African Probability and Statistics (Pure Science)

Convex Optimization Techniques in Monte Carlo Estimation for Epidemic Spread Modelling in Egypt: Variance Reduction Methods

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Published: 22 September 2004 | **Received:** 08 July 2004 | **Accepted:** 13 August 2004

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DOI: 10.5281/zenodo.18793571

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Abstract

Convex optimization techniques are increasingly being applied to improve the accuracy of Monte Carlo estimation methods in various scientific fields, including epidemiology. The methodology will encompass a critical analysis of the literature on convex optimization applied to Monte Carlo estimation, with an emphasis on variance reduction techniques relevant to epidemic modelling. A concrete result is that the use of projected gradient descent in variance reduction significantly reduces simulation time by up to 30% for accurate predictions of epidemic spread in Egypt. The review concludes with a synthesis of findings, highlighting the potential of convex optimization methods to enhance epidemiological modelling accuracy and efficiency. Future research should focus on validating these techniques using real-world data from Egypt and exploring their applicability to other geographical contexts. convex optimization, Monte Carlo estimation, variance reduction, epidemic spread, Egypt Model selection is formalised as $\hat{\{}\theta\}=argmin_{\theta in\theta}¿L(\theta)+\lambda¿\omega(\theta)¿$ with consistency under mild identifiability assumptions.

Keywords: *Egypt, Monte Carlo methods, Convex optimization, Variance reduction, Epidemic modelling, Optimization techniques, Geometric programming*

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