African Geometry and Topology (Pure Science)

Topological Data Analysis under Regularization for Telecom Network Reliability in Kenya: A Theoretical Framework

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Abstract

Theoretical frameworks in Topological Data Analysis (TDA) are essential for understanding complex networks like telecommunications infrastructures. In Kenya, TDA has been applied to enhance network reliability and optimise resource allocation. The methodology involves constructing TDA persistence diagrams from network data, applying L1-regularization to avoid overfitting, and employing cross-validation for model selection. This theoretical framework provides a robust methodology for enhancing telecom network reliability in Kenya through the application of TDA and regularization techniques. The findings suggest that further empirical studies should be conducted to validate these models with real-world data. Policymakers could also consider implementing these methods to improve network resilience and efficiency. Model selection is formalised as $\hat{\{}\theta\} = argmin_{\theta in\theta} ¿ L(\theta) + \lambda ¿ \omega(\theta) ¿$ with consistency under mild identifiability assumptions.

Keywords: *Kenya, Topological Data Analysis, Persistent Homology, Sheaf Theory, Simplicial Complexes, Functorial Methods, Regularization Techniques*

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