



Monte Carlo Estimation Variance Reduction in Predicting Agricultural Yield Using Partial Differential Equations in Kenya 2002

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Abstract

Agricultural yield prediction is crucial for farmers and policymakers in Kenya. Accurate predictions can help manage resources efficiently and mitigate risks associated with climate variability. The methodology involves developing a stochastic model based on PDEs that incorporates historical data from various regions of Kenya. Monte Carlo simulations with variance reduction techniques (e.g., importance sampling) are used to estimate yields, accounting for spatial and temporal variability in climate factors affecting agriculture. Our findings indicate that the use of PDE-based models combined with variance reduction methods significantly improved the accuracy of yield predictions compared to traditional deterministic approaches. Specifically, the method reduced the estimation variance by approximately 20% across different regions in Kenya. The study demonstrates the effectiveness of integrating PDEs and Monte Carlo techniques for agricultural yield prediction, particularly when variance reduction is applied. These findings contribute to more robust decision-making processes in agriculture management. Future research should explore the scalability of these methods across larger geographical scales and incorporate additional variables such as soil quality and pest infestations into the models. Agricultural yield, Monte Carlo estimation, Partial Differential Equations, Variance reduction, Kenya Under standard regularity and boundary assumptions, the forecast state is modelled by $\text{partial}t u(t, x) = \kappa \dot{\partial} \{xx\} u(t, x) + f(t, x)$, and stability follows from bounded perturbations.

Keywords: Kenyan, Partial Differential Equations, Monte Carlo Method, Variance Reduction, Stochastic Modelling, Geostatistics, Numerical Integration

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