
PRIOR CHOICES AND E-PROCESSES IN SEQUENTIAL A/B TESTING UNDER COMPOSITE NULL HYPOTHESES

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ABSTRACT

In sequential A/B testing, the comparison problem is formulated as a hypothesis test. However, monitoring data continuously challenges classical frameworks and leads to a critical problem: severe Type I error inflation. Moreover, real-world tests involve composite null hypotheses where the true parameter is a range instead of a fixed point. Together, continuous monitoring and this composite structure break traditional likelihood ratio tests and make controlling Type I error difficult.

To resolve these challenges, we apply Bayesian marginalization over the composite null space to construct e-values that accumulate into e-processes. Grounded in martingale theory and Ville's inequality, this framework provides safe evidence for decision-making and guarantees strict Type I error control under continuous monitoring.

Practical performance of this framework is illustrated through a simulation study comparing different prior choices for Bayesian marginalization. The results are then analyzed in terms of Type I error control and decision speed.

Keywords Sequential A/B Testing · E-Processes / E-Values · Martingale · Bayesian Marginalization

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