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Topological Data Analysis for Financial Risk Estimation in Nigeria: Regularization and Cross-validated Model Selection

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Abstract

Topological Data Analysis (TDA) is a relatively new technique in data science that uses algebraic topology to analyse complex datasets. In Nigeria's financial sector, understanding and quantifying risk are crucial for effective management. TDA offers a novel approach to identifying patterns and anomalies within large financial datasets. We employ TDA tools such as persistent homology to analyse financial transaction data from a sample of Nigerian banks. Regularization techniques are used to prevent overfitting, ensuring the model generalizes well beyond the training dataset. Cross-validation is applied iteratively to optimise model parameters and minimise prediction errors. Our analysis reveals distinct topological features indicative of high-risk sectors within the financial sector, such as credit default swaps and equity investments. These findings suggest that specific regulatory measures might be needed in these areas. This study demonstrates the potential of TDA for risk assessment in Nigerian finance through rigorous model selection methods. The identified patterns offer actionable insights into managing financial risks effectively. Based on our findings, we recommend a phased implementation strategy involving pilot studies and gradual deployment across different sectors to ensure robustness and efficacy of the proposed models. Topological Data Analysis, Financial Risk Estimation, Nigeria, Regularization, Cross-validated Model Selection Model selection is formalised as $\hat{\{}\theta\}=argmin_{\theta in\theta}¿L(\theta)+\lambda¿\omega(\theta)¿$ with consistency under mild identifiability assumptions.

Keywords: *Geography, Africa, Topological Data Analysis, TDA, Simplicial Complexes, Homology Groups, Manifold Reconstruction, Regularization, Model Selection*

ABSTRACT-ONLY PUBLICATION

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