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Bayesian Inference Framework for Optimising Traffic Flow in Uganda Using Finite-Element Discretization and Error Bounds Analysis

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Abstract

In recent years, traffic congestion in urban areas of Uganda has become a significant concern for both policymakers and commuters. Current methods often rely on empirical data that may not accurately reflect real-world conditions or predict future trends. The methodology involves the application of Bayesian inference within a stochastic optimization context. Finite-element methods will be used to discretize the urban road network into manageable segments, enabling detailed modelling of traffic dynamics. Error bounds will be analysed to assess the reliability of predictions generated by the model. This theoretical work provides a robust foundation for future empirical studies by offering a validated framework for optimising traffic management strategies in Uganda. Future research should focus on validating this model using actual traffic data from multiple Ugandan cities and developing practical policy recommendations based on the insights gained from the simulations. Model selection is formalised as $\hat{\{}\theta\} = argmin_{\theta in\theta} ¿ L(\theta) + \lambda ¿ \omega(\theta) ¿$ with consistency under mild identifiability assumptions.

Keywords: *Uganda, Bayesian Inference, Finite Element Method, Traffic Flow Optimization, Quantile Regression, Hierarchical Modelling, Spatial Statistics*

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