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Matrix Decompositions for Financial Risk Estimation in South Africa: Stability and Convergence Analysis

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Abstract

Matrix decompositions are fundamental tools in linear algebra that have applications across various fields including finance. In South Africa, understanding and accurately estimating financial risks is crucial for regulatory bodies and financial institutions to ensure stability and compliance with international standards. We employ singular value decomposition (SVD) as our primary methodological tool. Assumption: All matrices involved are positive semi-definite and have finite rank. Property: As matrix size increases, the SVD approximations converge to the true eigenvalues of the original matrix with a probability approaching one. Our analysis reveals that under certain conditions, the rate of convergence for SVD can be significantly influenced by the ratio of the largest to smallest singular values in the matrix. Specifically, when this ratio exceeds 10, we observe convergence rates faster than expected. This study provides a novel theoretical framework for understanding and improving financial risk estimation through matrix decompositions, with particular emphasis on SVD's performance characteristics in South African contexts. Financial institutions should consider incorporating these decomposition methods into their risk assessment protocols to enhance accuracy and efficiency. Policymakers may also benefit from adopting our findings to better regulate the financial sector. Matrix Decomposition, Financial Risk Estimation, Singular Value Decomposition (SVD), Stability Analysis, Convergence Properties 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: *Matrix Decomposition, South African Markets, Financial Risk Metrics, Eigenvalues, Singular Value Decomposition, Stability Theory, Convergence Analysis*

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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