

USE OF PRINCIPAL COMPONENT ANALYSIS (PCA) TO ANALYZE CRIME DATA OF RAJASTHAN

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Abstract: The secondary data was collected from the state crime record bureau of Rajasthan in which different stage of 21 crimes are taken from 2007 to 2017. Total crime in Rajasthan has registered under the Indian Panel Code (IPC), Special and Local Laws (SLL). Case Officer Scheme of Rajasthan include the cases of heinous crimes like murder, rape, serious property offences or any other sensational case. The Rajasthan high court has issued directions to all the subordinate courts to conduct expeditious trial of cases taken up under the Case Officer Scheme. Nevertheless, the crime rate is increased in the year 2017 as compared to the year 2007. The crime rate graph is shown the increasing trend. This paper presents the PCA on the available data on the crime of the state of Rajasthan. As one of the most effectively recorded crimes and law enforcement data on crime statistics report of Rajasthan are collected by police department. PCA shows the correlation between the crimes and the distribution of the crimes in the state. The PCA has suggested to retain four components that explain about 90.69 percent of the total variability of the data set.

Keywords: Official statistics, cognizable crime, SLL (Special and Local Laws), IPC (Indian panel code), PCA (Principal component analysis).

1. Introduction

The mode of collection of information for crime data of Rajasthan collected from the government official site from www.police.rajasthan.gov.in. The criminal procedure code 1974 divides two-types of crimes one is cognizable and other one is non-cognizable. Day by day crime rate are increasing in Rajasthan. According to State Crime Records Bureau (SCRB), Rajasthan has 1, 69,943 IPC offences reported in the Rajasthan state during 2017. Rajasthan is at the sixth rank in India based on crime rate in 2017 by Google Wikipedia. It means that Rajasthan is involved in top 10 most violent states listed in India. The data regarding crime is available online up-to-date 2017 only. Crime is a big social problem for any government. It is affecting to marketing, social, political, psychological, economical, standard of living and a peaceful life of a common person.

Principal Component Analysis is a multivariate analysis, which is mostly used for data reduction. PCA is used to reduce 21 distinct variables that affect the crime rate of Rajasthan into four important variables which cover all other variables. For the analysis purpose, the secondary data from the period 2007 to 2017 of Crime related 21 variables are taken from SCRB of Rajasthan.

The police department can prevent crime by new technology, informer persons; provide better service in route level department. The main role of police department is to protect the persons and property from crimes. However, in recent years, Cyber Crime has also been flourishing and due to cyber-crimes many problems has arises. The responsible factors for crimes are unemployment, high lifestyle and low income, high technology, political interfere, less police personnel in hotspot area/sensitive area and even government servant's personal information are not secure.

There is not enough police force in India to curb the crime. So, the graph of crime is constantly increasing. Total actual strength of police persons including all ranks are 88,220 whereas it should be 1,06,255 as sanctioned strength. It means 18,035 posts are vacant as per 2017 crime data.

The crime considered as crime against properties, which includes robbery, Dacoity, Prep. & assembly for Dacoity, burglary and theft and crimes against human body which include murder, attempt to murder, riots, rape, Culpable Homicide not amounting to murder, grievous hurt, dowry death, assault on women with intent of outrage her modesty, insult to the modesty of women, cruelty by husband and relatives and kidnapping and abduction.

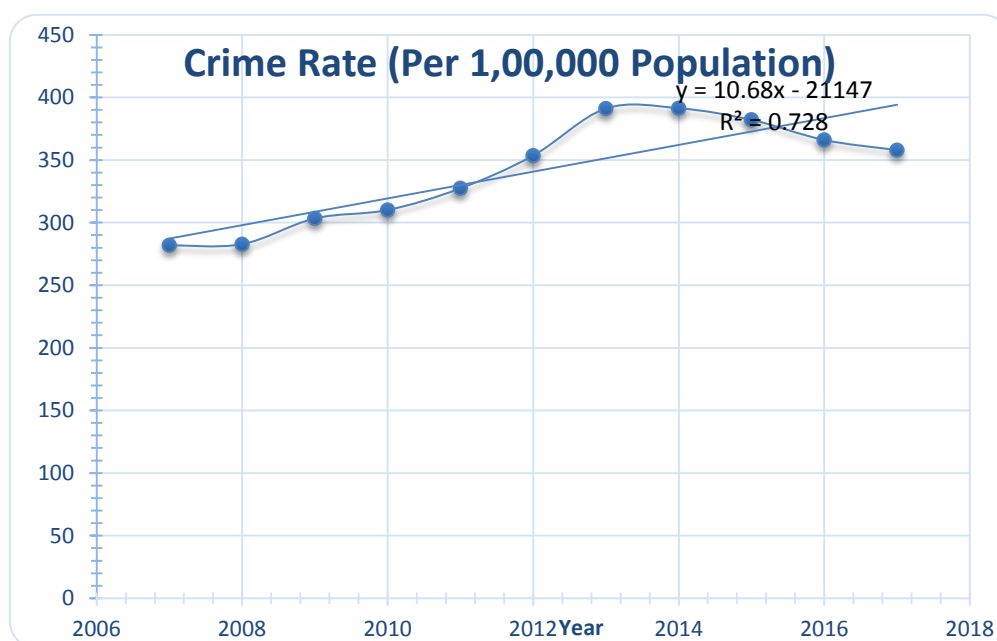
In this paper, PCA technique is applied on these 21 variables, which reduces into four components that explained 90.69% variability of the data set.

Official Statistics of Rajasthan Police like police range 8, police commissioner 2, revenue districts 33, police station 861, women police stations 40, Police population ratio (per lac of population) 155, density of police personnel (per 100 sq. km.) 31 according to crime report of Rajasthan in year 2017.

The following data provide the opportunity to identify trends in crime over a period. The data show crime has sharply increased from the 2007 to 2017. They provide useful information on the social make up of offenders. Crime data show that offenders are mostly form working class, male, and juvenile.

Table 1 : Cognizable crimes registered during 2007-2017

Year	Number of Offences			Crime Rate (Per 1,00,000 Population)
	IPC	SLL	Total	
2007	148870	37631	186501	282
2008	151174	40359	191533	282.74
2009	166565	43780	210345	303.33
2010	162957	49810	212767	310.06
2011	165622	58982	224604	327.31
2012	170948	71604	242552	353.47
2013	196224	72155	268379	391.10
2014	210418	58140	268558	391.36
2015	198080	64096	262176	382.06
2016	180398	70749	251147	365.99
2017	169943	75612	245555	357.84

**Fig 1: Crime rate per lakh population in Rajasthan.**

2. Review of literature

Ahmed Shafeeq, and Binu [1] have used exploratory spatial analysis method on crime data to study the influence of states in crime rate in India. Ayoola, Adeyemi and Jabaru [2] have analyzed 28 crime variables by using PCA. In addition, reduce into 8 components which explained 93.81% of the total variability of the data. Govindaswamy, Kethineni and

Santosh [3] used data mining and clustering techniques on crime application and gave a concept which has divided into different subsets of crime. Dreze and Khera [4] have explored the links between murder rates at the district level and such socio-economic variables as poverty, urbanization, literacy, demographic and social composition of the population. Olakorede, Adams and Olanrewaju [5] has analyzed the twenty major crime data of Abuja capital city of Nigeria. Moreover, they have explained the correlation between the crimes. Also, they have determined the distribution of the crime. Olufolabo, Akintande and Ekum [6] have summarized eighteen major crimes reported to the police between the periods of 1996-2014. Moreover, they have explained the correlation between the crimes. In addition, to determine the distribution of the crimes in OYO state in the Nigeria they have used Principal Component Analysis and found six components that explained about 83.79 percentage of the total variability of the data set. Manolache, Totan and Burcea [7] have evaluated the statistical significance of the difference of crime rates in the Romanian development regions. They found that the criminality rate was rapidly increasing. Gulumbe, Dikko and Bello [8] have analyzed a case study of Kastina State crime data in which the average of eight major crimes reported by the police for the period of 2006-2008. They have applied correlation analysis and principal component analysis. They proved that there is a significant correlation between robbery, theft and vehicle theft by using PCA. They have suggested that in place of eight variables only five components are sufficient and explained 78.94 percentage of the total variability of the data set. Usman, Yakubu and Bello [9] have applied PCA to find out the number of principal components to be retained on the seven variables. The results of the statistical analysis proved that the three components explained up to 89.40 percentage of the total variability of the data set. Erick, Wanyonyi and Muchwanju [10] have focused on statistical analysis of causes of crimes in Nairobi Country using data collected via questionnaires. PCA analysis revealed that three PCs that explain about 52.6 percentage of the total variability of the causes of crimes against person and two PCs explain about 42.2 percentage of the total variability of the causes of crimes against property. Zhao and Tang [11] have given an overview to key theories from criminology, summarized crime analysis on urban data, reviewed state-of-the-art algorithms for various types of computational crime.

3. Data Collection and Research Methodology

The crime data for the period 2007 to 2017 for the state of Rajasthan collected from the website www.crimerajasthan.gov.in of the crime department of Rajasthan. From these 11-year data, it can be found out the similarities among the crimes committed and significant difference among crimes committed. The data consist 21 major crimes are Dacoity, prep. & Assembling for Dacoity, Robbery, Burglary, Theft, Murder, Attempt to Murder, Grievous hurt, Homicide not amounting to Murder, Grievous hurt, Riots, Rape, Dowry Death, Assault on Women with intent to outrage her modesty, Insult to the modesty of Women, Cruelty by husband & relative, Kidnapping, Criminal Breach of trust, Cheating, Counterfeiting, Arson and Other IPC Crime.

Frequencies of crimes of each category mentioned against the study period and crime rate calculated by the following formula

$$\text{Crime Rate} = \frac{\text{Number of Crimes}}{\text{Total number of population}} \times 1,00,000$$

Some descriptive statistical review of the data to explain distribution and the crime rate over the last 11 years in the state of Rajasthan is given. To understand the prevalence of a crime over the period and to identify the significant components of crime rate in the state of Rajasthan PCA technique is applied.

3.1 Principal Component Analysis

Principal Components Analysis (PCA) is like a Factor Analysis. This analysis run in SPSS on own twenty-one variables. First, PCA for all twenty-one variables is run and scree plot of the data is obtained and determined four principal components. Our first intension was covered high percentage of the information by the principal components. These four principal components represent 90.69% of the variance. Principal components analysis (PCA) is a variable reduction technique that shares many similarities to exploratory factor analysis. Its main aim is to reduce a larger set of variables into a smaller set of 'artificial' variables, called 'principal components', which account for most of the variance in the original variables. If these variables are highly correlated, it implies that the components extracted have a high degree of relationship with the original variables.

4. Analysis and Results

Mean is mostly used to measure the central tendency. The mean is sensitive to extremely large or small values. Table 2 is the output of univariate data analysis. It is observed that the standard deviation of burglary, theft, rape, assault of women, cruelty by husband and relative, kidnapping and abducting, cheating are very high which show that these crimes are spread out more in different years.

Table 2 : Descriptive Statistics

	Mean	Std. Deviation	Analysis N
Dacoity	53.4545	15.47491	11
Preparation And Assembling For Dacoity	74.9091	15.73820	11
Robbery	948.5455	184.01052	11
Burglary	5248.8182	638.74875	11
Theft	24609.6364	3819.52479	11
Murder	1467.3636	109.90839	11
Attempt To Murder	1643.2727	82.60641	11
Culpable Homicide Not Amounting To Murder	83.6364	16.65697	11
Grievous Hurt	1781.1818	348.61406	11
Riots	782.8182	444.56604	11
Rape	2471.0000	1044.39571	11
Dowry Death	455.5455	26.94203	11

Assault On Women With Intent To Outrage Her Modesty	3634.8182	1416.07463	11
Insult To The Modesty Of Women	19.2727	6.32599	11
Cruelty By Husband And Relative	12184.5455	2618.75754	11
Kidnapping And Abducting	3948.8182	1359.16539	11
Criminal Breach Of Thrust	662.5455	149.11161	11
Cheating	18038.0909	3797.77262	11
Counterfeiting	46.5455	11.99470	11
Arson	508.9091	81.82231	11
Other IPC Crimes	95990.7273	8327.77924	11

Table 3: Correlation Between Different types of cognizable crime in Rajasthan.

The correlation matrix show different levels of correlation between the crimes.

1	Crime	Dacoity	PrepAndAssemblingForDacoity	Robbery	Burglary	Theft	Murder	AttemptToMurder	CulpableHomicideNotAmountingToMurder	GrievousHurt	Riots	Rape	DownyDeath	AssaultOnWomenWithIntentToOutrageHerModesty	InsultToTheModestyOfWomen	CrueltyByHusbandAndRelative	KidnapingAndAbducting	CriminalBreachOfThrust	Cheating	CounterFeiting	Arson	OtherIPCcrimes
1	Dacoity	1.00	0.26	0.51	0.67	0.29	0.08	0.78	-0.82	-0.15	0.16	0.33	-0.69	0.48	0.17	-0.02	0.27	-0.22	-0.11	-0.10	0.33	0.27
2	PrepAndAssemblingForDacoity	0.26	1.00	0.38	0.36	0.08	0.26	0.47	-0.24	-0.13	0.06	0.14	-0.36	0.22	-0.25	0.26	0.12	0.11	-0.04	0.15	0.09	0.56
3	Robbery	0.51	0.38	1.00	0.93	0.87	0.80	0.45	-0.14	-0.75	-0.55	0.83	-0.51	0.88	-0.19	0.72	0.84	-0.48	0.68	-0.20	-0.27	0.77
4	Burglary	0.67	0.36	0.93	1.00	0.75	0.69	0.67	-0.34	-0.57	-0.35	0.72	-0.58	0.80	-0.09	0.62	0.71	-0.32	0.53	-0.13	-0.07	0.80
5	Theft	0.29	0.08	0.87	0.75	1.00	0.91	0.13	0.15	-0.93	-0.85	0.97	-0.21	0.93	-0.22	0.85	0.98	-0.76	0.90	-0.46	-0.60	0.57
6	Murder	0.08	0.26	0.80	0.69	0.91	1.00	0.08	0.31	-0.88	-0.87	0.90	-0.03	0.83	-0.40	0.98	0.91	-0.60	0.91	-0.38	-0.70	0.73
7	AttemptToMurder	0.78	0.47	0.45	0.67	0.13	0.08	1.00	-0.64	0.08	0.32	0.15	-0.79	0.38	0.30	0.01	0.13	0.17	-0.17	0.27	0.55	0.46
8	CulpableHomicideNotAmountingToMurder	-0.82	-0.24	-0.14	-0.34	0.15	0.31	-0.64	1.00	-0.32	-0.50	0.11	0.52	-0.02	-0.02	0.34	0.18	-0.14	0.47	-0.17	-0.59	-0.14
9	GrievousHurt	-0.15	-0.13	-0.75	-0.57	-0.93	-0.88	0.08	-0.32	1.00	0.90	-0.93	0.02	-0.84	0.30	-0.81	-0.94	0.83	-0.85	0.56	0.78	-0.41
10	Riots	0.16	0.06	-0.55	-0.35	-0.85	-0.87	0.32	-0.50	0.90	1.00	-0.86	-0.25	-0.71	0.46	-0.85	-0.88	0.82	-0.91	0.42	0.88	-0.34
11	Rape	0.33	0.14	0.83	0.72	0.97	0.90	0.15	0.11	-0.93	-0.86	1.00	-0.15	0.96	-0.32	0.83	0.99	-0.84	0.85	-0.40	-0.63	0.52
12	DownyDeath	-0.69	-0.36	-0.51	-0.58	-0.21	-0.03	-0.79	0.52	0.02	-0.25	-0.15	1.00	-0.38	-0.52	0.04	-0.14	-0.11	0.13	-0.15	-0.47	-0.35
13	AssaultOnWomenWithIntentToOutrageHerModesty	0.48	0.22	0.88	0.80	0.93	0.83	0.38	-0.02	-0.84	-0.71	0.96	-0.38	1.00	-0.15	0.73	0.95	-0.73	0.74	-0.30	-0.42	0.55
14	InsultToTheModestyOfWomen	0.17	-0.25	-0.19	-0.09	-0.22	-0.40	0.30	-0.02	0.30	0.46	-0.32	-0.52	-0.15	1.00	-0.42	-0.31	0.36	-0.30	-0.07	0.50	-0.33
15	CrueltyByHusbandAndRelative	-0.02	0.26	0.72	0.62	0.85	0.98	0.01	0.34	-0.81	-0.85	0.83	0.04	0.73	-0.42	1.00	0.84	-0.52	0.91	-0.41	-0.70	0.74
16	KidnapingAndAbducting	0.27	0.12	0.84	0.71	0.98	0.91	0.13	0.18	-0.94	-0.88	0.99	-0.14	0.95	-0.31	0.84	1.00	-0.82	0.87	-0.38	-0.65	0.52
17	CriminalBreachOfThrust	-0.22	0.11	-0.48	-0.32	-0.76	-0.60	0.17	-0.14	0.83	0.82	-0.84	-0.11	-0.73	0.36	-0.52	-0.82	1.00	-0.64	0.41	0.69	-0.02
18	Cheating	-0.11	-0.04	0.68	0.53	0.90	0.91	-0.17	0.47	-0.85	-0.91	0.85	0.13	0.74	-0.30	0.91	0.87	-0.64	1.00	-0.43	-0.70	0.51
19	CounterFeiting	-0.10	0.15	-0.20	-0.13	-0.46	-0.38	0.27	-0.17	0.56	0.42	-0.40	-0.15	-0.30	-0.07	-0.41	-0.38	0.41	-0.43	1.00	0.55	-0.06
20	Arson	0.33	0.09	-0.27	-0.07	-0.60	-0.70	0.55	-0.59	0.78	0.88	-0.63	-0.47	-0.42	0.50	-0.70	-0.65	0.69	-0.70	0.55	1.00	-0.17
21	OtherIPCcrimes	0.27	0.56	0.77	0.80	0.57	0.73	0.46	-0.14	-0.41	-0.34	0.52	-0.35	0.55	-0.33	0.74	0.52	-0.02	0.51	-0.06	-0.17	1.00

Source: Police department of Government of Rajasthan.

From the above tables it is concluded that Dacoity has significant correlation between Robbery, Burglary, Attempt to Murder, Outrange Modesty and similarly Burglary has a very strong relationship with Dacoity, robbery, theft, murder, attempt to murder, rape, outrange modesty, kidnapping, cruelty by husband and relative, cheating and other IPC

crime. Culpable Homicide not a mounting murder has significant correlation only with dowry death. Grievous hurt has shown significant correlation between riots, criminal breach of trust and counterfeiting. Rape has positive relationship with robbery, burglary, theft, murder, outrage modesty, cruelty by husband and relative, kidnapping, cheating and other IPC crime. It is implied that if out of all the above-mentioned crimes is controlled then rape cases will be decreased. Dowry death is positive correlated with homicide not a mounting murder. Insult women modesty has positive significant correlation between riots, criminal breach of trust and arson. Such crimes can be prevented by looking after the strong positive correlation with other variables also.

It is observed that all the crimes are correlated with each other but some crimes are positively strong correlated to each other. If we want to prevent any special crime then we should find out the strongly positive correlated crimes.

Table 4: Communalities Initial Extraction

	Initial	Extraction
Dacoity	1.000	.970
Preparation And Assembling For Dacoity	1.000	.640
Robbery	1.000	.938
Burglary	1.000	.934
Theft	1.000	.988
Murder	1.000	.987
Attempt To Murder	1.000	.905
Culpable Homicide Not Amounting To Murder	1.000	.913
Grievous Hurt	1.000	.944
Riots	1.000	.974
Rape	1.000	.986
Dowry Death	1.000	.875
Assault On Women With Intent To Outrage Her Modesty	1.000	.944
Insult To The Modesty Of Women	1.000	.978
Cruelty By Husband And Relative	1.000	.956
Kidnapping And Abducting	1.000	.978
Criminal Breach Of Trust	1.000	.941
Cheating	1.000	.933
Counterfeiting	1.000	.452
Arson	1.000	.896
Other IPC Crimes	1.000	.915

Communalities is the proportion of each variable's variance that can be explained by the component. The initial value of the communality in a principal components analysis is 1. The extraction value indicates the proportion of each variable's variance.

Variables like Dacoity, robbery, burglary, theft, murder, attempt to murder, culpable homicide not amounting to murder, grievous hurt, riots, rape, assault on women with intent to outrage her modesty, insult to the modesty of women, cruelty by husband and relative, kidnapping and abducting, criminal breach of trust, cheating and other IPC crimes. In which high value of crimes well represented in the common factor space. In addition, Preparation and assembling for Dacoity, dowry death, counterfeiting and arson with low values are not well represent.

From table 4, It is seen that all types of crime are best representative of the common factor, because the principal components explain the high proportion of variances.

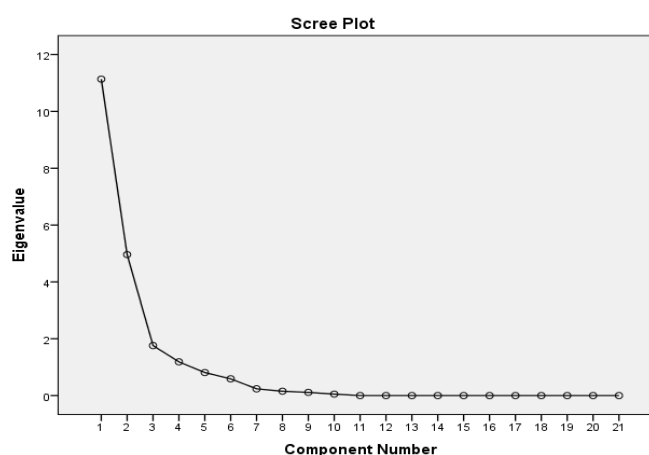
Table 5: Eigen Values (Total Variance Explained)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	11.135	53.025	53.025	11.135	53.025	53.025
2	4.962	23.628	76.653	4.962	23.628	76.653
3	1.760	8.380	85.033	1.760	8.380	85.033
4	1.188	5.656	90.689	1.188	5.656	90.689
5	.810	3.856	94.546			
6	.590	2.810	97.355			
7	.237	1.130	98.485			
8	.154	.735	99.220			
9	.112	.531	99.751			
10	.052	.249	100.000			

The eigenvalues often used to determine how many factors have to be retained. One rule of thumb is to retain those factors whose eigenvalues are greater than one.

The eigenvalues and the cumulative proportions of the explained variance has displayed in table 5 and scree plot of eigenvalue is show in figure 2.

A commonly accepted rule is that PCs with eigenvalues larger than one is first four PCs. So, the first four PCs can be retaining to explain 90.69 percent of the total variability. In this table, 21 components extracted during a PCA, because we used 21 variables. In initial eigenvalues, cumulative percentage second row value is 76.653 it means only first two components together account for 76.653% of the total variance. Similarly, if we see in row fourth then cumulative percentage value is 90.689% of the total variance. It means only four components cover 90.689% variance in total variance. Extraction sum of squared loadings show the number of rows reproduced on the right side of the table, which is determined, by the number of principal components whose eigenvalues are one or greater than one.

Fig 2: Scree plot of the principal component.

The scree plot graph shows the eigenvalue against the component number. It is observed in graph that after four components the line is almost flat. It means that only four components are more useful whose eigenvalues are greater than one.

Table 6: Eigen Vectors: Component Factors Estimate

	Component			
	1	2	3	4
Kidnapping And Abducting	.981		-.117	
Rape	.979		-.130	
Theft	.978		-.154	
Murder	.963		.207	.115
Grievous Hurt	-.947	.156	.149	
Assault On Women With Intent To Outrage Her Modesty	.916	.275	-.172	
Cruelty By Husband And Relative	.913	-.121	.284	.162
Cheating	.902	-.274		.210
Riots	-.885	.434		
Robbery	.856	.445		
Criminal Breach Of Trust	-.754	.237	.392	.403
Burglary	.727	.631		
Arson	-.684	.647		
Other IPC Crimes	.626	.424	.562	.167
Counterfeiting	-.441	.267	.422	
Attempt To Murder		.943		
Dowry Death	-.113	-.866	.193	-.272
Dacoity	.230	.829	-.357	-.321
Culpable Homicide Not Amounting To Murder	.195	-.780	.108	.505
Preparation And Assembling For Dacoity	.196	.476	.607	
Insult To The Modesty Of Women	-.359	.302	-.573	.655

This factor component matrix shows the expected pattern, with high positive and high negative. This table contains component loadings, which are the correlations between the variable and the correlations between the variables and the component. Because these are correlations, possible values range from -1 to +1.

Table 7: Component Score Coefficient Matrix

	Component			
	1	2	3	4
Dacoity	.021	.167	-.203	-.270
Preparation And Assembling For Dacoity	.018	.096	.345	-.067
Robbery	.077	.090	.037	.053
Burglary	.065	.127	.031	.046
Theft	.088	.011	-.087	.056
Murder	.087	-.011	.118	.097
Attempt To Murder	.009	.190	.013	.059
Culpable Homicide Not Amounting To Murder	.018	-.157	.061	.425
Grievous Hurt	-.085	.031	.085	.013
Riots	-.079	.088	.010	.033
Rape	.088	.010	-.074	-.080
Dowry Death	-.010	-.175	.110	-.229
Assault On Women With Intent To Outrage Her Modesty	.082	.055	-.098	-.013
Insult To The Modesty Of Women	-.032	.061	-.326	.551
Cruelty By Husband And Relative	.082	-.024	.162	.136
Kidnapping And Abducting	.088	.003	-.066	-.031
Criminal Breach Of Thrust	-.068	.048	.223	.339
Cheating	.081	-.055	.015	.177
Counterfeiting	-.040	.054	.240	-.077
Arson	-.061	.130	-.011	.082
Other IPC Crimes	.056	.085	.320	.141

Fig 3: Component Plot Chart in Rotated Space.

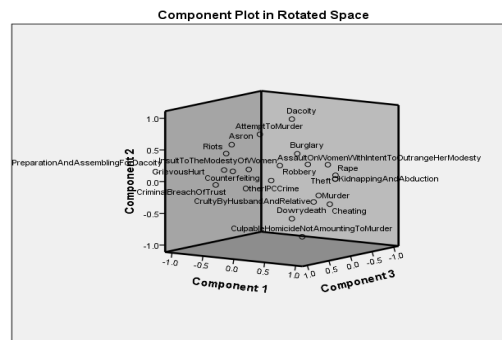


Table 6 above concentrated on the four PCs that explains 91 percent of the total variability of the data set. Component 1 has a positive relationship with kidnapping, theft, murder, rape, Assault on women with intent to outrage her modesty, Cruelty by husband and relative, Cheating, Robbery, Burglary, Other IPC crimes. Component 2 has a positive relationship with Burglary, Arson, Attempt to murder, Dacoity. Component 3 has a positive relationship with Other IPC crime and Preparation and Assembling for Dacoity. Component 4 has a positive relationship with Culpable homicide not amounting to murder and Insult to the Modesty of Women.

Table 8: Rank of Total Cognizable Crime of Division-wise of Rajasthan

Sr. No.	Division	District	Rank in 2011	Rank in 2017
1	Ajmer	Ajmer, Bhilwara, Nagaur, Tonk	7	3
2	Bharatpur	Bharatpur, Dholpur, Karauli, Sawai Madhopur	1	1
3	Bikaner	Bikaner, Churu, Sri Ganganagar, Hanumangarh	2	7
4	Jaipur	Alwar, Dausa, Jaipur, Jhunjhunun, Sikar	5	4
5	Jodhpur	Jodhpur, Barmer, Jaisalmer, Jalore, Jodhpur, Pali, Sirohi	3	2
6	Kota	Baran, Bundi, Jhalawar, Kota	6	6
7	Udaipur	Udaipur, Banswara, Chittorgarh, Dungarpur, Rajsamand, Pratapgarh, Udaipur	4	5

When comparing the total division-wise cognizable crime of Rajasthan in year 2011 and 2017. Form the output results we found that highest rank in Bharatpur division in both the year i.e. 2011 & 2017 in which consist districts Bharatpur, Dhampur, Karauli and Sawaimadhampur. Whereas the minimum in the Bikaner division consists districts Bikaner, Churu, Sri Ganganagar and Hanumangarh. The basic and off sure reason behind this such as unemployment, poverty, a lower per capita income that can affect the crime rate in Rajasthan. The crimes are significant rise of Rajasthan in 2011 as compared to 2017.

Fig: 4 Property Crime in Rajasthan in 2017.

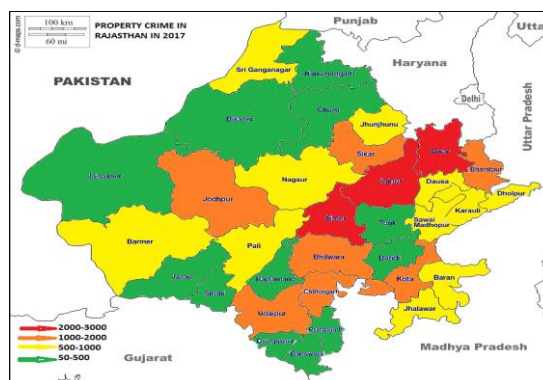
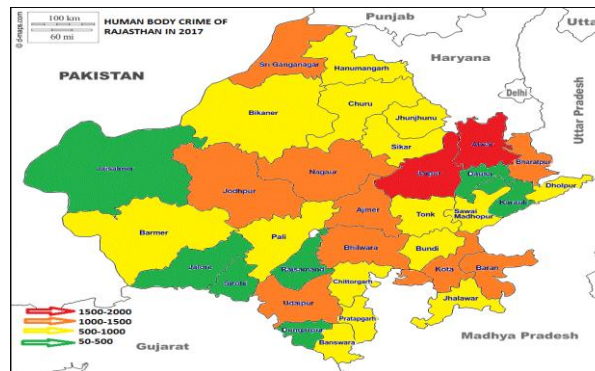


Fig 5: Human body crime of Rajasthan in 2017

The Objective of the map is to represent the high and low crime rate in Rajasthan. The figure 4 and figure 5 divides the data into standard deviation units such that the orange and red pictures are the focus of attention. Figure 4 tells us that about safety for your property according to the area in Rajasthan. Figure 5 suggests that the area in Rajasthan where one can live comfortably. The Range in crime data values divided into four classes like crimes between 50-500, 500-1000, 1000-1500, 1500-2000. The district-wise data refers to details on crimes committed under IPC (Indian penal code) in the year 2017. Rajasthan accounted for 5.5% of total IPC crime reported in the country. From the output result, it is found that Human body IPC crime have maximum contribution by the districts Jaipur and Alwar. Moreover, in Property crime Jaipur, Alwar and Ajmer are highest crime.

5. Conclusion

In this paper, crime rate is taken into consideration from 2007 to 2017 in the Rajasthan state and found that crime rate is increasing continuously. If it will not be properly managed than in future the rank of Rajasthan in the crime rate will be increased. The main objective of this paper is to analyses the different types of crime from 2007 to 2017. All the crimes are high proportion of their variance. PCA analysis reveals that four PCs that explain about 90.69% of the total variability of the different crimes. Whoever, two PCs that explain about 76.65% of the total variability of cse of crimes.

Component first may be viewed as a measure of unsafe of state of Rajasthan in terms of crime rate because majority of crime rate positively related with first component. Component second can viewed as a measure of common and common crime in the state of Rajasthan. Component third suggested that Preparation and Assembling for Dacoity and Other IPC Crime has very much related with daily offence in the state of Rajasthan. Component fourth deals with the crime in which insult of modesty of women is mostly considered.

The total four component cover the variability about 91 percent. Thus, by identify the distribution of these crime in the state of Rajasthan will allow the investors to invest in the state institution like tourisms and travels to increase the economy of Rajasthan. They can be relax and plain to invest their funds.

It is concluded that women crime should be fixed specially on the component first. Which covers approximately 53.025 percent.

It has been concluded from the research that the first component named as social offences should take into consideration on top priority basis by the government of Rajasthan. The component second named as economic offences, which include Burglary, Dacoity, Attempt to Murder, and Arson should be controlled by the government.

The third component as Misdemeanour offences, which consists preparation and assembling for Dacoity and other IPC crime. The fourth component as Felony offences, which consist insult of women and culpable homicide not amounting to murder.

So all the crimes are divided into four components one social offences, which is very severe and second is economic offences, third is Misdemeanour offences and fourth is Felony offences.

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