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Modeling and Analysis of Accident in an Urban Area

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MODELING AND ANALYSIS OF ACCIDENT IN AN URBAN AREA

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Abstract

Every year, it is estimated that over 3,00,000 people die, and 1-1.5 lakh people are wounded in traffic accidents throughout the world. In this study we were doing accidents hotspot analysis of Prayagraj, Uttar Pradesh. Accidental data at various places in a study area is collected from SP Traffic office and with the help ArcGIS software. In this study includes the accident analysis in which prioritization of some major places of hotspot area is done by the ArcGIS, with the help of two different method first is Getis-Ord Gi* and Kernel Density Estimation method. Each data point represents single vehicle accident. At the same location multiple accidents have been observed. To identify such locations where multiple accidents were reported (Black spots) by using Hotspot analysis in ArcGIS. The Getis-Ord Gi* statistics is calculated by Hotspot analysis for every accidental dataset. The present study gives a z-score value of 47.82, there is less than 1% likelihood that is cluster pattern which means, a greater number of possible of occurrence of clustered pattern that is 99%. And in the kernel density method we analyzed for hotspot areas using point feature in kernel density tool. KDE has classified the number of accidents as very low, low, medium and very high. Hence it shows both the methods adopted for accidental data analysis using Hotspot analysis tool are perfectly matching with results but kernel density is gives better result. The Hotspot analysis study Black spots were identified and in turn advised to government that identified location must be considered to take preventive measures to reduce number of accidents.

Keywords: *Accidents, Hotspot Analysis, Getis-Ord Gi* method, Kernel Density Estimation.*

1. Introduction

1.1 Background

"Loss, casualty, injury, and damage occurred unintentionally due to increase in number of vehicles on road or lack of presence of mind during driving a vehicle and the loss has happened unfortunately is termed as accident. Although road accidents cannot be completely avoided, they can be mitigated to some extent with proper traffic engineering and management. (Dandona) As a result, a comprehensive investigation of traffic accidents is essential. A thorough assessment of the accident's cause will aid in the development of preventative design and control measures. The existing road network in the city is inadequate. Functionally the roads do not have any hierarchy as each individual road changes its characteristics after a short distance. At present around 4.6% of the total developed area is devoted to roads which is much below the desired level. (Rabbani) Moreover, the vehicular population growth is quite high, with just 4,384 registered motor vehicles in 1981 to 2,94,164 in 2001, an increase of around 67 fold in the span of two-decades. Every year, it is estimated that over 3,00,000 people die and 1-1.5 lakh people are wounded in traffic accidents throughout the world. In compared to industrialized countries, detailed analysis of worldwide accident records shows that death rates per licensed vehicle in underdeveloped countries are quite high. Furthermore, road accidents have been proven to cost poor nations roughly 1% of their yearly gross national product (GNP), which they cannot afford to lose. (Anderson) Bangalore's rapid population boom due to IT and other related businesses resulted in a vehicle population rise of around 1.5 million, with an annual growth rate of 7-10 percent. Urban transport facilities in most of the Indian cities are inadequate and deteriorating over the years. The development of public transport system has not kept pace with the traffic demand both in terms of quality and quantity. As a result, the use of the undesirable modes such as personalized transport, mainly two-wheelers, and intermediate public transport, mainly three- wheelers, is growing at a rapid speed. The existing road network in the city is inadequate. Functionally the roads do not have any hierarchy as each individual road changes its characteristics after a short distance.

1.2 Objective

In this work we have done a statistical analysis, which is the study of collection, analysis, interpretation, and presentation of sample data. It is used to refer to a collection of methods used to refer to a collection of methods used to process large data collected and to produce an overall report.

1. The Getis-Ord Gi* statistic (pronounced G-I-star) is calculated by the Hot Spot Analysis tool for each feature in a dataset.
2. The Kernel Density tool is used to determine the density of features in the vicinity. In this tool there are two type of method to that is point and linear features to calculating the KDE.

2. Study Area

The study area includes major accident spots in Prayagraj, Uttar Pradesh located at 25º26'3.69" N, 81º50'48.81" E which has population of 20.50 Lakhs as per Master plan 2021. In comparison to 2018, 2019 and 2020 accident data a greater number of accidents took place in the year 2019. In total 1413 accidents took place in the year 2019 among them Grievously injured, Minor injury and killed are 612, 353, and 599 respectively. State Highway is seen as dominating over National Highway and other roads in terms of accidental rates. The study visits to these hazardous locations and collecting the data required from GIS and cross checking from taken the data by police record.

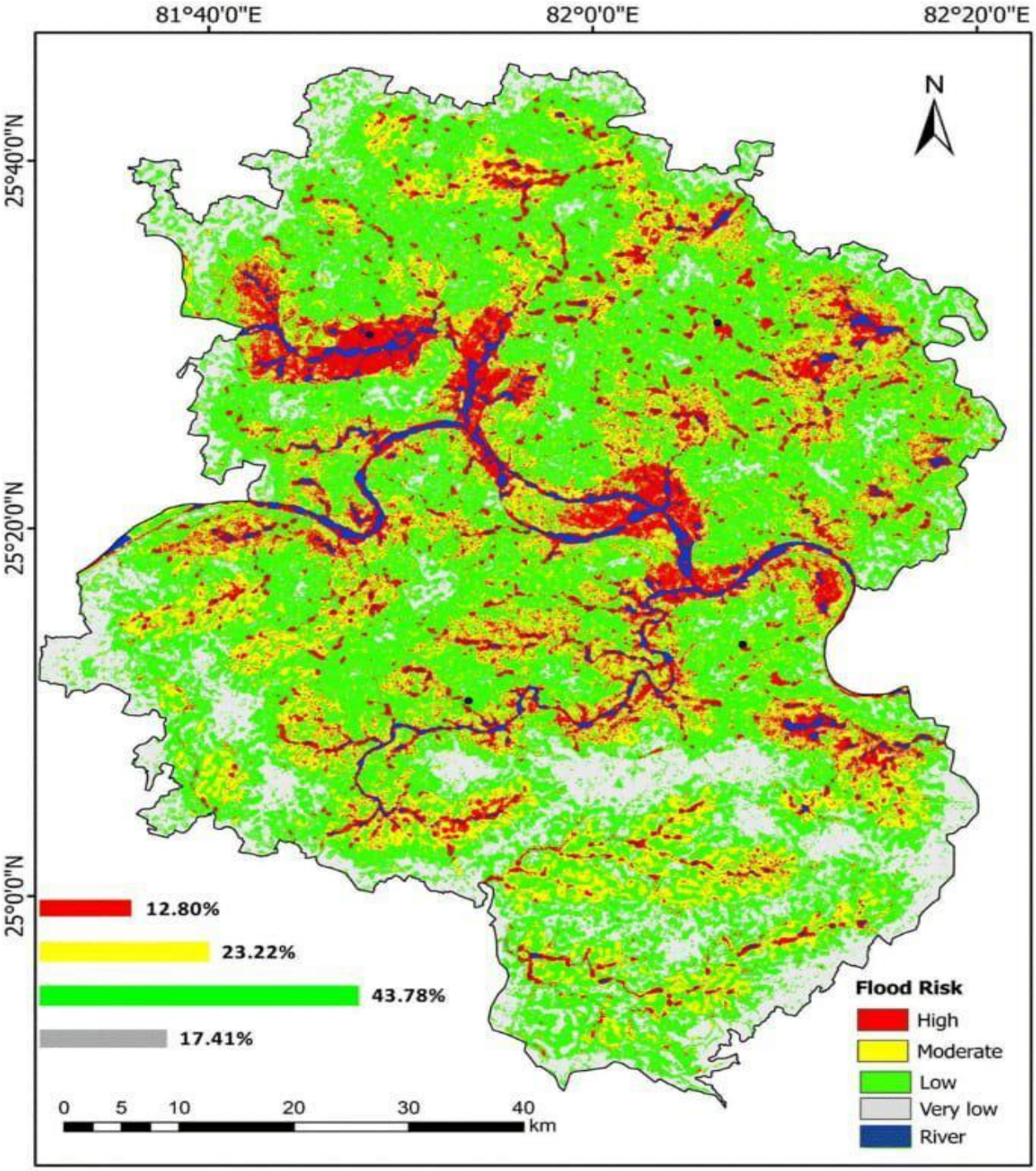


Figure 1: Study area showing Prayagraj, Uttar Pradesh

3. Methodology

The research study's technique, which was used, has undergone the Modelling and analysis of accident in an urban area in Prayagraj, Uttar Pradesh. Method for analyzing of accidental data at various hotspot places in a study area is using Hotspot analysis of ArcGIS software. The following chart shows the main steps of research works The Getis-Ord Gi* statistic (pronounced G-i-star) is calculated by the Hot Spot Analysis tool for each feature in a dataset. The z-scores and p-values that result indicate where characteristics with high or low values cluster spatially. This tool operates by examining each feature in the context of its surroundings. A high-value feature is intriguing, but it may or may not be a statistically significant hotspot. A statistically significant z-score is obtained when the local sum for a feature and its neighbors is compared proportionally to the sum of all features. When the local sum differs significantly from the expected local sum, and the difference is

too large to be due to chance, a statistically significant z-score is obtained

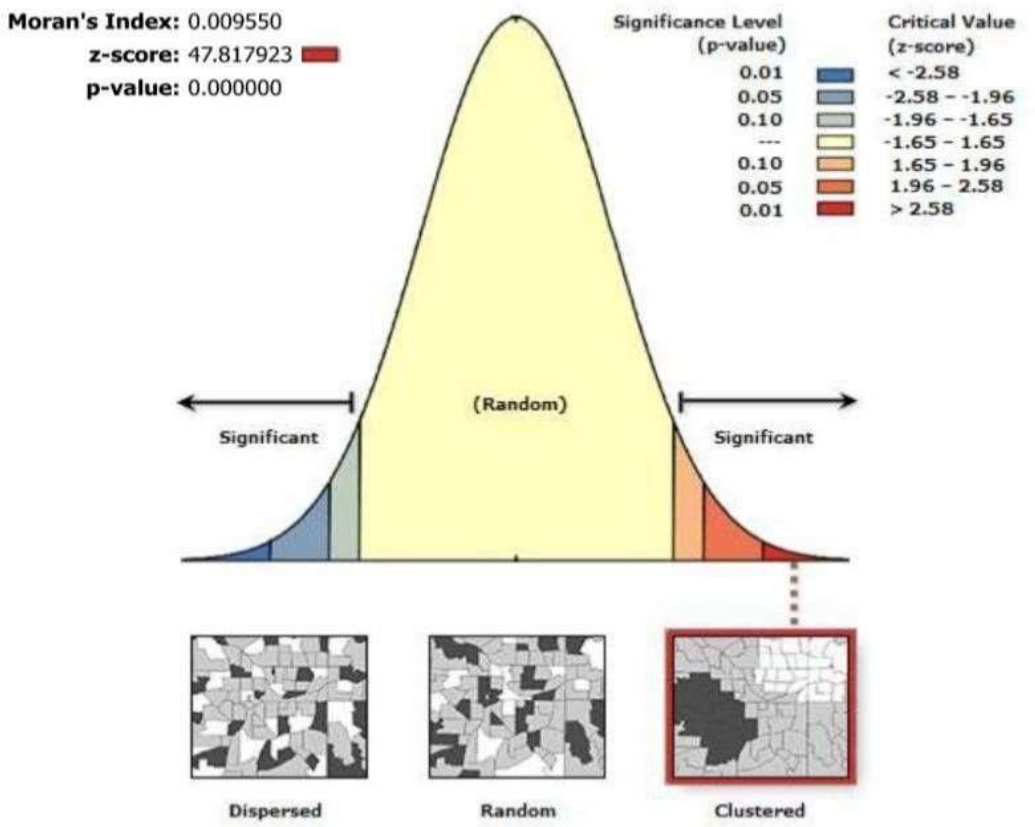
Kernel Density Estimation: - The Kernel Density instrument establishes the density of features the region around those features. In this tool there are two types of method to that is point and linear features to calculating the KDE. In KDE method we are finding the density of houses and accident data of the various places and hotspot analysis of roads are all possibilities. In the KDE method the density of method of point feature around each final output raster value have measured. Each point is covered by a smooth curving surface. The surface value is highest at the point's position and decreases as distance from the heighten awareness, ultimately hitting zero at the Search radius distance from the point.

4. Results and Discussion

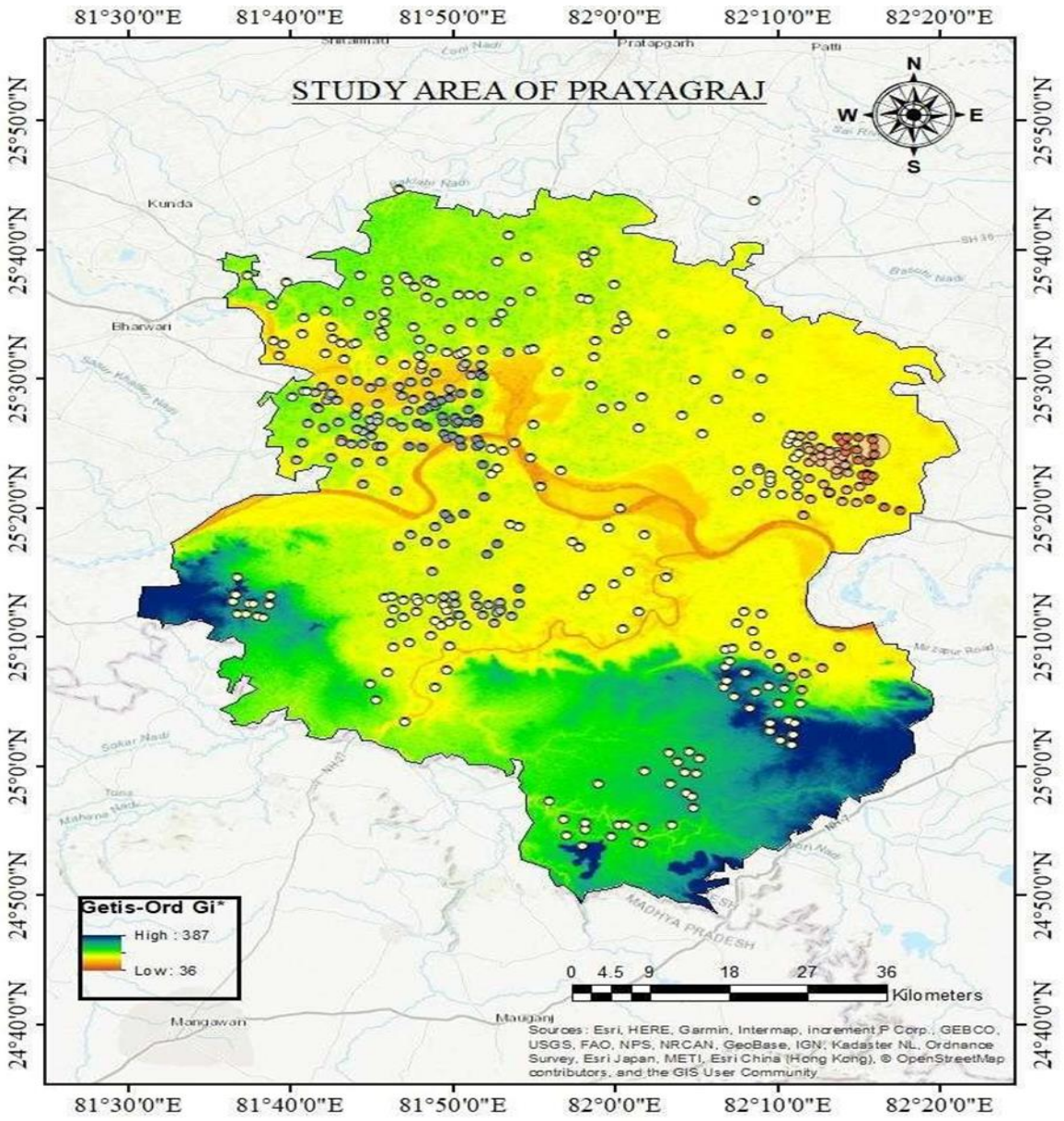
4.1 Result

The study is under consideration for research study in Prayagraj, Uttar Pradesh. The present study includes analysis of accidental data collected from S.P traffic office, which is loaded into ArcGIS software program. Each data point represents single vehicle accident. At the same location multiple accidents have been observed. To identify such locations where multiple accidents were reported (Black spots) by using Hotspot analysis in ArcGIS. Further to know whether the high or low clustering value is differential using Kernel Density tool and Getis-Ord Gi* statistical approach. The Getis-Ord Gi* statistics is calculated by Hotspot analysis for every accidental dataset. Significant level of (p-value) varies from 0, 0.10, 0.05 and 0.01 on the both side of probability curve and Critical value (z-score) varies from less than -2.58 to greater than 2.58. The present study gives a z-score value of 47.82, there is less than 1% likelihood that is cluster pattern which means, more number of possible of occurrence of clustered pattern that is 99%.

Spatial Autocorrelation Report



Given the z-score of 47.82, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.


STUDY AREA OF PRAYAGRAJ
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Patti
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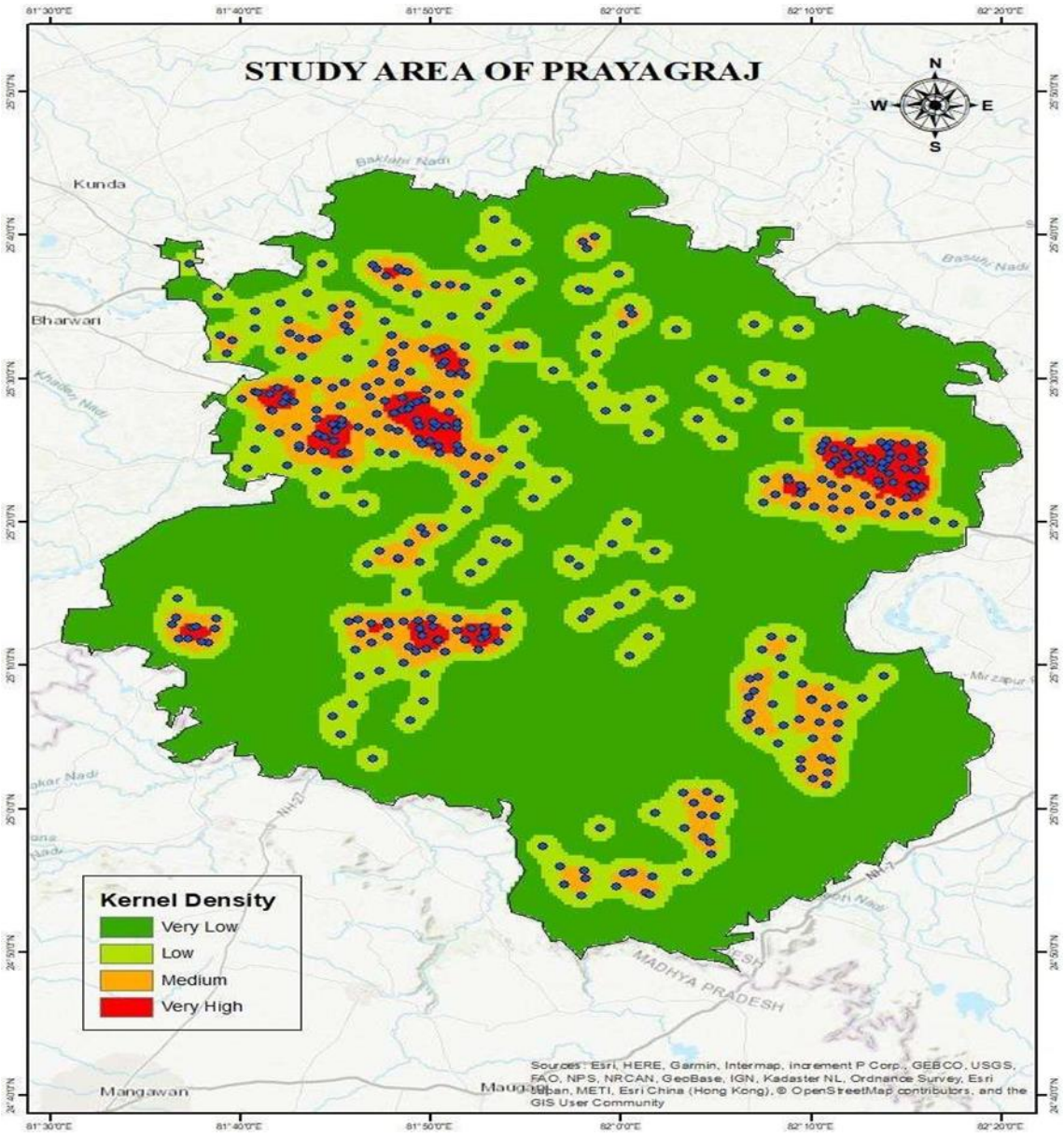
Bharwan
Mirzapur Road
MADHYA PRADESH
Mangawan
Maugani
Getis-Ord Gi*
High : 387
Low : 36
0 4.5 9 18 27 36
Kilometers
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), © OpenStreetMap contributors, and the GIS User Community



Kernel density estimation method is used to determine the density of feature of accidental data set. In this tool it has two different method of approach that is point and linear feature for calculating the KDE. The research study has analyzed for hotspot areas using point feature in kernel density tool. KDE has classified the number of accidents as very low, low, medium, and very high.

4.2 Discussion

In this present study of Hotspot analysis using Getis-Ord Gi* approach because it is a statistical analysis of hotspot analysis tool which in turn gives critical value (z-score) and significant value (p-value) and type of pattern of accident is noticed but KDE tool is utilized to verify the multiple accidents occurring at same location is classified based on density.

5. Conclusion

It was observed from research study that, multiple accidents occurring at same location is identified by Getis-Ord Gi* statistical approach and Kernel Density Estimation approach in hotspot analysis tool. Figure 10 and figure 11 shows a common location highlighted as red color are considered as hotspots. Hence it shows both the methods adopted for accidental data analysis using Hotspot analysis tool are perfectly matching with results and it is concluded that possibility of accidents occurrence is in clustered pattern from. The Hotspot analysis study Black spots were identified and in turn advised to government that identified location must be considered to take preventive steps to reduce considered to take preventive steps to reduce number of accidents.

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