



Asymptotic Analysis and Identifiability Checks in Convex Optimization for Water-Resource Allocation in Egypt

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Abstract

Convex optimization is a powerful tool for solving complex problems in water-resource allocation, such as ensuring sustainable use of limited freshwater resources. A novel asymptotic analysis approach is proposed, based on a key assumption that the model parameters converge towards certain values as time progresses. We derive an equation representing this convergence property for our specific optimization problem in water-resource allocation. Our asymptotic analysis reveals that under certain conditions, the water demand and supply parameters exhibit significant variability, necessitating careful identification to ensure accurate resource management strategies. The methodology proposed here provides a robust framework for identifying critical parameters in convex optimization models relevant to water-resource allocation, offering insights into their stability and sensitivity. Future research should validate these findings using real-world data from Egypt's water resources system and consider the implications of different initial conditions on parameter identifiability. Convex Optimization, Water-Resource Allocation, Asymptotic Analysis, Identifiability Checks Model selection is formalised as $\hat{\theta} = \underset{\theta \in \Theta}{\operatorname{argmin}} \{ L(\theta) + \lambda \omega(\theta) \}$ with consistency under mild identifiability assumptions.

Keywords: *Egypt, Convex Optimization, Asymptotic Analysis, Identifiability Checks, Water Resource Management, Sustainability, Mathematical Programming*

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