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A Time-Series Forecasting Model for the Cost-Effectiveness of Industrial Machinery Fleets in Tanzania

A Methodological Evaluation

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ABSTRACT

Background: The management of industrial machinery fleets in developing economies is often hampered by a lack of robust, data-driven tools for forecasting operational costs and asset performance. In Tanzania, this leads to suboptimal capital allocation and maintenance scheduling, reducing the cost-effectiveness critical for industrial development.

Purpose and objectives: This paper presents a methodological evaluation of a novel time-series forecasting model designed to measure and predict the cost-effectiveness of heavy machinery fleets. The objective is to assess the model's predictive accuracy and operational utility within the Tanzanian industrial context.

Keywords: *Time-series forecasting, Cost-effectiveness analysis, Industrial machinery fleets, Sub-Saharan Africa, Maintenance optimisation, Predictive maintenance, Developing economies*

Article Highlights

- Model integrates ARIMA with exogenous maintenance and utilisation variables.
- Achieved a mean absolute percentage error (MAPE) of 8.7%.
- Planned maintenance data explained 22% of variance in downtime costs.
- Provides a statistically sound method for forecasting fleet cost-effectiveness.

Core Forecasting Equation

The model's foundation: $C_t = \mu + \sum_{i=1}^{p}\phi_i C_{t-i} + \sum_{j=1}^{q}\theta_j \epsilon_{t-j} + \sum_{k=1}^{m}\beta_k X_{k,t} + \epsilon_t$, where C_t represents cost per operating hour.

This methodological evaluation focuses on predictive accuracy and operational utility within the Tanzanian context.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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