Performance Time Series Analysis in the Multiple Baseline Framework

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Performance time series (PTS) encode system state evolution, anomaly patterns, and structural change information, making them essential for proactive system maintenance and reliability assessment. Real-world systems typically operate under multiple normal modes, each corresponding to a distinct performance baseline, which renders the data-generating process structurally non-stationary. The core challenge lies in distinguishing normal mode switching from genuine anomalous behavior.

Given the continuous and streaming nature of performance metrics, this work argues that sequential analysis provides a natural methodological foundation for performance time series analysis. Research on PTS analysis should focus on three core components:

1) multiple-baseline modeling and switching detection;
2) multiple-baseline-aware anomaly detection mechanisms;
3) interpretable continuous health scores for system state quantification.

To support this framework, we formalize the multiple-baseline structure as interval-distribution pairs satisfying distributional consistency, temporal stability, reproducibility, and discriminability. We further construct a dataset containing 42 controllable perturbation-response validation pairs with mechanism-generated event-level anomaly annotations, along with a reproducible data collection paradigm.