African Geometry and Topology (Pure Science)

Asymptotic Analysis and Identifiability Checks in Dynamical Systems for Agricultural Yield Prediction in Uganda

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Abstract

Dynamical systems theory is a mathematical framework used to model complex phenomena over time. In agricultural contexts, these models can predict yield based on various environmental and socio-economic factors. Asymptotic analysis will be applied to derive simplified models that capture long-term trends, while identifiability checks will ensure that the model can accurately estimate all its parameters from observed data. Theoretical derivations will include a first-order differential equation representing yield changes over time with respect to rainfall and soil fertility. This theoretical framework provides a robust foundation for understanding and predicting agricultural yields in Uganda by incorporating key environmental and socio-economic factors into a dynamical systems model. Theoretical insights can inform future empirical studies by guiding the selection of relevant parameters and simplifying data collection protocols. The developed models should be tested with real-world data to validate their predictive power. 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 Geography, Dynamical Systems, Asymptotic Analysis, Identifiability Checks, Time Series Models, Nonlinear Dynamics, Parameter Estimation*

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