TOPIC: Modelling Road Traffic Accidents (RTAs) as a Stochastic Process : A Case of Kitwe town in Zambia.

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Outline

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Background

- Road Traffic Accidents (RTAs) are unexpected incidents on roadways involving vehicles, pedestrians, or others, leading to damage, injuries, or fatalities.
- RTAs are a significant public health concern, causing over 1.3 million deaths annually, and are among the leading cause of death (WHO, 2023).
- The economic impact is profound, with countries losing up to 3% of GDP annually, with developing countries like Zambia bearing a significant burden due to limited infrastructure and resources (WHO, 2023).
- Despite efforts to improve road safety globally, low and middle-income countries account for 93% of road traffic fatalities which includes Zambia (Gayatri & Guta, 2024).
- A number of major Zambian cities, faces a lot RTAs due to high traffic volume, emphasizing the need for effective mitigation strategies.

Literature (Zambia)

- Road Traffic Crashes in Zambia: A Retrospective Descriptive Analysis Using Epidemic Intelligence from Open Sources. (Ngulube .D, *et'al*, 2025).
- Road Traffic Accidents in Zambia: an analysis of causative factors and public health implications. (Chisenga .A, *et'al*, 2025).
- Modelling the Road Traffic Accidents and the associated risk factors along Kapiri Mponshi and Ndola road . (Phiri .D, 2024).
- Design and Development of a Road Accident Cases Reporting Mobile Application. (Musa .C & Nsama .L, 2024) .
- Modelling Deaths Associated with Road Traffic Accidents and other Factors on Great North Road in Zambia between the Years 2010 and 2016 Using Poisson Models. (Fisa .R, 2019).
- Trends in Road Traffic Deaths among Motorists in Lusaka from 2010 to 2013 . (Ikabongo .M, 2013).

Problem Statement

- According to RTSA, as at 11th January, 2026 we have 695, 740 active vehicle population and 80, 310 traffic violations.
- Road traffic accidents in Zambian cities threaten public safety and economic stability, yet there is limited research on modeling their stochastic nature.
- Current traffic safety strategies are limited in terms of a data-driven approach, leading to inefficient resource allocation.
- The study seeks to improve temporal spatial analysis, prediction and inform decision-making for traffic safety policies through statistical data driven approach.

Significance

- This study provides a data-driven approach to understanding and predicting Road Traffic Accidents in Zambia's CBDs, informing targeted interventions and policy decisions to enhance road safety, reduce accidents and promote sustainable urban development in Zambia.

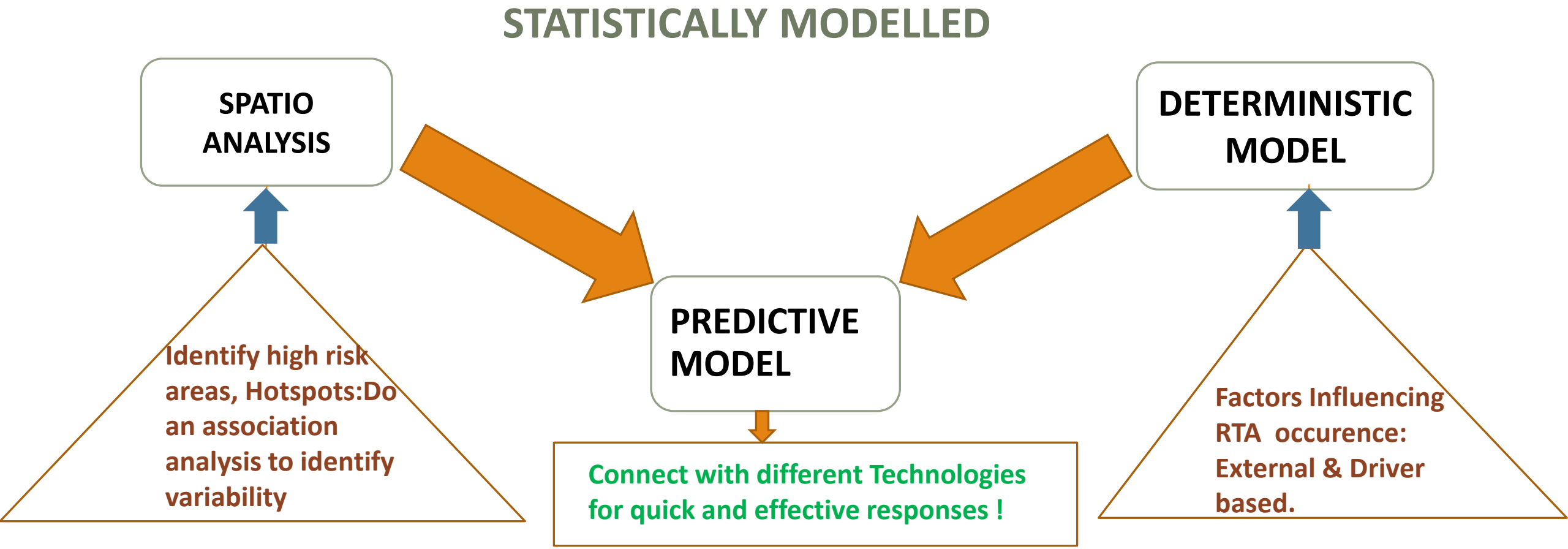
AIM

- To develop a Model of Road Traffic Accidents (RTAs) in Central Business Districts (CBDs) of Kitwe Town in Zambia, providing critical insights for policymakers, urban planners, and law enforcement agencies.

OBJECTIVES

1. To analyze patterns of RTAs in CBDs of Kitwe and Solwezi towns in Zambia.
2. To fit a Statistical model to assess the influence of different factors on RTAs occurrence.
3. To give recommendations which may help out in Road Safety.

MODEL CONCEPT



METHODOLOGY

- Use data (Quantitative & Qualitative) from RTSA, Police Traffic, Health facilities and road users.
- Analyze the statistical patterns.
- Apply a statistical distribution to have a model.
- Test the model against simulations and within sample performance.

- Road traffic accident (RTA) data are count data displayed over dispersion, where the variance exceeds the mean.
- Also from the AIC and BIC, we ranked the Poisson, Binomial and Negative Binomial Models to select a model which fits the data.

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Statistical Model

- To correct for over dispersion we chose Negative Binomial Regression Model.
- The NB model generalizes Poisson by introducing an additional dispersion parameter (α) that allows the variance to be greater than the mean:

$$\mathbf{Var(Y_i) = \mu_i + \alpha\mu_i^2}$$

Where Y_i is the count of accidents, μ_i is the mean count, and α is the dispersion parameter.

Con’t

- For prediction, the general form of the model used is

$$\log(\mu_i) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \ldots\ldots\ldots + \varepsilon_i$$

where μi is the expected number of accidents in the i-th observation, β_0 is the intercept term, X_1

is time of accident, X_2 is day of accident, X_3 is weather, X_4 licensed driver …..more contributing factors.

Findings (Kitwe Town)- Analysis

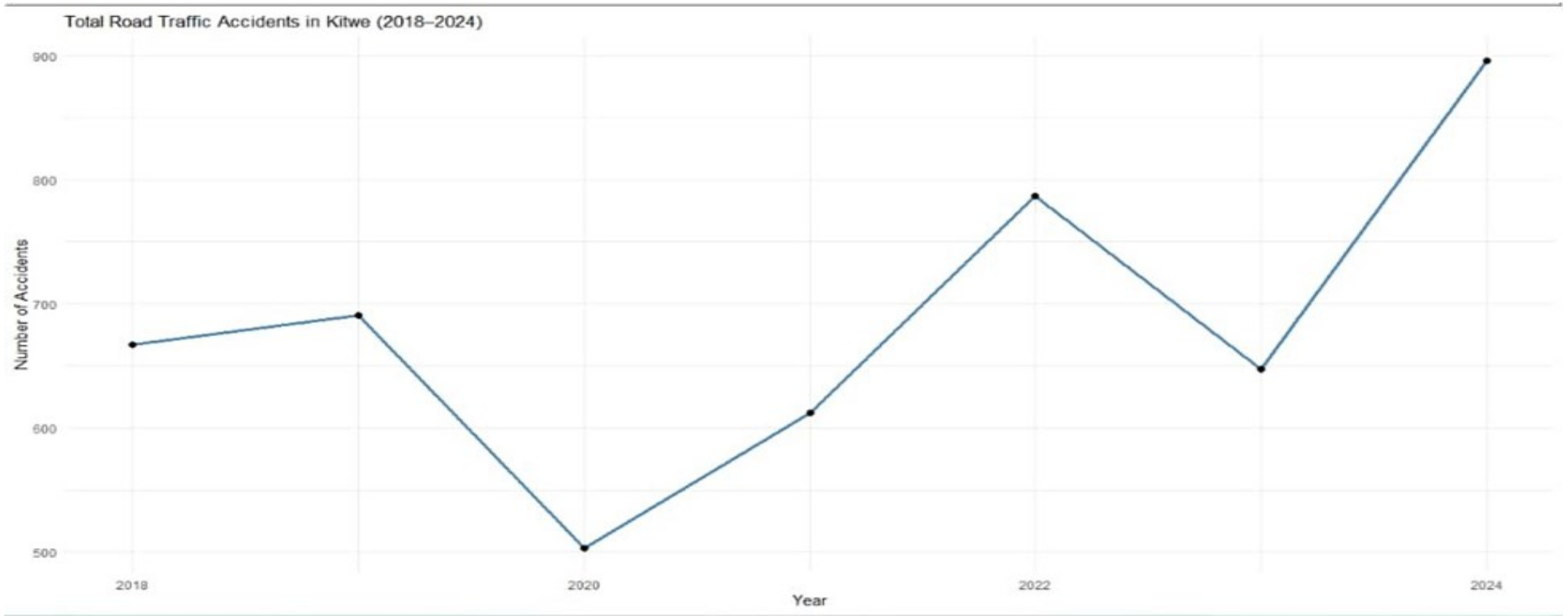

Figure 1: Yearly trend graph of Accidents

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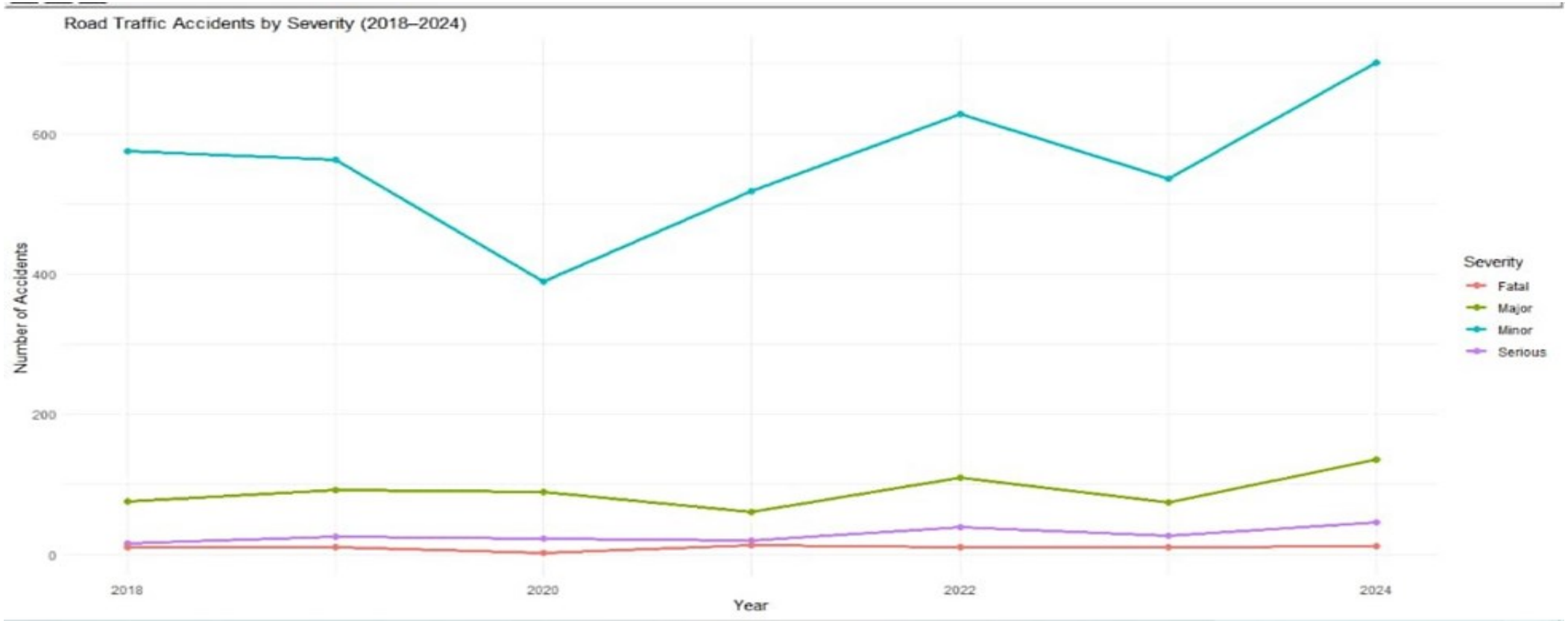

Figure 2: Trend line graph of Accidents associated with their severity

Accidents by Time of Day

Figure 3: Number of Accidents by Time of Day

Accidents by Day of the Week

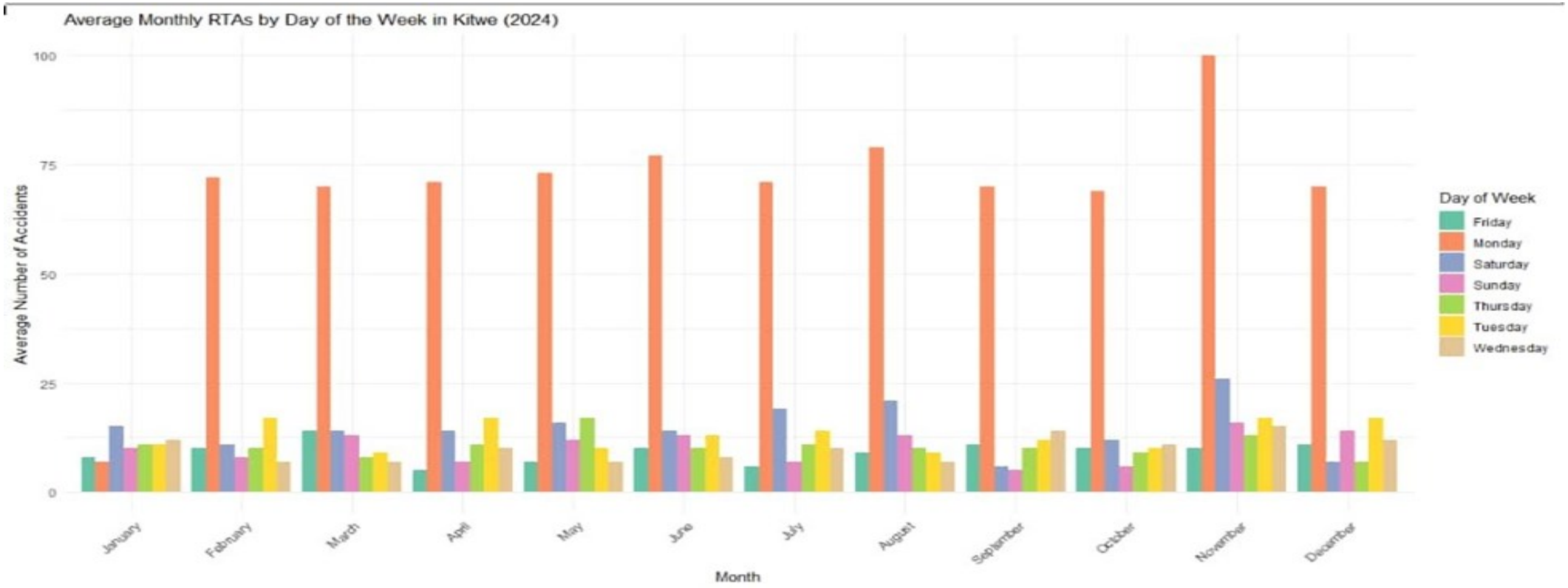

Figure 4: Accidents by Day of the Week

Predicted vs Simulated

Month	Predicted	Simulated
January	67	62
February	68	77
March	68	53
April	68	69
May	68	62
June	69	72
July	69	58
August	69	54
September	70	79
October	70	72
November	70	73
December	70	71

Table 1: Negative Binomial Regression Predicted Monthly RTAs for 2025

Interpretation of Results

- The regression results reveal that the time of day was found to be a significant predictor by the regression analysis. With so many cars, pedestrians, and public transportation drivers gathered in the central business district, peak traffic movement can be connected to higher accident rates around mid-morning and lunchtime hours.
- Drivers may take greater chances during these hours due to the pressure to get to markets, stores, and places of employment, which could increase the number of accidents.
- The predicted values for the year 2025 in Table 1 also illustrate the model's prediction capability which suggests that predictions for 2025 showed close alignment between observed, simulated, and predicted accident counts.

Conclusion

- In Kitwe CBD moving around 09-12 hours on a Monday you are high risk of facing road accident. The high prevalence of RTAs during this time of the day and day of the week is more attributed to behavioral actions. Therefore, this is the perfect time and day for road safety enforcers to do random checks within Kitwe CBD.

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Thank You for Listening!!!!