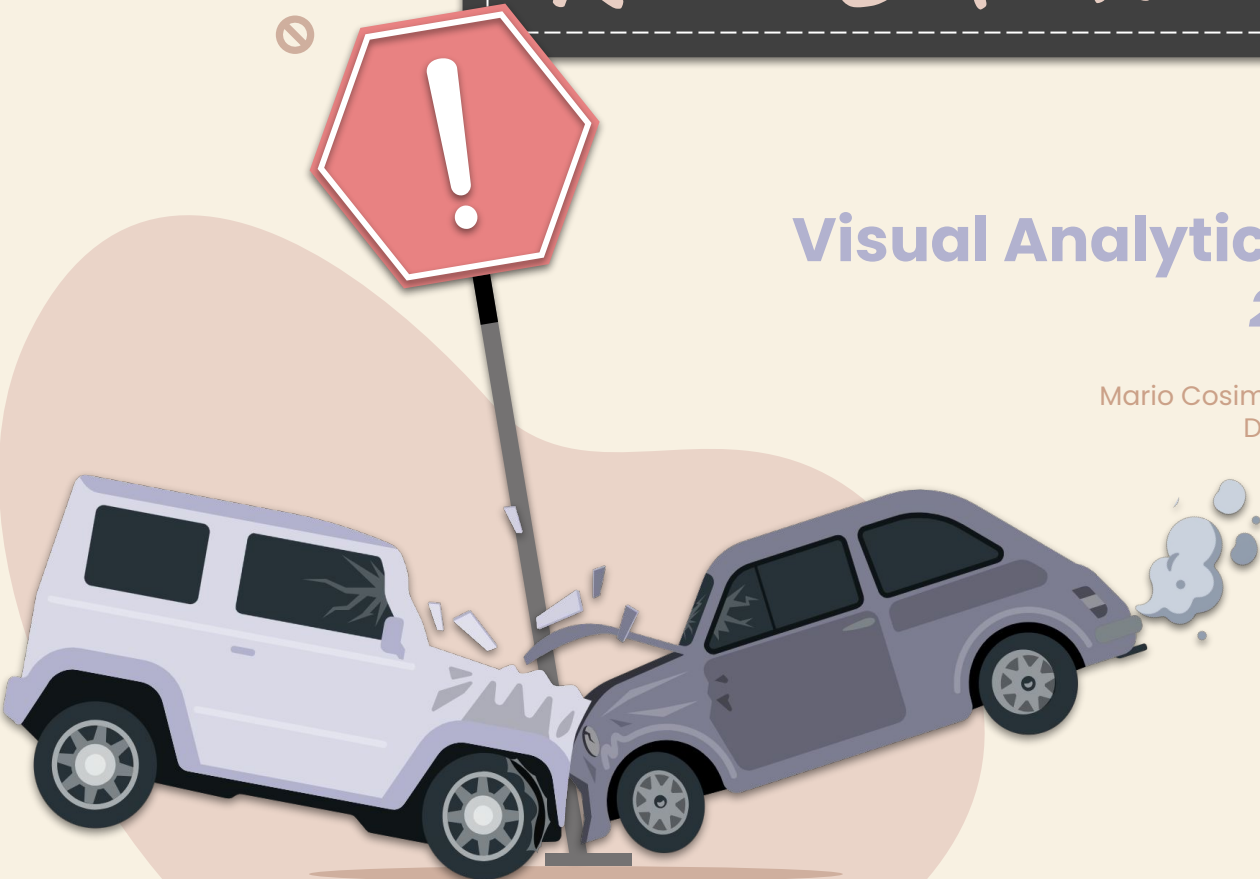


# Rome Safe Roads

## Visual Analytics project 2023-2024

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# Topic

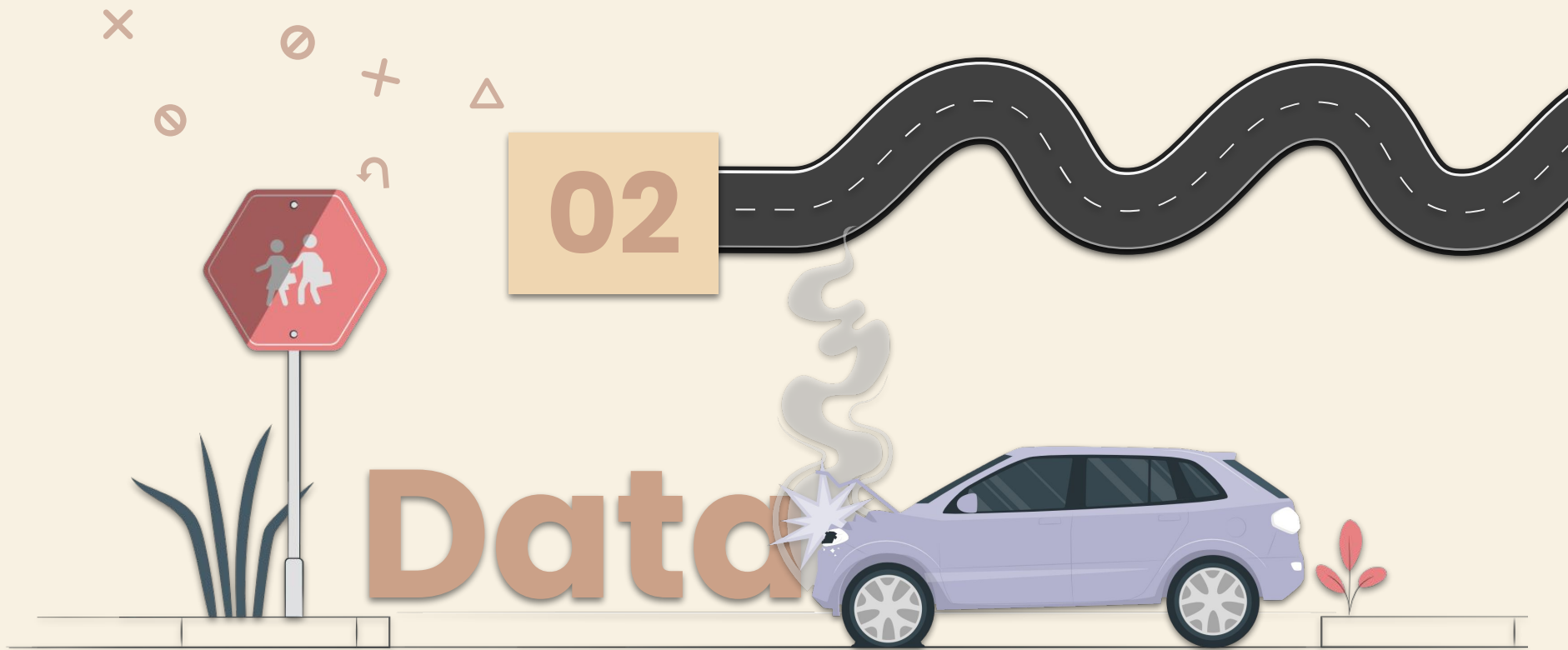
## Rome Safe Roads

Road accidents are a significant contributor to global mortality and injuries.

In a bustling metropolis like Rome, an average of 79 accidents occur daily, resulting in 0.3 fatalities and 100 injuries.

The study and analysis of traffic accidents can provide valuable insights for Rome Municipality into the underlying causes, consequences, and risk factors associated with these incidents, ultimately aiding the development of effective road safety strategies.





# Data sources 1/2



The data was collected from the official website of the Municipality of Rome ([Road accident dataset](#)).

The website contains data available in several formats (*xml*, *json*, *csv*) and grouped by month. For the conducted analyses only *.csv* files have been considered.

Some main fields in the chosen dataset are the following:

- *Protocollo*
- *DataOralIncidente*
- *NaturalIncidente*
- *particolaritastrade*
- *TipoStrada*
- *FondoStradale*
- *Pavimentazione*
- *Segnaletica*
- *CondizioneAtmosferica*
- *Traffico*
- *Visibilita*
- *Illuminazione*
- *NUM\_FERITI*
- *NUM\_RISERVATA*
- *NUM\_MORTI*
- *NUM\_ILLESI*
- *Longitude*
- *Latitude*
- *StatoVeicolo*
- *TipoVeicolo*
- *TipoPersona*
- *Sesso*
- *Tipolesione*
- *Deceduto*
- *DecedutoDopo*
- *CinturaCascoUtilizzato*
- *Airbag*

# Data sources 2/2



The entire data source used for the system has the following dimensions for each year:

- 2019 contains 79.283 tuples
- 2020 contains 54.222 tuples
- 2021 contains 73.100 tuples
- 2022 contains 47.060 tuples

Therefore, the total number of tuples given by summing all the four years is 253.665 while 37 are the attributes.

The **AS** (*AngeliniSantucci*) **Index** of the dataset defined as:

$$AS = \#tuples \times \#dimensions \quad \rightsquigarrow \quad AS = 253.665 \times 37 = 9.385.605$$

# Data pre-processing



## DATE

Data organizing  
in time unit and  
accident counting



## ACCIDENT NATURE

Data filtering and  
grouping by different  
natures



## DISTRICT

Fatal accident  
counting and  
grouping by  
district



## PCA

Variables choice  
for clustering,  
based on  
accidents' severity,  
in two dimensions





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# Visualizations



**VERTICAL BAR CHART**

It visually represents the number of different accident natures on roadways

**CHOROPLETH MAP**

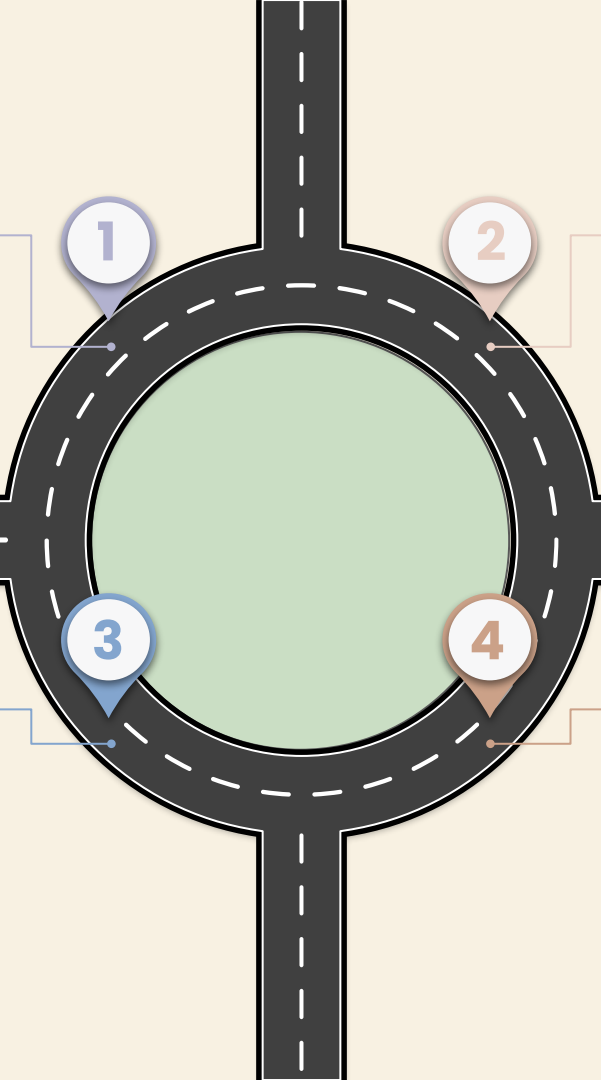
It allows to show road safety dynamics in the city of Rome

**TIME SERIES**

It displays the yearly trends of all road accidents within the capital

**SCATTER PLOT**

It plots the result of the dimensionality reduction using the technique of Principal Component Analysis (PCA)



# Vertical Bar Chart



## Visualization

By organizing accident natures along the x-axis and quantifying them on the y-axis, the chart provides an overview of the number of the occurred accidents for each nature.

## Insights

- Weather conditions influence
- Critical accidents nature

# Choropleth Map



## Visualization

The chart consists of a map subdivided into 15 districts, each characterized by an associated color representing the number of general or fatal accidents that occurred within its geographic boundaries.

## Insights

- Safer Districts
- Star-shaped of accidents concentration
- Critical streets and crossroads

# Time Series

Visualization

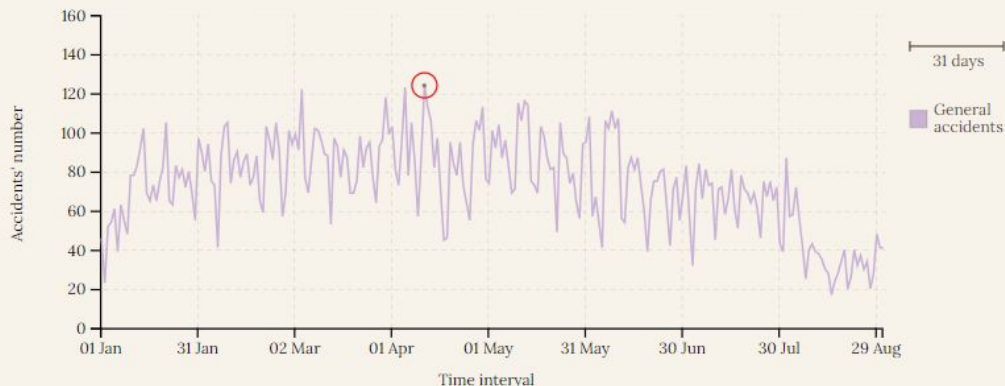


## Visualization

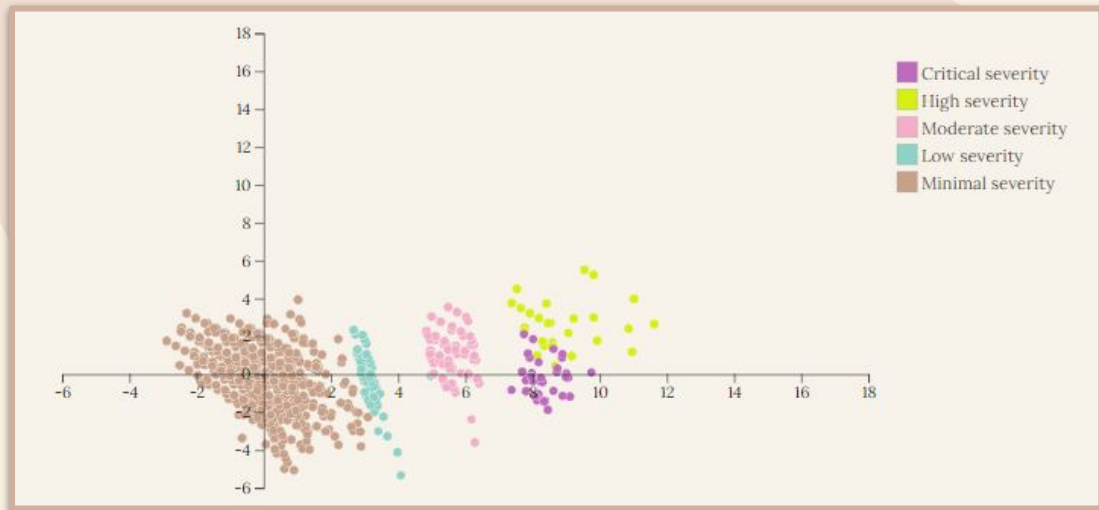
The chart offers a temporal perspective. The time is represented on the x-axis while the y-axis quantifies the number of accidents, visualizing the continuous evolution of accidents throughout the year.

## Insights

- Peaks comparison
- Side by side comparison
- Impact of Lockdown on Road Accidents in 2020



# Scatter Plot



## Visualization

The chart plots the result of the dimensionality reduction using the technique of Principal Component Analysis (PCA). The points are represented based on two dimensions. In this way it is possible to see which accidents are similar and which are outliers.

## Insights

- Cluster patterns based on severity accidents
- Presence of eventual outliers in some clusters

04



# Analytics

# Dimensionality reduction

## Principal Component Analysis

The analytical process is focused on applying Principal Component Analysis (PCA) real time on demand as a technique for dimensionality reduction. That was possible developing a backend service deployed on a server with the support of Flask framework.

In Rome Safe Roads system, steps are the following:

Steps needed are the following:

- Dataset preprocessing including the handling of missing data, feature normalization and outlier management
- Data standardization
- Selection of two principal components to compute PCA. The key variables identification is based on observed variance

The resulting visualization provides a perspective on the correlation between different factors such as traffic intensity, fatalities, injuries and more.





# Future Perspectives



# Intended user

The Rome Safe Roads system can be used as an asset for the dedicated members of the Polizia Locale di Roma. It offers a comprehensive tool for enhancing the operational efficiency and decision-making capabilities.

The system can be considered a force source, enabling to strategically allocate resources where they are needed most.

By identifying critical areas and accident natures, the Polizia Locale di Roma can optimize their own utility and interventions, ensuring a customized and effective approach to enhancing road safety.



# Application cases

## Preventive traffic management

Polizia Locale di Roma and traffic authorities enhance road safety through Rome Safe Roads data analysis, signal improvements, and awareness campaigns.

1

## Pedestrian safety in urban environment

Polizia Locale di Roma deploys safety pedestrian plan using Rome Safe Roads data to monitor and adapt strategies based on accident analysis.

2

# Future Improvements

Future perspectives

## Traffic city management

Urban planning and integration with transport agencies allows faster interventions in specific situations

## IoT Integration

Responsive Traffic Management with Advanced Sensors

## Collaborative research

Partnering with authorities for a more accurate dataset.

# References 1/3

Future perspectives

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## Dataset

[1] Comune di Roma. Traffico stradale di Roma. Open Data del Comune di Roma.(2022). <https://dati.comune.roma.it/catalog/dataset/d108>

## Tools

[2] Cynthia Brewer, Mark Harrower and The Pennsylvania State University, ColorBrewer (Version 2.0) [Source Code]. <https://colorbrewer2.org>

[3] Openpolis. (2023). Geojson-italy. <https://github.com/openpolis/geojson-italy>

[4] Pedregosa, F., Varoquaux, G., Gramfort, A., Michel, V., Thirion, B., Grisel, O., ... & Vanderplas, J. (2011), Scikit-learn (Version 1.3.2)[Source Code]. <https://github.com/scikit-learn/scikit-learn>

[5] Michael Bostock, D3.js (Version 4.13.0) [Source Code]. <https://d3js.org/>

[6] Wes McKinney, Pandas (Version 0.25.3) [Source Code]. <https://pandas.pydata.org/>

[7] GeoPandas contributors, GeoPandas (Version 0.14.3) [Source Code]. <https://github.com/geopandas/geopandas>

[8] MapBox contributors, MapBox (Version 3.2.0) [Source Code]. <https://www.mapbox.com/>

# References 2/3

## Related works

[9] Antonio Comi, Antonio Polimeni, Chiara Balsamo, Department of Enterprise Engineering, University of Rome Tor Vergata, 00118 Rome, Italy, Road Accident Analysis with Data Mining Approach: evidence from Rome from 24th Euro Working Group on Transportation Meeting (2022), edited by Margarida Coelho, volume 62, pages 798–805. [Online] Available:

[https://www.sciencedirect.com/science/article/pii/S2352146522002265?ref=pdf\\_download&fr=RR-2&rr=83f4d021eb03bb0b](https://www.sciencedirect.com/science/article/pii/S2352146522002265?ref=pdf_download&fr=RR-2&rr=83f4d021eb03bb0b)

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<https://www.sciencedirect.com/science/article/pii/S0001457518300873>

[11] B. Wali, A.J. Khattak, T. Karnowski, The relationship between driving volatility in time to collision and crash-injury severity in a naturalistic driving environment (2020) [Online] Available:

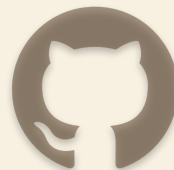
<https://www.sciencedirect.com/science/article/pii/S2213665720300269>

## How can be Rome Safe Road system be located with respect to existing literature?

Existing literature mainly predicts accidents based on drivers behavior and vehicle types, overshadow road factors. Rome Safe Road analyzes accident causes and dynamics for tailored prevention measures.

# References 3/3

The entire work is published on the GitHub page



Tap here

- Discover the **live version** of the project running the server file `/app.py` and reaching the following link: <http://localhost:63342/visual-analytics/index.html>
- A detailed **scientific paper** have been realized to provide a complete project documentation: <https://github.com/2029254/RomeSafeRoads/blob/main/docs/ScientificPaper.pdf>

Innovation begins with collaboration.  
Share your thoughts!



**THE  
END**



**Thank you for the attention!**

**Let's go to the demo!**