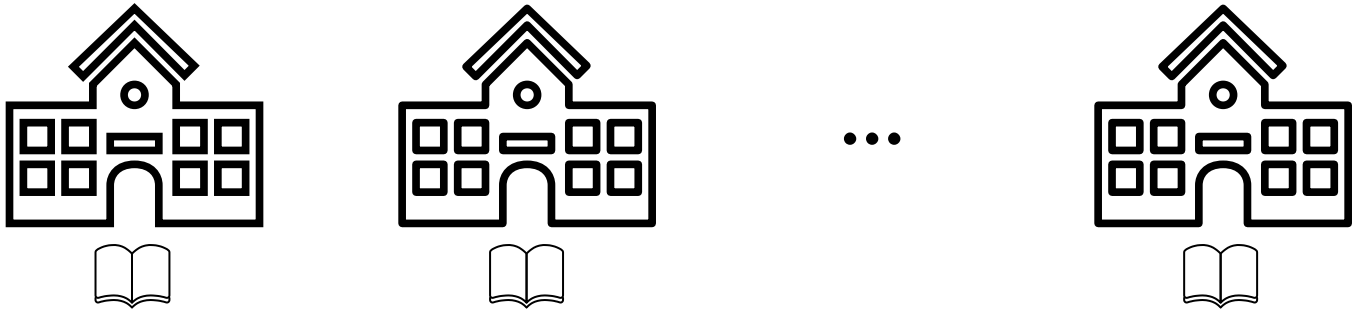
SREE

On power analyses for individual site impacts in multisite trials

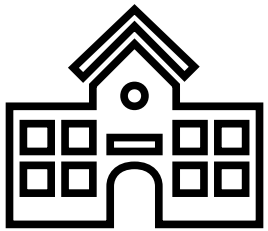
Jonathan Che & Luke Miratrix

Multisite trials & Multilevel models

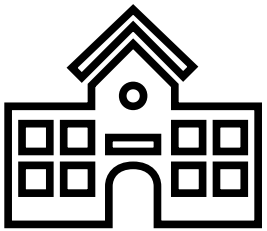
A multisite trial is a bunch of single-site trials



We could separately estimate effects at each site, but…

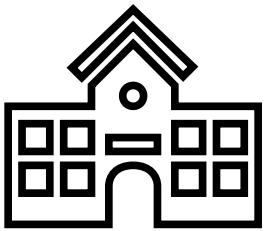


$\hat{\tau}_1$



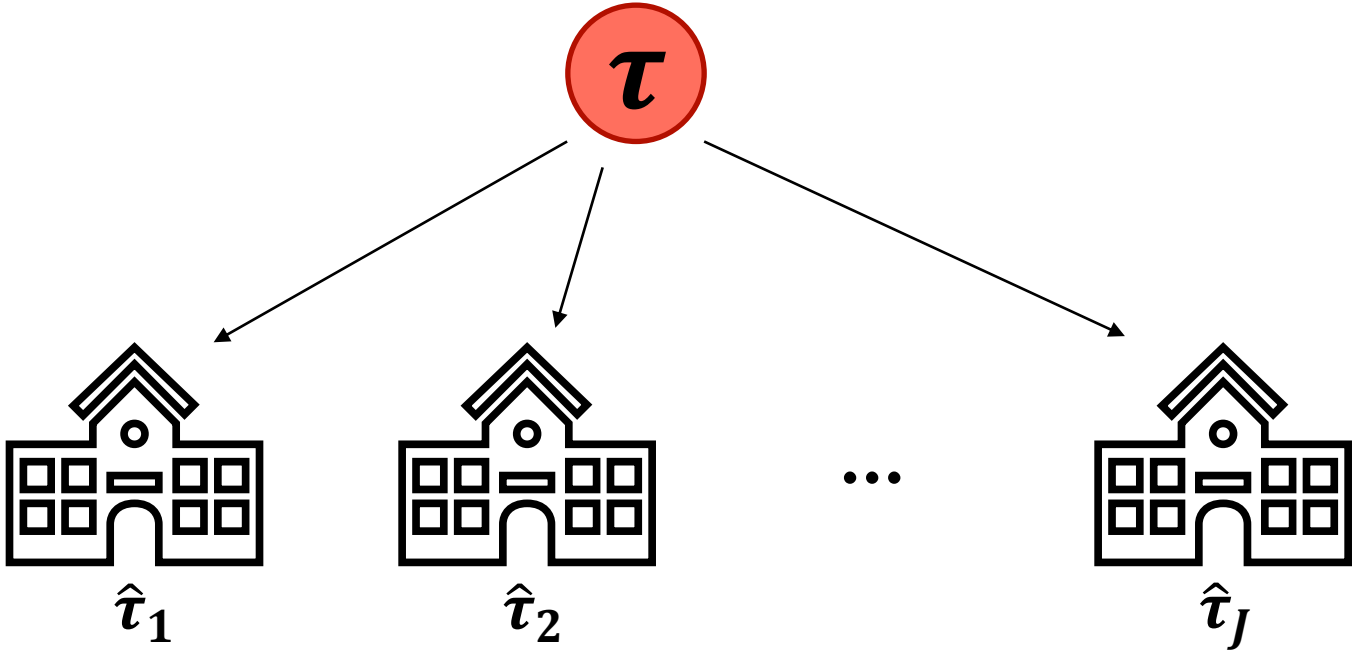
$\hat{\tau}_2$

…



$\hat{\tau}_J$

Multilevel models (MLMs) produce partially pooled effect estimates



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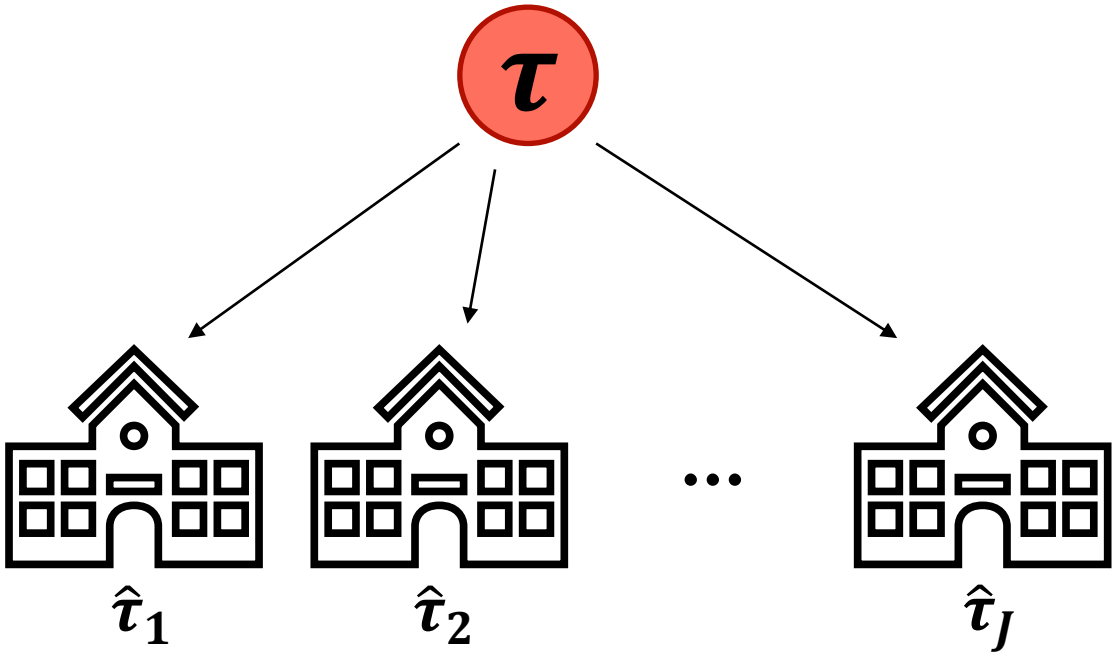

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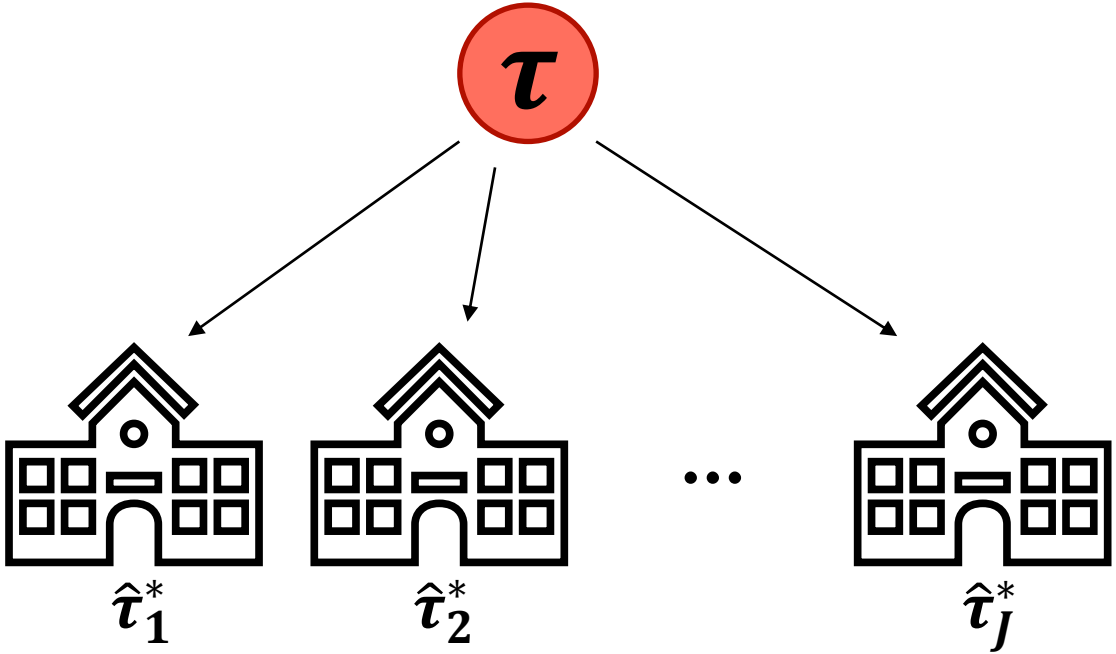
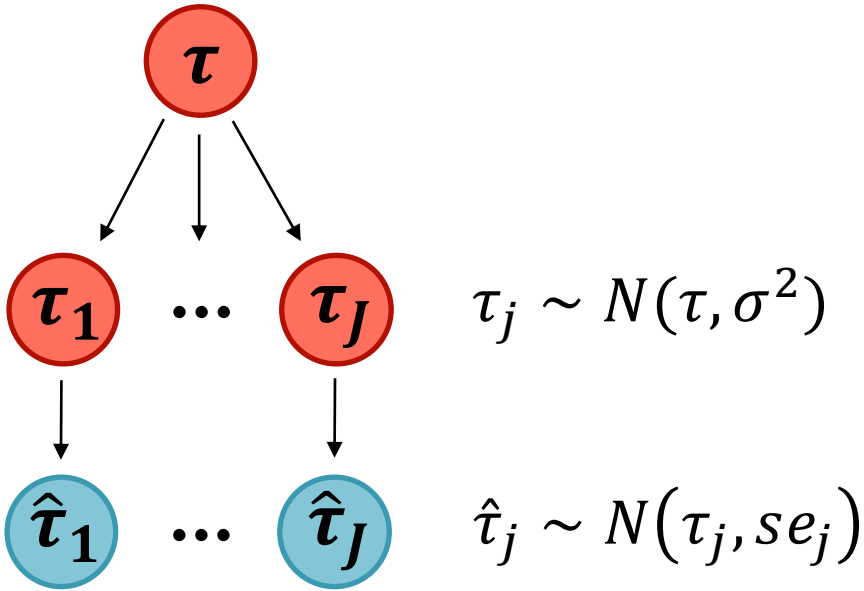


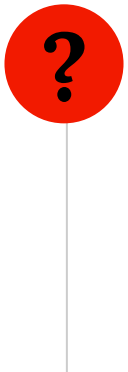
MLM notation



What do we want from our MLM?

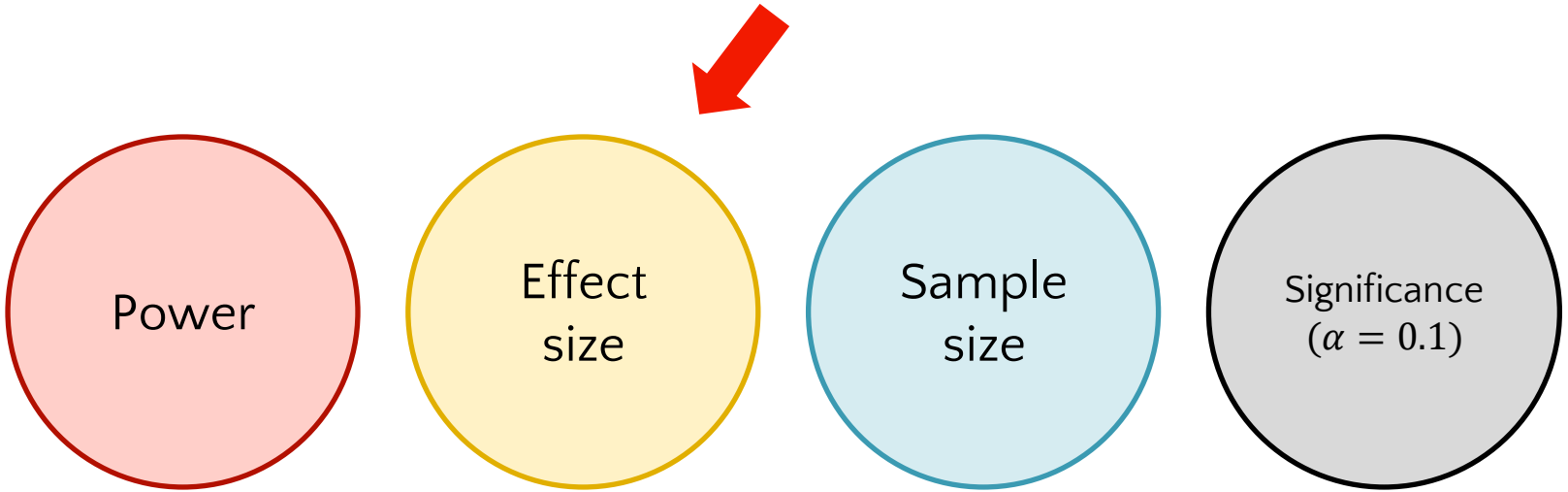
1. Estimates of τ, σ^2
2. Estimates of $\{\tau_1, \ldots, \tau_J\}$

How should we power a multisite trial to estimate τ_j?

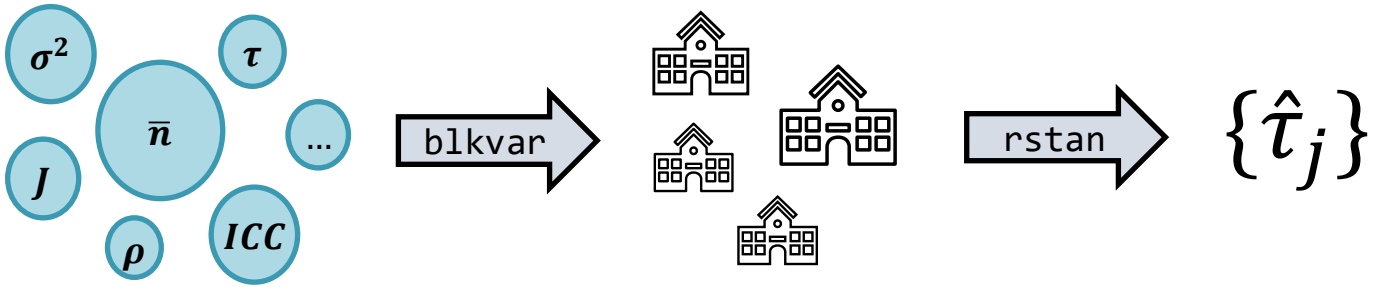


Power analysis

A basic power analysis

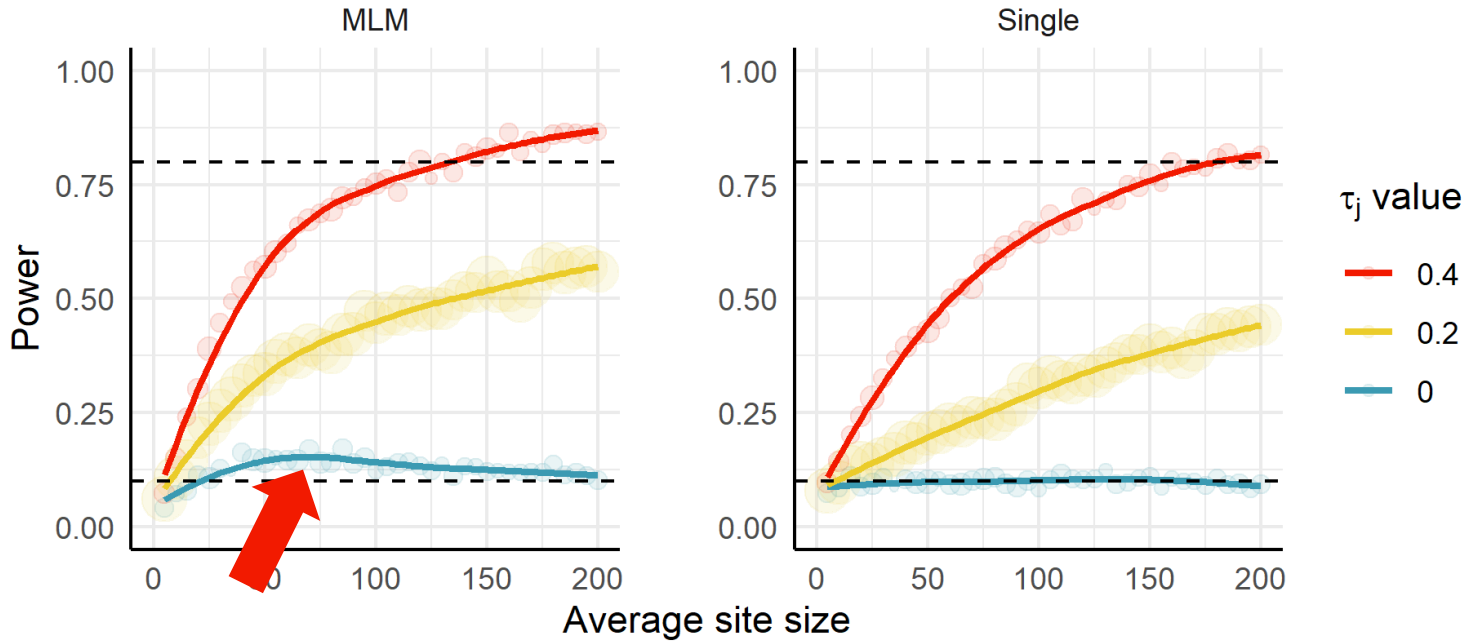


Simulation-based power analysis pipeline

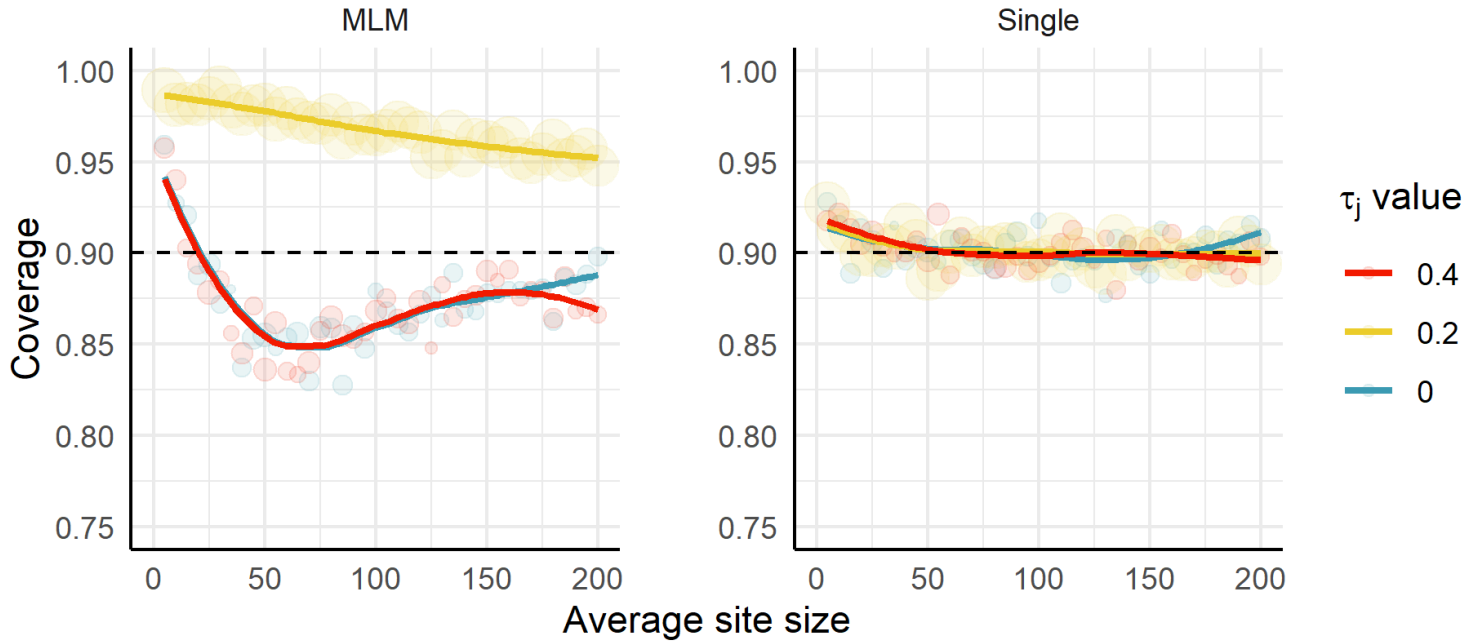


$\tau_1, \ldots, \tau_{25} \sim N(0.2, 0.2^2)$

MLMs increase power at fixed τ_j values, but...

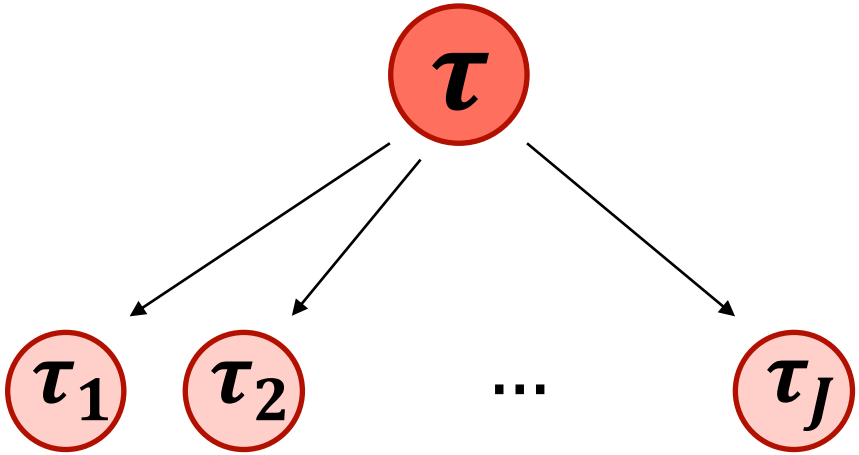


...MLMs don't have appropriate coverage for fixed τ_j values

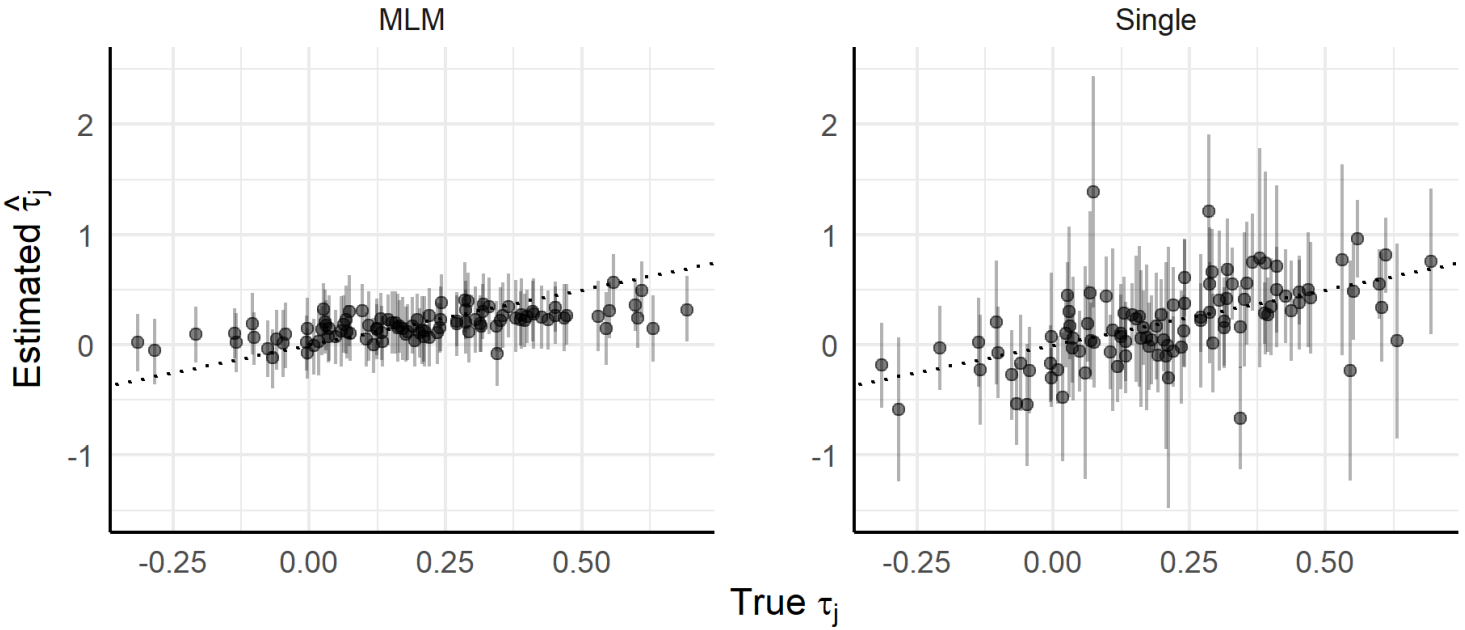


MLMs have appropriate coverage across random τ_j values

$$\tau_j \sim N(\tau, \sigma^2)$$



Example: MLMs don't have appropriate coverage for fixed τ_j



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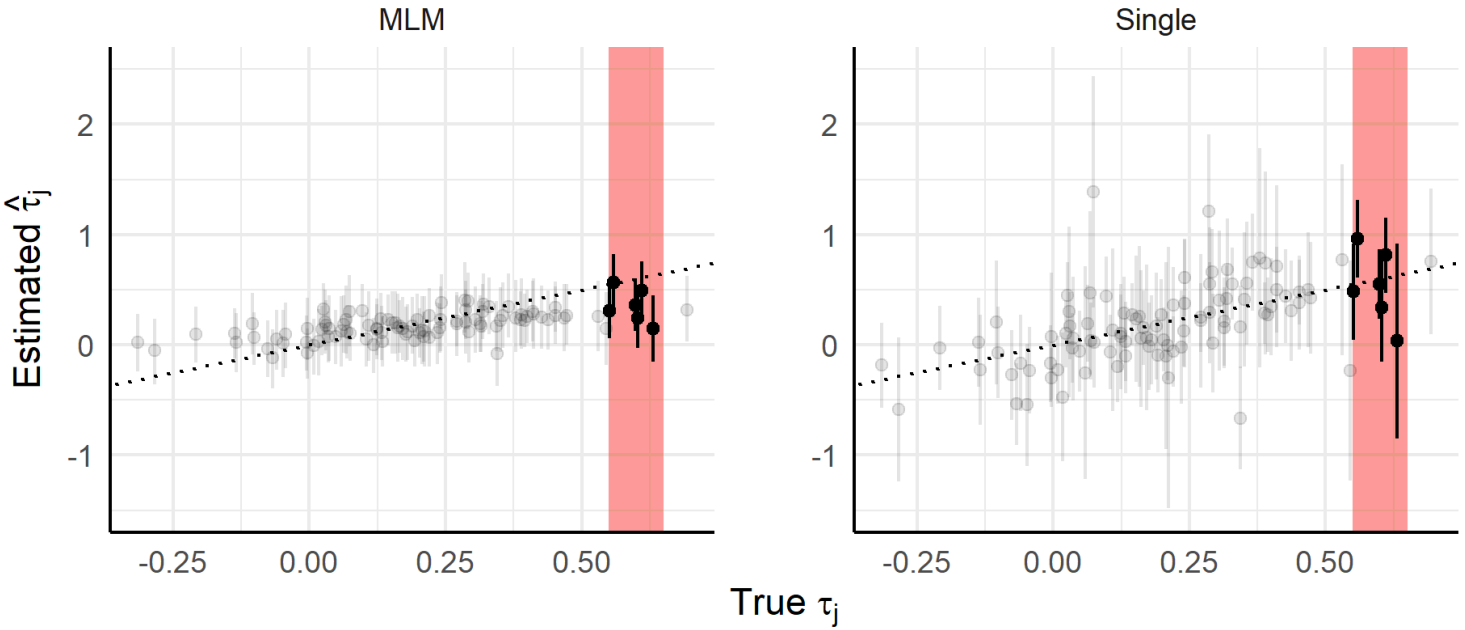
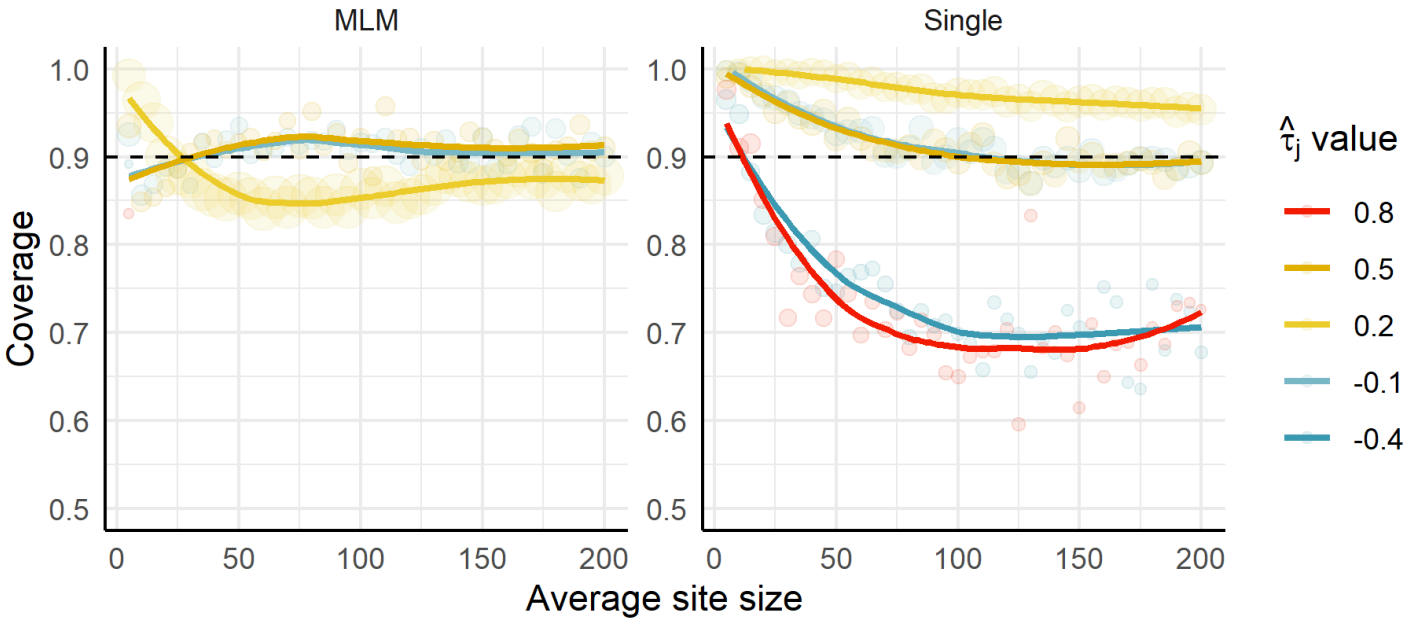


MLMs have appropriate coverage at estimated $\hat{\tau}_j$ values



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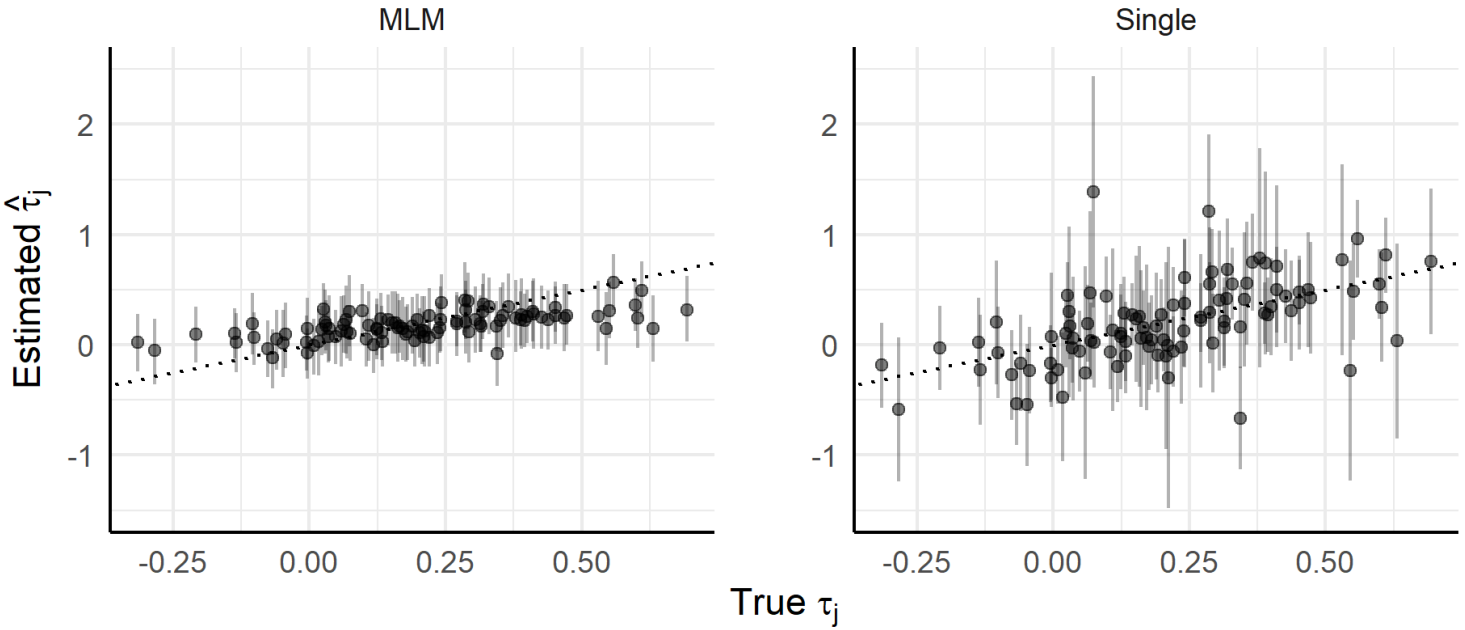

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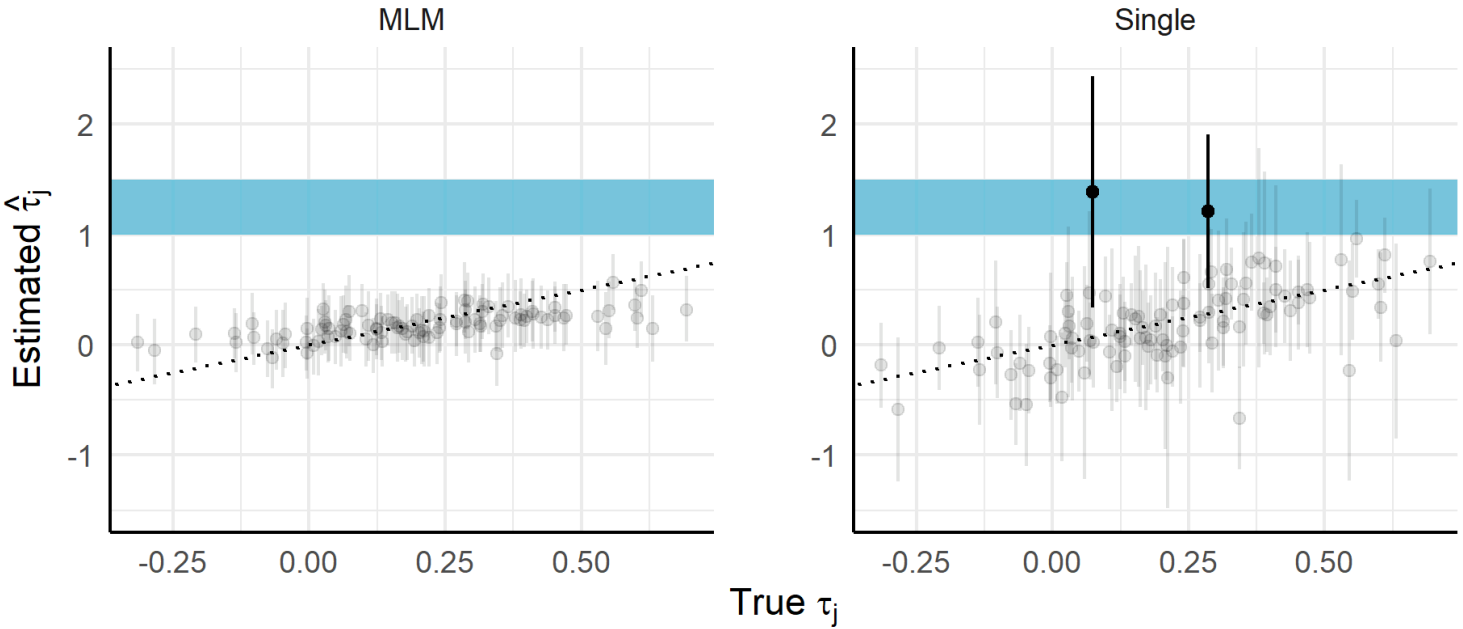

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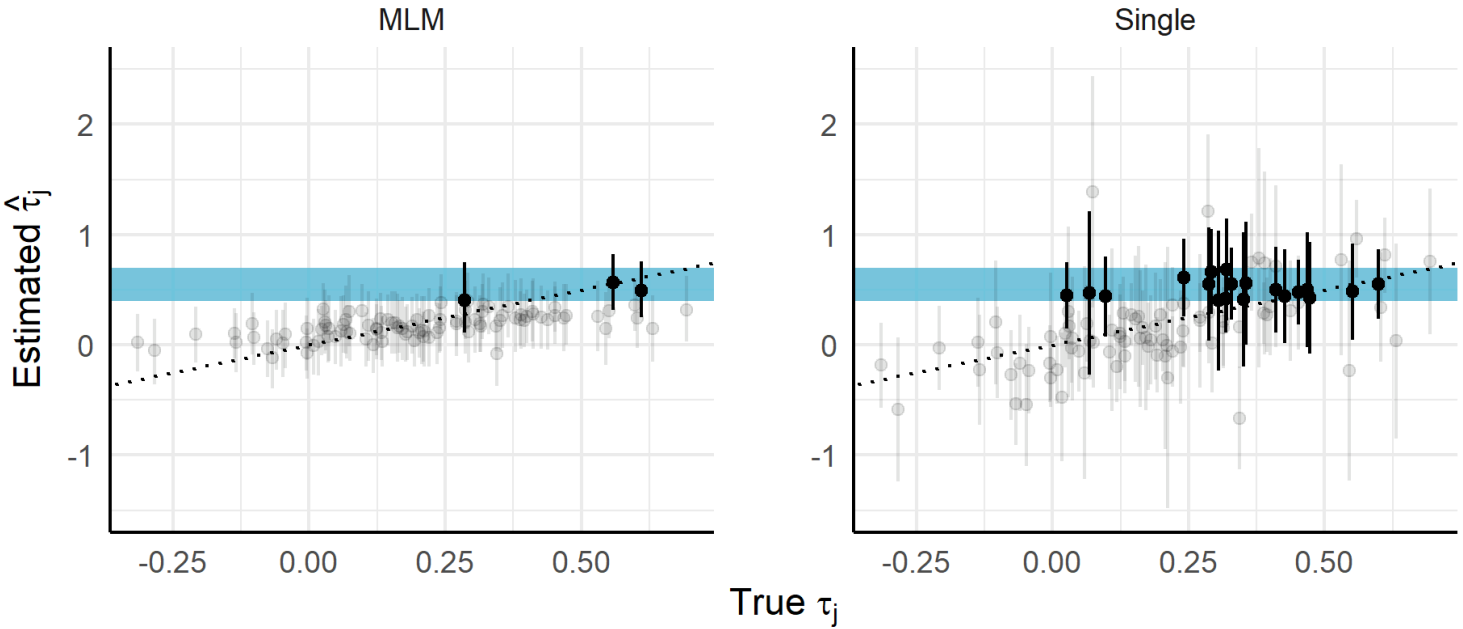
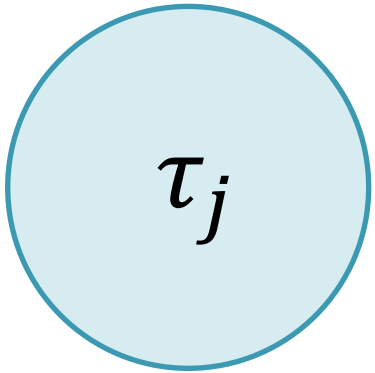


Summary

	Multilevel model interval estimates	Single-site interval estimates
Width	Narrower	Wider
Unconditional coverage	✓	✓
Coverage cond. on $\tau_j = c$	Poor for extreme τ_j	✓
Coverage cond. on $\hat{\tau}_j = c$	✓	Poor for extreme $\hat{\tau}_j$

Conclusions

Our proposed solution



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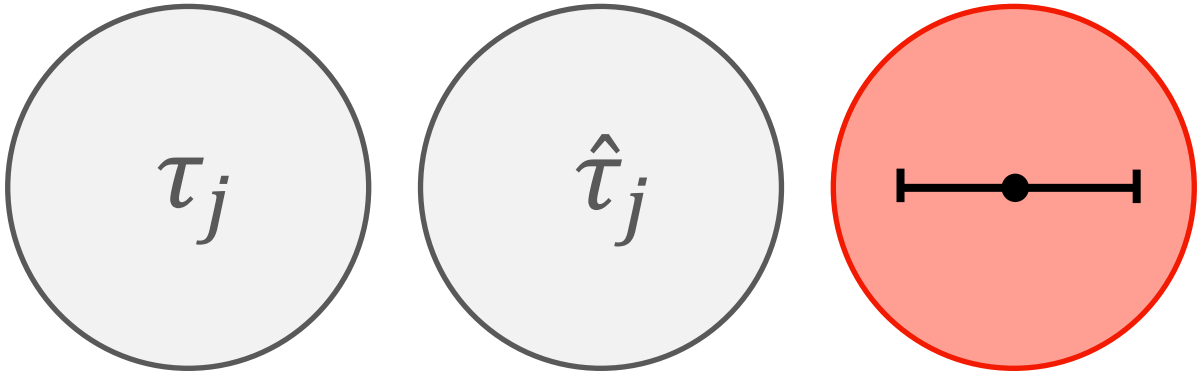
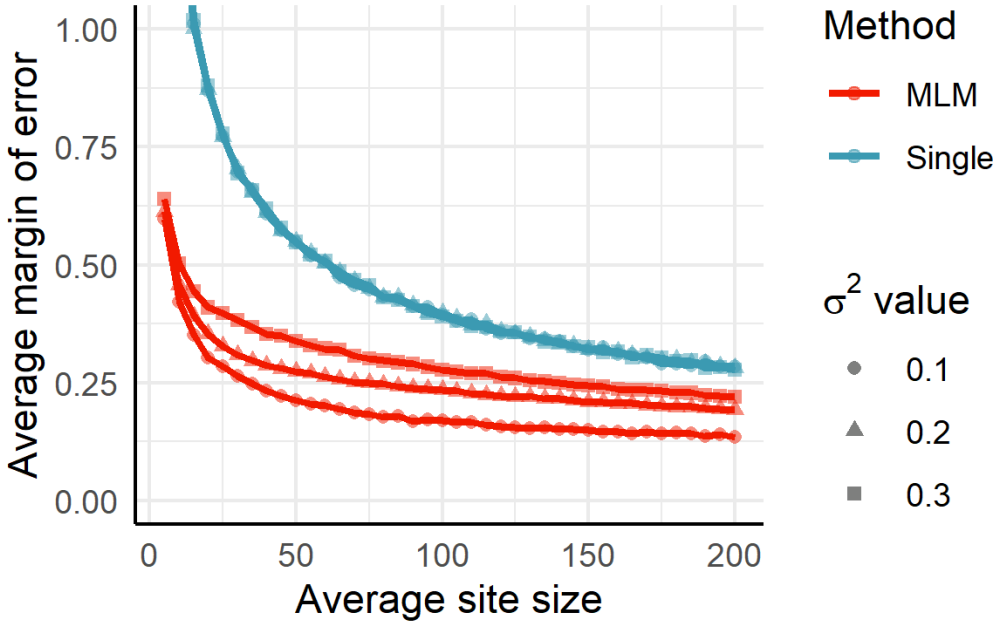


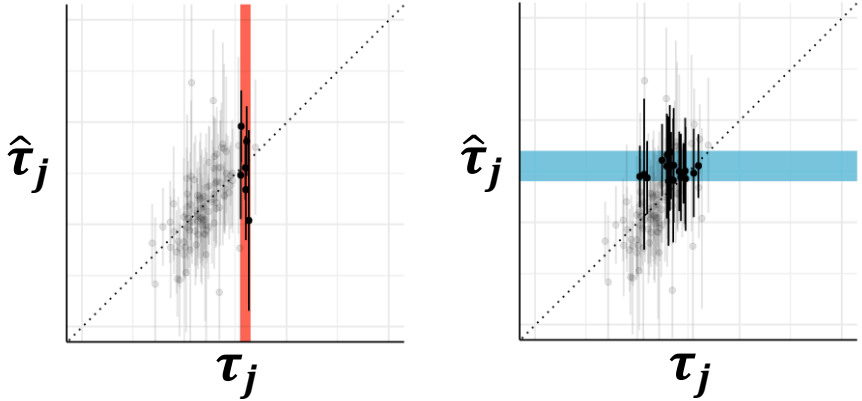
Example “power” analysis

- $J = 25$
- $ICC = 0.2$
- $\tau = 0.2$
- $\sigma^2 = 0.1, 0.2, 0.3$
- $\sigma_y^2 = 0.8$
- $\rho = 0$
- varying n_j



Conclusion

1



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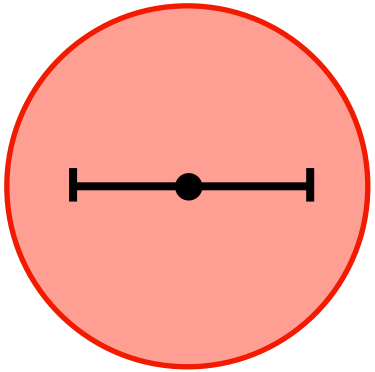

Thank you!

Questions?

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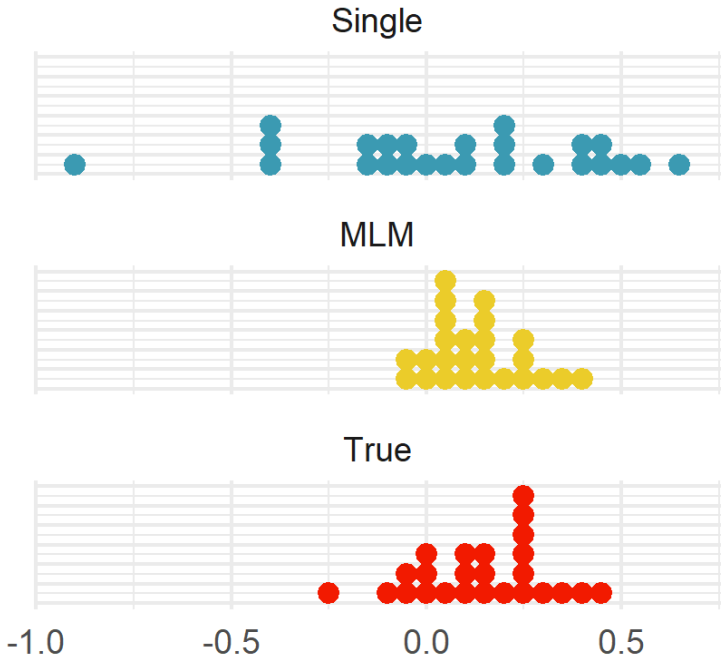
Shrinkage biases site-level effect estimates



$[\tau_j \sim N(0.2, 0.2^2)]$

MLMs have appropriate coverage across random τ_j values