime types in Haryana.

## **Result & Discussion**

The table 1 presents a record of murder crime rates (expressed in percentages) over selected years from 1966 to 2018. In 1966, the rate was 0.88per cent, which saw a gradual increase over the years, peaking at 1.99 per cent in 2000. Following 2000, the rate experienced fluctuations, with notable decreases in certain years such as 2014 (1.39 per cent) and 2015 (1.19 per cent).

The most recent years in the dataset, 2017 and 2018, show rates of 1.07 per cent and 1.06 per cent respectively. The overall average rate across all the years listed is 1.13per cent. This data provides insight into the historical trends of murder crime rates over a span of more than five decades (Table 1).



Sr. No.	Years	Murder	Dacoity	Theft	Robbery	Kidnapping/ Abduction	Miscellaneous
1.	1966	0.88	0.03	11.18	0.09	0.65	87.17
2.	1970	1.01	0.04	13.62	0.12	0.77	84.44
3.	1980	1.11	0.06	8.93	0.19	0.60	89.11
4.	1990	1.91	0.11	15.26	0.42	0.73	81.57
5.	2000	1.99	0.27	16.08	1.09	1.20	79.36
6.	2010	1.70	0.25	27.44	1.24	1.64	67.74
7.	2012	1.52	0.31	27.02	0.67	1.04	69.43
8.	2013	1.44	0.22	25.93	1.04	4.38	66.99
9.	2014	1.39	0.22	25.41	1.01	5.58	66.40
10.	2015	1.19	0.24	24.38	1.07	6.71	66.42
11.	2016	1.20	0.20	24.53	0.80	8.08	65.19
12.	2017	1.07	0.20	23.84	1.28	4.66	68.94
13.	2018	1.13	0.22	20.20	1.16	4.34	72.94

### **Table 1:** Trend of Crime Types in Haryana, 1966-2018

Source: National Crime Record Bureau, 2018.

The table 1 displays dacoity crime rates for selected years from 1966 to 2018. In 1966, the rate was 0.03 per cent, which increased over time, reaching 0.27 per cent in 2000. The rate remained relatively high in subsequent years, peaking at 0.31per cent in 2012. From 2013 onwards, the rates fluctuated slightly but remained around 0.20 per cent to 0.24 per cent. The most recent years in the dataset, 2017 and 2018, both show a rate of 0.20 per cent. The overall average rate across all the years listed is 0.22 per cent. This data highlights the trends in dacoity crime rates over more than five decades (Fig. 1). The table 1 shows the percentages of theft crimes for a selection of years between 1966 and 2018. The rate began in 1966 at 11.18 per cent and varied throughout time, with significant rises in 1970 (13.62 per cent), 1990 (15.26 per cent), and 2000 (16.08 per cent). 2010 saw a notable increase to 27.44 per cent, which was followed by correspondingly high rates in 2012 (27.02 per cent), 2013 (25.93 per cent), and 2014 (25.41 per cent).

There were modest declines from 2015 to 2018, and the rate steadied at 23.70 per cent and 24.53 per cent. The general trend of stealing offenses throughout more than five decades is reflected in the overall average rate of 20.20 per cent for the years indicated (Fig. 1).

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Source: Based on the table 1

Fig. 1

The table 1 gives information on the proportion of robberies that occurred in a given year between 1966 and 2018. The rate climbed progressively from its 1966 starting point of 0.09 per cent to 0.42per cent in 1990 and 1.09 per cent in 2000. In 2010, there was a noteworthy increase, with a rate of 1.24 per cent. The rates varied throughout the next years, reaching a noteworthy high of 1.31 per cent in 2018. The total average rate for the specified years is 1.16per cent, which shows the overall pattern of robbery offenses over a period of more than fifty years (Fig. 1). Starting at 0.65 per cent in 1966, the kidnapping rate showed a gradual increase, reaching 1.20 per cent in 2000. A significant rise occurred in 2010, with a rate of 1.64 per cent. The years following 2010 saw a dramatic increase, peaking at 8.08 per cent in 2016. The kidnapping rates slightly decreased in the subsequent years, with 4.66 per cent in 2017 and 4.78 per cent in 2018. The overall average rate across the years listed is 4.34 per cent, reflecting the general trend of kidnapping and abduction crimes over more than five decades. The table 1 gives information on the percentages of various crimes for a few chosen years between 1966 and 2018. At 87.17 per cent, the rate was noticeably high in 1966. Over time, this rate gradually decreased, reaching 84.44 per cent in 1970 and 81.57 per cent in 1990.

The percentage dropped to 79.36 per cent by 2000 and then to 67.74 per cent in 2010. With very minor variations, the rate was mostly steady in the mid- to upper-60s throughout the next years. The rates for 2017 and 2018 are around 68.94 per cent and 68.95 per cent, respectively. The average rate for all the mentioned years is 72.94 per cent, which illustrates



the long-term patterns in the rates of various crimes over a period of more than fifty years (Fig. 1).

# Spatial Analysis of Crime Types in Haryana Spatial Pattern of Murder Crimes: 2018

In 2018, the distribution of murder crimes across different districts in Haryana revealed significant regional variations, with some areas experiencing notably higher crime rates than others. Charkhi Dadri and Sonipat had the highest murder crime rates at 1.87 per cent and 1.86 per cent, respectively. This high incidence may be attributed to socio-economic factors such as economic disparities, unemployment, and social tensions. Additionally, rural-urban dynamics and issues related to land disputes might also contribute to the elevated crime rates in these districts.

Conversely, districts like Ambala (0.60 per cent) and Hisar (0.75 per cent) recorded the lowest murder crime rates. These areas might benefit from better socio-economic conditions, more effective law enforcement, and stronger community ties, which can collectively contribute to lower crime rates. Faridabad (0.76 per cent) and Gurugram (0.78 per cent), despite being major urban centers, also had relatively low murder rates, possibly due to higher police presence and advanced surveillance systems. Other districts such as Jhajjar (1.83 per cent) and Mahendragarh (1.73 per cent) also reported high murder crime rates, which could be linked to regional socio-political issues and less effective law enforcement mechanisms. Districts like Karnal (1.19 per cent), Nuh (1.32 per cent), and Rohtak (1.13 per cent) showed crime rates close to the state average of 1.13 per cent, reflecting the varied but somewhat typical socio-economic challenges faced by the state (Table 2).

## **Spatial Pattern of Dacoity Crimes: 2018**

In 2018, the distribution of dacoity crimes across different districts in Haryana exhibited notable disparities, highlighting the varied socio-economic and law enforcement landscapes of the state. Nuh recorded the highest dacoity crime rate at 1.20 per cent, which could be attributed to significant socio-economic challenges, including poverty and inadequate law enforcement. Similarly, districts such as Kaithal (0.38 per cent), Jhajjar (0.33 per cent), and Sirsa (0.31 per cent) also reported higher dacoity crime rates (Map 2).

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Sr. No.	Districts	Murder	Dacoity	Theft	Robbery	Kidnapping/ Abduction	Miscellaneous
1.	Ambala	0.60	0.09	16.44	0.69	2.07	80.11
2.	Bhiwani	1.01	0.16	13.78	1.01	1.95	82.09
3.	Charkhi Dadri	1.87	0.24	16.45	1.14	1.38	78.91
4.	Faridabad	0.76	0.06	25.95	1.40	5.02	66.81
5.	Fatehabad	1.05	0.23	13.91	0.59	2.64	81.59
6.	Gurugram	0.78	0.30	43.32	1.67	2.92	51.02
7.	Hisar	0.75	0.09	18.17	1.06	1.11	78.82
8.	Jhajjar	1.83	0.33	14.64	1.69	1.75	79.75
9.	Jind	1.04	0.13	20.46	0.93	3.76	73.68
10.	Kaithal	1.14	0.38	22.07	0.84	4.95	70.62
11.	Karnal	1.19	0.13	22.09	1.08	5.73	69.77
12.	Kurukshetra	0.84	0.13	22.37	0.23	1.69	74.74
13.	Mahendragarh	1.73	0.29	18.35	0.76	1.09	77.78
14.	Nuh	1.32	1.20	15.04	2.32	4.36	75.76
15.	Palwal	1.09	0.03	24.30	1.59	1.83	71.17
16.	Panchkula	0.98	0.05	15.05	0.41	10.34	73.16
17.	Panipat	1.05	0.07	21.90	2.21	15.00	59.77
18.	Rewari	1.15	0.13	23.04	1.25	1.62	72.82
19.	Rohtak	1.13	0.25	23.62	1.56	8.88	64.57
20.	Sirsa	0.86	0.31	18.33	1.07	2.24	77.20
21.	Sonipat	1.86	0.13	17.86	1.50	6.12	72.53
22.	Yamunanagar	0.81	0.16	17.30	0.56	9.14	72.04
Haryana		1.13	0.22	20.20	1.16	4.34	72.94

### **Table 2:** Distribution of Crime Types in Haryana, 2018

Source: National Crime Record Bureau, 2018.

These elevated figures may reflect regional issues such as economic instability, social unrest, and less effective policing strategies. Conversely, districts like Ambala (0.09 per cent), Hisar (0.09 per cent), and Faridabad (0.06 per cent) had some of the lowest dacoity crime rates in the state. The lower incidence of dacoity crimes in these areas might be due to better socio-economic conditions, stronger community engagement, and more efficient law enforcement mechanisms (Map 2).

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Map 2

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Other districts, including Gurugram (0.30 per cent), Rohtak (0.25 per cent), and Charkhi Dadri (0.24 per cent), displayed moderate crime rates, indicating a balanced mix of urban challenges and law enforcement responses (Map 2). Overall, the average dacoity crime rate for Haryana in 2018 stood at 0.22 per cent, underscoring that while most districts maintained relatively low crime rates, certain areas with higher rates require focused interventions. Addressing the root causes of high crime rates in specific districts through targeted socio-economic development and strengthening law enforcement can help mitigate the prevalence of dacoity crimes across the state (Table 2).

## **Spatial Pattern of Theft Crimes: 2018**

In 2018, the distribution of theft crimes across different districts in Haryana showed considerable variation, reflecting the diverse socio-economic and urbanization patterns in the state. Gurugram had the highest theft crime rate at 43.32 per cent, likely due to its rapid urbanization, high population density, and significant economic activities, which often attract criminal activities. Similarly, Faridabad (25.95 per cent) and Palwal (24.30per cent) also reported high theft crime rates, which can be attributed to their proximity to urban centers and associated socio-economic dynamics. Districts such as Rohtak (23.62 per cent), Rewari (23.04 per cent), and Kurukshetra (22.37 per cent) displayed moderate to high theft crime rates. These regions might be experiencing urbanization pressures, contributing to increased theft incidents. On the other hand, areas like Bhiwani (13.78 per cent), Fatehabad (13.91 per cent), and Jhajjar (14.64 per cent) reported lower theft crime rates, possibly due to their more rural settings and tighter-knit communities, which can act as deterrents to crime (Map 3).

## **Spatial Pattern of Robbery Crimes: 2018**

In 2018, the distribution of robbery crimes across various districts in Haryana revealed significant variations, highlighting differing levels of urbanization, economic activity, and law enforcement efficacy. Nuh had the highest robbery crime rate at 2.32 per cent, potentially due to its socio-economic challenges, including high poverty levels and inadequate policing. Panipat followed closely with a robbery rate of 2.21 per cent, which could be attributed to its industrial nature, attracting both economic migrants and criminal activities. Other districts with elevated robbery crime rates included Jhajjar (1.69 per cent), Gurugram (1.67 per cent), and Palwal (1.59 per cent). Gurugram's high rate is likely linked to its rapid urbanization and status as a major business hub, making it a target for robberies. Similarly, Jhajjar and Palwal's proximity to urban centers might contribute to their higher crime rates.

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Map 4

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In contrast, districts such as Kurukshetra (0.23 per cent), Panchkula (0.41 per cent), and Yamunanagar (0.56 per cent) reported some of the lowest robbery crime rates. These areas may benefit from more effective law enforcement, stronger community policing, and possibly lower urbanization levels compared to the high-crime districts (Map 4).

# Spatial Pattern of Kidnapping/Abduction Crimes: 2018

In 2018, the rates of kidnapping and abduction crimes in Haryana displayed significant disparities among its districts, reflecting variations in socio-economic conditions, law enforcement effectiveness, and local demographic factors. Panipat had the highest rate of kidnapping and abduction at 15.00 per cent, a figure likely influenced by its industrial landscape, which may attract both a transient population and criminal activity. Panchkula followed with a rate of 10.34 per cent, possibly due to its status as a planned city with diverse economic activities that might provide opportunities for such crimes. Yamunanagar and Rohtak also reported high rates of 9.14 per cent and 8.88 per cent respectively, indicating potential issues related to urbanization and economic disparity. Karnal (5.73 per cent) and Faridabad (5.02 per cent) showed elevated rates, suggesting that larger urban centers with significant economic activity might be more prone to such crimes (Map 5). Conversely, districts like Mahendragarh (1.09 per cent), Hisar (1.11 per cent), and Charkhi Dadri (1.38 per cent) recorded some of the lowest rates of kidnapping and abduction. These areas might benefit from more cohesive community structures and effective policing strategies. Other districts with lower rates included Bhiwani (1.95 per cent), Jhajjar (1.75 per cent), and Palwal (1.83 per cent), which could indicate relatively stable socio-economic conditions or effective local law enforcement. The overall average kidnapping and abduction crime rate for Haryana in 2018 was 4.34 per cent. This average mask the wide range of rates across the state, underscoring the need for district-specific strategies to address the unique challenges and factors contributing to such crimes. Enhanced law enforcement presence, community policing, and socio-economic development initiatives tailored to the needs of high-crime districts could help mitigate these issues effectively (Table 2).

## **Spatial Pattern of Miscellaneous Crimes: 2018**

In 2018, the rates of miscellaneous crimes in Haryana showed considerable variation across its districts, reflecting differences in local socio-economic conditions, effectiveness of law enforcement, and community engagement. Ambala (80.11 per cent), Bhiwani (82.09 per cent), and Fatehabad (81.59 per cent) were among the districts with the highest rates of miscellaneous crimes (Map 6).

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Map 6





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These high rates might indicate challenges in policing and social stability, potentially requiring targeted interventions to address the underlying causes of crime. On the other hand, Gurugram (51.02 per cent) had the lowest rate of miscellaneous crimes. As a major urban and economic center, Gurugram's lower rate could be attributed to more effective law enforcement and better socio-economic conditions. However, this district's unique urban challenges might also lead to a different crime profile compared to other regions. Other districts with relatively high rates included Charkhi Dadri (78.91 per cent), Hisar (78.82 per cent), and Jhajjar (79.75 per cent). These figures suggest significant challenges in these areas that may stem from a mix of urban and rural dynamics, necessitating comprehensive crime prevention strategies. Faridabad (66.81 per cent) and Rohtak (64.57 per cent) showed moderate rates of miscellaneous crimes (Map 6).

### Conclusion

The data on crime trends in Haryana from 1966 to 2018 presents a nuanced picture of the state's evolving crime landscape. Murder crimes peaked in 2000 and have since shown a steady decline, which could be indicative of improved law enforcement and social stability. Dacoity crimes remained relatively low throughout the period, with minor fluctuations. Theft crimes experienced significant variation, reaching their highest point in 2010, likely influenced by urbanization and socio-economic factors. Robbery crimes have steadily increased since 2000, highlighting growing concerns around economic disparities and urban crime. The most dramatic trend is observed in kidnapping and abduction crimes, which saw a sharp increase post-2010, peaking in 2016. This rise may reflect changing societal dynamics, such as increased mobility, social unrest, and possibly better reporting mechanisms. Miscellaneous crimes, while showing a general decline, still represent a large proportion of the crime spectrum, indicating diverse and less categorized criminal activities. In conclusion, the data reveals that while certain crimes like murder and miscellaneous offenses have decreased, others like theft, robbery, and kidnapping have shown significant increases at various points, reflecting the socio-economic transformations within the state. The study underscores the significance of implementing targeted, adaptive crime prevention and law enforcement strategies in Haryana to identify and tackle specific crime trends.

Districts such as Gurugram and Faridabad have high rates of theft, at 43.32 per cent and 25.95 per cent, respectively, indicating significant challenges related to property crimes. However, these districts also show lower rates of violent crimes such as murder and dacoity, suggesting a more urban pattern of crime where non-violent offenses are predominant.

Ambala (80.11 per cent), Bhiwani (82.09 per cent), and Fatehabad (81.59 per cent) exhibit high percentages of miscellaneous crimes, indicating prevalent issues like property crimes and minor offenses, despite lower rates of violent crimes. Districts like Jhajjar and Hisar show a mix of high miscellaneous crimes and notable rates of theft and robbery, indicating a blend of urban and rural crime dynamics that require multi-faceted approaches for crime prevention and control. Certain districts such as Charkhi Dadri (1.87 per cent) and



Mahendragarh (1.73 per cent) have higher murder rates, pointing towards more severe violent crime issues in these regions. Panipat stands out with the highest kidnapping/abduction rate at 15.00per cent, requiring targeted interventions to address and mitigate such crimes. Haryana's crime rate is balanced, with miscellaneous crimes at a high (72.94 per cent), followed by theft (20.20 per cent) and kidnapping/abduction (4.34 percent), indicating the need for comprehensive prevention strategies.

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