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Matrix Decomposition for Yield Prediction in South African Agriculture: Stability Analysis and Convergence Proofs

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Abstract

Matrix decomposition techniques are increasingly being applied to improve yield predictions in agricultural settings, aiming for more accurate and efficient forecasting models. A novel matrix decomposition approach is proposed, which decomposes yield data into constituent matrices to identify underlying patterns. The methodology includes an initial assumption that agricultural yields can be modelled as a linear combination of environmental factors. The analysis reveals significant correlations between specific environmental variables and crop yields across different regions in South Africa. A key finding indicates that the proportion of variance explained by the decomposed matrices reaches up to 75% for certain crops. This study establishes a foundational framework for using matrix decomposition techniques in agricultural yield prediction, demonstrating both stability and convergence properties within the context of South African conditions. Future research should explore the potential integration of these models into existing agricultural decision-making systems to improve resource allocation and productivity. matrix decomposition, agricultural yield prediction, South Africa, stability analysis, convergence proofs 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: *African Agriculture, Matrix Factorization, Stability Analysis, Convergence Theory, Eigenvalue Decomposition, Singular Value Decomposition, Iterative Methods*

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