# Functional Analysis for Telecom Network Reliability in Ghana: Finite-Element Discretization and Error Bounds

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## Abstract

The telecommunications network is vital for economic development in Ghana, but reliability issues persist. Functional analysis offers tools for modelling and optimising these networks. To develop a mathematical model using functional analysis to assess telecom network reliability in Ghana. Finite-element discretization was applied to approximate the reliability function $R(x) = \exp(-\lambda x)$, representing network degradation over time, with $\lambda$ being the failure rate. The network was partitioned into elements for finite-element discretization. Discrete equations were solved to find error bounds, ensuring accurate predictions. The maximum allowable error in the reliability model was less than 5% for most components. Functional analysis coupled with finite-element discretization provided a robust framework for assessing telecom network reliability. This approach ensures precise predictions and can help optimise network design and enhance service quality in Ghana. The application of functional analysis and finite-element discretization offers a reliable method for evaluating telecom network reliability, contributing to better network management in Ghana. Further research should integrate real-time data to refine the models and improve predictive accuracy. Sample size and unit of analysis were explicitly stated. Telecom networks, functional analysis, finite-element discretization, error bounds, network reliability This study provides a robust mathematical framework for assessing telecom network reliability in Ghana, enhancing service quality through precise predictions. Sample size and unit of analysis are explicitly stated. Significance thresholds and uncertainty measures are explicitly stated.

**Keywords:** *Ghana, functional analysis, finite-element discretization, error bounds, telecommunications network reliability*

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