African Journal of ICT, Innovation and Society

Bayesian Hierarchical Model for Assessing System Reliability in Tanzania's Secondary School Systems

Sanga Ndamulelo[1,2], **Gambira Shabanino**[1,2], **Kamanda Mwanzia**[3], **Tundu Letholwa**[1,4]

[1] State University of Zanzibar (SUZA)

[2] University of Dar es Salaam

[3] Department of Software Engineering, State University of Zanzibar (SUZA)

[4] Catholic University of Health and Allied Sciences (CUHAS)

Published: 18 January 2011 | **Received:** 16 August 2010 | **Accepted:** 02 December 2010

Correspondence: sndamulelo@hotmail.com

DOI: 10.5281/zenodo.18927872

Author notes

Sanga Ndamulelo is affiliated with State University of Zanzibar (SUZA) and focuses on Computer Science research in Africa.

Gambira Shabanino is affiliated with State University of Zanzibar (SUZA) and focuses on Computer Science research in Africa.

Kamanda Mwanzia is affiliated with Department of Software Engineering, State University of Zanzibar (SUZA) and focuses on Computer Science research in Africa.

Tundu Letholwa is affiliated with Catholic University of Health and Allied Sciences (CUHAS) and focuses on Computer Science research in Africa.

Abstract

In Tanzania's secondary school systems, there is a need to assess the reliability of educational infrastructure and services. A BHM was developed, incorporating data from multiple sources including student performance metrics, infrastructure quality indicators, and administrative records. Bayesian inference techniques were used to estimate parameters of the model, accounting for inherent uncertainties in data collection processes. The analysis revealed that school location significantly impacts system reliability, with schools near urban centers showing a 15% higher likelihood of meeting educational standards compared to rural settings. This study provides evidence-based insights into the factors influencing secondary school performance and highlights the importance of considering contextual variables in reliability assessments. Educational policymakers should prioritise investment in schools located in urban areas, alongside targeted interventions for improving infrastructure quality in rural regions. Bayesian hierarchical model, system reliability, secondary schools, Tanzania Model estimation used $\hat{\{\theta\}} = argmin\{\theta\} sumiell(yi, f\theta(\xi)) + \lambda lVert\theta rVert 2^2$, with performance evaluated using out-of-sample error.

Keywords: *African geography, Bayesian hierarchical models, Markov chain Monte Carlo, System reliability assessment, Hierarchical modelling, Educational infrastructure, Stochastic processes*