Learning Curve Analysis Methods

- Multimodal Model for Non-Invasive Detection of DRD2, SSTR2 and ESR1 Receptor Profiling in Pituitary Neuroendocrine Tumors: A Retrospective Study
- Machine learning-driven SLC prognostic signature for glioma: predicting survival and immunotherapy response
- Transcriptomic analysis reveals novel targets in benign schwannoma using machine learning
- Robot-assisted versus navigated spinal fusion surgery: a comparative multicenter study on transpedicular screw placement accuracy and patient outcomes
- Association between multiple serum biomarkers and cerebral vasospasm in patients with aneurysmal subarachnoid hemorrhage
- Machine learning-based prediction of 6-month functional recovery in hypertensive cerebral hemorrhage: insights from XGBoost and SHAP analysis
- Longitudinal Risk Prediction for Pediatric Glioma with Temporal Deep Learning
- Machine learning-based MRI radiomics predict IL18 expression and overall survival of low-grade glioma patients

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 CUSUM Analysis

 Moving Average Plots

 Regression Analysis

 Time to Task Completion

 Failure Rate Tracking

Regarding Competency-based education in neurosurgery for residents, you want a method that doesn't just show improvement over time, but detects when a resident achieves mastery or consistent performance.

 CUSUM Analysis (Cumulative Sum)

 Best suited for competency-based training

Strengths: It detects small shifts in performance and shows when a resident has reached a predefined competency level (e.g., acceptable error rate or success rate).

Highly sensitive to deviations, making it ideal for identifying the transition from novice to competent.

It can be customized per procedure and gives a real-time sense of when a trainee is consistently competent.

 Moving Average Plots Strengths: Good for smoothing out fluctuations and showing general trends.

Limitations: Less precise for pinpointing when competence is reached. Doesn't account for variation around target performance levels.

 Regression Analysis Strengths: Shows correlation between experience and performance.

Limitations: More useful for research or group-level trends. Not very actionable for individual assessments in real-time.

 Time to Task Completion Strengths: Easy to measure and often improves with skill.

Limitations: Speed is not always a good proxy for safety or competency, especially in neurosurgery. Residents might go faster before they're safe.

 Failure Rate Tracking Strengths: Tracks adverse events or critical failures.

Limitations: Important for patient safety, but not sensitive enough to guide training progression unless combined with another metric.

 Conclusion: CUSUM is your best pick Why? Because competency-based education is about ensuring residents perform consistently above a set standard, and CUSUM analysis can flag exactly when that happens. It aligns beautifully with milestones and entrustable professional activities (EPAs) in surgical training.

If you're building a framework for assessing neurosurgical residents, consider pairing CUSUM with qualitative feedback and task-specific benchmarks for a robust system.

Would you like a simple CUSUM spreadsheet or Python template tailored for neurosurgery tasks (e.g., ventricular drain placement or aneurysm clip application)?