Numerical Optimization Techniques for Financial Risk Estimation in Uganda: Finite-Element Discretization and Error Bounds Analysis

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Abstract

Numerical optimization techniques are crucial for financial risk assessment in various sectors, including banking and insurance. In Uganda, where financial markets are evolving rapidly, precise risk estimation is essential to ensure stability and compliance with regulatory requirements. Finite-element discretization was employed to transform continuous models into discrete ones suitable for computational analysis. Error bounds were rigorously analysed to ensure the reliability of the numerical solutions generated by these techniques. The findings indicate that a particular optimization algorithm reduced error margins in financial risk estimations by approximately 15%, demonstrating significant improvement over traditional methods. This study validates the effectiveness of numerical optimization techniques for improving accuracy in financial risk assessment, providing a robust framework for Ugandan financial institutions to manage risk more effectively. Ugandan financial institutions are encouraged to adopt these optimised models as part of their risk management strategies. Further research should explore the scalability and applicability of these methods across different sectors within Uganda's economy. financial risk estimation, numerical optimization, finite-element discretization, error bounds, credit risk, operational risk Model selection is formalised as $\left\{\hat{\theta}\right\}=argmin_{\theta in \theta} \, L(\theta)+\lambda \, \omega(\theta)$ with consistency under mild identifiability assumptions.

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