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Spectral Methods and Condition-Number Analysis in Time-Series Econometrics for Epidemic Spread Modelling in Ethiopia

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Abstract

This study examines the application of spectral methods in time-series econometrics for modelling epidemic spread in Ethiopia. Spectral decomposition techniques are utilised to estimate the eigenvalues and eigenvectors of the time-series data representing epidemic dynamics. The condition number of the covariance matrix is calculated to assess the sensitivity of the model predictions to changes in input parameters. The spectral analysis revealed that the dominant eigenvalue was significantly greater than one, indicating potential instability unless carefully managed through regularization techniques. Condition-number analysis showed a moderate level of numerical stability across different datasets from Ethiopia's health records. The methodology demonstrated effectiveness in predicting epidemic trends by identifying and mitigating model sensitivity issues. Further research should explore the impact of varying initial conditions on the spectral decomposition results, particularly for different types of epidemics. 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: *Ethiopia, Time-Series Analysis, Spectral Methods, Eigenvalues, Condition Number, Econometrics, Stability Analysis*