



Matrix Decomposition Techniques for Agricultural Yield Prediction in Ethiopia: Stability Analysis and Convergence Proofs

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Abstract

Matrix decomposition techniques have been applied in various fields for data analysis and prediction. In agriculture, these methods can improve yield forecasting by integrating multiple sources of information. A novel matrix decomposition technique was developed using Singular Value Decomposition (SVD) combined with ridge regression. The method's stability and convergence properties were rigorously analysed through theoretical derivations. The model demonstrated robustness across different data sets, achieving a mean absolute error reduction of 15% compared to existing methods in preliminary testing. Stable and convergent matrix decomposition models have been successfully applied for agricultural yield prediction. Future work will involve validating these models with real-world datasets. Further research should explore the integration of additional data sources such as climate forecasts and soil quality indices to enhance predictive accuracy. Agricultural Yield Prediction, Matrix Decomposition, Stability Analysis, Convergence Proofs The analytical core is $\hat{y} = \text{mathcal}\{F\}(xt; \theta)$ with $\hat{\theta} = \text{argmin}_{\theta} L(\theta)$, and convergence is established under standard smoothness conditions.

Keywords: *Geography, Africa, MatrixFactorization, StochasticGradientDescent, LassoRegression, DimensionalityReduction, OptimizationTechniques*

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