

# Differentially Private Sequential Probability Ratio Tests

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AISTATS 2026   **Spotlight**

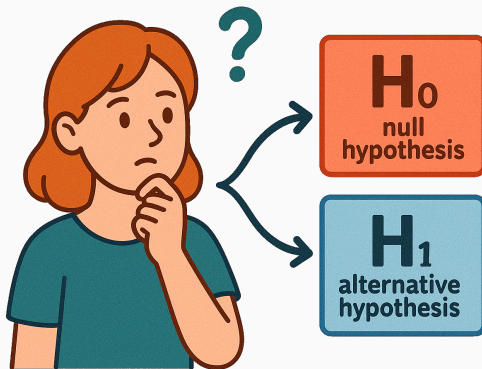


# Sequential Hypothesis Testing & SPRT

**Setup:** We observe samples  $X_1, X_2, \dots$  sequentially from distribution  $\nu_\theta$

**Goal:** Test  $H_0 : \theta = \theta_0$  vs  $H_1 : \theta = \theta_1$  with as few samples as possible

**Constraints:** False positive probability  $\leq \alpha$ , false negative probability  $\leq \beta$

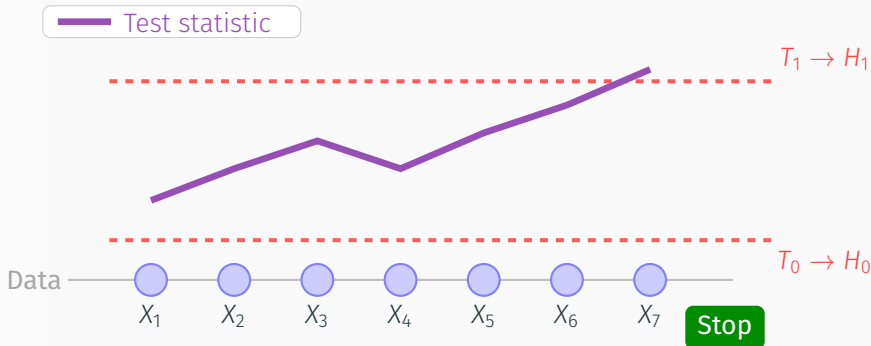


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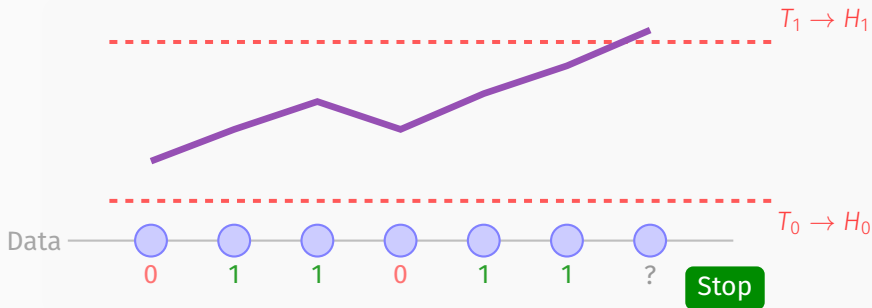


**SPRT.** Stop the moment the test statistic exits  $[T_0, T_1]$ .

**Optimal** (Wald, 1948): minimizes  $\mathbb{E}[\tau]$  among all valid tests.

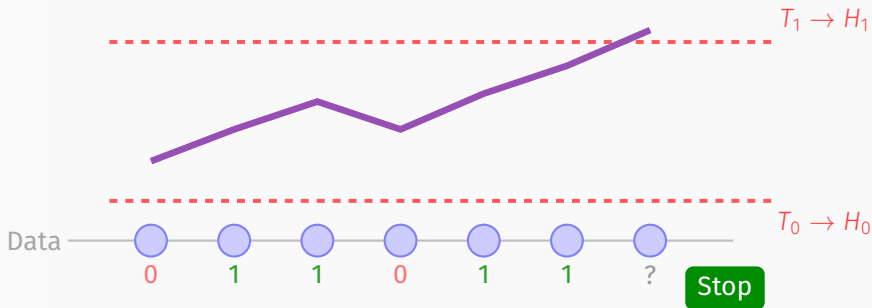
## ...but the stopping time leaks privacy

Clinical trial:  $H_0$ : drug success rate = 30% vs  $H_1$ : drug success rate = 70%



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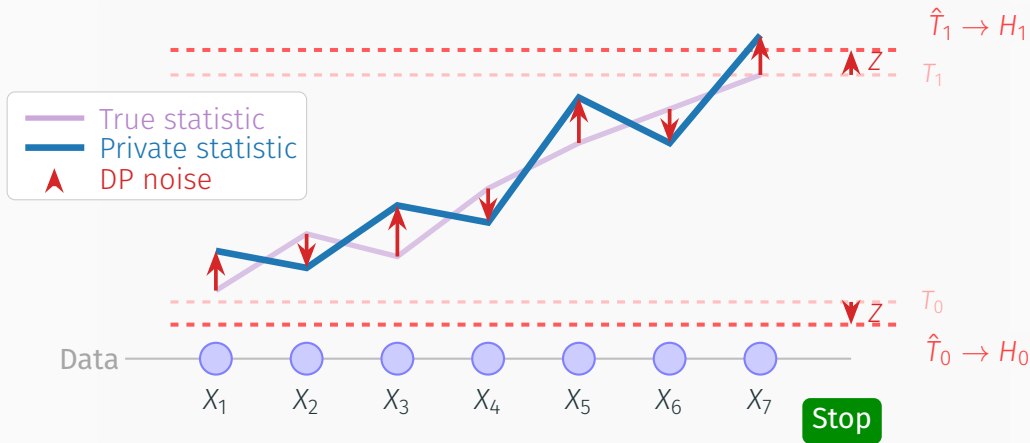


**Stopping  $\Rightarrow$  patient 7 was a SUCCESS**

A failure would have moved the statistic away from  $T_1$

The stopping time *itself* leaks the data.

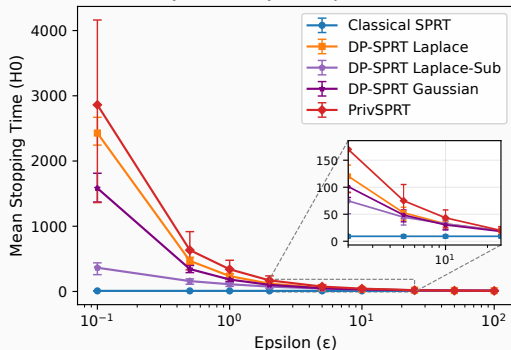
## DP-SPRT: Noisy Statistic, Noisy Thresholds, Private Testing



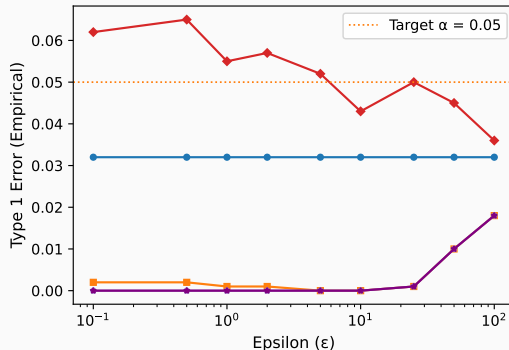
Component: **OutsideInterval** — a general DP mechanism for *double-sided* private monitoring.

# DP-SPRT works and it is theoretically calibrated

Sample complexity vs.  $\epsilon$



Type-I error vs.  $\epsilon$



Fewer samples than baseline<sup>1</sup>

Never violates the error target: calibrated *theoretically*, no Monte-Carlo tuning.

Matching lower bound  $\Rightarrow$  near-optimal for close hypotheses.

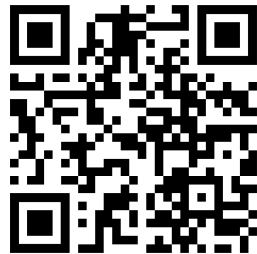
<sup>1</sup> W. Zhang, Y. Mei, R. Cummings. *Private Sequential Hypothesis Testing for Statisticians: Privacy, Error Rates, and Sample Size*. 2022.

# Come to the poster

On the poster you'll see:

- General **OutsideInterval** privacy mechanism
- Full **DP-SPRT** algorithm  
Laplace ( $\epsilon$ -DP) and Gaussian (Rényi-DP) instantiations.
- Privacy, correctness, and sample complexity
- Privacy amplification by subsampling

Check out the full paper



See you at the poster!