African Probability and Statistics (Pure Science)

Topological Data Analysis Replication for Epidemic Spread Modelling in Rwanda: Stability and Convergence Analysis

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Abstract

Topological Data Analysis (TDA) has shown promise in modelling epidemic spread by capturing topological features of network data. A dataset from Rwanda was analysed using TDA techniques. A simplicial complex model was constructed based on social contact networks, with an assumption that the epidemic spread can be represented as a continuous time Markov chain. Stability and convergence properties of the model were rigorously proven. The analysis demonstrated stable and convergent behaviour of the epidemic model over multiple iterations, indicating reliable predictions. Stability and convergence proofs support the utility of TDA for Rwanda's epidemic spread modelling. Further studies should explore scalability and real-time applicability in varying social contexts. Topological Data Analysis, Epidemic Spread Modelling, Stability, Convergence, Rwanda 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: *Rwanda, Topology, Persistent Homology, Simplicial Complexes, Network Analysis, Stability Theory, Convergence Analysis*

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