Statistical Forecasting of Crime Rate in Southern Region of India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This paper deals with the study on crime rate in southern region (Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, and Puducherry) of India. The data has collected from the well-defined source. A statistical approach has considered in analyzing the data for forecasting the behavior of the pattern of the data. The autocorrelation and partial autocorrelation has verified and presented as graphs. A detailed interpretation has presented for each state along with the concluding remarks.

1. INTRODUCTION

Crime is a social blunder. It is a criminal act that is against the law of the state and harshly condemned by society. Acts or omissions prohibited by law that are punishable by imprisonment or a fine are referred to as crimes. Crimes include murder, robbery, burglary, rape, drunken driving, child maltreatment, and failure to pay taxes. The word "crime" comes from the Latin word "crimen," which means "offence" as well as "wrongdoer." Crime is regarded as a form of antisocial behaviour. Each society may have its own definition of crime. It is possible for a crime to be legal or illegal. Illegal and punishable crime is the violation of any rule of administration or law of the state of practice of any wrong doing and harmful to self or against

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third parties, provided in criminal law. All acts of self-defense are legal and unpunishable crimes.

According to the Rigveda and other scriptures, ancient Indian women enjoyed a high position of respect in society. From the Vedic period to present times, volumes might be written about the standing of our women and their heroic achievements. Women lost their position and were consigned to the background as a result of social, political, and economic developments. Many harmful habits and traditions arose, enslaving women and tying them to the confines of their homes. According to official statistics, women's sex ratio, health status, literacy rate, employment participation rate, and political engagement rate are all dropping. On the other side, in some parts of India, societal problems such as dowry deaths, child marriage, domestic violence, rape, sexual harassment, and exploitation of women workers are common. Humiliation, rape, kidnapping, molestation, dowry death, torture, and wife-beating have all become more common over time.

"The semantic meaning of 'crime against women' is direct or indirect physical or mental cruelty to women. Crimes which are 'directed specifically against women' and in which 'only women are victims' are characterized as 'crime against women'. It's also crucial to define what constitutes "crime" against women. Abuse is another term for crime, and it refers to any type of physical aggression or misbehaviour. Domestic violence occurs when a crime is committed at home and involves family members such as children, spouses, parents, or servants. Hitting, kicking, biting, shoving, restraining, and hurling things are all examples of domestic violence. In broad terms, it includes threats, sexual abuse, emotional abuse, controlling or domineering, intimidation, stalking, passive/covert abuse and economic deprivation, rape, abduction, kidnapping, murder (all cases of criminal violence, dowry death, wife battering, sexual abuse, maltreatment of a widow and for an elderly women (all cases of domestic violence) and eve-teasing, forcing wife/daughter-in-law to go for feticide, forcing a young widow to commit sati, etc (all cases of social violence), are issues which affect a large section of society.

In 1993, the United Nations issued the Declaration on the Elimination of Crime Against Women, which defined "crime against women." It is defined as any act of gender-based violence that causes physical, sexual, or psychological harm or suffering to women, including threats of such actions, coercion, or arbitrary denial of liberty, whether in public or private life.

1.1 Crime against Women In India

With each passing year, the number of violent crimes in India, particularly those against women, including rape, that are reported in official statistics continues to rise. This violence thrives in an environment of sustained economic growth and rising inequality between rich and poor in Indian society, as evidenced by the country's GINI coefficient, which has risen from 0.32 to 0.38 in the last two decades. India's new wealth and development achievements, as seen by its GDP increase from $450.42 billion in 2000 to $1841.7 billion in 2013, appear to have borne no fruit for its women. Official figures show that the number of offences against women registered in 2012 increased by 24.7 percent when compared to 2008. Ranging from the so-called eve teasing and outright sexual harassment on the street or workplace, to harassment for dowry, molestation in public transport vehicles, and the often- reported rape, these crimes against women reflect the vulnerability and deep-rooted problems related to the position of women in these issues, care of victims of rape being onesuch example.

Although a thorough instruction on the establishment of Rape Crisis Centres (RCCs) and Specialized Sexual Assault Treatment Units (SATUs) was communicated to all state governments in 2009, no such units have been established in the states, with the exception of New Delhi. According to the law, a female police officer must record the victim's statement and provide medical and legal assistance. However, female police officers make up only 6.5 percent of the force, making this difficult to accomplish. Furthermore, most district and sub-district hospitals in the country lack the equipment and resources necessary to provide rape victims with the care that is required by law.

It has been reported that traumatised victims often have to go from one hospital to another for forensic examination following rape. Victims often sit for hours in soiled clothes in the hospital and feel humiliated all over again in the course of insensitive history- taking by doctors and health workers. Their pain is exacerbated by the government's judgmental views and lack of privacy in the healthcare system.

1.2 Crime against Women in South India

In India, violence against women is widespread and occurs both in the public and private arenas. Patriarchal societal standards, as well as inter and intra gender hierarchies, support it. Women are oppressed and discriminated against not only because of their gender, but also because of caste, class, ability, sexual orientation, tradition, and other factors. That exposes them to a continuum of violence throughout the life cycle. The manifestations of violence against Women are a reflection of the structural and institutional inequality that is a reality for most women in India (Manjoo Rashida, 2013). Most forms of violence are not unique incidents but are ongoing, and can even continue for decades. Violence is nearly universally under-reported due to the sensitivity of the subject (Watts Charlotte, Zimmerman Cathy, 2002).

The detailed explanation for various forms of violence against women prevalent in India and their statistical summary are as follows:

- Kidnapping & Abdication
- Female Trafficking
- Assault on Women with intent to outrage her modesty
- Attempt to commit Rape
- Acid Attacks and attempts to acid attack
- Insult to the modesty of Women
- Indecent Representation of Women Prohibition Act
- Abetment of Suicide of Women
- The Immoral Traffic Prevention Act
- Rape

1.3 Objectives

- To forecast the crime rate of Karnataka.
- To forecast the crime rate of Andhra Pradesh.
- To forecast the crime rate of Tamil Nadu.
- To forecast the crime rate of Puducherry
- To forecast the crime rate of Kerala.

2. REVIEW OF LITERATURE

UNICEF [1] in its working paper titled "DOMESTIC VIOLENCE AGAINST WOMEN AND GIRLS" discussed the global burden of domestic violence and its implication over the women and highlight how the women face various forms of discrimination in her life. Violence against women is considered a global epidemic in which victims are subjected to physical, psychological, and sexual abuse, as well as torture and murder. Women are deprived of equality, security, dignity, self-worth, and their right to enjoy fundamental freedoms as a result of this violation.

Across the globe, some type of violence is prevalent in every country. Culture, class, education, income, ethnicity, and age are all factors in the prevalence of violence. The vulnerability, on the other hand, varies from group to group. Women belong to minority groups, indigenous and migrant women, refugee women and women in conflict zone are more vulnerable than the others. It's alarming to learn that between 20 and 50 percent of women who have experienced violence have come from a close relationship, either with their partner or with family members. However, the scope of domestic abuse is hidden because the majority of occurrences go unreported and unrecorded because most women are unwilling to report incidents of assault. The very first reason is insensitiveness he healthcare professional and police professionals in responding such cases and the second reason is the fear, and unawareness associated with the legal systems.

Mary Ellsberg and Lori Heise [2] in "Researching Violence against Women A practical guide for researchers and activists" focus on the shift of international attention towards the violence against women. If we consider almost 20 years back and try to understand the scenario, then at that point of time violence against women was not an issue worthy of international attention or concern. Violence against women has a significant health impact, and she is forced to compromise her physical and mental health, as well as develop low self-esteem. It also increases the risk of long-term consequences such as physical disability, drug and alcohol abuse, and depression. Despite this impact, societies around the world were unconcerned about the issues. Domestic violence victims suffered greatly in silence as a result of society's attitude. Various women's groups raised issues on a local, national, and international scale through a series of advocacy initiatives. Finally, Violence against women was recognised as a legitimate human rights issue.

Although there is a growing concern about domestic violence in the current setting, there is

still a dearth of universally agreed-upon terms for addressing violence against women. Many of the terms used in the domestic violence preview have various meanings in different parts of the world. For example, the phrase "domestic violence" is used in most regions of the world to describe the abuse of women by current or past male intimate partners. Domestic violence, on the other hand, in Latin America refers to any violence that occurs within the home, including abuse against children and the elderly.

Pamela Jumper, Roe Bubar, et al. [3] in its report prevent Violence Against Indian Women is the project report which was initiated to explore the patterns of violence against women in Native communities and to examine the readiness of the communities to address violence prevention in a meaningful way. This project highlights both primary and secondary prevention of violence against women, by developing culturally appropriate strategies and ideas for materials aimed at changing community norms to intolerance of the behaviour and actively trying to prevent it, as well as secondary prevention, by determining culturally appropriate ways in which intervention may occur where intimate violence has already occurred, based on the data. There were four parts to the project. The first was a determination of each community's readiness to accept and confront violence against women as a community problem in Native American communities throughout the western United States.

The second component addressed issues relevant to violence against women and their children, including prevalence, cultural factors contributing to or sanctioning it, intervention and prevention through focus groups and semi-structured interviews. The third component utilized the information gained through the first two components to develop suggestions for materials and culturally appropriate methods for prevention intervention. The fourth component explored the potential impact and pitfalls of collaborative partnerships between researchers, practitioners and the Native community on research projects related to violence.

Shannan Catalano, Erica Smith, Howard Snyder, Rand [4] in a report titled Female Victims of Violence highlighted on the finding of two kind of violent crime know as nonfatal and fatal violent. Furthermore, it focuses on nonfatal intimate partner violence (IPV), fatal IPV, rape and sexual assault, and stalking by assessing the scope of crimes against women as well as crime and victim characteristics. It also drew attention to the trends of crime. Per Bureau of Justice Statistics, National Crime Victimization Survey during 2008 552,000 incidences of nonfatal violence among the female aged 12 years or older by an intimate partner was reported which include rape, sexual assault, simple assault. According to the data, the rate of victimisation by an intimate partner was 4.3 per 1,000 females in the same year, whereas the rate of intimate relationship violence against males was 0.8 per 1,000 males age 12 or older. This demonstrates the seriousness of the societal situation. Simple assault is the most common type of non-fatal violence, accounting for 458,310 instances. In addition, non-fatal violence trends reveal that between 1999 and 2008, there was a decrease in intimate violence.

DS Bullar [5] in the article Acid Throwing: A Cause of Concern in India published in Indian Journal of clinical practice discussed about the concern and consequences of the acid attack and highlighted the legal provision available regarding this in the country Acid attack is one form of crime against women found in the country which is growing in the recent period. The primary goal of acid attack offenders is to disfigure, damage, torture, or murder victims for a variety of reasons. As a result, in the vast majority of cases, acid is thrown in the victim's face. Acid assault causes blindness and facial scarring, posing a physical difficulty in her life that necessitates long-term medical treatment for her improvement. They also go through various psychological problems like, anxiety, depression, lower self-esteem. the physical deformities forced then to be away from the livelihood generative activities which also create economic hardship for the victim. According to one study, 55 percent of acid attack cases are caused by a male partner's refusal of a marriage proposal. In 18% of cases, the husband is the perpetrator of the crime of abusing his female counterpart. 2% said they had never had a sexual or romantic encounter with a female member. India is ranked as the world's fourth most dangerous country for women to live in. Acid attacks are becoming increasingly common. Almost 153 incidents were recorded in the print media between January 2002 and October 2010. Scholars, on the other hand, believe that the picture is considerably brighter.

If we look at the current Indian legislation, we can see that after the 2013 case, the Supreme

Court issued a directive requiring all states and union territories to grant licences to retailers selling acid. It is also stated that the shop must retain all records, including the buyer's photo identification, address, and quantity sold to him. Furthermore, the sale of acid is forbidden unless and until the retailer keeps a record book and keeps it up to date. In the supreme court judgement, it is also stated that the acid attack is a non-bailable offence, and compensation of Rs. 3,000,000 is provided. Moreover after the Nirbhaya case, parliament approved a bill which talked about strengthening laws on assaults against women. The bill also includes the crime of acid attack, making it a criminal offence punishable by a minimum of ten years in jail.

Sushma Reddy M, et al. [6] has discussed the crime rate in India through a paper entitled Forecasting India's Crime Rate, here the data (2001-2013) analysis carried out on ARIMA model and went for forecasting through the Regression analysis. Pradeep BS [7] has studied the Crime rate analysis and made prediction machine learning. Using the concept of Machine Learning one can extract previously unknown, useful information from an unstructured data. Instead of focusing on causes of crime occurrence like criminal background of offender, political enmity etc. and the focusing is mainly on crime factors of each day.

Harrendorf S et al. [8] studied on the International Statistics on Crime and Criminal Justice. In this paper discussed various crimes and its respective justice in the European countries. Singh [9] et al. has performed the K-means Clustering Analysis of Crimes on Indian Women.

Maity et. al. [10] has studied the analysis of growth and identifications of the determinants of crime against women by a National survey. Ravinder Kaur Surjit S et al. [11] has analyzed the sex ratio imbalances and crime rates prepared for United Nations Population Fund.

Sisman and Bektas [12] discussed on Linear regression methods according to objective functions. Lolayekar AP et al. [13] has presented the crimes against women in India and a district level analysis (1991–2011) has taken and presented well. Anser MK. et al. [14] has studied the Dynamic linkages between poverty, inequality, crime, and social expenditures in a panel of 16 countries. A detailed statistical analysis has presented for the society.

3. DATA AND DATA STUDY

3.1 Data

The secondary data was taken from the government website of National Crime Records Bureau (NCRB) and Statistical analysis has carried out through SPSS Software.

Web Site: https://ncrb.gov.in

NCRB has been appointed as Central Nodal agency by MHA to manage technical and operational functions of the online cyber-crime reporting portal and associated work of Cyber Crime Prevention against Women & Children (CCPWC) scheme under the supervision and administrative control of Cyber & Information Security (CIS) Division of MHA.

Priorities of the police have change to maintenance of law and order, check of Militant and Organised Criminal Gangs, maintenance of VIP Security and Handle Dharma and Rallies by Trade Union and Political Party. Rate of Crime have increased and activities of Criminal has widened due to use of better communication system and transport. There is neither staff nor time for maintenance of Crime Records manually. Harnessing and exchange of Information on Criminal operating in neighbouring Police Stations, Districts and state has become next to impossible. The need was felt to do away this manual maintenance of records and manual sharing of information on the Crime & Criminal of Inter-District and Inter-State nature. The computerization and computer network of Crime Criminal records and the Police Computer Network was considered only viable alternative.

3.2 Data Study

3.2.1 Crime against women

Right from the time of her birth or even before a girl could become victim of a crime or target of a crime. Lets look at the stages in a woman's life and discuss the threats briefly. Just as the stages vary, nature of crimes vary too. Below are illustrations/tables that highlight important aspects of the issue. The 2012 National Crime Records Bureau report of India states a reported crime rate of 46 per 100,000, rape rate of 2 per 100,000, dowry homicide rate of 0.7 per 100,000 and the rate of domestic cruelty by husband or his relatives as 5.9 per 100,000. A 2014 study in

the Lancet states, "Whereas an 8·5% prevalence of sexual violence in the country [India] is among the lowest in the world, it is estimated to affect 27·5 million women in India [given India's large population]. Further, the 2006 survey found that 85% of women who suffered sexual violence, in or outside of marriage, never sought help, and only 1% report it to the police.

3.2.2 Sexual harassment at workplace

Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 was passed with the objective of providing protection to the women at workplace. Sexual harassment is when one person subjects another person to an unwelcome act of physical intimacy like grabbing, brushing, touching, pinching, eve teasing, makes an unwelcome demand or request directly or by implication for sexual favours from another person, shows a person any sexually explicit visual material, in the form of pictures/cartoons/pin-ups/calendars/ screensaver version computers/any offensive written material / pornographic e-mails or any other form of unwelcome conduct of a sexual nature, eve teasing, jokes likely to cause awkwardness or embarrassment, innuendos, sexist remarks. This statute superseded the Vishakha Guidelines for prevention of sexual harassment introduced by the Supreme Court of India. Every employer is required to constitute an Internal Complaints Committee at each office or branch with 10 or more employees. The Act covers students in schools and colleges as well as patients in hospitals, employers and local authorities will have to set up grievance committees to investigate all complaints. Any aggrieved woman may file a complaint in writing to the Internal committee/ Local Committee within 3 months from the date of incident or the date of the last incident in case of a series of incidents. The victim can also file a complaint with Police under Indian Penal Code 1860 under Sections 294,354, 354A,509.

3.2.3 Time series and forecasting

Time series forecasting is the process of predicting values in future time steps of a time series based on information from previous time steps. This extrapolation process is carried out by a forecasting model, which is a set of algorithmic actions known as a forecasting method. A time series could be just a univariate sequence of values in a variable indexed by time

or it can be a multivariate sequence of values where many different external factors could be used to better explain the effects on the time series. For example, external factors of crime could be various indicators like locality, weather and population.

3.2.4 Methodology: Autoregressive Integrated Moving Average (ARIMA)

A popular and widely used statistical method for time series forecasting is the ARIMA model. ARIMA is an acronym that stands for Auto Regressive integrated Moving Average. It is a class of model that captures a suite of different standard temporal structures in time data. An autoregressive integrated moving average, or ARIMA, is a statistical analysis model that uses time series data to either better understand the data set or to predict future trends.

4. OUTPUT FOR THE ANALYSIS DATA

4.1 Andhra Pradesh

4.1.1 Interpretation

As per the above results for the State Andhra Pradesh:

➤ The plotted graph shows the crime data from the year 2009 to 2019 in Andhra Pradesh
➤ In the plotted graph, the crime is peak in the year 2014 then downfall further and there is rise in the year 2018.
➤ In the Autocorrelation, as per Box Statistic there is a significant in the lags.
➤ Also as we can see that there is negative correlation in the 6 lags whereas 3 having positive correlation. The same has plotted ACF plot.
➤ In the Partial Auto Correlation, the maximum lags have negative in term and plotted as PACF plot
➤ In modelling Holt model has chosen to forecast the data.
➤ Here in R-squared value: 0.476 represents that 47.6% variation has explained to predict the forecast.
➤ Better models may be chosen further to improvise the R-squared value.
➤ Bayesian Information Criterion (BIC) is 17.394 which means the lower the BIC the model will be best fit.
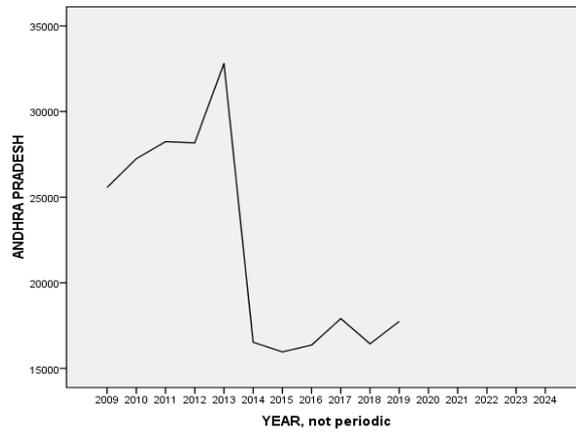
**Fig. 1. Analysis data**
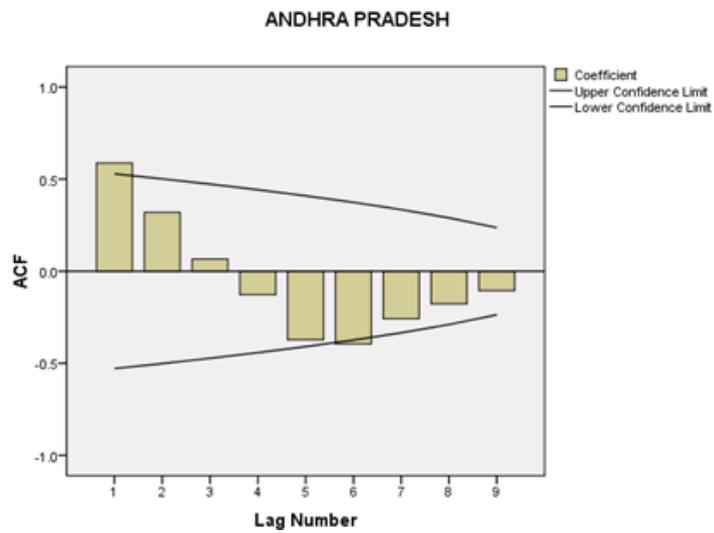
Fig. 2. Autocorrelation
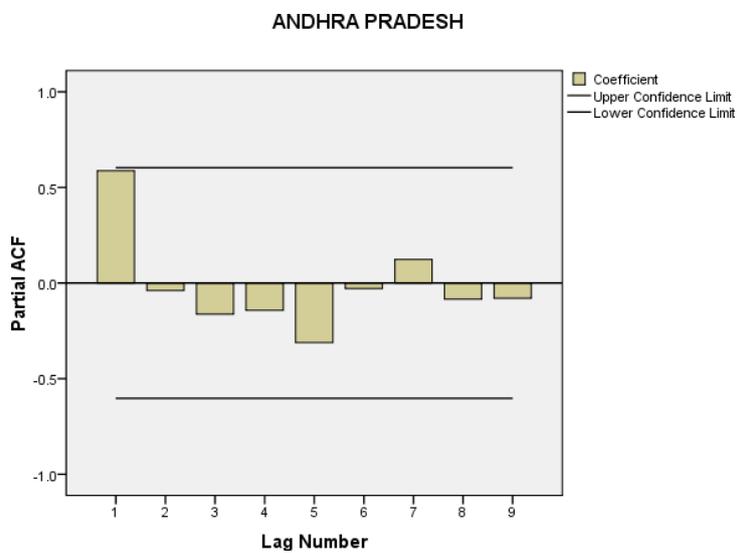
Fig. 3. Partial autocorrelation

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Table 1. Forecast

Model		2020	2021	2022	2023	2024	2025
Andhra Pradesh	Forecast	14097	12699	11301	9903	8505	7106
	UCL	24986	23643	22299	20955	19611	18267
	LCL	3208	1755	302	-1150	-2602	-4054

➢ Residuals and Standard error of ACF and PACF has presented.

➢ The Forecast for the year 2020 to 2025 has analysed and presented in the table.

➢ The forecast data has plotted as a graph with the existing data where there is down fall in the years 2020 to 2025.

➢ The UCL and LCL has presented for the forecast data.
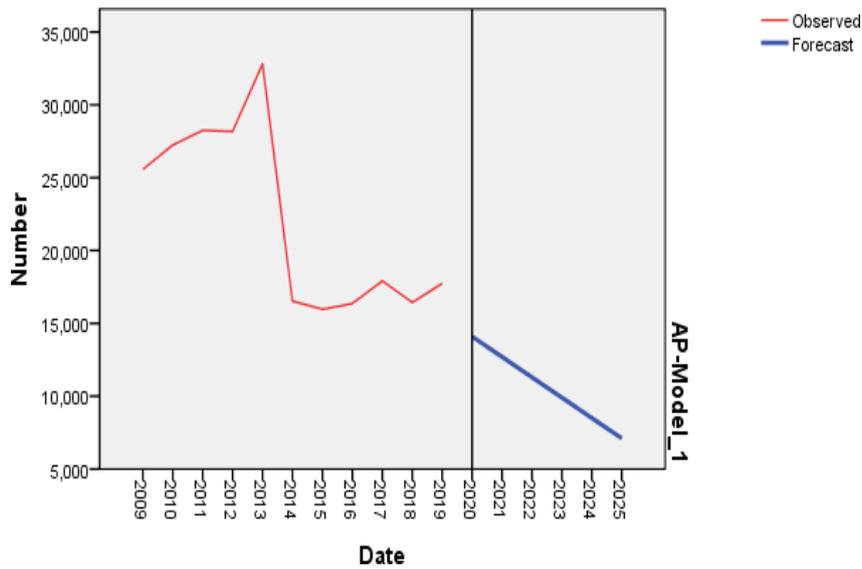
Fig. 4. Model data

4.2 Karnataka
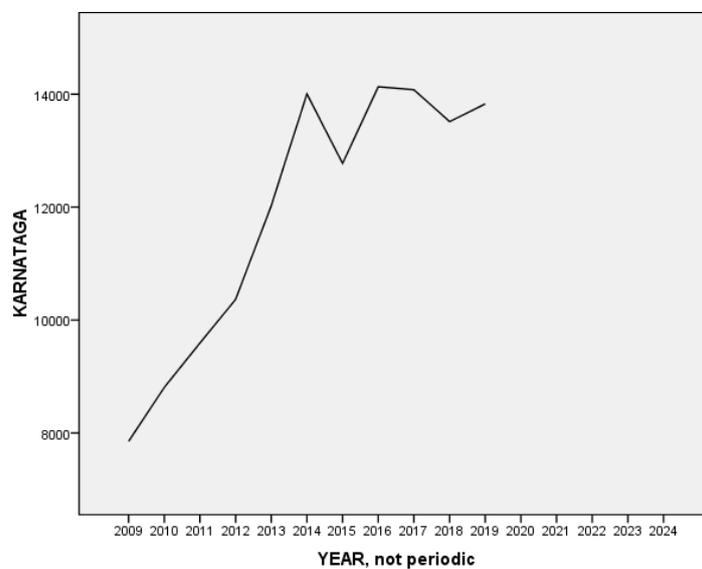
Fig. 5.
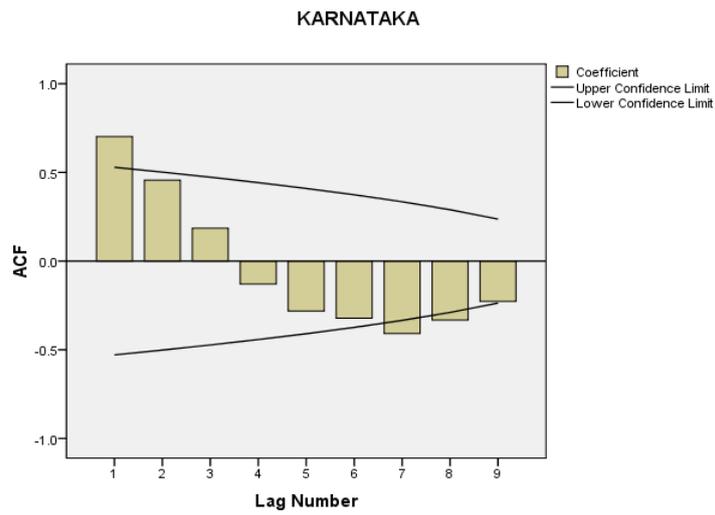
KARNATAKA

Fig. 6. Auto correlations
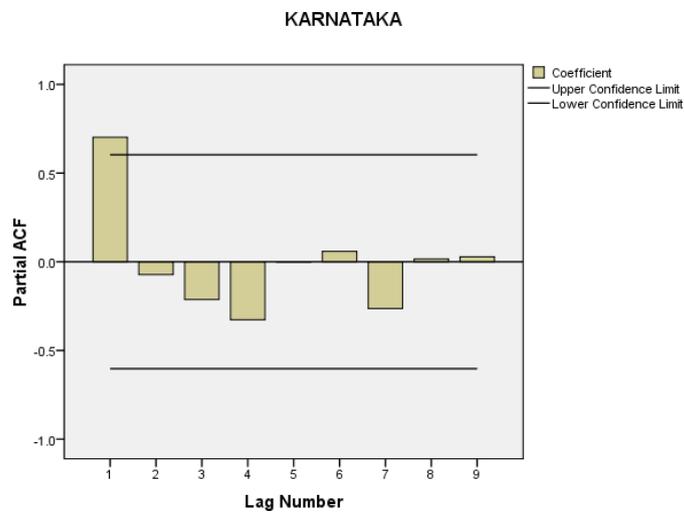
KARNATAKA

Fig. 7. Partial autocorrelations
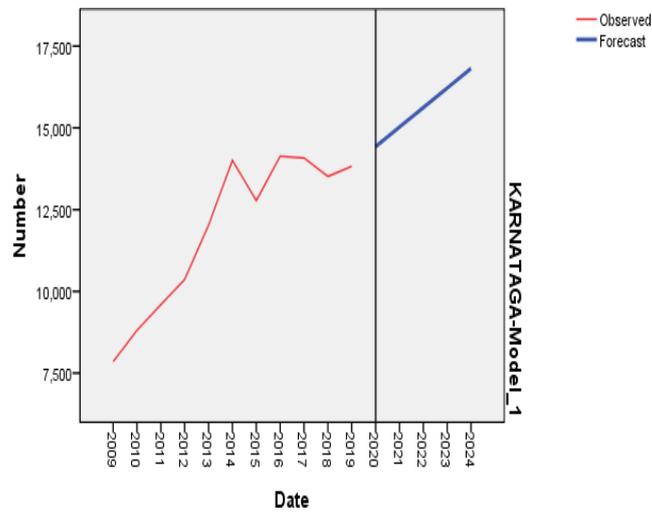
Fig. 8.

Table 2. Forecast

Model		2020	2021	2022	2023	2024
Karnataka	Forecast	14426	15023	15621	16218	16816
	UCL	16687	18221	19537	20741	21872
	LCL	12164	11825	11704	11696	11760

4.2.1 Interpretation

As per the above results for the State Karnataka:

> - The plotted graph shows the crime data from the year 2009 to 2019 in Karnataka
> - In the plotted graph, the crime is peak in the year 2014 then downfall further and there is rise in the year 2018.
> - In the Autocorrelation, as per Box Statistic there is a significant in the lags.
> - Also as we can see that there is negative correlation in the 6 lags whereas 3 having positive correlation. The same has plotted ACF plot.
> - In the Partial Auto Correlation, the maximum lags have negative in term andplotted as PACF plot
> - In modelling Holt model has chosen to forecast the data.
> - Here in R-squared value: 0.756 represents that 75.6% variation has explainedto predict the forecast.
> - Better models may be chosen further to improvise the R-squared value.
> - Bayesian Information Criterion (BIC) is 14.045 which means the lower the BIC the model will be best fit.
> - Residuals and Standard error of ACF and PACF has presented.
> - The Forecast for the year 2020 to 2025 has analysed and presented in the table.
> - The forecast data has plotted as a graph with the existing data where there is increase in the years 2020 to 2025.
> - The UCL and LCL has presented for the forecast data.

4.3 Kerala
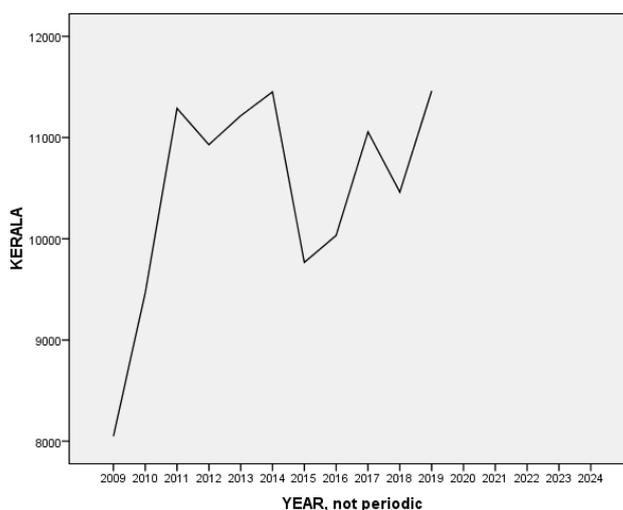
Fig. 9.

Table 3. Forecast

| Model		2020	2021	2022	2023	2024	2025
Kerala	Forecast	10471	10471	10471	10471	10471	10471
	UCL	12838	12838	12838	12838	12838	12838
	LCL	8103	8103	8103	8103	8103	8103
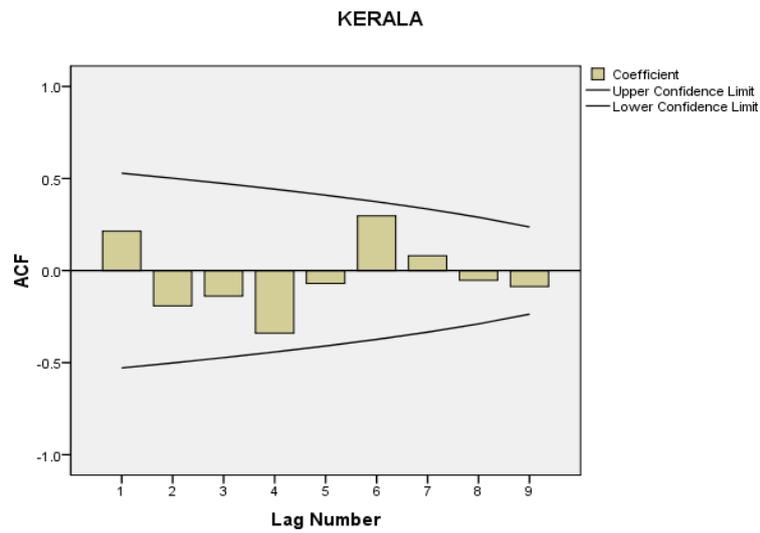
KERALA

**Fig. 10. Autocorrelations**
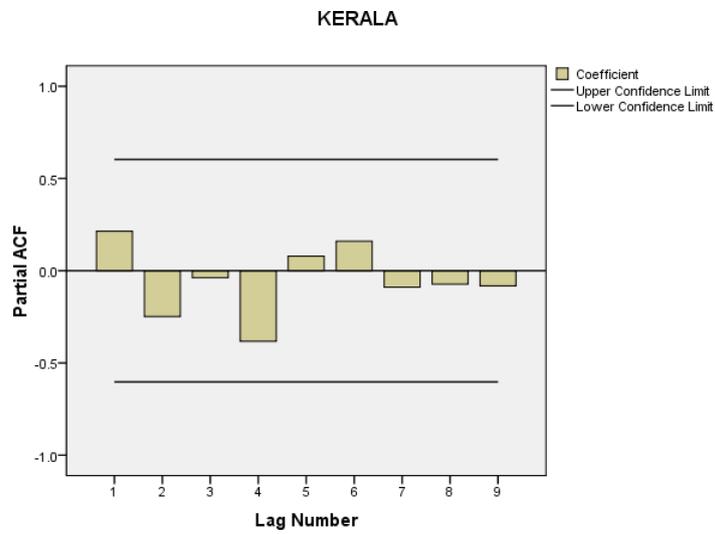
KERALA

Fig. 11. Partial autocorrelations
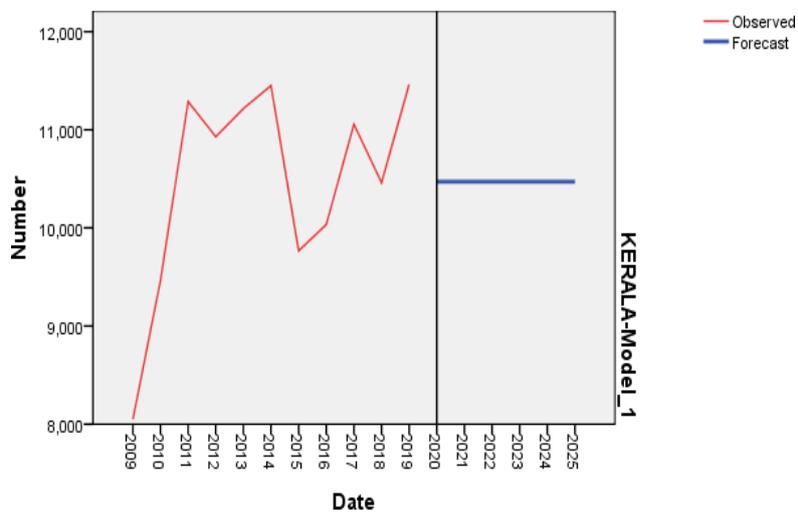
Fig. 12.

4.3.1 Interpretation

As per the above results for the State Kerala:

➢ The plotted graph shows the crime data from the year 2009 to 2019 in Kerala.
➢ In the plotted graph, the crime is peak in the year 2014 then downfall further and there is rise in the year 2018.
➢ In the Autocorrelation, as per Box Statistic there is a significant in the lags.
➢ Also as we can see that there is negative correlation in the 6 lags whereas 3 having positive correlation. The same has plotted ACF plot.
➢ In the Partial Auto Correlation, the maximum lags have negative in term and plotted as PACF plot
➢ In modelling Holt model has chosen to forecast the data.
➢ Better models may be chosen further to improvise the R-squared value.
➢ Bayesian Information Criterion (BIC) is 14.155 which means the lower the BIC the model will be best fit.
➢ Residuals and Standard error of ACF and PACF has presented.
➢ The Forecast for the year 2020 to 2025 has analysed and presented in thetable.
➢ The forecast data has plotted as a graph with the existing data where there is either increase or decrease in the years 2020 to 2025.
➢ The UCL and LCL has presented for the forecast data.

4.4 Tamilnadu

4.4.1 Interpretation

As per the above results for the State Tamil Nadu:

➢ The plotted graph shows the crime data from the year 2009 to 2019 in Tamil Nadu.
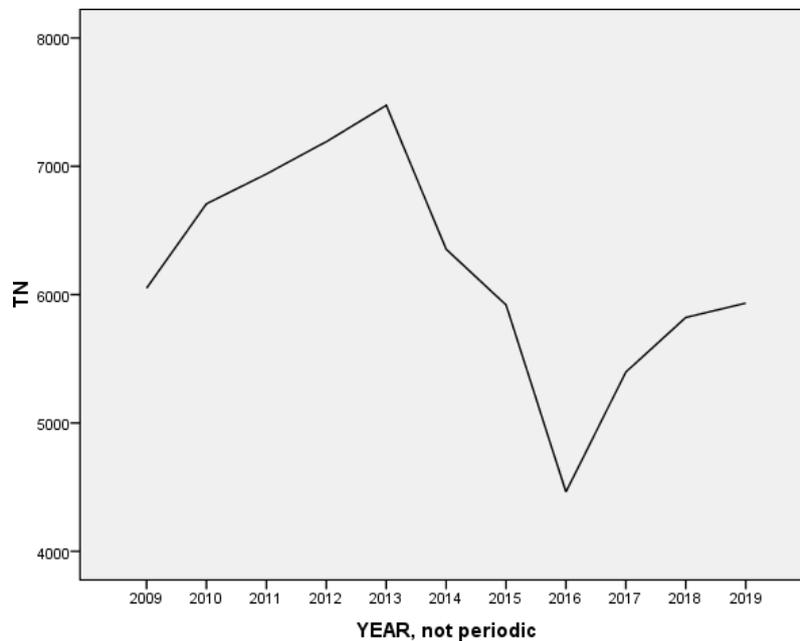

Fig. 13.

Table 4. Forecast

Model		2020	2021	2022	2023	2024
Tamil Nadu	Forecast	5934	5934	5934	5934	5934
	UCL	7550	8219	8733	9166	9548
	LCL	4318	3649	3135	2702	2320
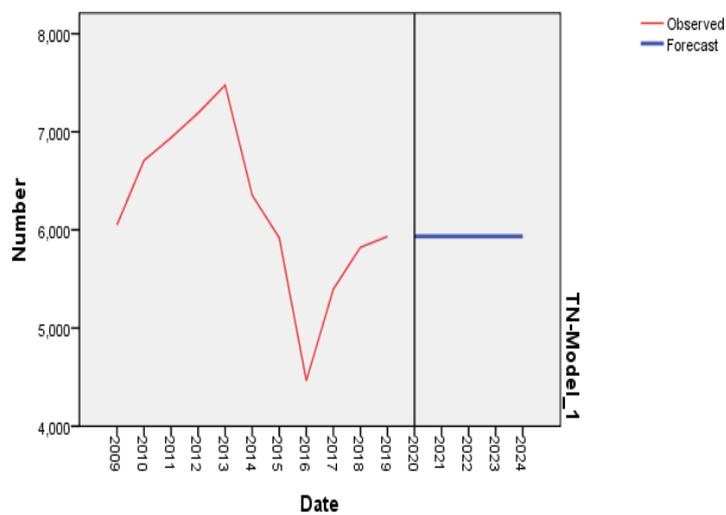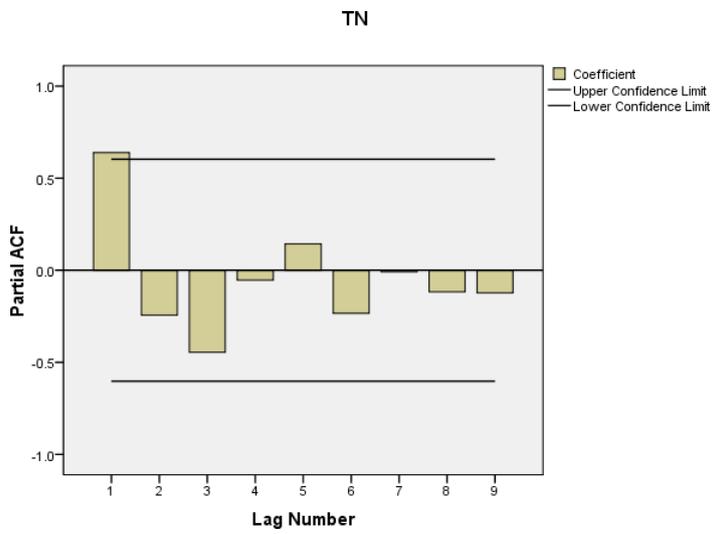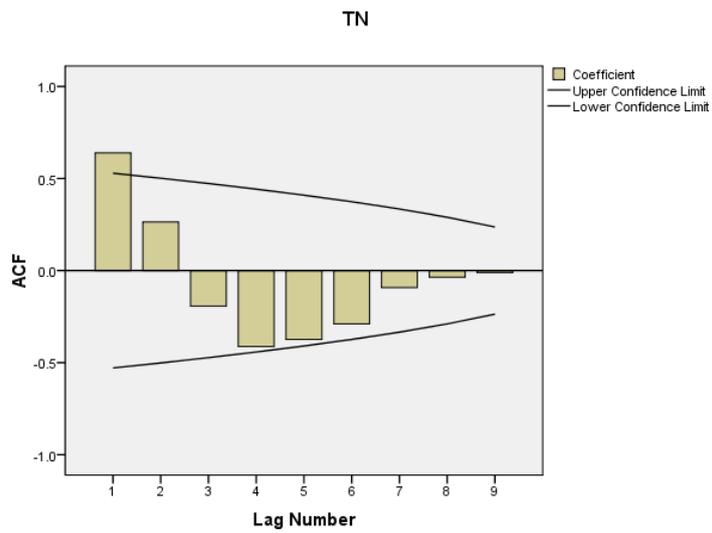
TN

Fig. 14. Autocorrelations

TN

Fig. 15. Partial autocorrelations

Fig. 16.

➢ In the plotted graph, the crime is peak in the year 2014 then downfall further and there is rise in the year 2018.

➢ In the Autocorrelation, as per Box Statistic there is a significant in the lags.

➢ Also as we can see that there is negative correlation in the 6 lags whereas 3 having positive correlation. The same has plotted ACF plot.

➢ In the Partial Auto Correlation, the maximum lags have negative in term andplotted as PACF plot

➢ In modelling Holt model has chosen to forecast the data.

➢ Here in R-squared value: 0.291 represents that 29.1% variation has explainedto predict the forecast.

➢ Better models may be chosen further to improvise the R-squared value.

➢ Bayesian Information Criterion (BIC) is 13.391 which means the lower the BIC the model will be best fit.

➢ Residuals and Standard error of ACF and PACF has presented.

➢ The Forecast for the year 2020 to 2025 has analysed and presented in the table.

➢ The forecast data has plotted as a graph with the existing data where there is either increase or decrease in

the years 2020 to 2025.

➢ The UCL and LCL has presented for the forecast data.

4.5 Puducherry

4.5.1 Interpretation

As per the above results for the State Puducherry:

➢ The plotted graph shows the crime data from the year 2009 to 2019 in Puducherry.

➢ In the plotted graph, the crime is peak in the year 2014 then downfall further and there is rise in the year 2018.

➢ In the Autocorrelation, as per Box Statistic there is a significant in the lags.

➢ Also as we can see that there is negative correlation in the 6 lags whereas 3 having positive correlation. The same has plotted ACF plot.

➢ In the Partial Auto Correlation, the maximum lags have negative in term andplotted as PACF plot

➢ In modelling Holt model has chosen to forecast the data.
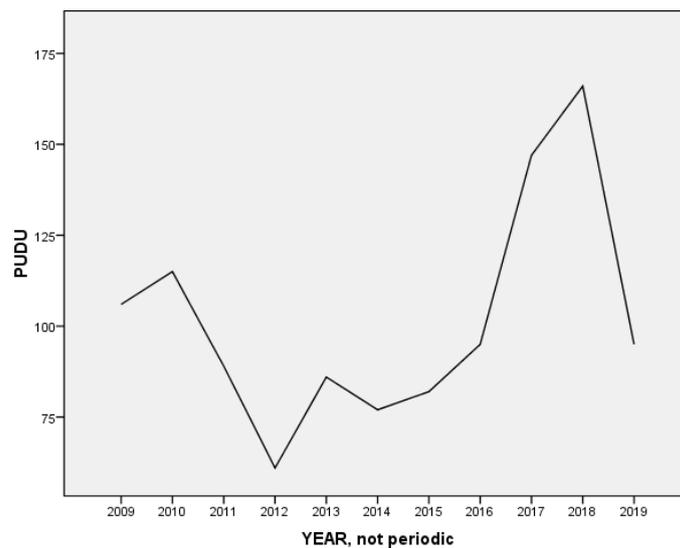
Fig. 17.

Table 5. Forecast

| Model		2020	2021	2022	2023	2024
Puducherry	Forecast	102	102	102	102	102
	UCL	171	171	171	171	171
	LCL	33	33	33	33	33

PUDU
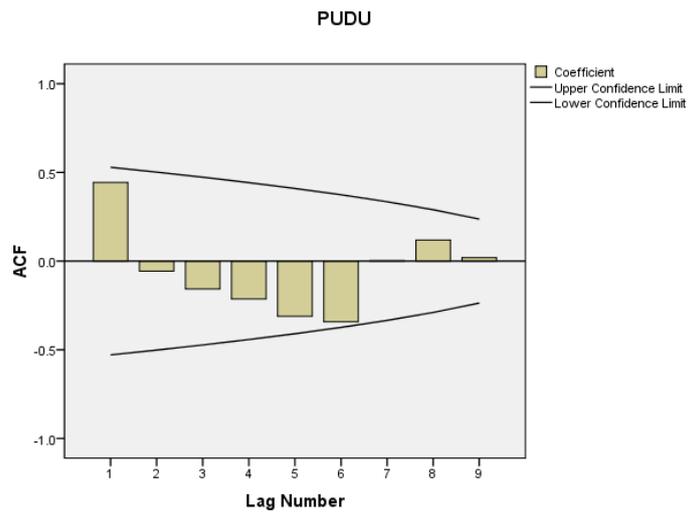

Fig. 18. Autocorrelations

PUDU
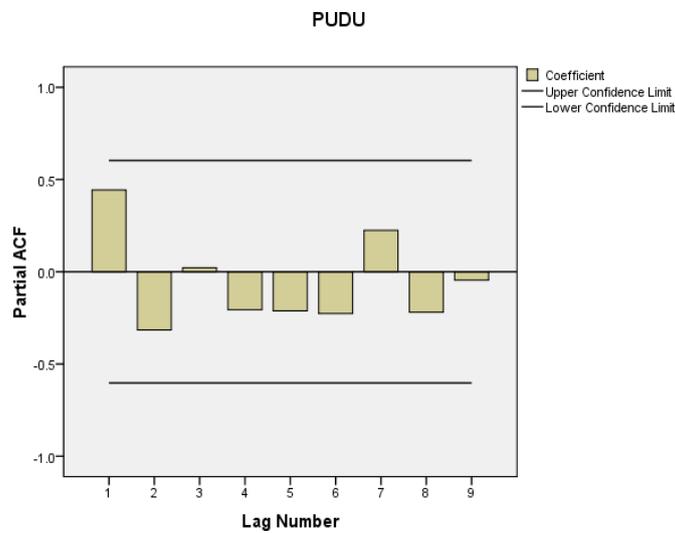
**Fig. 19. Partial Autocorrelations**
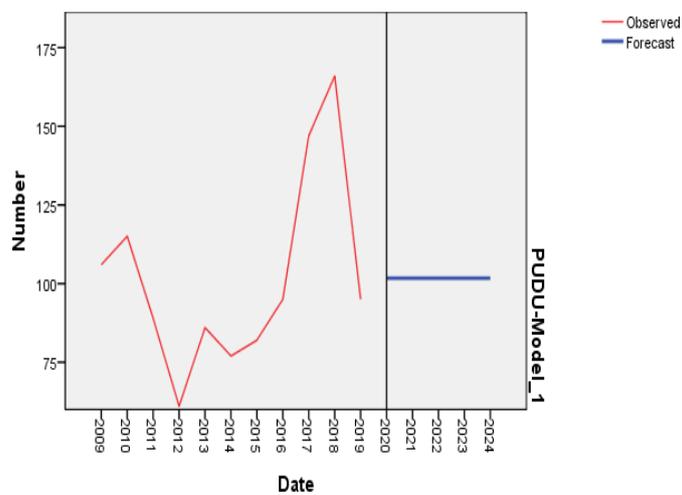
Fig. 20.

- Better models may be chosen further to improvise the R-squared value.
- Bayesian Information Criterion (BIC) is 7.078 which means the lower the BIC the model will be best fit.
- Residuals and Standard error of ACF and PACF has presented.
- The Forecast for the year 2020 to 2025 has analyzed and presented in the table.
- The forecast data has plotted as a graph with the existing data where there is either increase or decrease in the years 2020 to 2025.
- The UCL and LCL has presented for the forecast data

5. CONCLUSION

- The plotted graph shows the crime data from year 2009 to 2019 in the following states in south India (Andhra Pradesh, Karnataka, Kerala, Tamilnadu, Puducherry).
- The forecast for the year 2020 to 2025 and presented above. The forecast data has plotted as a graph with the existing data where there is down fall in the years 2020 to 2025 (Andhra Pradesh).
- The forecast data has plotted as a graph with the existing data where there in increase in the year 2020 to 2025 (Karnataka).
- The state Kerala have shown a rate of either increase or decrease in the data in the years 2020 to 2025.
- The state Puducherry have shown a rate of either increase or decrease in the data in the years 2020 to 2025.
- The state Tamil Nadu have shown a rate of either increase or decrease in the data in the years 2020 to 2025.
- The UCL and LCL has presented for the forecast data.
- The forecast data has plotted as a graph with a exiting state Karnataka as increase in the crime rate in the year 2020 to 2025. And the south India state Andhra Pradesh shows downfall in the following year 2020 to 2025.
- The state Kerala, Tamil Nadu and Puducherry have shows a rate of increase nor decrease in the data in the year 2020 to 2025.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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