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Regularization Techniques and Cross-validated Model Selection for Agricultural Yield Prediction Using Partial Differential Equations in South Africa 2006

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Abstract

The agricultural sector in South Africa has seen significant interest due to its importance for food security and economic growth. The study employs PDE models to capture the dynamics of agricultural systems, applying L2 regularization to prevent overfitting. Cross-validation is used to optimise hyperparameters ensuring robust model performance across different regions in South Africa. A key finding indicates that incorporating spatial and temporal derivatives into the PDE framework significantly improves predictive accuracy compared to traditional regression methods. The proposed method demonstrates improved predictive power for agricultural yield, offering a practical tool for policymakers and farmers aiming at enhancing crop management strategies. Future research should focus on expanding model validation across diverse climatic zones and incorporating additional data sources such as soil quality indicators to enhance prediction accuracy. Partial Differential Equations, Agricultural Yield Prediction, Regularization Techniques, Cross-validated Model Selection Under standard regularity and boundary assumptions, the forecast state is modelled by $partialt\, u(t,x) = \kappa ¿ \partial\{xx\} u(t,x) + f(t,x)$, and stability follows from bounded perturbations.

Keywords: *African continent, PDEs, regularization, cross-validation, inverse problems, Sobolev spaces, stability analysis*