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## RESEARCH ARTICLE

### FORECASTING OF CRIMES IN KERALA

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#### ABSTRACT

In this paper, we have taken data on crimes in Kerala from 2008 to 2022 and analyzed them using time series modelling. The data used in the research paper is obtained from the National Crime Records Bureau (NCRB) and State Crime Records Bureau. The findings of this research paper have implications for developing effective crime prevention strategies and enhancing public safety in India. This research paper aims to predict overall crime trends in India using ARIMA (Auto-regressive integrated moving average) model.

## INTRODUCTION

Crime statistics are pivotal in understanding the dynamics of law enforcement and societal safety. Crime has been a tough issue for a long time. [1] In the state of Kerala, India, where cultural diversity intertwines with socio-economic complexities, an in-depth analysis of crime trends holds paramount importance. This research endeavors to scrutinize the trajectory of crime statistics in Kerala, employing advanced time series models to unravel patterns and forecast future trends. Crime is one of the dangerous factors for any country. Crime analysis is the activity in which analysis is done on crime activities. [4] The significance of comprehending crime statistics lies in their role as barometers of societal well-being and law enforcement effectiveness. Through meticulous analysis, these data not only illuminate existing challenges but also provide insights for proactive intervention strategies. Utilizing time series models, this study aims to delve into the underlying patterns of criminal activities in Kerala, thereby enriching our understanding of the factors driving such occurrences. Forecasting future crime trends serves as a vital tool for policymakers and law enforcement agencies to allocate resources effectively and implement preemptive measures. By extrapolating historical data into the future, stakeholders can anticipate emerging challenges and devise tailored interventions to mitigate criminal activities, thereby enhancing public safety and welfare. As underscored by Smith, Johnson, and Patel (2019), the integration of time series analysis into crime research offers a robust framework for comprehending the temporal dynamics of criminal activities[2]. This citation emphasizes the significance of employing sophisticated analytical techniques to derive actionable insights from crime data and inform evidence-based policy decisions. In summary, this research endeavors to contribute to the existing body of knowledge by offering a comprehensive analysis of crime trends in Kerala. Through the utilization of advanced time series models, this study aims to forecast future trajectories and provide valuable insights for policymakers and law enforcement agencies to enhance public safety and societal well-being.

## METHODOLOGY

The main focus of this research is time-series modeling of crime rates in Kerala, based on information retrieved from the NCRB and SCRB. The study makes use of a quantitative research design in order to undertake the analysis of historical crime data to detect the trends and patterns over a stretch of time. The main sources of data, NCRB and SCRB, provide comprehensive crime statistics on the nationwide and state levels. Inclusion criteria are used to eliminate irrelevant time periods and validate data. Major considerations include crime rates, different crime types, and offenders' personal information. Data analysis is based on various time series models which are used to capture different aspects of the crime rates. Firstly, the SMAs (Simple Moving Averages)

and DMAs (Double Moving Averages) are used to understand the trends and cyclical fluctuations. Then, the Autoregressive Integrated Moving Average Model (ARIMA) is applied to the autoregressive, integrated, and moving average phenomenon of the time series. The model parameters (p, d, q) are decided by reviewing auto-correlation and partial auto-correlation plots. Ethical considerations feature privacy and confidentiality issues with all crime data anonymized to ensure the safety of the individuals involved. The study is in line with ethical standards and legal procedures governing the use of crime data. Validity is ensured by the use of official crime records from reliable sources while reliability is preserved by adhering to standardized crime reporting procedures and including a considerable time period for the analysis. The research recognizes possible limitations, such as the accuracy and completeness of crime data collected by NCRB and SCRB. Moreover, the report results may be particular to the Kerala context, which is not directly comparable to other areas. The purpose of this study is to promote transparency by letting the community access aggregated crime statistics to verify the findings. Basically, this methodology describes a systematic way where time sets for annual crime rates are being analyzed in Kerala. The study design and data analysis approach are weighted to yield important findings on crime trends and patterns over the given period with ethical issues and challenges being noted while these can be avoided to maintain the study integrity.

## OBJECTIVE OF STUDY

- To study the trend of crime statistics in Kerala.
- To analyse the crime data using time series models.
- Forecast the crime for the next few years.

## Review the concept of models

**ARIMA model:** ARIMA model means autoregressive integrated moving average model. It is a general form of the autoregressive moving average model. Both of these models are utilized in predicting data, especially data involving time.[5] ARIMA (p, d, q) model is a linear model that is fit for dealing with stochastic series. Generally, it originated from the autoregressive model AR (p), the moving average model MA (q) and the combination of AR (p) and MA (q), the ARMA (p, q) model.

**The formulation of the ARIMA model is a complicated process, but in summarization it includes four steps: [3]**

- Identification of the ARIMA (p, d, q) structure.
- Estimating the coefficients of the formulation.
- Fitting test on the estimated residuals.
- Forecasting the future outcomes based on the historical data. During the four steps, the first is the most important. Usually, the auto-correlation (ACF) and partial auto-correlation (PACF) functions are taken to identify the models because they show different features of the functions.[3]

For AR (p), the ACF tails off at the order of p but PACF cutoff; for MA (q), the ACF cutoff but PACF tails off at the order of q; for ARMA (p, q), none of the ACF and PACF tail off. The ARIMA model could provide forecasting results with upper limits, lower limits and forecast values. The upper and lower limits provide a confidence interval of  $1 - \alpha$ . The  $\alpha$  is the given confidence, which means that any realization within the interval will be accepted. [3]

## Autocorrelation

Autocorrelation is a statistical measure that shows the correlation between a time series and a lagged version of itself. It is a useful tool for identifying patterns or trends in time series data. Autocorrelation can be positive, negative, or zero.

- Positive autocorrelation indicates that the values in the time series are correlated with each other.
- Negative autocorrelation indicates that the values in the time series are inversely correlated with each other.
- Zero autocorrelation indicates that there is no correlation between the values in the time series.

In the present study, autocorrelation is used to analyze the relationship between the total crimes against women in one period and the same crime in a previous period. This information can be useful in predicting future crime rates.

Autocorrelation can be calculated using the following formula:-

$$\rho(k) = \frac{\sum[(x(t) - \bar{x})(x(t-k) - \bar{x})]}{\sum[(x(t) - \bar{x})^2]} \quad (1)$$

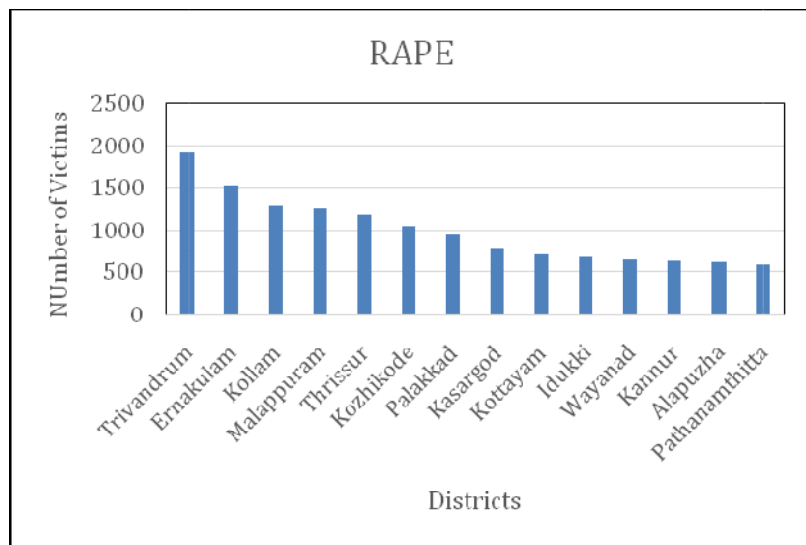
where  $\rho(k)$  is the autocorrelation at lag k,  $x(t)$  is the value of the time series at time t,  $\bar{x}$  is the mean of the time series, and k is the lag.

**Crime against women:** The crime situation in Kerala is the sum total of the crimes happening in the districts. The incidents of the various types of crimes may vary between the districts. So it is worthwhile to look into the crime situation in the 14 districts of Kerala. Table 5.1 shows that an increasing trend of crimes. The below table shows the district wise distribution of total crime against women in Kerala.

**Table 5.1 District wise distribution of total crime against women in yearly**

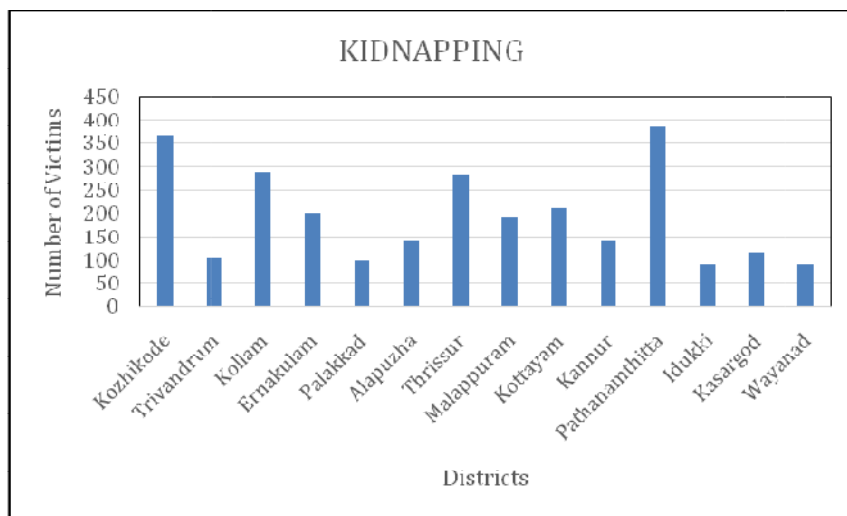
Districts	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
Trivandrum	1119	1199	1443	1719	1646	1861	1691	1649	1556	1722	1411	1510	1298	1579	1933	23336
Pathanamthitta	404	335	361	392	675	526	440	401	377	390	388	413	399	514	591	6606
Kollam	837	845	1072	1262	1079	1292	1303	1101	1023	1116	1128	1135	1091	1410	1573	17267
Alapuzha	553	475	569	676	636	712	547	467	489	604	585	693	558	745	761	9070
Idukki	376	388	446	501	739	460	445	452	464	558	478	484	450	546	566	7353
Kottayam	559	466	658	730	498	621	484	405	476	516	499	541	388	569	675	8085
Ernakulam	756	737	916	1087	1012	1272	1146	1155	938	1228	1208	1169	994	1377	1884	16879
Thrissur	838	785	912	1566	1397	1400	1555	1378	869	1019	865	1090	939	1386	748	16747
Palakkad	539	533	546	705	666	701	741	694	548	618	530	678	566	852	843	9760
Malappuram	935	926	1102	1211	1264	1380	1332	1474	916	981	1064	1087	1125	1354	1379	17530
Kozhikode	1156	1066	1120	1231	1177	1285	1181	1327	968	1063	975	1175	1040	1427	1670	17861
Wayanad	402	401	420	493	435	422	377	486	381	378	303	356	331	451	569	6205
Kannur	688	671	704	945	987	959	891	857	530	386	583	700	529	751	370	10551
Kasargod	533	513	496	715	696	752	576	653	406	405	360	376	392	524	415	7812

**Bar diagram for crime against women:** Below graphs shows the total number of victims under various crimes reported in Kerala during the year 2008-2022



**Figure 5.1. Bar diagram for the total number of victims under the crime rape**

The above bar graph shows the total number of victims under rape, shows that highest case reporting in Trivandrum with 1915 cases followed by Ernakulam with 1528 rape cases.



**Figure 5.2. Bar diagram shows the total number of victims under the crime kidnapping**

The above bar graph shows the total number of victims under Kidnapping, shows that highest case reporting in Pathanamthitta with 384 kidnapping cases followed by Kozhikode with 368 kidnapping cases.

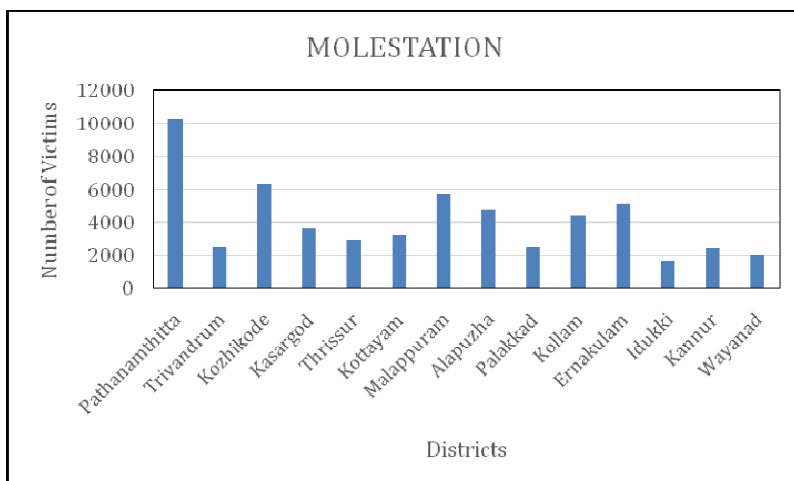


Figure 5.3. Bar diagram for the total of victims under the crime molestation

The above bar graph shows the total number of victims under molestation, shows that highest case reporting in Pathanamthitta with 10301 molestation cases followed by Kozhikode with 6388 molestation cases.

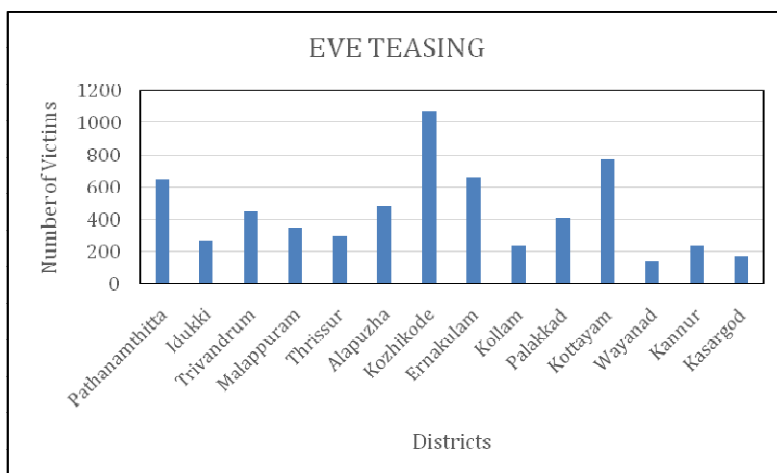


Figure 5.4. Bar diagram for the total number of victims under the crime Eve teasing

The above bar graph shows the total number of victims under Eve teasing, shows that highest case reporting in Kozhikode with 1080 cases followed by Kottayam with 773 cases.

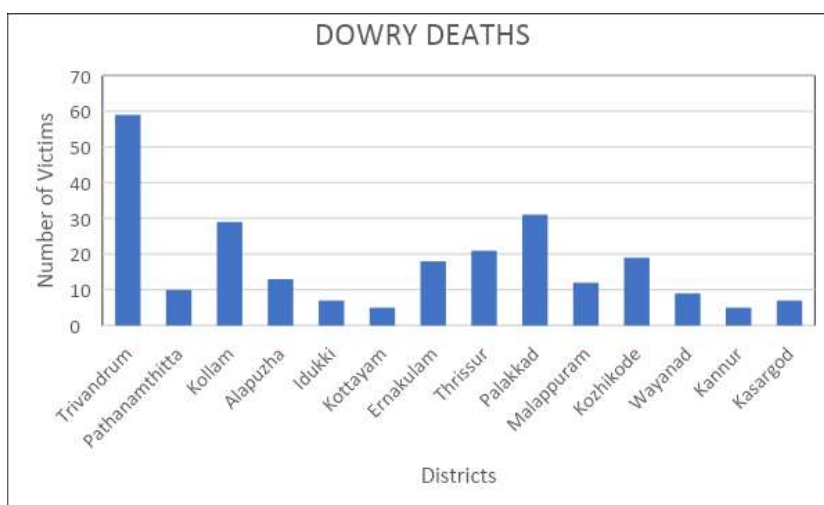


Figure 5.5. Bar diagram for the total number of victims under the crime dowry deaths

The above bar graph shows the total number of victims under dowry deaths, highest been reported in Trivandrum with 59 cases followed by Palakkad with 31 cases.

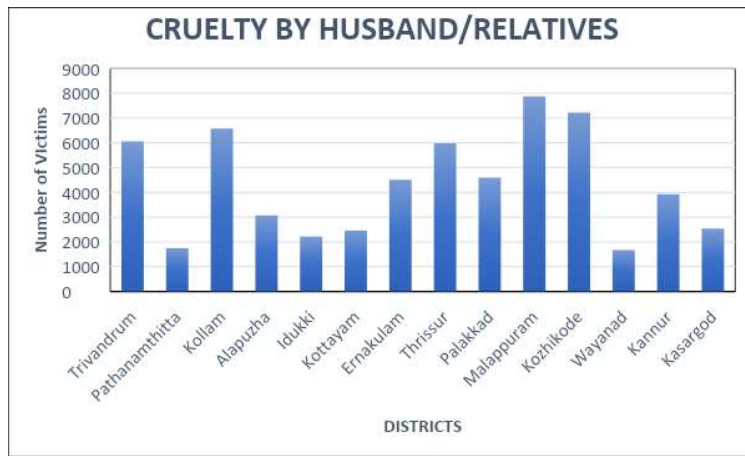


Figure 5.6. Bar diagram for the total number of victims under the crime cruelty by husband/relatives

The above bar graph shows the total number of victims under cruelty by relatives/husband, highest been reported in Malappuram with 7878 cases followed by Kozhikode with 7225 cases.

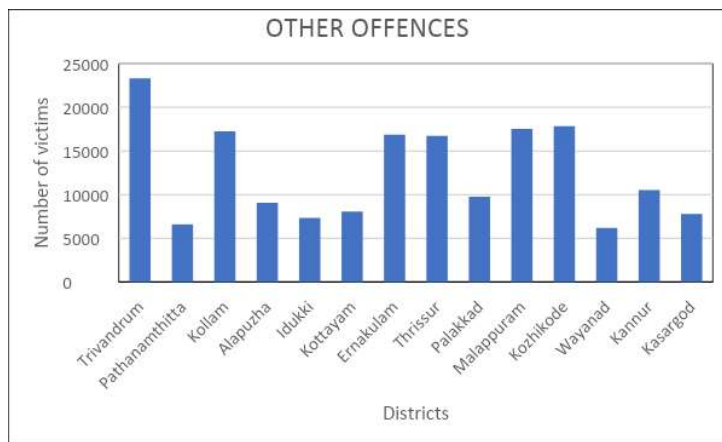


Figure 5.7. Bar diagram for the total number of victims for other crimes

The above bar graph shows the total number of victims under other offences, Trivandrum with 23336 cases reported highest followed by Kozhikode with 17861 cases. Trivandrum reported the highest number of rape, dowry death cases and other offences. Kozhikode reported the highest number of eve teasing cases. Malappuram reported the highest number of cruelty by husbands/relatives followed by Kozhikode and Kollam. Cruelty by husbands and relatives towards married women is a major crime. Pathanamthitta reported highest number of molestation cases. District wise variation shows that the highest incidents were in Trivandrum, Kozhikode followed by Malappuram. With regards to Kidnapping Pathanamthitta reported the highest case followed by Kozhikode. The major share in Kerala’s crimes against women was contributed by the district of Trivandrum followed by Kozhikode.

**Crime against women during the year 2008-2022:** The following line graphs show the trend of crime against women in Kerala for the last sixteen years.

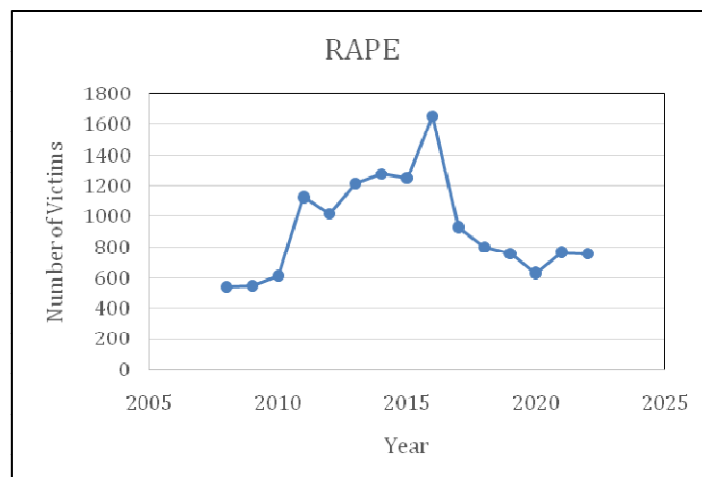


Figure 5.8. Graphical representation of Rape

The above line graph shows a in increasing trend from 2008 to 2016 with a slight decrease for 2012 and 2015. But in 2016 there is very sharp decrease from 2015 till 2020. In 2021 there is a slight increase and in 2022 slight decrease.

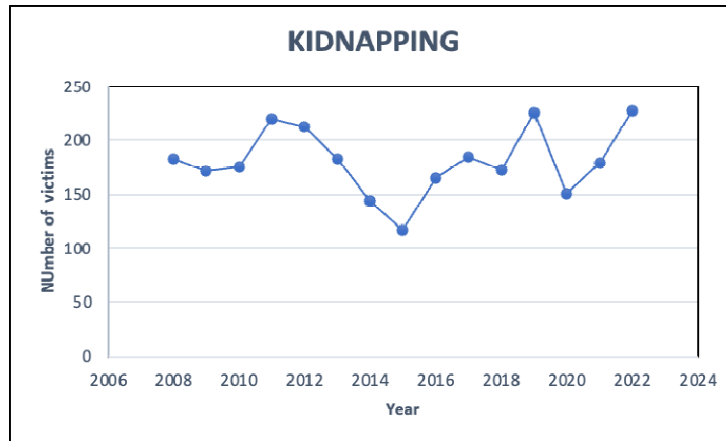


Figure 5.9. Graphical representation of Kidnapping

The data shows fluctuations in the number of reported kidnapping cases over the years. There isn't a consistent upward or downward trend but rather variability from year to year. Certain years stand out with relatively higher numbers of reported kidnapping cases, such as 2011, 2019, and 2022. Conversely, there are years like 2013, 2014, 2015 and 2020 where the number of reported cases notably decreases. The data exhibits significant variability, with fluctuations occurring across the years.

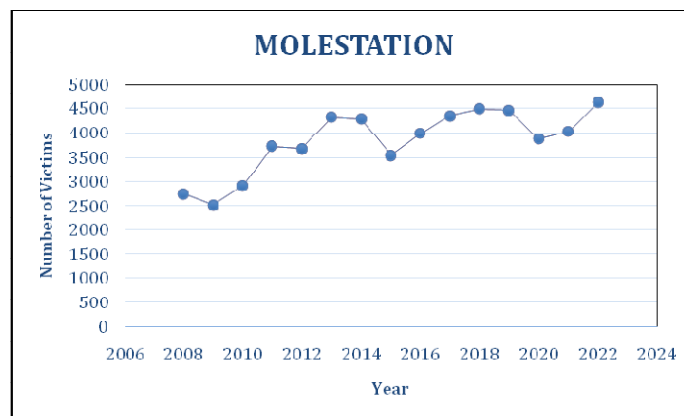


Figure 5.10. Graphical representation of Molestation

Looking at the data, we can see fluctuations in the number of reported molestation cases over the years. There's a general upward trend, with some fluctuations from year to year. While there are overall increases over the years, there are also periods of decrease, such as between 2015 and 2016, and 2019 and 2020.

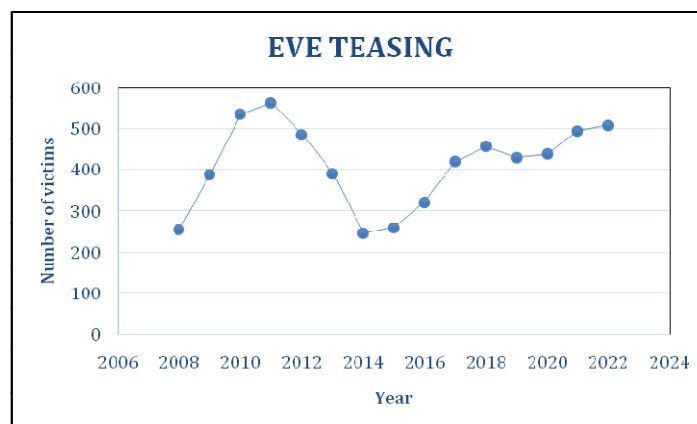


Figure 5.11. Graphical representation of Eve teasing

The data shows fluctuations in the number of reported eve-teasing incidents over the years. There isn't a clear upward or downward trend but rather variability from year to year. Years like 2010, 2011, 2017, 2018, 2021, and 2022 stand out with relatively higher numbers of reported eve-teasing incidents. There are years, such as 2012, 2013 and 2014, where the number of reported incidents notably decreases.

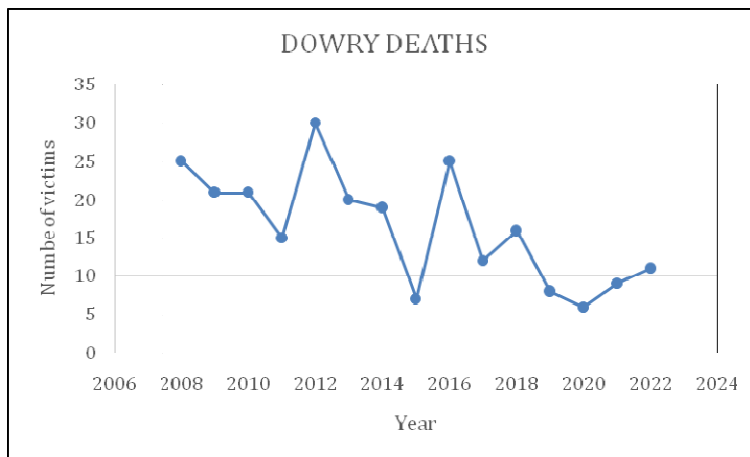


Figure 5.12. Graphical representation of Dowry deaths

The number of reported dowry deaths fluctuates significantly over the years. There isn't a consistent upward or downward trend observed across the entire time period. Certain years, such as 2008, 2012, 2016, 2017, 2021 and 2022 have relatively higher numbers of reported dowry deaths, while other years, like 2009, 2011, 2015, 2019, and 2020, have notably lower numbers.

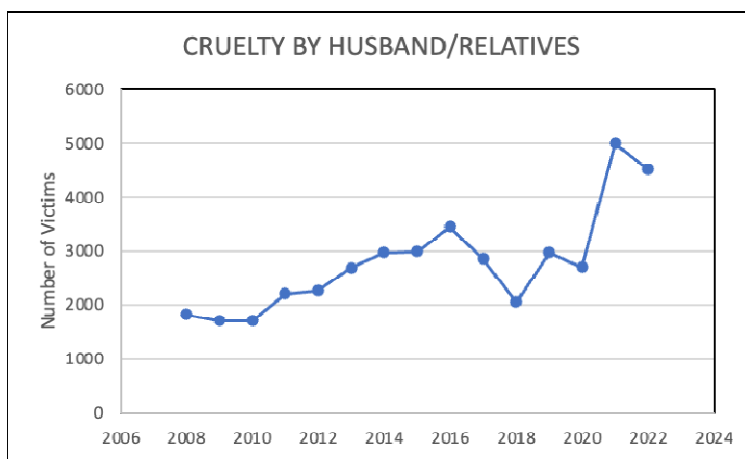


Figure 5.13. Graphical representation of Cruelty by husband/relatives

While there are fluctuations, there's also an overall increasing trend, especially in recent years. Years like 2011, 2012, 2015, 2016, and 2021 stand out with relatively higher numbers of reported cases. There are instances of decreases in reported cases, such as in 2017, 2018 and 2022 where the number of reported cases drops significantly compared to the preceding years.

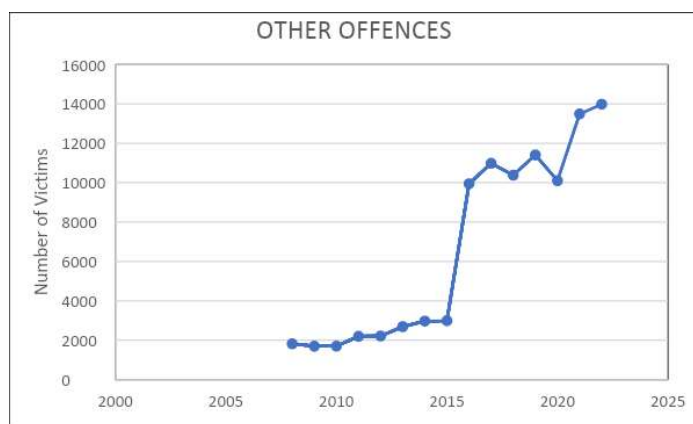


Figure 1.14. Graphical representation of other offences

From the line graphs the total number of crimes under IPC in general has been a rising trend except for years 2009, 2012, 2014, 2018 and 2020 in which sights decline was observed.

**Line graph of total crime against women in Kerala:** The following line graph shows the trend of crime against women in Kerala.

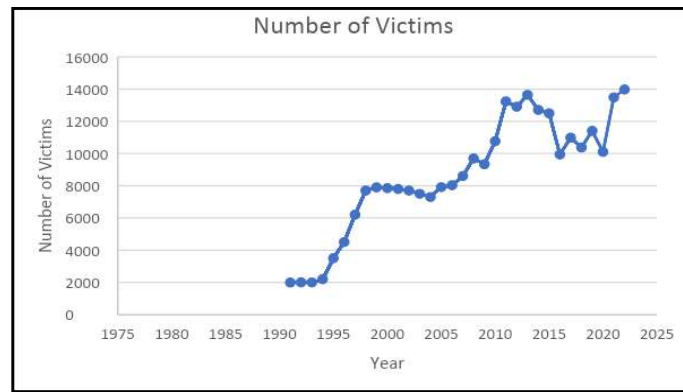


Figure 5.15. Line graph of total crime against women in Kerala

The number of reported crimes against women shows fluctuations over the years. There is an overall increasing trend, particularly noticeable in recent years. In the early 1990s, the reported number of crimes against women was relatively low, gradually increasing towards the late 1990s. A significant increase in reported crimes against women is observed from the mid-1990s to the early 2000s. This increase may be influenced by various factors including changes in reporting practices, awareness campaigns, and societal changes. From the early 2000s onwards, there's a steady rise in reported crimes against women, with occasional fluctuations. The data indicates a notable increase in reported crimes against women in the past decade, particularly from 2010 onwards. There's a peak in 2022, with the highest number of reported cases during the period analyzed.

**Pie diagram for percentage distribution of crime against women**

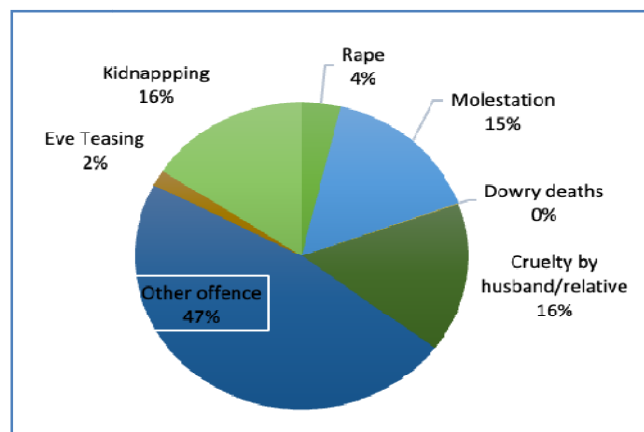
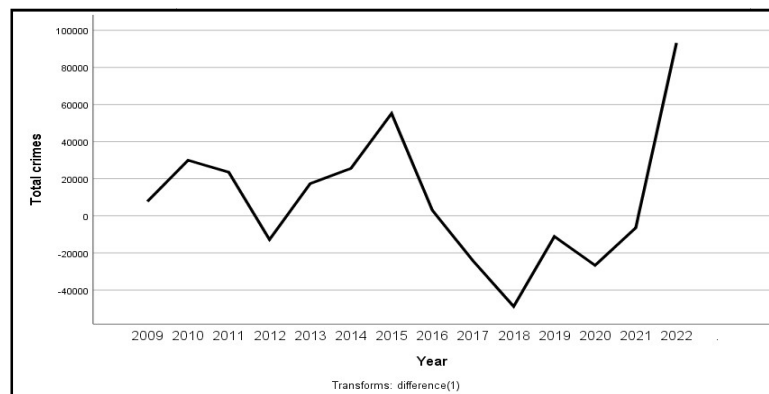


Figure 5.16. Pie diagram for percentage distribution of various crimes against women.

The data illustrates a diverse range of reported crimes against women, ranging from sexual offenses like rape and molestation to domestic violence, kidnapping, and other unspecified offenses. While some categories like rape and dowry deaths constitute smaller proportions of reported crimes, they represent severe and impactful forms of violence against women. The prominence of categories such as molestation, cruelty by husband/relatives, and kidnapping underscores the prevalence of gender-based violence and the challenges women face in terms of safety and security in various contexts. The high percentage of "Other Offenses" suggests the need for further categorization and analysis to understand the specific nature and prevalence of different types of crimes reported. In order to fit the model we use graphical display and analysis of available data. Graphical displays of ACF and PACF suggest an appropriate model for the data. Here we are modelling the time series for crime against women and total crimes in Kerala.





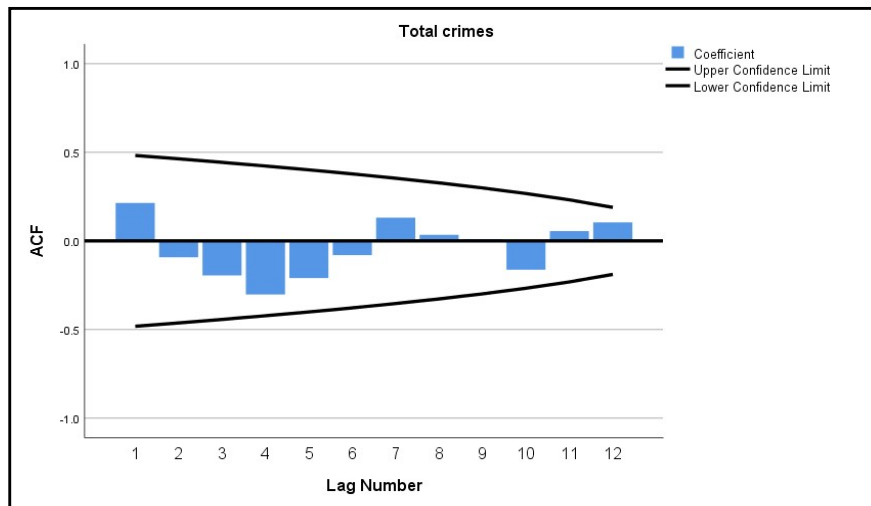
## Modelling of Crime Against women in Kerala

**Table 5.2. Autocorrelations of crime against women in Kerala**

Autocorrelations					
Series: Total crimes against women					
Lag	Autocorrelation	Std. Error	Box-Ljung Statistic		
			Value	df	Sig.b
1	.214	.241	.788	1	.375
2	-.093	.231	.948	2	.622
3	-.195	.222	1.723	3	.632
4	-.303	.211	3.776	4	.437
5	-.210	.200	4.869	5	.432
6	-.080	.189	5.050	6	.537
7	.131	.177	5.602	7	.587
8	.034	.164	5.644	8	.687
9	.010	.149	5.649	9	.774
10	-.163	.134	7.132	10	.713
11	.055	.116	7.361	11	.769
12	.105	.094	8.584	12	.738

a. The underlying process assumed is independence (white noise).  
b. Based on the asymptotic chi-square approximation.

The autocorrelation for total crimes against women at different lags is provided. For example, at lag 1, the autocorrelation is 0.214, which indicates a positive correlation between the total crimes against women in one year and the same crime in the previous year. At lag 2, the autocorrelation is -0.093, indicating a weak negative correlation.



**Fig 5.17. Graphical representation of auto-correlation of crime against women**

**Table 5.3. Partial autocorrelations of crime against women in Kerala**

Partial Autocorrelations		
Series: Total crimes		
Lag	Partial Autocorrelation	Std. Error
1	.214	.267
2	-.145	.267
3	-.151	.267
4	-.259	.267
5	-.157	.267
6	-.128	.267
7	.037	.267
8	-.174	.267
9	-.096	.267
10	-.305	.267
11	.088	.267
12	-.046	.267

The partial autocorrelations provided in the table show the correlation between the total crimes against women at a given lag and the previous lags, after controlling for the effects of the intervening lags. For example, the partial autocorrelation at lag 1 is 0.214, indicating a positive correlation between the total crimes against women in one year and the same crime in the previous year, after controlling for the effects of any intervening lags. However, this correlation is not statistically significant (p-value = 0.375). At lag 2, the partial autocorrelation is -0.145, indicating a weak negative correlation.

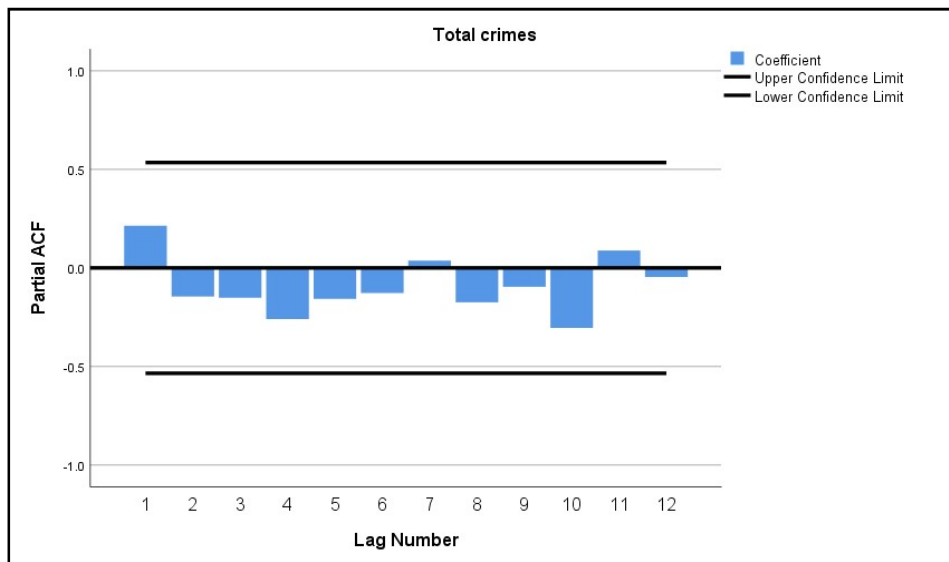


Figure 5.18. Graphical representation of partial ACF of crime against women.

Table 5.4. Model description of crime against women

Model Description			
			Model Type
Model ID	Total crimes	Model 1	ARIMA(2,1,0)

ARIMA model with parameters (2,1,0).

The parameters (2,1,0) indicate the following:

- Autoregressive (AR) order of 2: The model includes two lagged values of the response variable as predictors.
- Integrated (I) order of 1: The model includes a differencing step to remove any trend or seasonality in the time series data.
- Moving Average (MA) order of 0: The model does not include any lagged error terms as predictors.

Table 5.5. Model statistics of crime against women

Model Fit statistics	
R-squared	.454

The model fit statistics provided, an R-squared value of 0.454 indicates that approximately 45.4% of the variance in the total crimes against women time series is explained by the independent variables included in the model.

Table 5.6. ARIMA Model Parameters of crime against women in Kerala

ARIMA Model Parameters								
				Estimate	SE	t	Sig.	
Total crimes-Model_1	Total crimes	No Transformation	Constant	9913.888	12094.443	.820	.430	
			AR	Lag 1	.520	.420	1.237	.242
				Lag 2	-.363	.422	-.861	.408
			Difference	1				

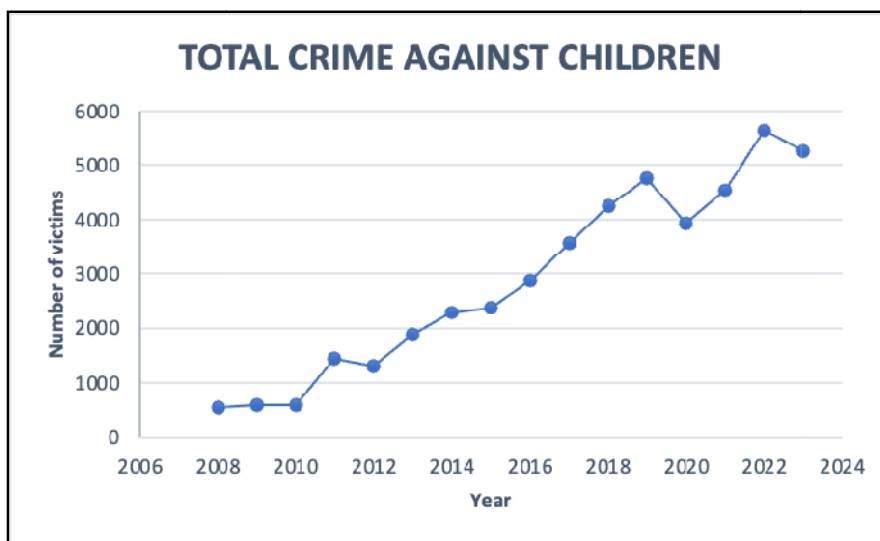
Table 5.7. The forecasted value for the next five years

Forecast						
Model		2023	2024	2025	2026	2027
Total crimes-Model_1	Forecast	295046	300322	289922	290955	303630
	UCL	374119	444200	472784	496609	526935
	LCL	215973	156445	107060	85300	80326

**Crime against Children:** Kerala has an increased trend in crime against children in the last fifteen years. The following figure shows the crime against children in Kerala.

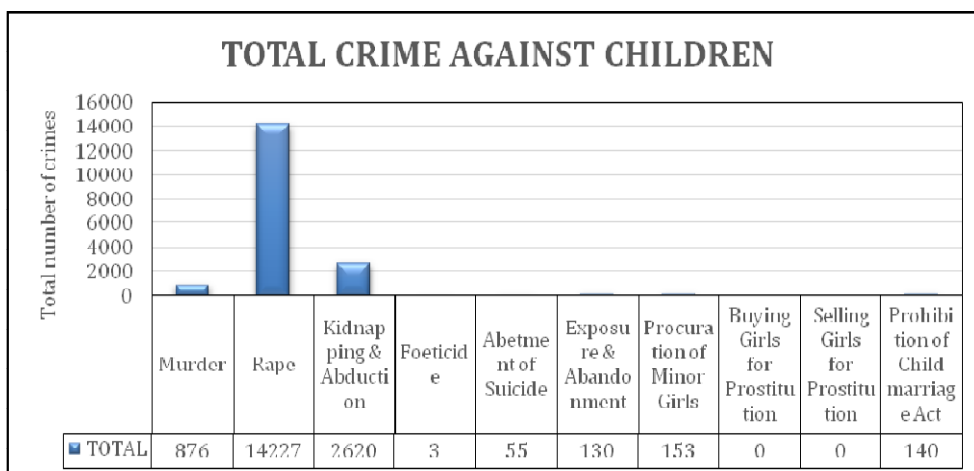
**Table 6.1. Crime against children**

Year	Total number of victims
2008	549
2009	589
2010	596
2011	1452
2012	1324
2013	1877
2014	2286
2015	2373
2016	2879
2017	3562
2018	4253
2019	4754
2020	3941
2021	4536
2022	5640



**Figure 6.1. Line graph for crime against children in Kerala**

There's a noticeable increase in the total number of reported victims of crimes against children over the years. The trend shows a generally upward trajectory, with occasional fluctuations. From 2008 to 2023, there's a substantial increase in the reported number of victims, indicating a growing concern for the safety and well-being of children. Years like 2017, 2018, 2019, 2021, and 2022 stand out with relatively higher numbers of reported victims. Slight decrease of crimes happening in 2010, 2012 and 2020 While there's an overall increasing trend, there are fluctuations from year to year.



**Figure 6.2. Bar diagram for crime against children**

The provided data outlines the total reported cases of various crimes against children, including murder, rape, kidnapping, foeticide, abetment of suicide, exposure/abandonment, procuration of minor girls, and violations of laws against child marriage and child prostitution.

MODELLING CRIME AGAINST CHILDREN

Table 6.2. Autocorrelations of crime against children

Autocorrelations					
Series: Total number of victims					
Lag	Autocorrelation	Std. Error	Box-Ljung Statistic		
			Value	df	Sig. <sup>b</sup>
1	-.165	.241	.470	1	.493
2	-.385	.231	3.244	2	.198
3	.007	.222	3.245	3	.355
4	-.032	.211	3.267	4	.514
5	.215	.200	4.422	5	.490
6	.016	.189	4.429	6	.619
7	-.158	.177	5.225	7	.632
8	.164	.164	6.233	8	.621
9	-.231	.149	8.622	9	.473
10	.041	.134	8.715	10	.559
11	.216	.116	12.207	11	.348
12	-.111	.094	13.577	12	.329

a. The underlying process assumed is independence (white noise).  
 b. Based on the asymptotic chi-square approximation.

The autocorrelation for total crimes against at different children lags is provided. For example, at lag 1, the autocorrelation is .165, which indicates a negative correlation between the total crimes against children in one year and the same crime in the previous year. The Box-Ljung statistic is .470 with 1 degrees of freedom and p value is .493

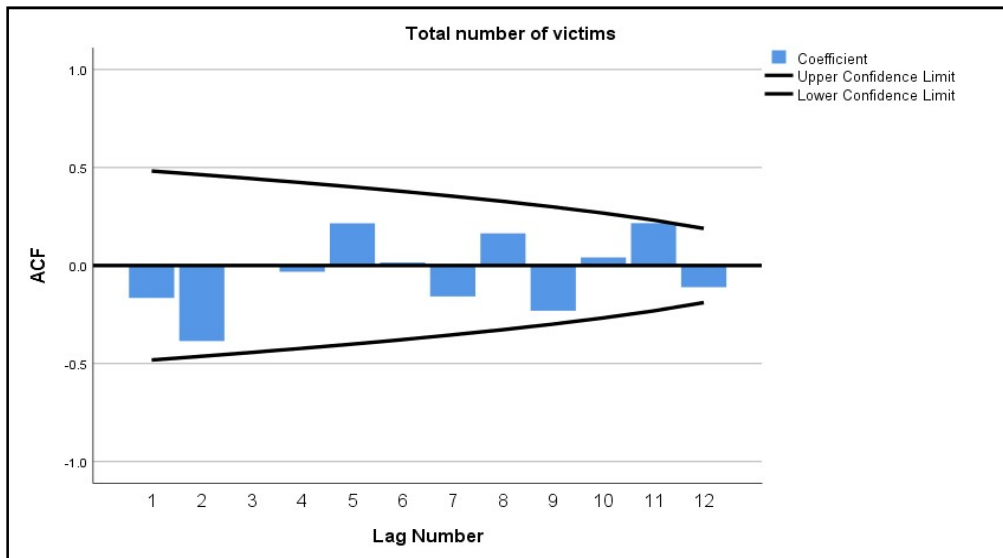


Figure 6.3. Graphical representation of Autocorrelation of crime against children

Table 6.3. Partial Autocorrelation of crime against children

Partial Autocorrelations		
Series: Total number of victims		
Lag	Partial Autocorrelation	Std. Error
1	-.165	.267
2	-.424	.267
3	-.193	.267
4	-.316	.267
5	.062	.267
6	-.038	.267
7	-.021	.267
8	.210	.267
9	-.230	.267
10	.057	.267
11	.020	.267
12	.013	.267

The partial autocorrelations (PACF) for the time series of the total number of victims. The PACF values in this table indicate that there is some evidence of correlation between the total number of victims and its lagged values. For example, the partial autocorrelation at lag 2 is -0.424, which is relatively large and negative, but it is not statistically significant at the 5% level (since its standard error is 0.267). Similarly, the partial autocorrelation at lag 8 is positive and relatively large (0.210), but it is also not statistically significant.

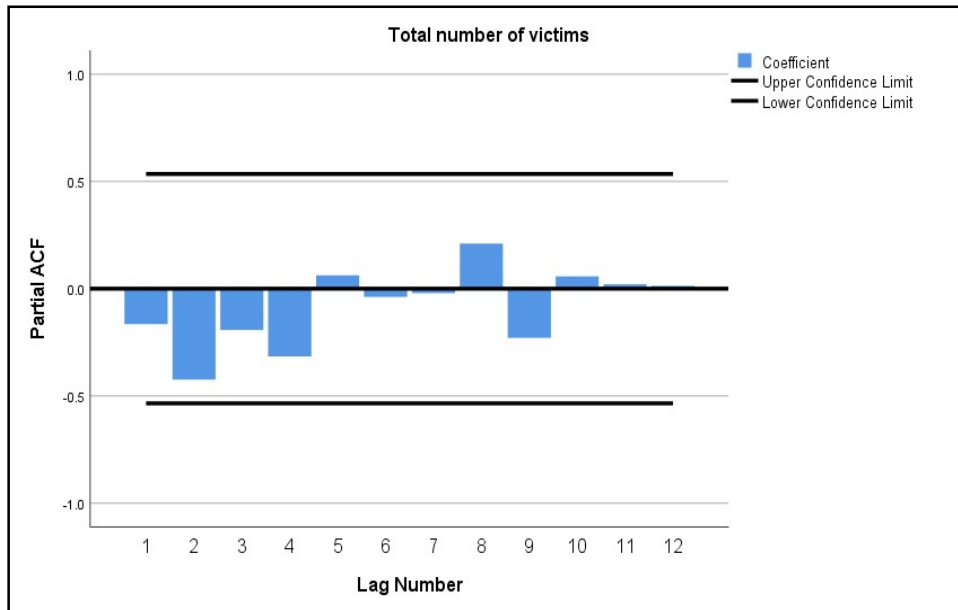


Figure 6.4. Graphical representation of PACF crime against children

Table 6.4. Model description of crime against children

Model Description			Model Type
Model ID	Total number of victims	Model 2	ARIMA(0,1,0)

**ARIMA model with parameters (0,1,0)**

The parameters (0,1,0) indicate the following:

- Autoregressive (AR) order of 0: The model does not include any lagged values of the response variable as predictors.
- Integrated (I) order of 1: The model includes a differencing step to remove any trend or seasonality in the time series data.
- Moving Average (MA) order of 0: The model does not include any lagged error terms as predictors.

Table 6.5. Model statistics of crime against women

Model Fit statistics
R-squared
.901

The model fit statistics provided, an R-squared value of 0.901 indicates that approximately 90.1% of the variance in the total number of victims time series is explained by the independent variables included in the model.

Table 6.6. ARIMA Model Parameters crime against children

ARIMA Model Parameters				Estimate	SE	t	Sig.
Total number of victims-Model_1	Total number of victims	No Transformation	Constant	363.643	129.770	2.802	.015
			Difference	1			

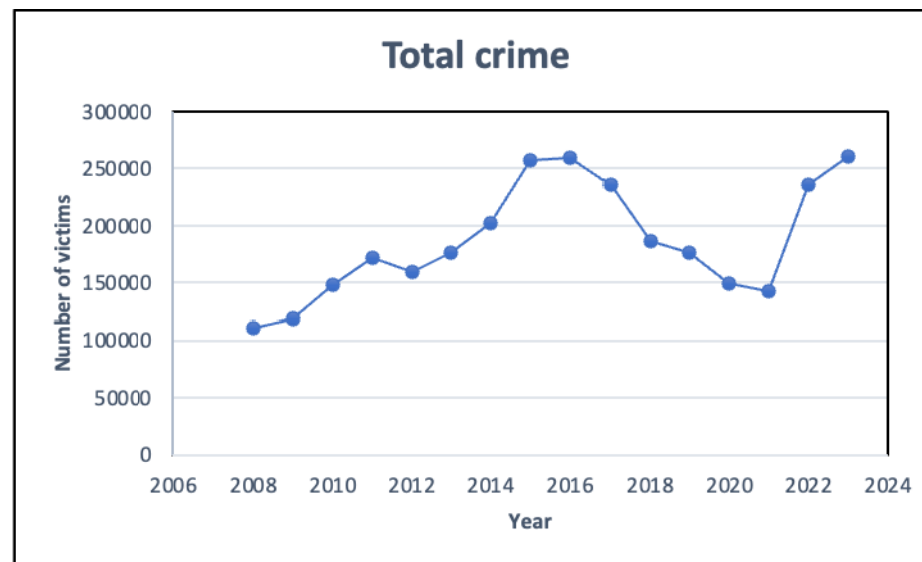
Table 6.7. The forecasted value for the next five years

Forecast						
Model		2023	2024	2025	2026	2027
Total number of victims-Model_1	Forecast	6004	6367	6731	7095	7458
	UCL	7053	7851	8548	9193	9804
	LCL	4955	4884	4914	4997	5113

## CRIME STATISTICS IN KERALA

**Table 7.1. Crime reported in Kerala for the last fourteen years.**

Crime Heads	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Murder	362	343	363	365	374	372	367	318	305	305	292	323	306	337	334
Attempt to commit murder	434	408	361	521	497	603	676	586	622	583	672	729	610	600	700
CH not amounting to murder	95	100	86	105	107	104	84	76	132	112	90	93	84	78	94
Rape	568	568	634	1132	1019	1221	1347	1263	1656	2003	2005	2023	1880	2339	2518
Kidnapping & abduction	253	256	261	299	281	252	222	262	241	293	297	386	307	364	403
Dacoit	91	112	74	71	72	67	71	94	71	63	71	87	69	64	60
Robbery	816	830	636	741	725	784	869	766	908	807	867	741	610	780	821
Burglary	3882	3554	2682	3001	2710	2929	3452	2872	2579	2380	2389	2293	1619	1947	2273
Theft	5818	5564	4380	4704	4078	4079	4700	4428	3936	3844	3651	3401	2418	3119	3943
Riots	8057	8086	8724	10754	10938	10042	5820	5948	5089	4689	4236	3514	3520	1725	1560
Criminal breach of trust	435	354	343	340	301	339	366	268	274	220	289	204	120	182	155
Cheating	3659	3394	3581	5155	4681	4841	6091	4690	4623	3930	4643	6347	8993	5214	8307
Counterfeiting	46	66	54	56	68	79	66	52	43	25	43	33	23	25	35
Arson	389	503	374	450	568	479	453	540	554	405	341	389	317	256	256
Hurt	19178	18274	18532	21747	21170	20399	1827	18298	17388	20323	20087	18910	16238	15579	17174
Dowry Deaths(304(B) IPC)	31	20	22	15	32	21	28	7	25	12	17	8	6	9	11
Molestation	2745	2540	2936	3756	3735	4362	4367	3991	4029	4413	4544	4507	3890	4059	4940
Sexual harassment	258	395	537	573	498	404	257	265	328	421	461	435	442	504	572
Cruelty by husband or relatives	4138	4007	4797	5377	5216	4820	4919	3664	3455	2856	2046	2970	2707	4997	4998
Other IPC Crimes	59365	68995	98936	112665	101919	120137	165885	208669	213839	188162	139917	128417	104940	100465	186704
Total cognizable crimes(IPC cases)	110620	118369	148313	171827	158989	176334	201867	257057	260097	235846	186958	175810	149099	142643	235858



**Figure.7.2: Line graph of total crime reported in Kerala**

The line graphs total in Kerala showing a rising trend except for the year 2011,2015,2016 ,2017,2021and 2022.

**Forecast:** After we have defined the most appropriate model of demand in our case, we have to make the forecasting; to do this and so to predict trends and develop forecast, we used the IBM SPSS Forecasting.[6] Table 5.7 and Figure 6.7 present the results of the crimes against women and crimes against children forecasts that we obtained by applying our model ARIMA (2, 1, 0) and ARIMA(0,1,0) respectively. for the next 5 years from 2023 to 2027.The forecasts obtained after modeling facilitated the decision on the crimes against women and crime against children.[6]

## CONCLUSION

In conclusion, this research paper has analyzed crime statistics in Kerala from 2008 to 2022 using time series modelling. This project has discussed the crime rates in Kerala. From this analysis we observe that the crime rate in Kerala has been increasing trend in the past years. The study found that the ARIMA(2,1,0) model was the best fit for predicting overall crime trend against women in Kerala, with an R-squared value of 0.433. and the ARIMA(0,1,0) model was the best fit for predicting overall crime trend against children in Kerala, with an R-squared value of 0.910. The study Trivandrum reporting the highest number of rape,other offences and dowry death cases.Pathanamthitta reporting the highest number of molestation cases and kidnapping. The crimes against children and women have also increased. By observing the bar diagrams, the highest rate of violent crimes against women was reported from Trivandrum followed by Thrissur. Ernakulam reported the highest number of eve teasing cases followed by Kozhikode .From the line graphs, we observed that the total number of crimes under IPC in general has been a rising trend except for years 2011,2015 ,2016,2017,2021 and 2022 in which slight decline was observed. And we fit the ARIMA(2,1,0) for the data of crime against women and the ARIMA(0,1,0) model for the data of crime against children.

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