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Bayesian Hierarchical Model Evaluation for Yield Improvement in South African Industrial Machinery Fleets Systems

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Abstract

Industrial machinery fleets in South Africa face challenges in optimising performance and yield efficiency. A Bayesian hierarchical model was developed to analyse data from multiple industrial machinery systems, accounting for variability at different levels (e.g., specific equipment type, fleet size). The model revealed a significant improvement potential of 15% in yield efficiency when applied across diverse fleets, with particular gains observed in high-utilization mining operations. The Bayesian hierarchical approach demonstrated robustness and adaptability to varying industrial settings, offering practical avenues for enhancing fleet performance. Implementing the model requires comprehensive data collection strategies tailored to specific machinery types within different operational contexts. The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *South Africa, Bayesian hierarchical model, industrial machinery, fleet systems, yield efficiency, statistical methods, optimization techniques*

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