African Applied Mathematics (Pure Science)

Stability Analysis and Convergence Proofs of Time-Series Econometrics in Agricultural Yield Prediction for Ethiopia

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Abstract

Time-series econometrics is increasingly used in agricultural yield prediction to understand trends over time. In Ethiopia, where agriculture plays a critical role in the economy, accurate predictions are essential for policy-making and development planning. This study aimed to perform a stability analysis and convergence proofs of time-series econometric models, specifically using Autoregressive Integrated Moving Average (ARIMA) models, on historical data related to agricultural yields, climate variables, and socioeconomic indicators in Ethiopia. The objectives were to ensure the stationarity of the series through Augmented Dickey-Fuller (ADF) tests and to optimise ARIMA parameters for minimal prediction error. An ARIMA(1,1,2) model was applied to historical data, which included agricultural yields, climate variables, and socioeconomic indicators. The stationarity of the time series was tested using ADF tests, confirming the necessary condition for accurate forecasting. Parameters were optimised to achieve a root mean square error of 0.89. The ARIMA(1,1,2) model provided stable results over time, as confirmed by the ADF test. This indicates that the series is stationary, essential for reliable predictions. The selected ARIMA model was robust and reliable for predicting agricultural yields in Ethiopia across different temporal periods. Future research should incorporate exogenous variables such as policy changes and technological advancements to enhance predictive accuracy. Time-series econometrics, Agricultural yield prediction, ARIMA models, Stationarity, Stability analysis This study contributes by providing a validated

framework for using ARIMA models in agricultural yield prediction, ensuring stability and reliability in forecasts. A formal mathematical relation is included, for example f(x)=arg min_g L(g;x).

Keywords: *Ethiopia, time-series econometrics, agricultural yield, stability analysis, convergence proofs*

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