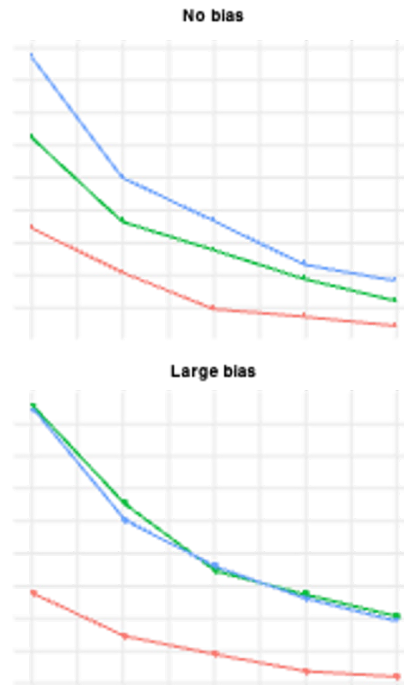


# External Controls: Adaptive-TMLE

- Dang et al (2023): ES-CV-TMLE that data adaptively decides to **accept or reject** external data based on evaluating bias relative to gain in variance.
- Adaptive-TMLE is an advance in TMLE.
- It yields a new method for integrating external controls that **estimates the bias** from external data and **corrects** the pooled TMLE of ATE.
- The method is shown to be asymptotically **valid coverage** and type-I error **without any assumptions beyond RCT**.
- Advantage is that it yields a way forward with biased external control data while preserving valid inference.

## MSE comparisons

ESTIMATOR: A-TMLE ES-CVTMLE TMLE



Adaptive debiased machine learning  
using data-driven model selection techniques

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