African Probability and Statistics (Pure Science)

Finite-Element Discretization and Error Bounds in Numerical Optimization for Epidemic Spread Modelling in Senegal

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Abstract

Epidemic spread modelling in Senegal requires accurate numerical optimization techniques to predict disease progression. A finite-element approach was employed to discretize the differential equations representing epidemic spread. An assumption of constant population density across regions was made, leading to an eigenvalue problem that included the diffusion coefficient as a parameter. The method yielded accurate predictions with error bounds under conditions where the diffusion coefficient varied significantly between different regions in Senegal. This study contributes by providing a robust numerical optimization framework for epidemic spread modelling, ensuring reliable predictions are made across diverse regional settings in Senegal. Further research should explore how varying population densities affect model accuracy and investigate the impact of incorporating additional factors such as mobility and healthcare access into the models. Model selection is formalised as $\hat{\{}\theta\} = argmin_{\theta in\theta} ¿ L(\theta) + \lambda ¿ \omega(\theta) ¿$ with consistency under mild identifiability assumptions.

Keywords: *Sub-Saharan, Senegal, NumericalOptimization, FiniteElement, Discretization, ErrorBounds, DifferentialEquations*

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