African Probability and Statistics (Pure Science)

Stochastic Processes Framework for Traffic Flow Optimization in Tanzania Using Finite-Element Discretization and Error Bounds Analysis

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Abstract

Traffic flow optimization in Tanzania is crucial for improving road safety and reducing congestion. However, traditional deterministic models often fail to capture the stochastic nature of traffic dynamics due to unpredictable factors such as weather conditions and driver behaviour. The methodology involves formulating a stochastic differential equation (SDE) for traffic flow dynamics based on the continuous-time Markov process. Finite-element methods are employed to discretize the SDE over spatial domains representing different road segments in Tanzania. Error bounds are analysed using properties of the finite element approximation. This theoretical framework provides a robust method for optimising traffic flow in Tanzania by accounting for the inherent uncertainties. The finite-element discretization approach offers a practical solution for policymakers aiming to enhance road safety and efficiency. Policymakers should consider implementing this model as part of their planning strategies, alongside empirical validation studies to ensure its applicability in real-world conditions. Model selection is formalised as $\hat{\{}\theta\}=argmin_{\theta in\theta}¿L(\theta)+\lambda¿\omega(\theta)¿$ with consistency under mild identifiability assumptions.

Keywords: *Tanzania, Stochastic Processes, Finite-Element Method, Discretization, Error Analysis, Monte Carlo Simulation, Queueing Theory*

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