SPATIO-TEMPORAL ANALYSIS OF TRANSPORT CRASH DATA IN KERALA

By Jacob Sapphire J C, University of Madras.

by Jacob Sapphire.pianist

Ebin Sam <ebin.natpac@gmail.com>
to me

PFA

Regards,

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KSCSTE - NATIONAL TRANSPORTATION PLANNING AND RESEARCH CENTRE
(An Institution of Kerala State Council for Science, Technology & Environment)
K. Karunakaran Transpark, Akkulam, Thuruvikkal P.O.,
Thiruvananthapuram – 695 011, Kerala.

CERTIFICATE

This is to certify that **Mr. Jacob Sapphire J. C.** (Reg. No. 33223412), **Master of Science** in **Applied Geography** from **Department of Geography, University of Madras, Guindy Campus, Chennai – 600085** have undergone eight-weeks internship from 13th May 2024 to 5th July 2024. During this period, he has undergone training in the preparation of maps and spatio-temporal analysis of data under my guidance.

Wishing him every success in the future endeavors.

Thiruvananthapuram
05.07.2024

Ebin Sam S
Scientist & Coordinator
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Internship at NATPAC

Traffic Engineering & Safety Division
KSCSTE - NATIONAL TRANSPORTATION PLANNING & RESEARCH CENTRE (NATPAC)

EBIN SAM S - SCIENTIST

KSCSTE & NATPAC

Kerala State Council for Science, Technology and Environment.

Focus

Transport crash data analysis.

Internship Details

1 **Purpose**

Analyze crash data in Kerala.

2 **Duration**

May-July 2024, Full-time.

3 **Location**

KSCSTE, NATPAC, Thiruvananthapuram.

Project Overview

1

Phase 1: Data Collection

Crash data from 2021-2023.

2

Phase 2: Spatial Analysis

Utilized ArcGIS Pro for visualizations.

3

Phase 3: Interpretation

Insights for road safety planning.

Executive summary

The crash data from 2021 to 2023 revealed that **2022** had the highest number of victims and accidents, followed by **2021**, with **2023** having the lowest. Various analyses like **Spatial Analysis, Hotspot Analysis, and Temporal Analysis** were conducted using tools like ArcGIS. The study identified persistent **hotspots in urban areas**, especially during peak traffic hours and winter months, highlighting critical patterns. Using the **Space-Time Cube**, crash events were visualized by time, date, and location. These insights are valuable for improving **public safety**, **policy decisions**, and **urban planning** to reduce future crash rates.

Internship Description

- **Purpose and Goals of the Internship**:
- The primary goal of the internship was to conduct a **spatio-temporal analysis** of transport crash data in Kerala. The purpose was to apply spatial analysis techniques to understand crash patterns, identify hotspots, and contribute to improving road safety.
- **Internship Dates and Duration**:
- The internship took place from **May to July 2024** and lasted for a total of **8 weeks**. It was a **full-time** position at **KSCSTE, NATPAC**, in **Thiruvananthapuram**, Kerala.
- **Expectations During the Internship**:
- I was expected to:
  - Collect and process crash data from **2021 to 2023**.
  - Utilize **GIS tools** such as ArcGIS Pro for conducting **spatial analysis** and generating **visualizations**.
  - Perform analyses including **spatial autocorrelation**, **hotspot detection**, and **kernel density estimation**.
  - Provide **reports and insights** that could be used to inform **road safety measures** and **urban planning** in Kerala.

Tasks & Activities

Data Collection

Gathering accident records.

GIS Analysis

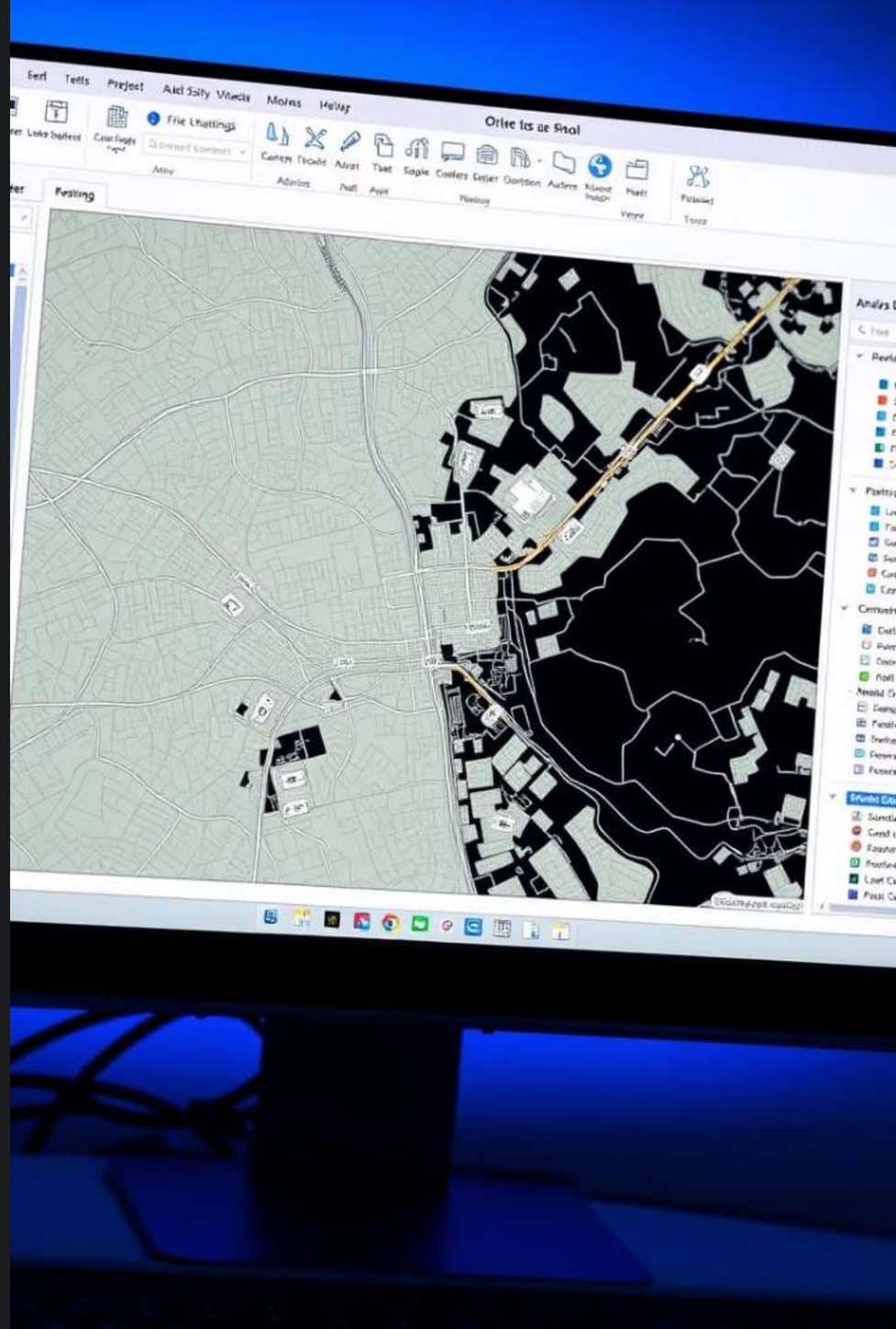
Mapping and spatial patterns.

Visualization

Creating informative maps.

Reporting

Documenting findings.



Internship Activities & Tasks

- **Main Responsibilities**:
  - Conducted **spatio-temporal analysis** of transport crash data from **2021 to 2023**.
  - Collaborated with team members on data collection and analysis processes.
  - Developed visualizations and reports to present findings on crash patterns.
- **Regular Tasks**:
  - **Data Collection**: Gathered crash data from various sources, including government databases and reports.
  - **Data Processing**: Cleaned and organized the data to ensure accuracy for analysis.
  - **Spatial Analysis**: Utilized **ArcGIS Pro** to perform various analyses, including:
    - **Spatial Visualization**: Created maps displaying crash locations and densities.
    - **Hotspot Detection**: Identified areas with a high frequency of crashes using **kernel density estimation**.
    - **Statistical Analysis**: Applied techniques such as **Moran's I** for assessing spatial autocorrelation.

Skills and Knowledge Development

- **Skills Developed**:
  - **Technical Skills**:
    - **GIS Analysis**: **ArcGIS Pro** .
    - **Statistical Techniques**: **Moran's I** for spatial autocorrelation and **Kernel Density Estimation** for **hotspot analysis**.
    - **3D Modeling**: Learned to create 3D visualizations of crash data, providing a new perspective on spatial relationships.
  - **Soft Skills**:
    - **Communication**: Improved communication skills through presenting findings to team members and preparing reports that summarize analysis results.
    - **Collaboration**: Developed teamwork skills by collaborating with colleagues on data collection and analysis tasks, fostering a collaborative work environment.

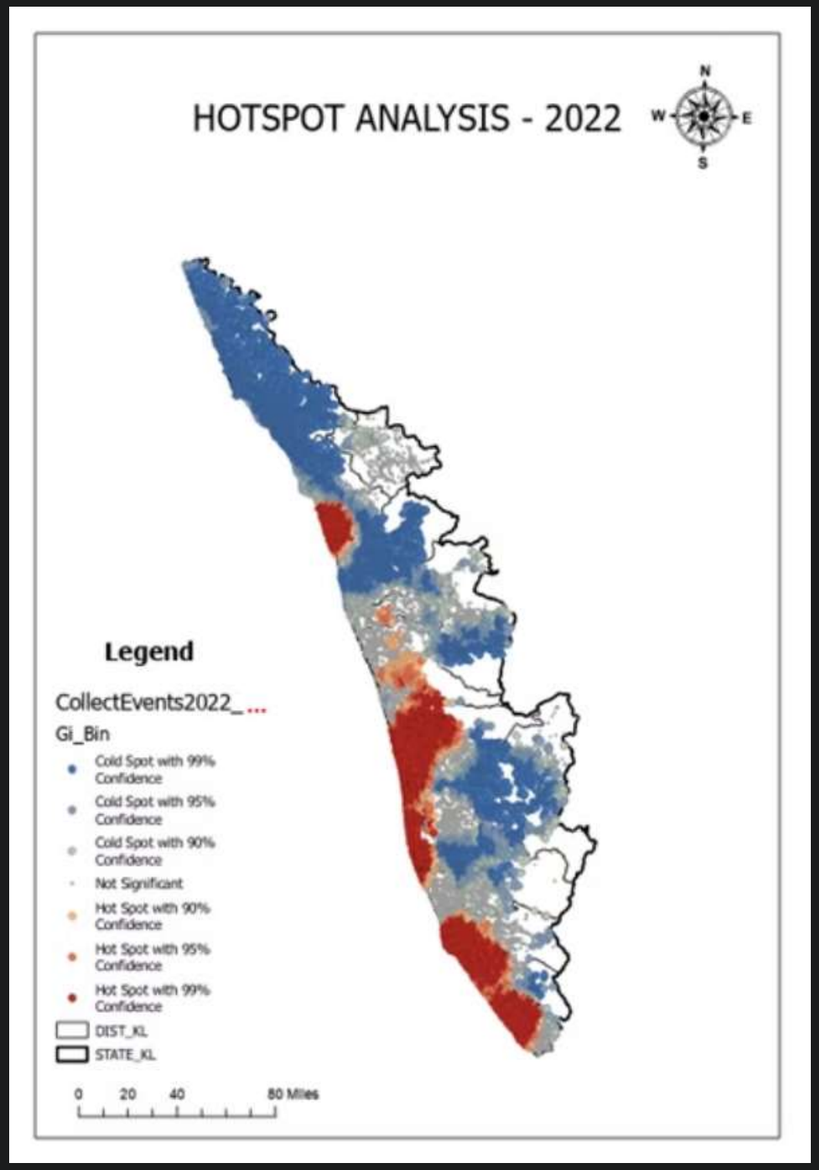
- **Application of Theoretical Knowledge**:

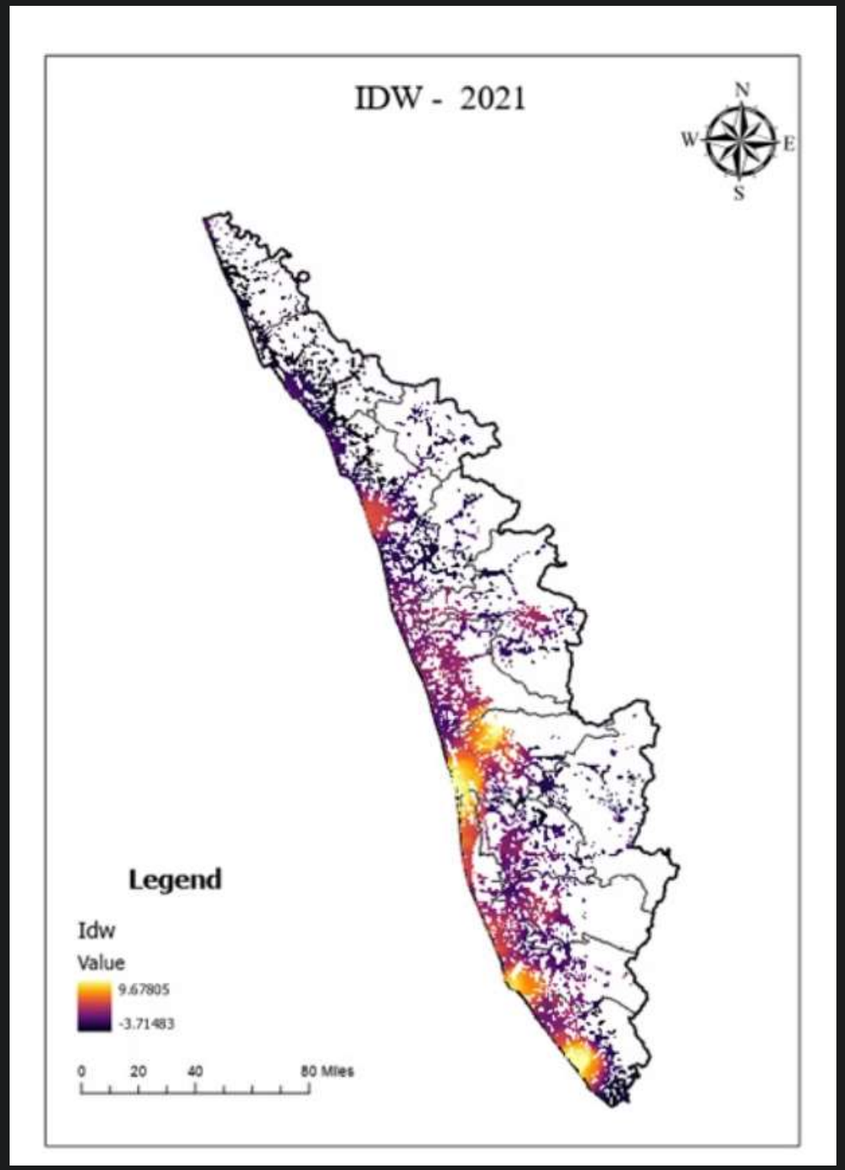
  - Applied concepts from my graduate program in Geography, particularly in **spatial analysis** and

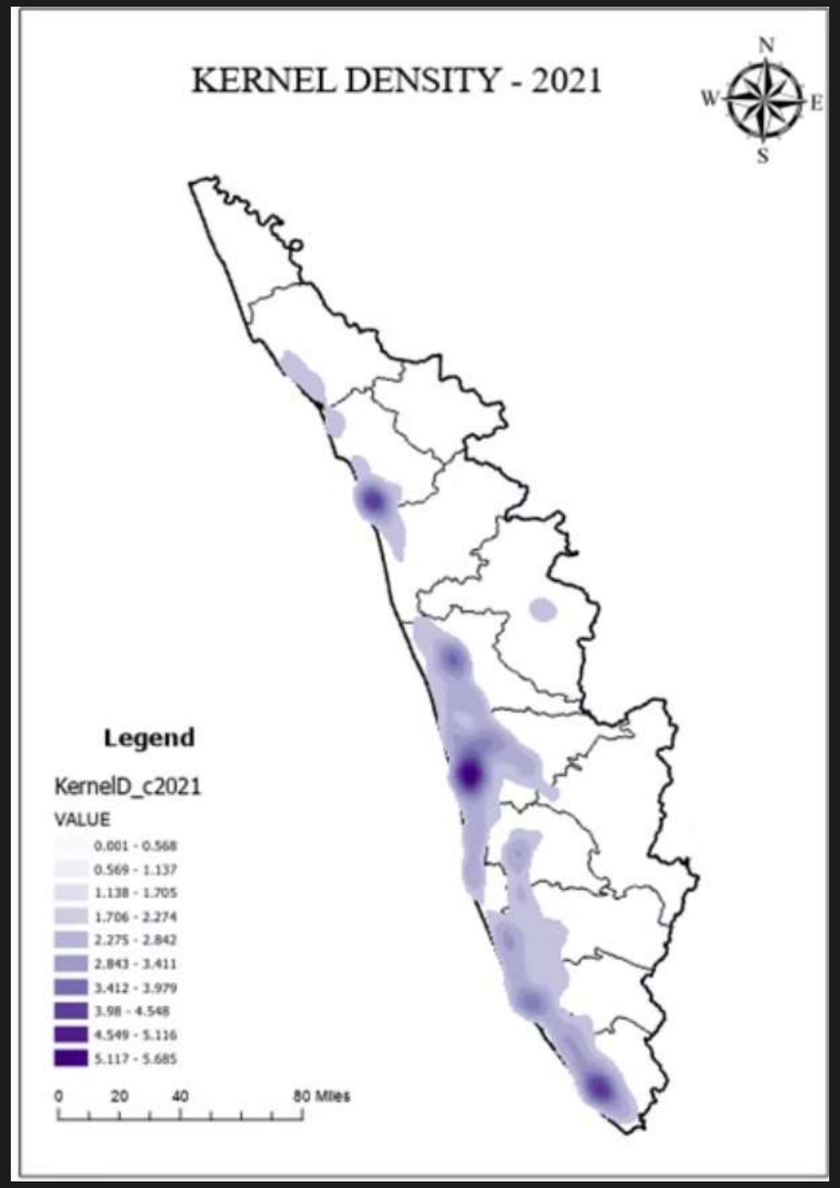
  For example:

    - Utilized theoretical frameworks for **spatial patterns** learned in class to analyze real-world crash data, identifying trends and anomalies in urban settings.

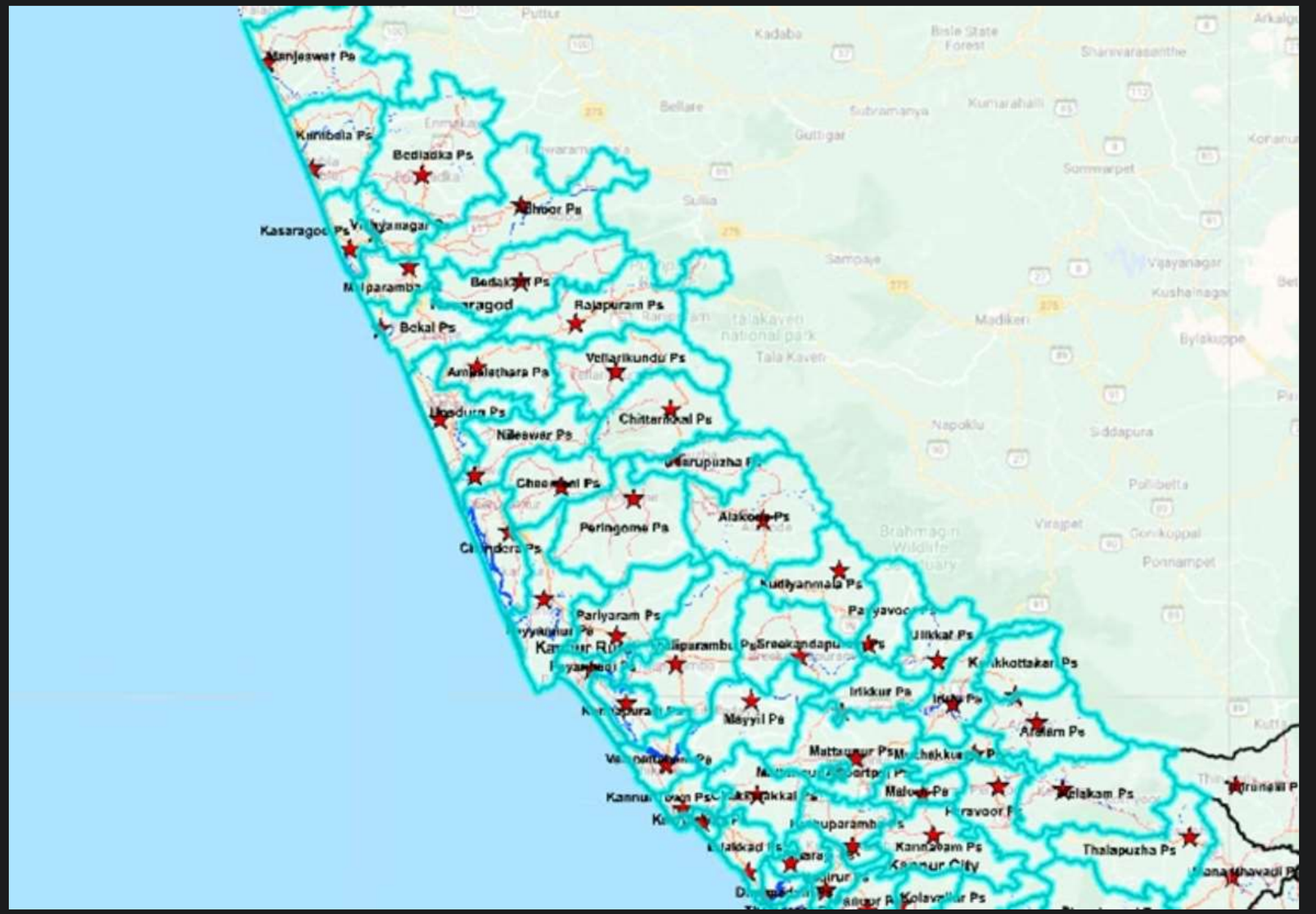
    - Implemented research methodologies covered in my coursework, such as systematic data collection and statistical analysis techniques, to ensure a robust approach to the internship tasks.

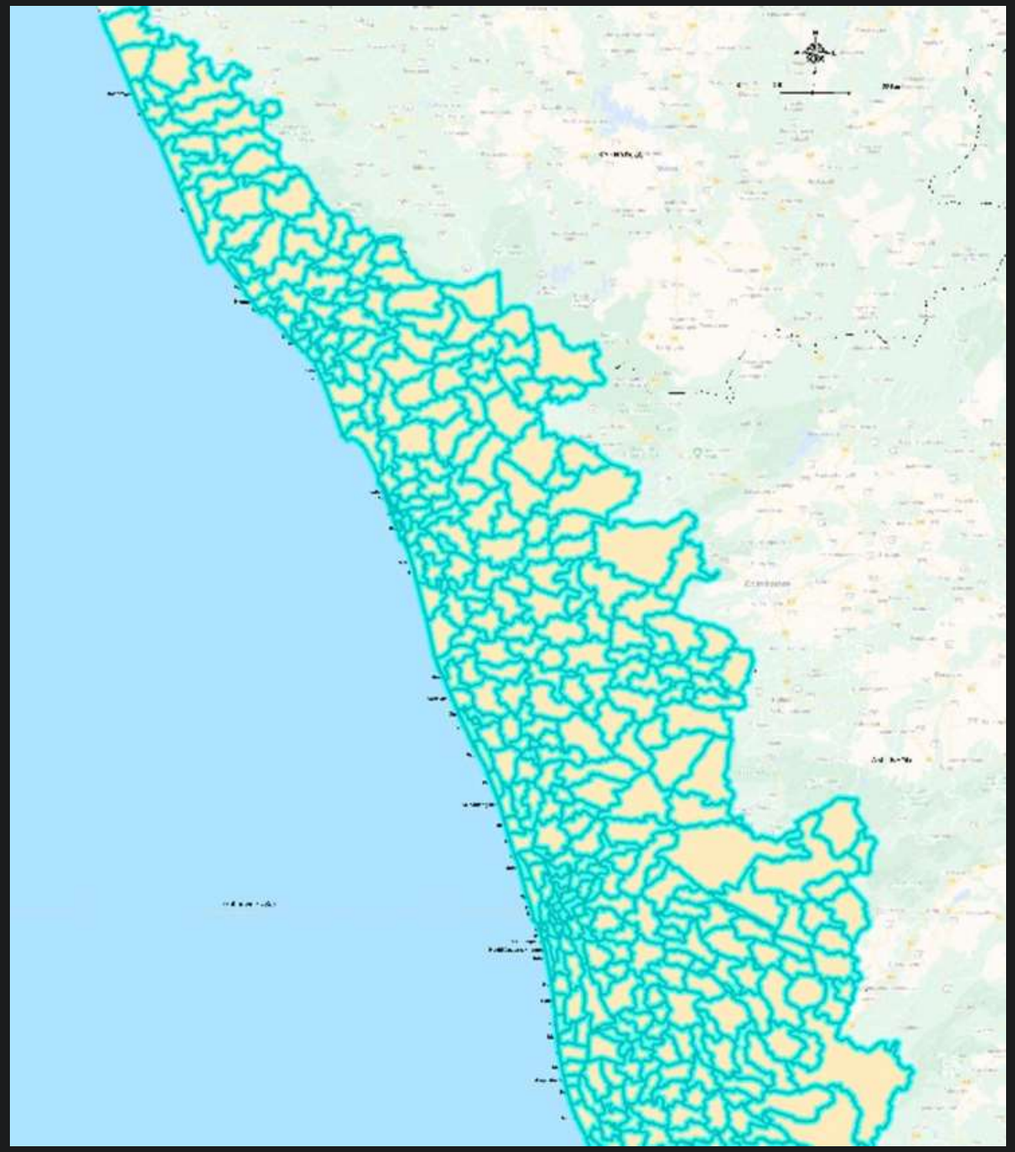

HOTSPOT ANALYSIS - 2022
N
W
E
S
Legend
CollectEvents2022_...
Gi_Bin
Cold Spot with 99% Confidence
Cold Spot with 95% Confidence
Cold Spot with 90% Confidence
Not Significant
Hot Spot with 90% Confidence
Hot Spot with 95% Confidence
Hot Spot with 99% Confidence
DIST_KL
STATE_KL
0 20 40 80 Miles

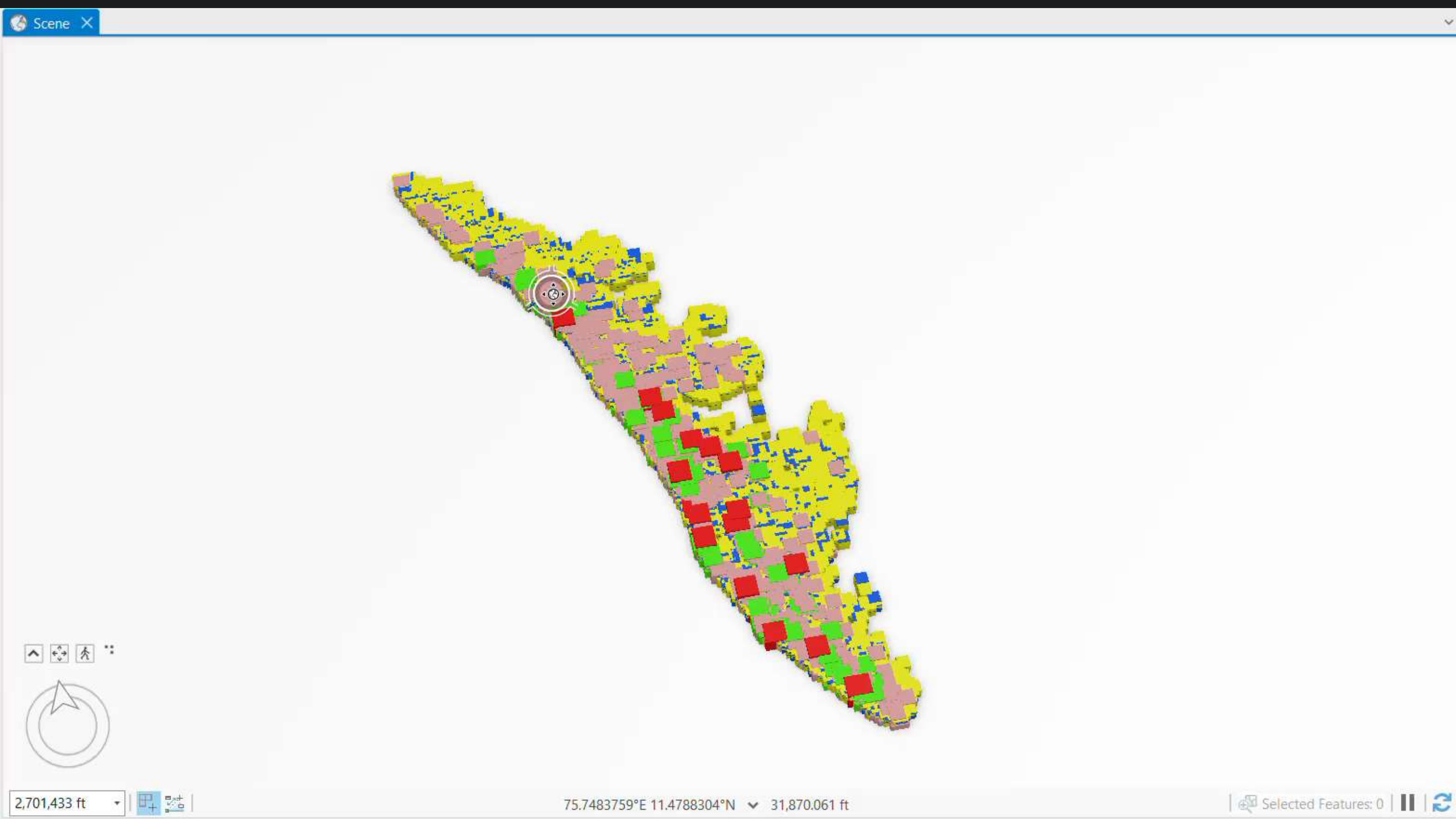

IDW - 2021
N
W
E
S
Legend
Idw
Value
9.67805
-3.71483
0
20
40
80 Miles


KERNEL DENSITY - 2021
N
W
E
S
Legend
KernelD_c2021
VALUE
0.001 - 0.568
0.569 - 1.137
1.138 - 1.705
1.706 - 2.274
2.275 - 2.842
2.843 - 3.411
3.412 - 3.979
3.98 - 4.548
4.549 - 5.116
5.117 - 5.685
0
20
40
80 Miles

CREATION OF POLICE JURISDICTION BOUNDARIES IN ArcGIS Pro


Manjeswar Ps
Kumbla Ps
Bedadka Ps
Kasaragod Ps
Bekal Ps
Rajapuram Ps
Vellarikundu Ps
Ambalathara Ps
Chittarikkal Ps
Nileswar Ps
Peringome Ps
Alakode Ps
Parlyaram Ps
Kuttiyanmala Ps
Irikkur Ps
Mayyil Ps
Aralam Ps
Malom Ps
Kannapuram Ps
Kannur City
Thalapuzha Ps
Kolavallur Ps

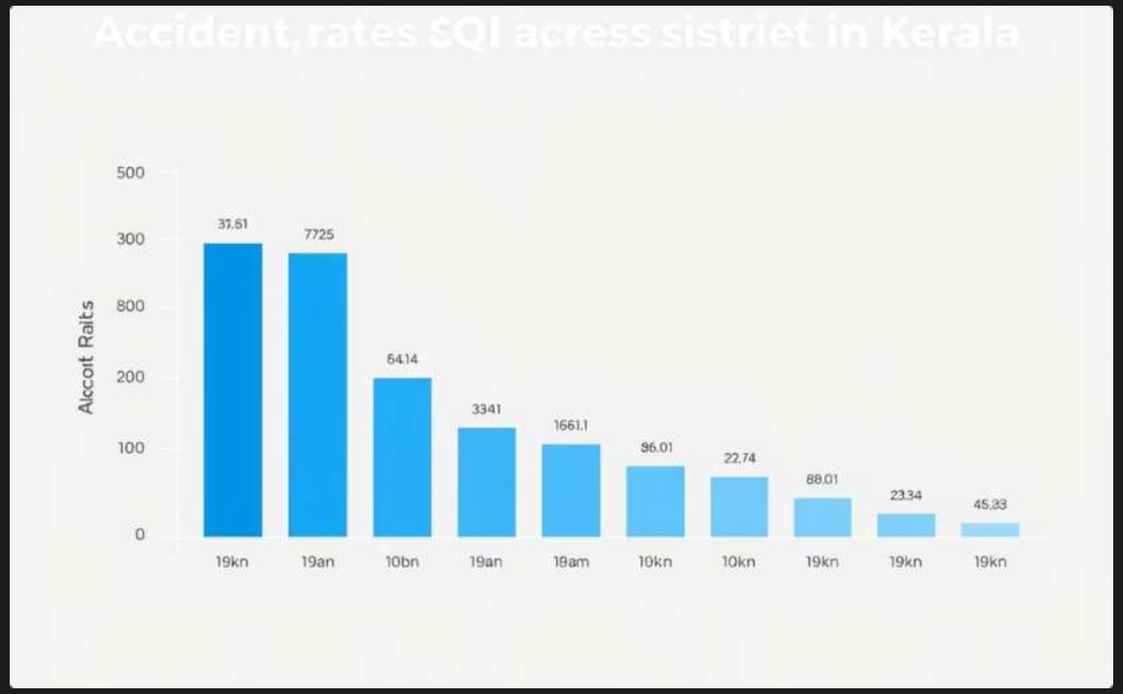



Scene
2,701,433 ft
75.7483759°E 11.4788304°N
31,870.061 ft
Selected Features: 0

Skills Developed

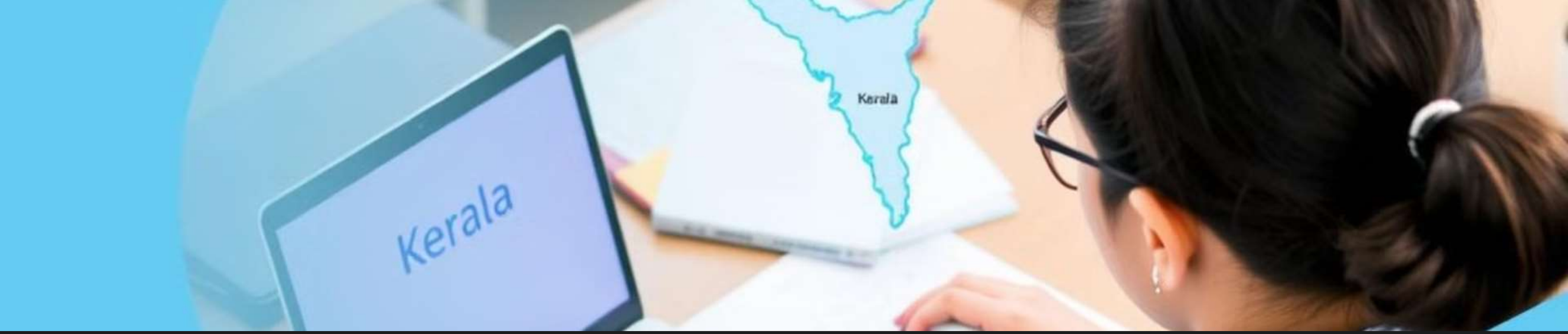
GIS Analysis

Using ArcGIS Pro effectively.



Data Visualization

Communicating findings visually.



Applying Knowledge

Geography

Spatial analysis foundation.

Statistics

Moran's I, Kernel Density.

3D Modeling

Visualizing data in 3D.

Challenges and Recommendations

- limited data resolution, which affected the accuracy of my analysis, and time constraints that restricted the scope of my work.
- encountered technical difficulties with GIS software,
- To address these issues, I recommend enhancing data collection methods to ensure better quality and completeness of crash data.
- Implementing a system for ongoing monitoring of crash hotspots would also be beneficial. Furthermore, providing additional training on **GIS tools** and extending the analysis duration would allow for deeper investigations into crash causation factors and predictive modeling, ultimately leading to more informed transportation planning decisions.

Conclusion

The internship provided a comprehensive understanding of transport crash analysis through the application of spatio-temporal analysis techniques. By engaging with real-world data, I was able to develop valuable technical skills in GIS analysis, data visualization, and statistical methods, while also enhancing my soft skills in communication and collaboration. The insights gained from analyzing crash patterns and identifying hotspots will contribute significantly to improving road safety planning in Kerala. Overall, this experience has solidified my knowledge and expertise in spatial analysis and has equipped me with practical skills that will be beneficial in my future endeavors in urban planning and transportation research.