

## Statistical Forecasting of Crime Rate in southern Region of India

### 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.

### 1.1 INTRODUCTION:

Crime is a public wrong. It is an act of offense which violates the law of the state and is strongly disapproved by the society. Crime is defined as acts or omissions forbidden by law that can be punished by imprisonment or fine. Murder, robbery, burglary, rape, drunken driving, child neglect and failure to pay taxes are examples of crimes. The term crime is derived from the Latin word "crimen" meaning offence and also a wrong-doer. Crime is considered as an anti-social behaviour. Each society may define crime in a different perspective. A crime may 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 third parties, provided in criminal law. Legal and not punishable crime is all acts of self-defence.

In the ancient Indian women held a high place of respect in the society as mentioned in Rigveda and other scriptures. Volumes can be written about the status of our women and their heroic deeds from the vedic period to the modern times. But later on, because of social, political and economic changes, women lost their status and were relegated to the background. Many evil customs and traditions stepped in which enslaved the women and tied them to the boundaries of the house. The official statistics showed a declining sex-ratio, health status, literacy rate, work participation rate and political participation among women. While on the other hand the spread of social evils like dowry deaths, child marriage, domestic violence, rape, sexual harassment, exploitation of women workers are rampant in different parts of India. Humiliation, rape, kidnapping, molestation, dowry death, torture, wife-beating etc. have grown up over the years.

"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 is equally important to clarify the concept of 'crime' against women. Crime is also known as abuse and include any sort of physical aggression or misbehave. When crime is committed at home it becomes domestic violence and involves family members such as children, spouse, parents or servants. Domestic violence may involve different means such as hitting, kicking, biting, shoving, restraining, throwing objects. 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 foeticide, forcing a young widow to commit sati, etc (all cases of social violence), are issues which affect a large section of society.

The United Nations defined 'Crime against women' in 1993 in Declaration on the Elimination of Crime against Women. It defines it as any act of gender-based violence that results in, or is likely to result in, physical, sexual or psychological harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or private life.

## **1.2 CRIME AGAINST WOMEN IN INDIA**

The numbers of violent crimes in India especially those against women including rape that are reported in official statistics are increasing with each passing year. This violence thrives within a milieu of steady economic growth, and increasing inequality between the rich and poor in Indian society; India's GINI coefficient that has increased from 0.32 to 0.38 in the last two decades in evidence. India's new riches and development strides as witnessed by its GDP growth from \$450.42 billion in 2000 to \$1841.7 billion seem to bear no fruits for its women. In 2012, the crimes against women reported by official statistics increased by 24.7 % compared to those reported in 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 one such example.

Although a detailed directive was sent to all the state governments on establishment of Rape crisis centres (RCCs) and 2pecialized Sexual Assault Treatment Units (SATUs) in 2009, no such units have been set up in the states even now, except in New Delhi. The law states that a female police officer should record the victim's statement, as well as assist her with medical and legal support. However, female police personnel account for only 6.5% of the police force, which makes difficult to implement this. Further, the government health services in the country lack the infrastructure and resources needed to implement care for rape victims as specified by the law in most district and sub-district hospitals.

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. Judgemental attitudes and lack of privacy in government

healthcare establishment worsens their trauma.

### **1.3 CRIME AGAINST WOMEN IN SOUTH INDIA**

Violence against Women in India is systematic and occurs in public as well as private spheres. It is underpinned by the patriarchal social-norms and inter and intra gender hierarchies. Women are discriminated against and subordinated not only on the basis of sex, but on the other grounds such as caste, class, ability, sexual orientation, tradition and other realities. 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. Because of the sensitivity of the subject, violence is almost universally under-reported (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 & Abduction
- 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

### **1.4 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 (2000) 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 as a global epidemic by which the victim women face physical, psychological and sexual abuse and even torture and death. Due to this violation women are deprived from equality, security, dignity, self-worth, and their right to enjoy fundamental freedoms.

Every country some or the other form of violence is prevailing across the globe. Violence prevails across the culture, class, education, income, ethnicity and age. However, the vulnerability is varying groups to groups. Women belong to minority groups, indigenous and migrant women, refugee women and women in conflict zone are more vulnerable than the others. It is shocking that at of all form of violence between 20 – 50 percentages of women experiencing violence are from the close relationship, either from the partner or from the family members. However, the magnitude of the domestic violence is not visible as most of the cases are unreported and unrecorded as most of the women are reluctant to report the incidence of violence. 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 (2003)** 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. The violence against women immense health impact and she must compromise her physical and mental health, develops low self-esteem. It also develops the long-term risk including physical disability, drug and alcohol abuse, and depression. Despite the such impact, societies across the globe was not concerned for the issues. To this attitude of the society domestic violence victim suffered a lot in complete silence. issues were brought up in to lime light by various women’s group at the local, national and international platform by series of advocacy initiatives. Finally, the violence women was considered as a legitimate human rights issue.

In present context although there is a growing concern towards the domestic violence but still there is lack of universally agreed-upon terminology for addressing the violence against women. Many of the terminology used in the preview of domestic violence have different meaning in different region. For example, in most of the parts of the globe the term “domestic violence” use to define the abuse of women by current or former male intimate partners. However, in in Latin America domestic violence” refers to any violence that takes place in the home, including violence against children and the elderly.

**Pamela Jumper, Roe Bubar, et.al (2003)** 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 addressed both primary prevention of violence against women by developing culturally-appropriate strategies and

ideas for materials aimed at changing community norms to intolerance of the behavior and actively trying to prevent it, as well as secondary prevention, by determining, from the data, culturally-appropriate ways in which intervention may occur where intimate violence has already taken place. The project had four components. The first was an assessment of each community's level of community readiness to accept and address violence against women as a community problem in Native American communities in 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 (2009)** in a report titled *Female Victims of Violence* highlighted on the finding of two kind of violent crime know as nonfatal and fatal violent. Moreover, it emphasizes on nonfatal intimate partner violence (IPV), fatal IPV, rape and sexual assault, and stalking by estimating the extent of crimes against women and the characteristic of crime and victim. further it highlighted 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. Further analysis of data indicates that in the same year the rate of victimization by an intimate partner was 4.3 per thousand females whereas the rate of intimate partner violence against males was 0.8 per 1,000 males age 12 or older. This reflects the severity of the problem with in the society. Among all form of non-fatal violence, the cases of Simple assault are the highest 458,310. Further the trends of the non- fatal violence show that there is a declining trend of intimate violence between 1999to 2008.

**DS Bullar (2014)** 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. In the Incidence of acid attacks the prime motto of the perpetrators is to disfigure, injure, torture or kill due to various reason. Therefore, in most of the case it is found that acid thrown in the face of the victim. Acid attack my leads to blindness, scarring of the face which create physical challenge in her life which need long term surgical treatment for her betterment. 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. One of the study shows that 55% of the acid attack case is due to the refusal of marriage proposal by a male partner. In 18% of the case the crime is committed by the

husband to abuse his female counterpart. 2 % also reported as deny of sexual or romantic encounter by a female member. India is considered as the 4th dangerous country in the world for a woman to live. The incidence of acid attack is growing tremendously. between 2002 January to 2010 October almost 153 cases have been reported in the print media. However according to the scholars, the picture is much higher.

In this scenario if we see the existing legislation of India then we can see that after 2013 case the supreme court come up with the direction that every states and union territories should issue license the retailer who is selling acid. It is also said that shop must keep all the record including the photo identity, address of the buyer and the quantity sold to him. More over sale of acid is completely prohibited unless and until the retailer maintain a log book and maintain it properly. In supreme court order, it is also mention that the acid attack is a non-bail able offence and made provision of compensation of rupees 3,00,000. Moreover after the Nirbhaya case, parliament approved a bill which talked about strengthening laws on assaults against women. The crime of acid attack was also included in the bill and made it criminal offence with a minimum prison term of ten year.

### **3. DATA AND DATA STUDY**

#### **3.1 DATA:**

The secondary data was taken from the government website of National Crime Records Bureau.

**Web Site:** <https://ncrb.gov.in>

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 orembarrassment, 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 officeor 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.

**4. OUTPUT FOR THE ANALYSIS DATA**

**4.1 ANDHRA PRADESH**

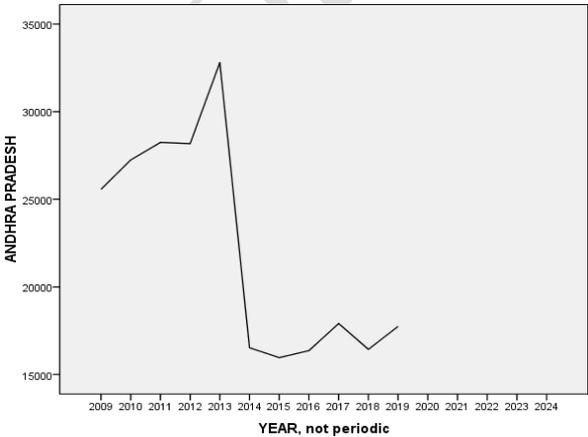
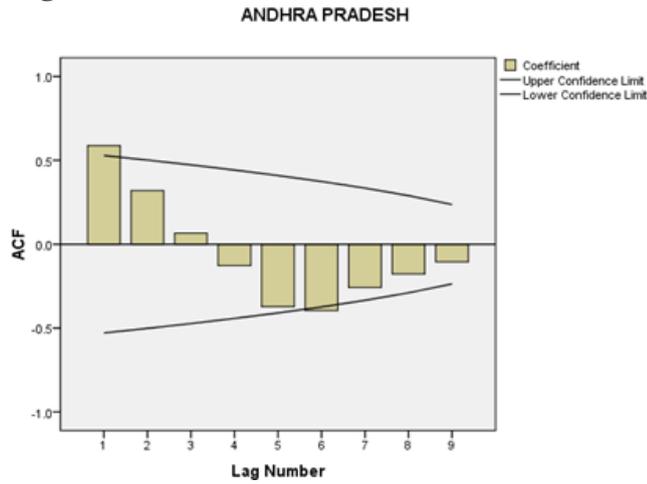
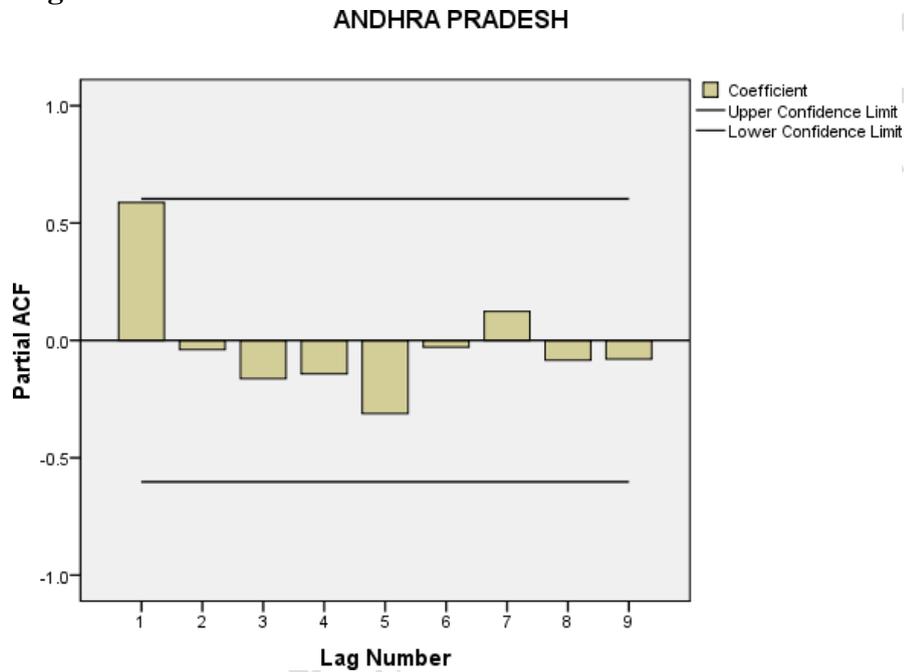


Fig 1: Analysis data

**Fig 2: Autocorrelation:**

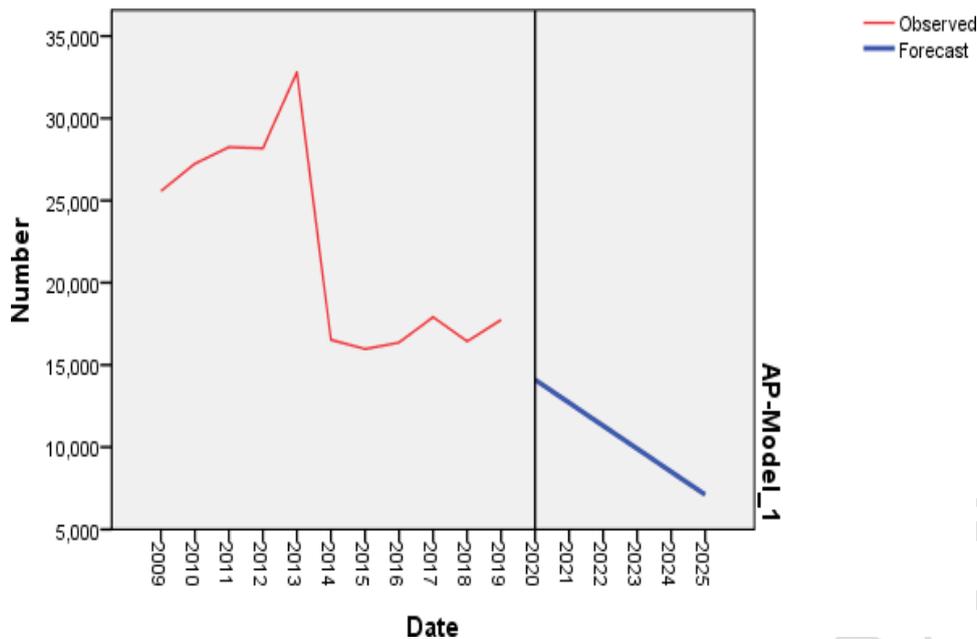


**Fig 3: Partial Autocorrelation**



**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



**Fig 4: Model data**

## **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 improve the R-squared value.
- Bayesian Information Criterion (BIC) is 17.394 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 downfall in the years 2020 to 2025.
- The UCL and LCL has presented for the forecast data.

## 4.2 KARNATAKA

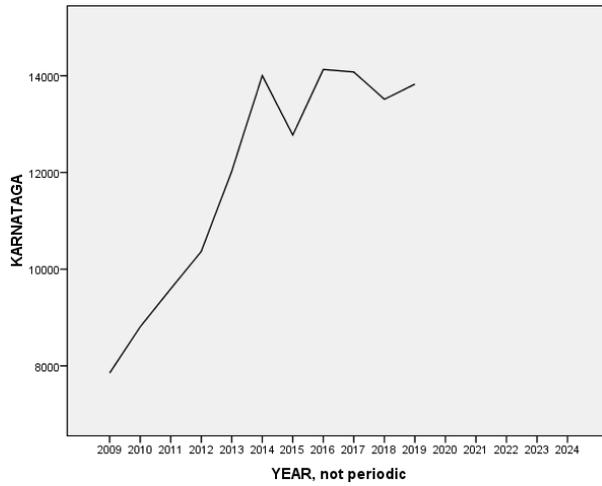


Fig 5:

Fig 6: Auto Correlations:

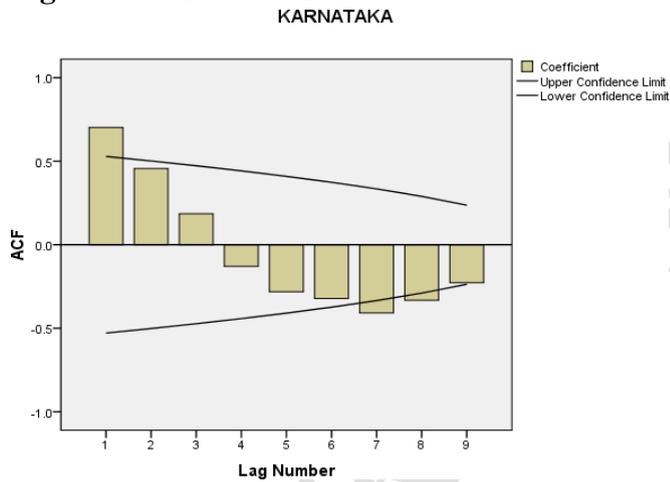
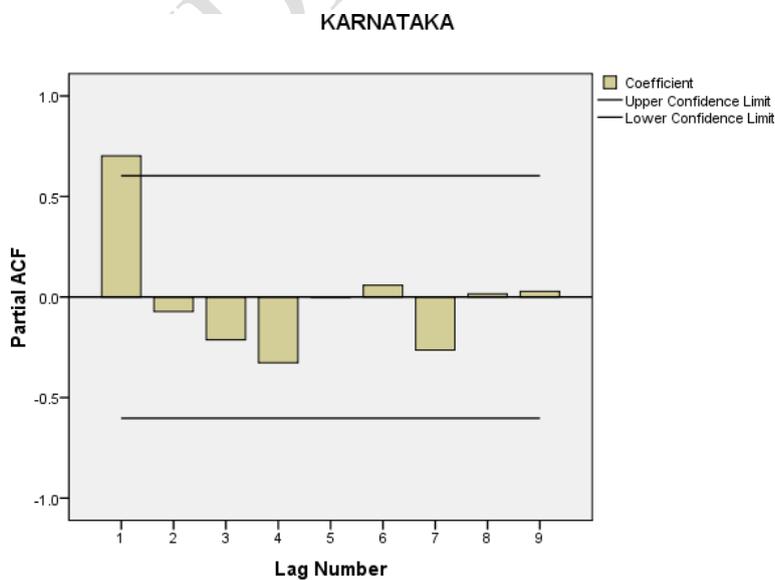
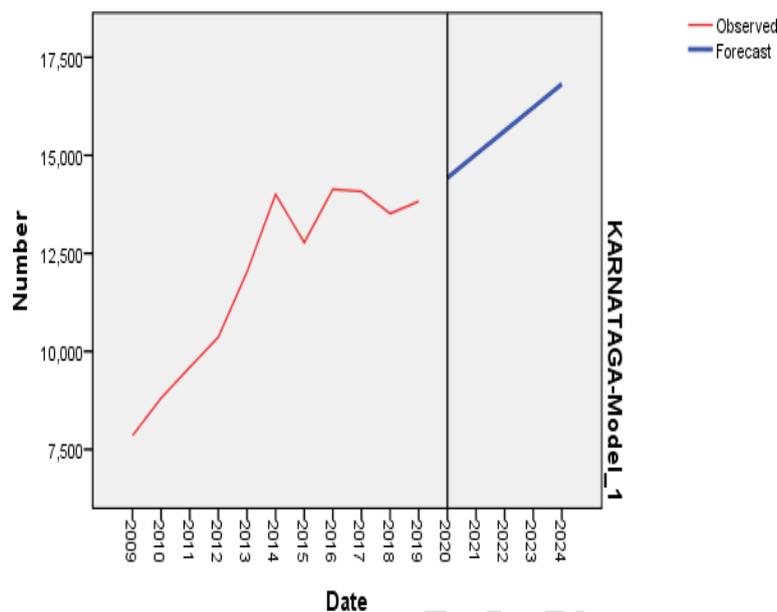


Fig 7: Partial Autocorrelations



**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



**Fig 8:**

### **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 and plotted 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 explained to predict the forecast.
- Better models may be chosen further to improve 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

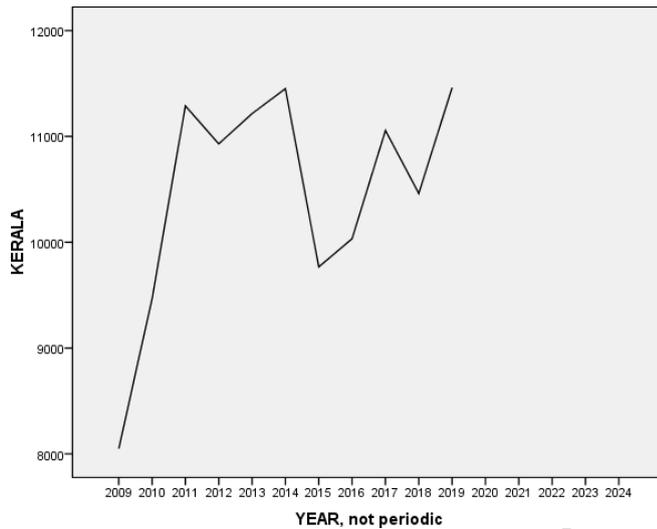


Fig 9:

### Fig 10: Autocorrelations

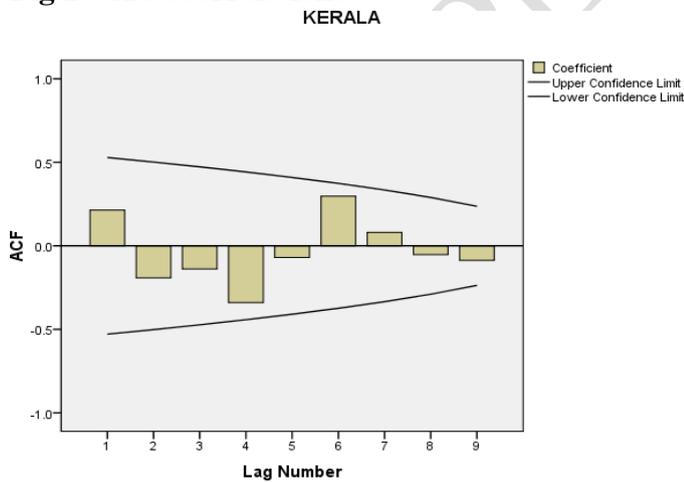
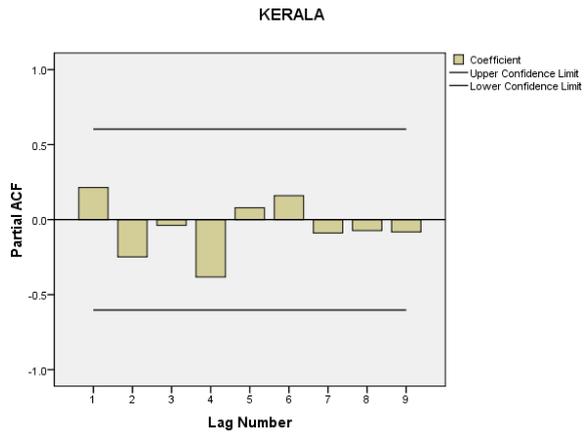


Fig 11: Partial Autocorrelations



UNDER PEER REVIEW

**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

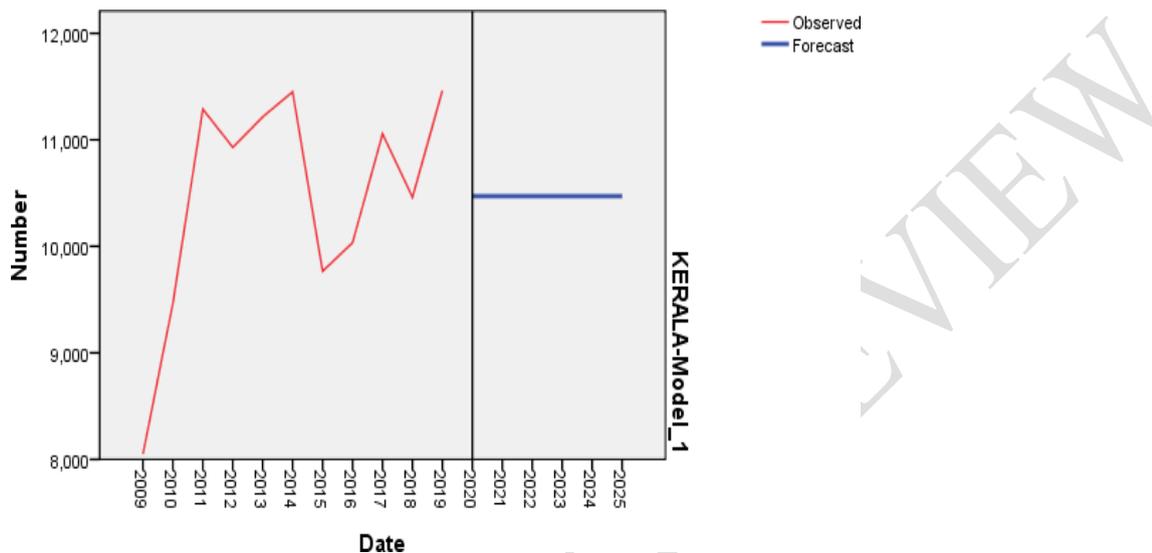


Fig 12:

### **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 improve 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 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.

## 4.4 TAMIL NADU

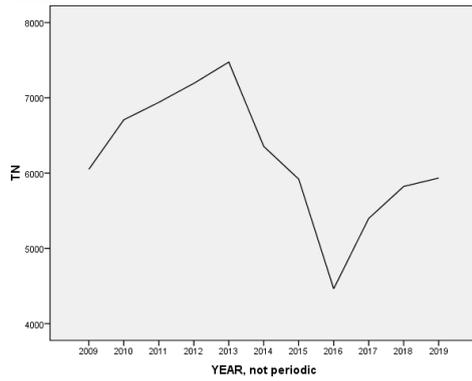


Fig 13:

Fig 14: Autocorrelations

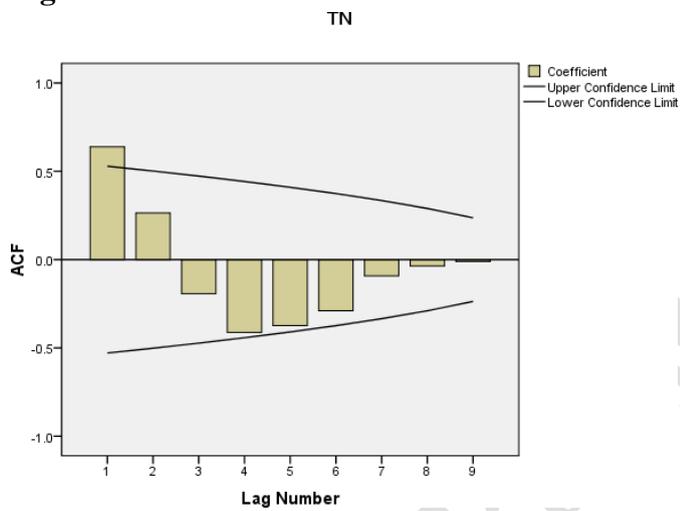
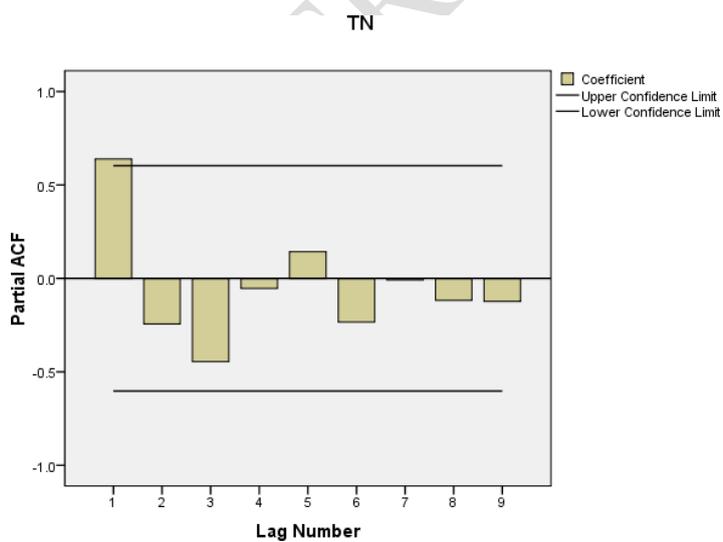
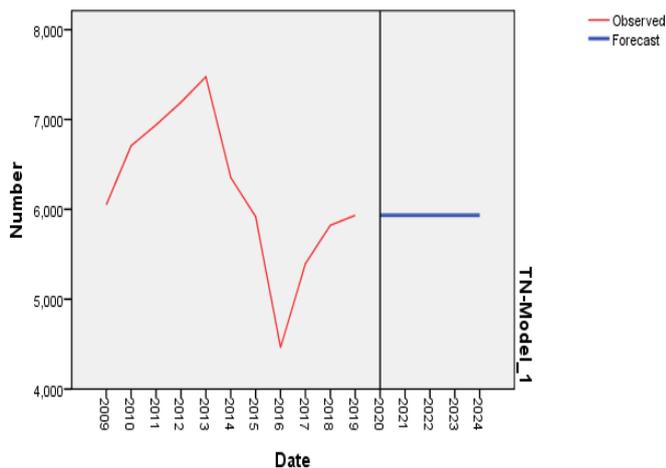


Fig 15: Partial Autocorrelations



**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



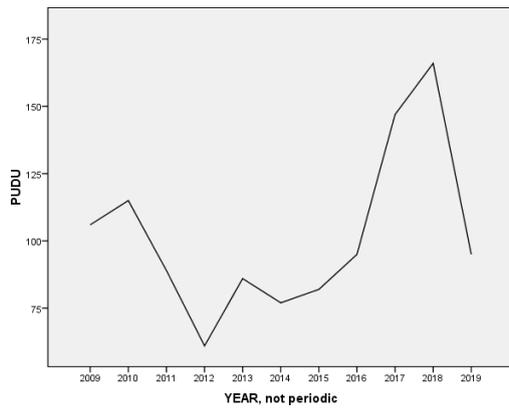
**Fig 16:**

## **INTERPRETATION**

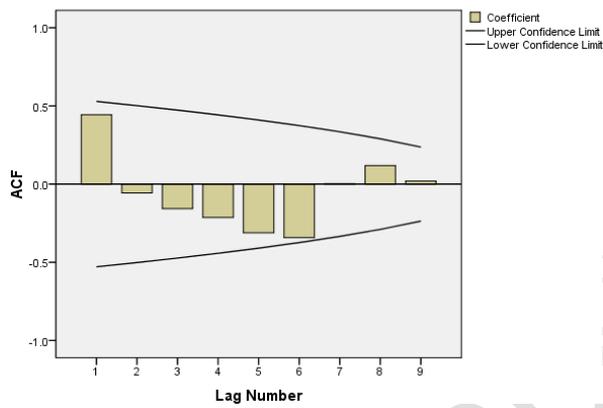
As per the above results for the State Tamil Nadu:

- The plotted graph shows the crime data from the year 2009 to 2019 in TamilNadu.
- In the plotted graph, the crime is peak in the year 2014 then downfall furtherand 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 3having 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 theBIC 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 iseither increase or decrease in the years 2020 to 2025.
- The UCL and LCL has presented for the forecast data.

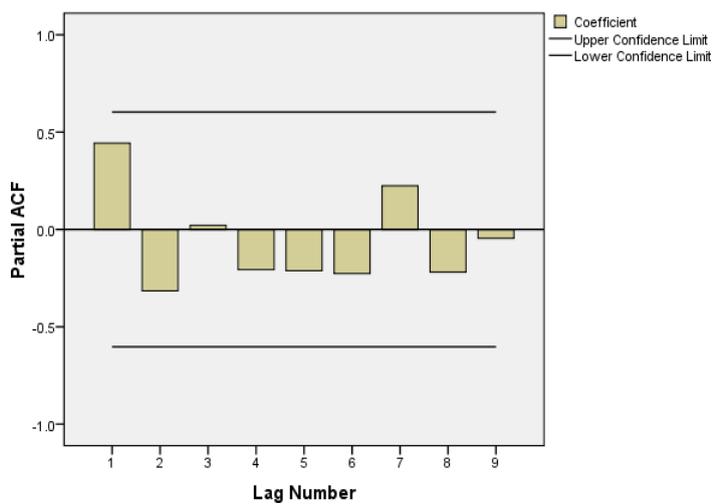
**Fig 17:**  
**4.5 PUDUCHERRY**



**Fig 18: Autocorrelations**  
 PUDU

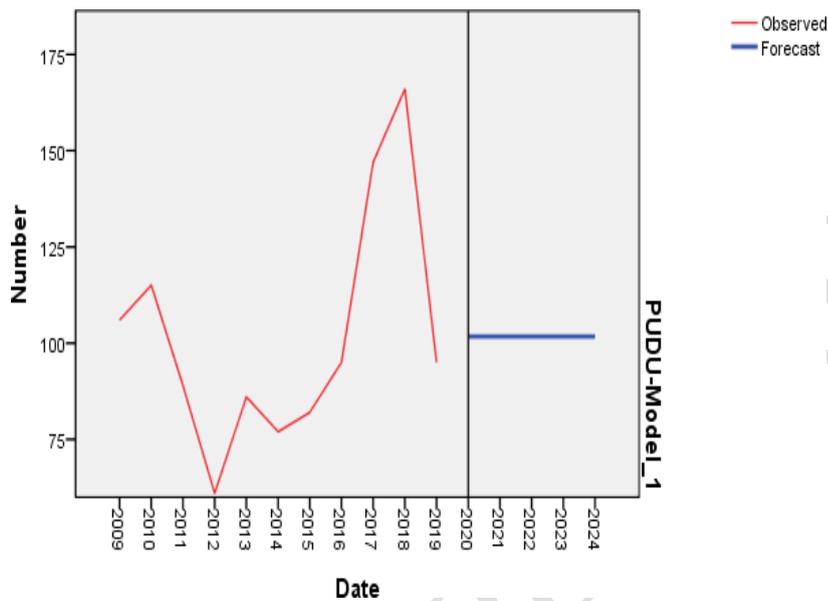


**Fig 19: Partial Autocorrelations**  
 PUDU



**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



**Fig 20:**

**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 and plotted as PACF plot
- In modelling Holt model has chosen to forecast the data.
- Better models may be chosen further to improve 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

## **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 is 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 existing 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.

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