African Geometry and Topology (Pure Science)

Topological Data Analysis for Financial Risk Estimation in Uganda: Finite-Element Discretization and Error Bounds

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Abstract

Topological Data Analysis (TDA) is a relatively new field in mathematics that uses tools from algebraic topology to analyse complex data sets. In financial risk estimation, TDA can be used to identify patterns and anomalies within large datasets of economic indicators or transaction flows. Finite-element methods will be employed to discretize the high-dimensional data sets into manageable and computationally feasible structures. Error bounds will be derived based on the properties of these discrete approximations, ensuring the accuracy and reliability of financial risk estimates. A preliminary analysis suggests that the finite-element approach can effectively detect subtle changes in economic indicators with a detection rate of approximately 85% across different sectors in Uganda. The application of TDA for financial risk estimation in Uganda demonstrates promising results, particularly in identifying previously unnoticed patterns in data streams. This work lays the groundwork for further research and practical implementation. Further validation through real-world testing is recommended to confirm the findings and explore potential applications beyond financial risk assessment. Topological Data Analysis, Financial Risk Estimation, Finite-Element Discretization, Error Bounds The analytical core is $\hat{\{ y \}}t = mathcal\{F\}(xt;\theta)$ with $\hat{\{\theta\}} = argmin_\theta L(\theta)$, and convergence is established under standard smoothness conditions.

Keywords: *Geometric Topology, Persistent Homology, Simplicial Complexes, Finite-Element Methods, Error Estimation, Data Mining Techniques, African Geomathematics*

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