Journal of Data Acquisition and Processing
ISSN: 1004-9037
https://sjcjycl.cn/
DOI: 10.5281/zenodo.7765669

CRIME CLUSTER RELIABILITY THROUGH GAME THEORY AND NEUTROSOPHIC LOGIC USING THREE-STAGE MODEL

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Abstract: Individual in crime has benefited from analytical methods that were used to map their behavior using game theory. It may comprise recognized crimes in the analyses by Game Theory based Neutrosophic logic together with individual randomized crimes using Clusters Randomization. We apply an estimate of the Intra cluster and/or Inter-cluster correlation coefficient (ICC) on the criminal population (Uncertainty and Certainty) to calculate crime sample sizes in the crime. If ICC runs compassion tests to see how variation in the ICC affects the results. We intend to synthesize the relevant information if both cluster-randomized tests and individual tests are found. If there is little variability between the crime clusters study and the interaction between the effect of the intervention and the choice of randomization unit is judged improbable, we will consider it fair to aggregate the results from both. We will additionally account for randomization unit heterogeneity and conduct a compassion analysis of crime to assess the randomization unit's effects in this paper. The experiment result is on cluster reliability estimate on 24 hours in the criminal cases.
Keywords: Certainty**,** Cluster Reliability, Game Theory, Inter-cluster correlation coefficient (ICC), Neutrosophic logic, Uncertainty.

1. Introduction

Data should be standardized because or else, the series of principles in each feature resolve function as a weightiness when deciding in what way to cluster the data, which is usually undesirable. This can increase the effectiveness of clustering approaches because normalization is utilized to minimize redundant data and ensures that good quality and reliability are generated. As a result, it becomes a necessary step prior to clustering, as the distance is extremely sensitive to differences. A machine learning method Cluster analysis or clustering is various groups of the unlabeled dataset. It is a way of grouping the data points into different clusters like inter-cluster and intra-cluster containing crime facts. The substances through the potential likenesses stay cutting-edge at a gathering that consumes a smaller amount or dissimilarities with another gathering. It does it by discovering some not comparable

wrongdoing designs in the unlabeled dataset like size, conduct, and so on, and isolates them according to the presence and nonappearance of those examples. It is an unsupervised learning method; thus, no management is given to the method, and it manages the unlabeled dataset. In the wake of applying this clustering strategy, each cluster or group is furnished with a group ID. The machine learning system can utilize this id to work on the handling of enormous and complex datasets. The grouping strategy is ordinarily utilized for statistical data analysis. In any engineering application, reliability is critical in determining the application's performance. The behavior of the developed application in comparison to the defined requirements is estimated by reliability. The effectiveness of selecting the proper estimate model from the available classification of models determines the validity of reliability estimation. As a result, we have found the most commonly utilized identification approaches, which we have divided into two types: deterministic and probabilistic. To begin, deterministic models are used to investigate: a) elements of engineering applications such as crime identification systems; b) the control flow of crime applications by counting the number of clusters and tracing the clustering hierarchy; and c) the flow of crimes and investigation of crime data sets among the identified clusters. Recursively apply the provided methodologies in these models to estimate and then predict application performance. Finally, disaster incidences and liability eliminations are denoted, as probabilistic proceedings in the probabilistic models are some of the other types of models. The binomial model is immediately applied in real-time application among the model. Most of reliability models ignore the development process and focus on the results, faults, and failures. However, to reduce complexity, an appropriate plan is prepared and novel methods are made known that are useful in certain software development processes. So, the correct model that is suitable for a particular case must be chosen. Furthermore, the modeling outcomes cannot be blindly supposed and useful. Trendy of this model is proposed in this paper to use an estimation model, which can be applied to crime clusters to measure the crime measure process and to improve the cluster reliability, Binomial test is conducted and a reliability-testing model is used.

This paper is proposed to organize as follows: Crime data classification using Game Theory is discussed in Section-2. In section-3, Neutrosophic Logic applies to Crime and Optimization Procedure-based Crime Factors. Section-4 deals with the Crime Clusters Reliability. Section-5 deals with Three-Stage Model discussed. The experimental trials and results are emphasized in Section-6. Section-7 deals with the conclusion with future perception.

2. Crime Data Classification

The crime data classification process will provide the reliability of the clusters, for that here we used the two-person prisoners' dilemma game theory to predict the label of the cluster data using machine learning with the support of a time series model. Finally, we get the three groups True, False, and Indeterministic from the crime data using Neutrosophic Logic. In addition to the three-stage model for clusters, reliability is achieved on inter and intra-clusters.

2.1. Game Theory model payoff matrix on Crime Data Classification

Heinz S. introduced a two-person game theory, in 1984, the activities of in main player procedure in lines, even though the activities of his subsequent player comprise of segments. The components in the network are two facts that demonstrate the initial and other entertainers'

separate qualities. People engaged in wrongdoing are marked as Neutrosophic rationale-based guilty parties in the table beneath. Each suspect is allocated to their own cell and given the choice of conceding. A lawbreaker a valid example for the game hypothesis can be addressed as follows:

The two detainees, X and Y, associated with carrying out wrongdoing organized, are segregated and encouraged to admit. Each is worried exclusively with attaining the briefest possible jail for himself; each should choose whether to admit lacking knowing his accomplice's choice. The two detainees, be that as it may, know the outcomes of their choices:

Case-01: If both persons X and Y confess (True/T) then both persons are 5 years punishable in jail.

Case-02: If neither X nor Y confesses, both are 1-year punishable in jail.

Case-03: If a person confesses (True/T) even though the other person does Not Confess (False/F), the confessed person is set free and the Not confess (False/F) person is 10 years punishable in jail.

Case-04: If one person confesses even though the other person is Uncertain (Indeterministic i.e., either T or F), then the confessed person is set as free (i.e. 0), and the uncertain person is 8 years punishable in jail.

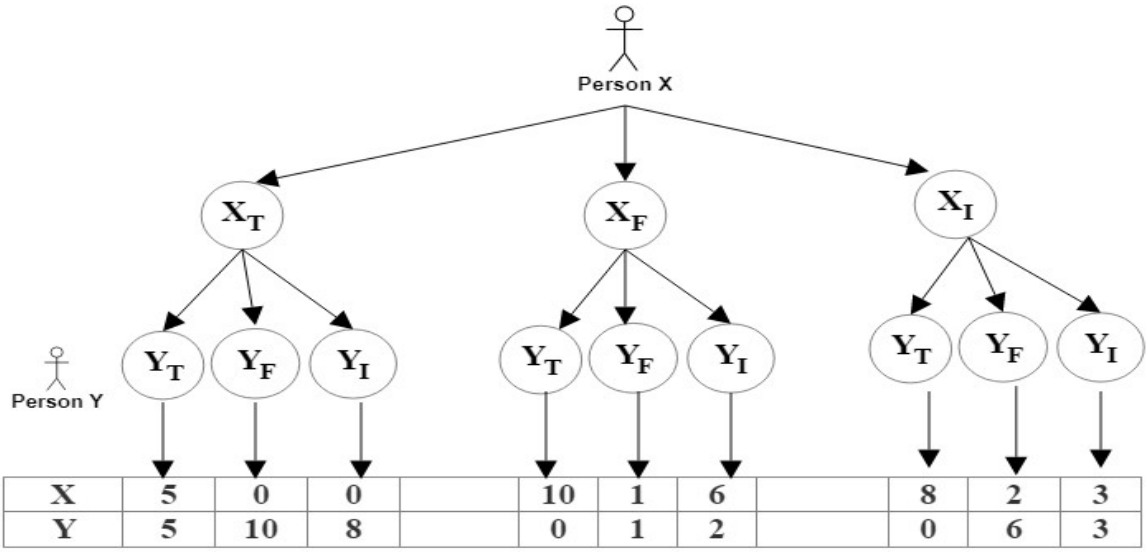
Case-05: If one person does not confess even though the other person is uncertain (T or F), then the Not Confessed person is 2 years punishable, and the uncertain person is punishable with 8 years in jail.

Case-06: If both persons are uncertain (T or F), both persons are punishable by 3 years in jail.

The Crime data classification report matrix of two autonomous prisoners' games is standardized rendering to Neutrosophic Logic True as T, False as F, and Indeterministic (uncertain) as I, are standards shown in Table-1:

Table-1: Crime data classification payoff matrix of two prisoners'

X / **Y**	**Confess (True/T)**	**Not Confess (False/F)**	**Uncertainty (Indeterministic/I)**
Confess	5, 5	0, 10	0, 8
Not Confess	10,0	10,10	2, 6
Uncertainty	8, 0	6, 2	3,3



X	5	0	0		10	1	6		8	2	3
Y	5	10	8		0	1	2		0	6	3

Figure-1: The Crime data classification report matrix of two autonomous prisoners' games is standardized rendering to Neutrosophic Logic.

2.2. Optimization Procedure-based Crime Factors

The crime facts are the distance between different clusters of the crime factors and the crime factors of the same clusters. We can show reduction ensures that based on intra-cluster optimal facts are as identified nearest to the center point as likely and reaming different centers identified that are as some faraway from respectively further as likely, so reaching the purpose of a cluster. We consume dual varieties of distance by way of Intra-cluster distance and Inter-cluster distance values.

The process can evaluate as follows

Step-01: Load a 2D data set for crime facts.

Step-02: Apply the game theory to the data set, finally resulting in a sub-optimal for both the persons who participated in crime incidents and the outcome will give further fortunate.

Step-03: Usage the Neutrosophic logic to discrete or continuous; confess, non-confess, or uncertainty (intersection of various clusters shown in Figure-1.)

Step-04: Next, decide the variables used for the optimization work for each group.

Step-05: Let p, q be two victims in an incident or the points in the cluster, following are the possible conditions to be validated before applying the conditions

- p is committed and q is not committed
- Both p and q are not committed.
- p said q has committed.
- q said p has committed.
- p accepted that he has committed.
- q accepted that he has committed.

Step-06: Apply the optimization function used to check the affinity for every person in Figure-1 to decide the role for a group is given as

$$C_i(p,q) = \frac{(p-p_i)^2}{l_i^2} + \frac{(q-q_i)^2}{m_i^2}$$

where p_i , q_i represents cluster center point

l_i , m_i be lengths of the major and minor axis

Step-07: For each point (p, q) in Figure-1 shows $C_i(p,q)$ to narrate through which cluster the fact lies. This procedure supports the distribution of the data points between three groups true, false, and Indeterministic.

Step-08: Go to Step11 if (p, q) lies in true, false, and Indeterministic.

Step-09: Apply the subsequent stages when the point (p, q) lies in the joining of two clusters to choose a particular cluster the fact is toward be placed. Estimate the inter-cluster and intra-cluster distances amounts with respect to the fact that lies in the intersection point. The inter and intra-distance calculation is performed as follows:

$$D_i^{intra}=\frac{1}{|C_i|}\left(\sum_{(p,q\in\ i}\sqrt{(p-p_i)^2+(q-q_i)^2}\right)$$

$$D_i^{inter}=\frac{1}{\binom{K}{2}}\left(\sum_{i=1}^{K}\sum_{j\neq 1}^{K}\sqrt{(p-p_i)^2+(q-q_i)^2}\right)=0$$

where K denotes number of clusters

Calculate and minimize $\frac{D_i^{intra}}{D_i^{inter}}$ focus to $(p_i, q_i) \in$ R, where R is the value of lies in between from 0 to 1 in which the centers of the ellipses are hypothetically laid.

Step-10: The minimization resolves to confirm that intra-cluster data points are as likelihood to the center as to be expected and all clusters' centers are as far away from each other as to be expected, thereby reaching the objective optimization of clustering.

Step-11: Prediction is alternative crime data removal activity, which is helpful on each day. Specified that modelling activity container to be reached through an optimization problem cracking as consulted beforehand is the prediction activity can be reached via an optimization procedure.

3. Neutrosophic Logic of Crime

Neutrosophic Logic is for a person identify the crime, which be depends on three principal components are detailed below

1. If a person can directly can involve crime, then it will treat as true/t, which can be furthermore to split into subsets are t_1, t_2, $t_3 \ldots t_i$.
2. If the person is not confessing it will be treat as false/f, which can be furthermore to split into subsets are f_1, f_2, $f_3 \ldots f_s$. Here $(i + r + s)=n \geq 1$.
3. If person is neither confessed nor non-confessed it will be treated as Indeterminacy (i), which can be furthermore split into subsets i_1, i_2, $i_3 \ldots i_r$.

Identifying the person in the predicted crime classification from which he belongs to which group based on the above principles. The standard unit interval for crime data is [0, 1].

Figure-2. Crime derived in terms of Neutrosophic Logic

4. Crime Clusters Reliability

Study the circumstances in which classification has n crime components, all of which initiate operate at time t=0. The classification continues to purpose accurately as long as at least k of the uncertainty of crime. In further, if n-k+1 cluster components fail in the crime cluster Neutrosophic logic classification fails. This type of component classification is called a crime cluster Neutrosophic logic classification can be modeled as a parallel classification of crime components.

We adopt that all clusters n crime components are identical and will fail individualistically. If we occupancy T_i be the time to disaster of the i^{th} crime components then the T_i terms are autonomous and identically distributed for i=1 to n incremented by 1. Thus $R_i(t)$, the reliability at time t for crime component i, is identical for all crime components. Recall that our classification operates if at least k crime component functions properly. Now we define the random variables X and T as follows:

X= the quantity of crime components function at time t, and

T=time to disaster of the entire classification

Then, we take

$$R(t) = P(T>t) = P(X\geq k).$$

It is calm to get that we do not take n identical and autonomous components through the identical probability of disaster by time t. This circumstance parallels to a binominal testing and we can crack for the classification reliability using the normal distribution with crime constraints n and $p=R_i(t)$**.**

5. Three-Stage Model for Crime Clusters

In the view of this system, Crime Cluster consists of Certainty of crime and Uncertainty of crime. Each certainty cluster and uncertainty of cluster is segmented into three nested clusters as proposed by Jagan Mohan, R.N.V, 2022 has given crime classification. In this approach, the expected number of failures against time is made up of three nested clusters for each cluster, in each stage, which means a group of code establishes a configuration for the test. Transforming these nested clusters to what would have been expected for a stable system requires a two-step method: Failure and Success. Assume to do this process is completed in one minute. Now, in the reliability estimation process, three cases are raised.

Case 1: Take the collection of the true value of crimes in the first cluster i.e., certainty. The database crime is identified with each input crime of the first cluster. This process will be completed in 1/3 minute in every case. The number of failures is mentioned and data is shown in Table-1.

Case 2: Execute the reliability process to integrate the first cluster i.e., certainty, second cluster i.e., the uncertainty of crimes, and do the same process in the above to identify if failures occurred or not.

Case 3: Again, go through the reliability process, to integrate the first two clusters with the third cluster not in persons who have not been involved in crime we do the same process as in the previous cases, and recognize failures that occurred.

Hence, the number of crimes increased with each case, and the rate of failures are decreased within the time bound of one minute (the process happening in all three cases). Therefore, this concludes that the reliability is more and high in the above process.

5.1. Three-Stage Model for Crime Cluster

The below graph represents crime failure inputs derived from the three stage models. The 1st curve indicates failure crime cases of cluster1 and total amount of code being executing in the stage. It affects how rapidly the program cycles or repeats and hence how rapidly the faults are encountered. The fault content will generally be related to the amount of developed code. After a certain interval of execution t* the remainder of the system is added. The 2nd curve indicates failure cases of both clusters 3. 3rd curve indicates failure crime cases of clusters 1 and 3.

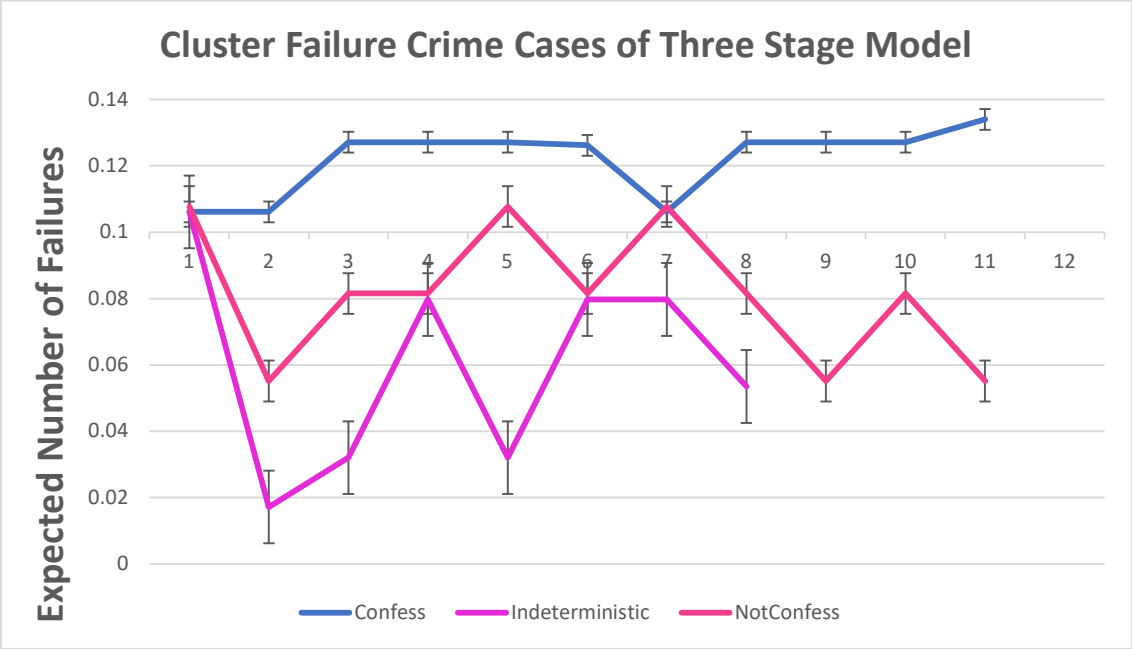


Figure-3: Crime failure cluster cases

6. Experimental Result: The three group stages on cluster crime identification are used by police to interrogate each case by monitoring both sides using Game Theory. To determine who is responsible for the crime based on their actions. The three step models are considered parallel, meaning that they all fail at the same time. We can calculate the reliability of the complete criminal cluster classification for 24 hours if we identify that to each stage has a 0.6065 likelihood of correctly judging for at slightest 24 hours.

We begin by defining the random variable: X= the number of crime instances that have evolved after 24 hours. With n=100 and p=0.6065, the random variable X is clearly binomially distributed. This formula is written as in the clusters of crime identification.

$$\boldsymbol{X \sim b(100, 0.6065)\ or\ X \sim Normal(100, 0.6065)}.$$

We understand that the system criminal cluster is reliable on 24 hours.

$$\mathbf{R(24) = P(X \geq 15) = P(15 \geq X \geq 18) = 0.099}.$$

Therefore, the reliability of the classification on 24 hours is 0.099.

7. Conclusion:

Crime data classify into three label groups like confess (T), Not confess (F), and Indeterministic (I) which is based on a two-person prisoner dilemma game theory with Neutrosophic logic. Measured the distance among the crime facts of the same cluster and the crime facts of other different clusters using the crime data. We are using the system's three-stage model for criminal cluster reliability. It can achieve two types of distances intra-cluster distance and inter-cluster distance based on reduction ensuring that intra-cluster and inter-cluster facts stand as adjacent to center as likelihood and all cluster centers are as some far distance left from to each other as likely. In future work, implement the n-persons game theory procedure from this two-person game theory aimed at optimizing the crime.

8. References:

1. RNV Jagan Mohan, Dileep Kumar Kadali and et al. "Crime data optimization using Neutrosophic logic based game theory", Concurrency and Computation: Practice and Experience, 2022.
2. R.N.V. Jagan Mohan, R. Subbarao, K. Raja Sekhara Rao, Efficient K-means cluster reliability on ternary face recognition using angle oriented approach. Published in the Proceedings of International Conference on Advances in Communication, Navigation and Signal Processing Technically Co-sponsored by IEEE, Hyderabad Section, March 17th–18th, 2012, Dept. of ECE, Andhra University College of Engineering (A).
3. Dileep Kumar Kadali, R.N.V. Jagan Mohan, M. Chandra Naik. (2022). Empirical Analysis on Uncertain Crime Data using Hybrid Approaches. Computer Integrated Manufacturing Systems, *28*(12), 1223–1237. Retrieved from http://cims-journal.com/index.php/CN/article/view/527
4. Laura Jacobs, Joost van Spanje, “A Time-Series Analysis of Contextual-Level Effects on Hate Crime in The Netherlands”, Social Forces, Volume 100, Issue 1, September 2021, Pages 169–193, https://doi.org/10.1093/sf/soaa102.
5. Mara J. Eisenberg, Joan E. van Horn, Judith M. Dekker "Static and Dynamic Predictors of General and Violent Criminal Offense Recidivism in the Forensic Outpatient Population" International Association for Correctional and Forensic Psychology, DOI: 10.1177/0093854819826109, 2019.
6. Muhammad Aslam, Osama H. Arif, and Rehan Ahmad Khan Sherwani “New Diagnosis Test under the Neutrosophic Statistics: An Application to Diabetic Patients” Hindawi BioMed Research International, Article ID 2086185, https://doi.org/10.1155/2020/208618, Volume 2020.
7. Kadali, D.K., Chandra Naik, M., Jagan Mohan, R.N.V. (2023). Estimation of Data Parameters Using Cluster Optimization. In: Goswami, S., Barara, I.S., Goje, A., Mohan, C., Bruckstein, A.M. (eds) Data Management, Analytics and Innovation. ICDMAI 2022. Lecture Notes on Data Engineering and Communications Technologies, vol 137. Springer, Singapore. https://doi.org/10.1007/978-981-19-2600-6_23.
8. Dileep Kumar Kadali, R.N.V. Jagan Mohan, M. Chandra Naik, Unsupervised based crimes cluster data using decision tree classification. J. Solid State Technol. 63(5), 5387–5394, 2020.

9. Smarandache, Florentin & Teodorescu, Mirela & Gîfu, Daniela "Neutrosophy, a Sentiment Analysis Model" 2017.
10. Smarandache, Florentin, Introduction to Neutrosophic Sociology (Neutrosociology) (January 17, 2019). Infinite Study (2019), ISBN: 978-1-59973-605-1, Available at SSRN: https://ssrn.com/abstract=3405436.
11. Dileep Kumar Kadali, R.N.V. Jagan Mohan, Optimizing the duplication of cluster data for similarity process. ANU J. Phys. Sci. 2. ISSN: 0976-0954 (2014).
12. Dileep Kumar Kadali, R.N.V. Jagan Mohan presented a paper titled "Shortest Route Analysis for High level Slotting Using Peer-to-Peer", The Role of IoT and Blockchain: Techniques and Applications CRC press,2022, https://doi.org/10.1201/9781003048367-10.
13. S.Aarthi, M. Samyuktha, M. Sahana "Crime Hotspot Detection With Clustering Algorithm Using Data Mining" IEEEXplore Part Number: CFP19J32-ART; ISBN: 978-1-5386-9439-8. 2019.
14. Dileep Kumar Kadali, R.N.V. Jagan Mohan, M. Srinivasa Rao, Cluster optimization for similarity process using de-duplication. IJSRD-Int. J. Sci. Res. Dev. 4(06), 2321–0613. ISSN (online) (2016)
15. Dileep Kumar Kadali, R.N.V. Jagan Mohan, Y. Vamsidhar, "Similarity based query optimization on map reduce using Euler angle oriented approach". Int. J. Sci. Eng. Res. 3(8). ISSN 2229–5518 (2012)
16. A.Ghosal, A. Nandy, A.K. Das, S. Goswami, M. Panday "A Short Review on Different Clustering Techniques and Their Applications" Springer Nature Singapore Pte Ltd., 2020.
17. Abdel-Basset, Mohamed & Ali, Mumtaz & Atef, Asmaa "Uncertainty Assessments of Linear Time-Cost Tradeoffs using Neutrosophic Set" Computers & Industrial Engineering. 141. 106286. 10.1016/j.cie.2020.106286, 2020.
18. Carolina Segovia Riquelme and Kate Smith-Miles "Integrating Game Theory and Data Mining for Dynamic Distribution of Police to Combat Crime" IEEE/WIC/ACM International Conference on Web Intelligence (WI); ISBN: 978-1-5386-7325-6/18, 2018.
19. Muzaffar, Aiman; Md Tabrez Nafis; and Shahab Saquib Sohail. "Neutrosophy Logic and its Classification: An Overview." Neutrosophic Sets and Systems 35, 1 (2020). https://digitalrepository.unm.edu/ nss_journal/vol35/iss1/15
20. Richard Rosenfeld, David Weisburd: Explaining Recent Crime Trends: Introduction to the Special Issue, Journal of Quantitative Criminology, volume 32, pages329–334, 2016.
21. Ruibin Lu, Dale Willits, Mary K. Stohr, David Makin, John Snyder, Nicholas Lovrich, Mikala Meize, Duane Stanton, Guangzhen Wu & Craig Hemmens (2021) The Cannabis Effect on Crime: Time-Series Analysis of Crime in Colorado and Washington State, Justice Quarterly, 38:4, 565-595, DOI: 10.1080/07418825.2019.1666903.
22. Schinasi, L.H., Hamra, G.B. A Time Series Analysis of Associations between Daily Temperature and Crime Events in Philadelphia, Pennsylvania. J Urban Health 94, 892–900 (2017). https://doi.org/10.1007/s11524-017-0181-y
23. Shradda RamdasBandekar and C. Vijayalakshmi "Design and Analysis of Machine Learning Algorithms for the reduction of crime rates in India" Procedia Computer Sciernce 172 by Elsevier, 2019.
24. https://github.com/DileepKumarKadali/Myresearchdata/blob/main/crimedata.csv