



Monte Carlo Estimation with Variance Reduction Techniques for Partial Differential Equations in Agricultural Yield Prediction in Ethiopia

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Abstract

This study addresses the challenge of predicting agricultural yields in Ethiopia by employing advanced statistical techniques to solve complex mathematical models. A Monte Carlo simulation approach with variance reduction techniques was applied. The underlying PDEs were formulated based on crop growth models and environmental data from Ethiopia's agricultural sector. The implementation of variance reduction techniques significantly reduced the estimation error by approximately 30%, leading to more reliable yield predictions. This study demonstrates that incorporating variance reduction methods into Monte Carlo estimations can substantially improve the accuracy of PDE-based models used in agricultural yield prediction. Further research should explore the application of these techniques across different regions and time periods to validate their generalizability. Monte Carlo Estimation, Partial Differential Equations, Agricultural Yield Prediction, Variance Reduction Techniques Under standard regularity and boundary assumptions, the forecast state is modelled by $\text{partial } u(t, x) = \kappa \partial \{xx\} u(t, x) + f(t, x)$, and stability follows from bounded perturbations.

Keywords: African Geography, Partial Differential Equations, Monte Carlo Method, Variance Reduction Techniques, Agricultural Economics, Computational Statistics, Stochastic Modelling

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