Improving on the Small Sample Size Inference

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In the beginning . . .

z-test assumptions

- data is normal
- you know σ

t-test

- data is normal
- you DON'T know σ

(i.e., you assume less)

What if?

What if your data isn't normal?

What if your variance isn't constant?

What if you misspecified the model?

What if your assumptions are wrong (or you don't want to make them)?

Enter the Sandwich!!

You learn about this as a grad student.

So called because multivariate form is $A^{-1}BA^{-1}$.

Computed from derivatives of log-likelihood.

Asymptotically correct variance estimates for estimators.

What me worry?

Sandwich is notoriously bad at small sample sizes.

There are several ad hoc attempts to correct it.

So far, there are no systematic attempts to do better.

What I did.

I analyzed the argument for the sandwich.

Noticed four approximating assumptions.

Developed a method using a pivot that only uses two of the approximating assumptions.

A pivotal moment

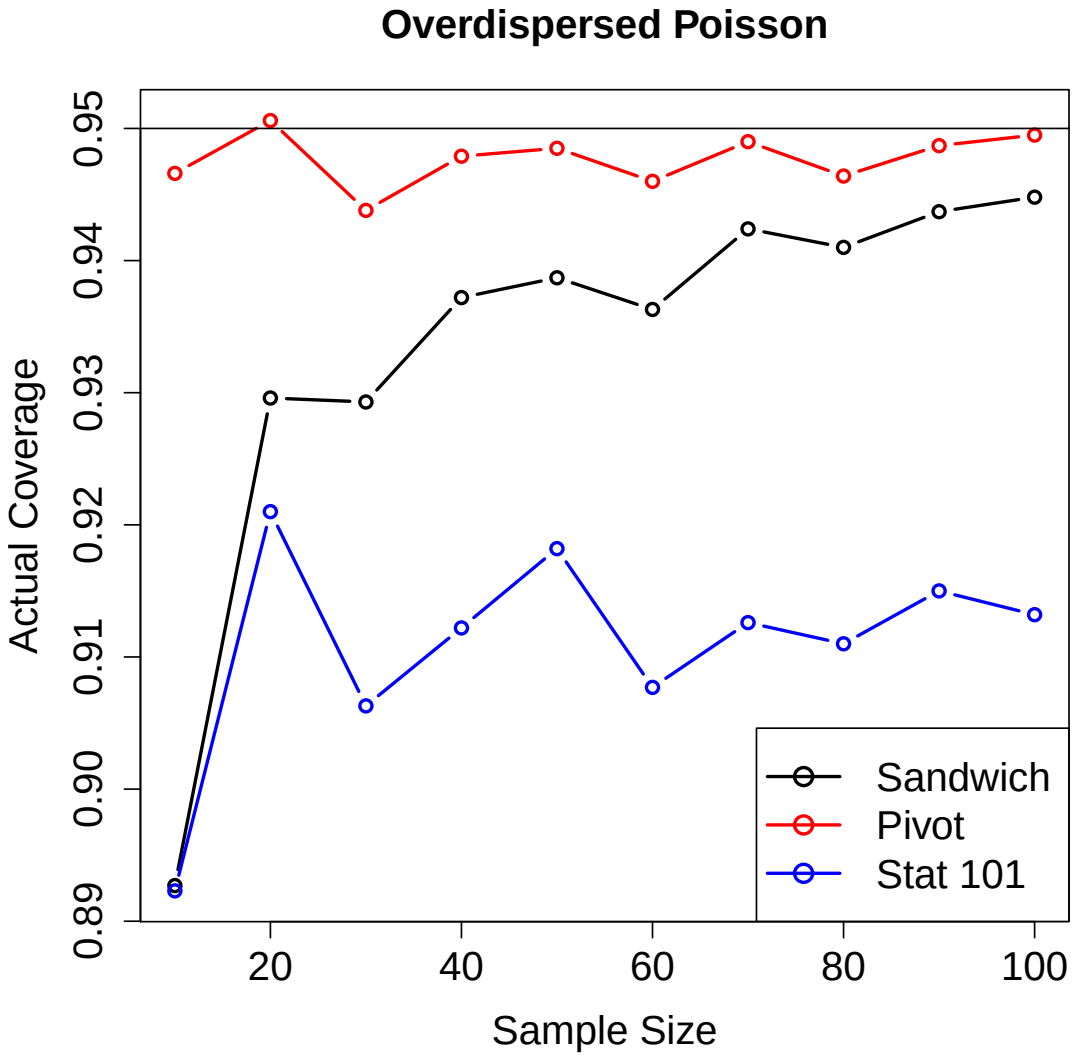
What is a pivot?

Common pivot: $\frac{\bar{X}-\mu}{\sigma/\sqrt{n}} \sim N(0,1)$

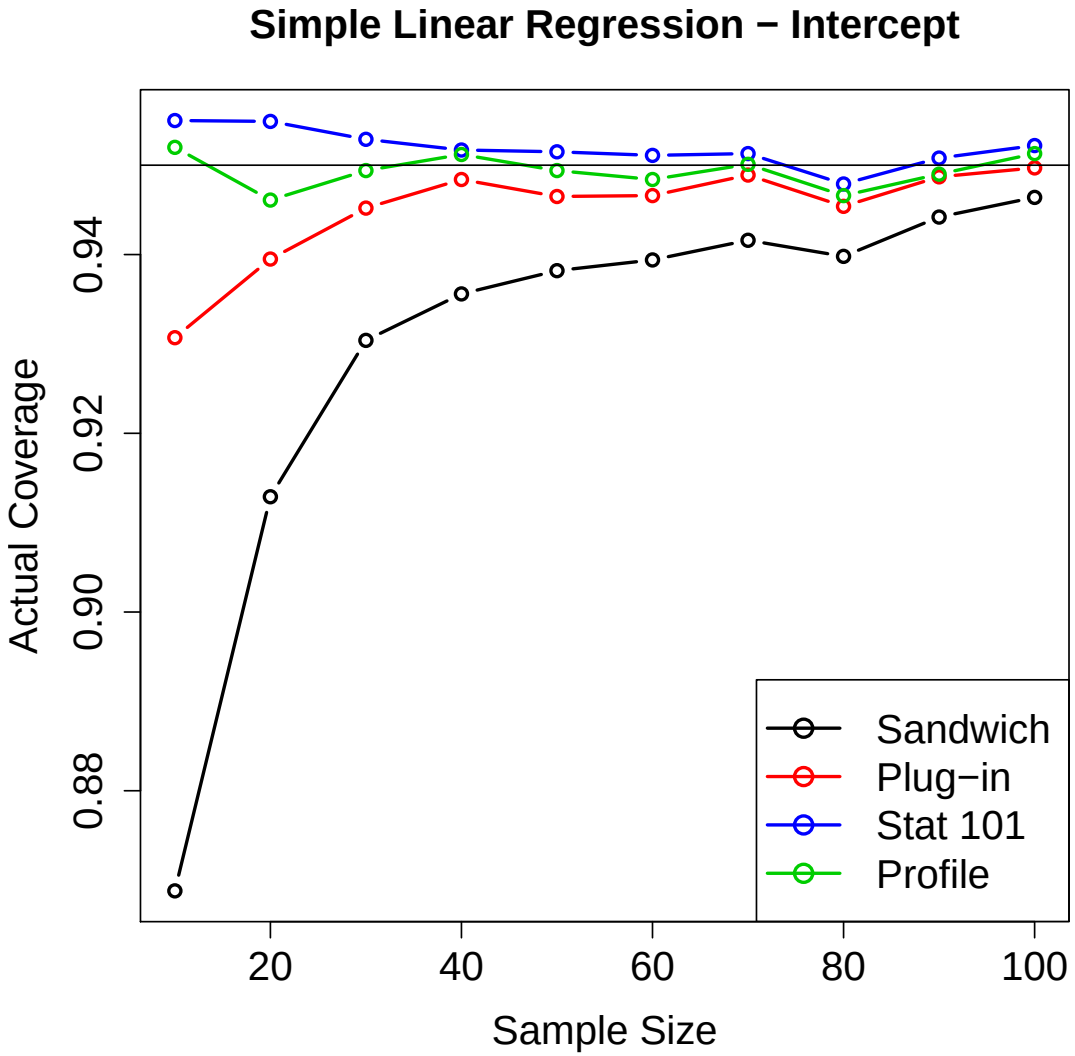
My pivot: $\sqrt{n}\frac{\frac{1}{n}\sum l_\theta(y_i,\theta)}{\frac{1}{n}\sum l_\theta(y_i,\theta)^2} \sim N(0,1)$

Invert the pivot to find confidence intervals.

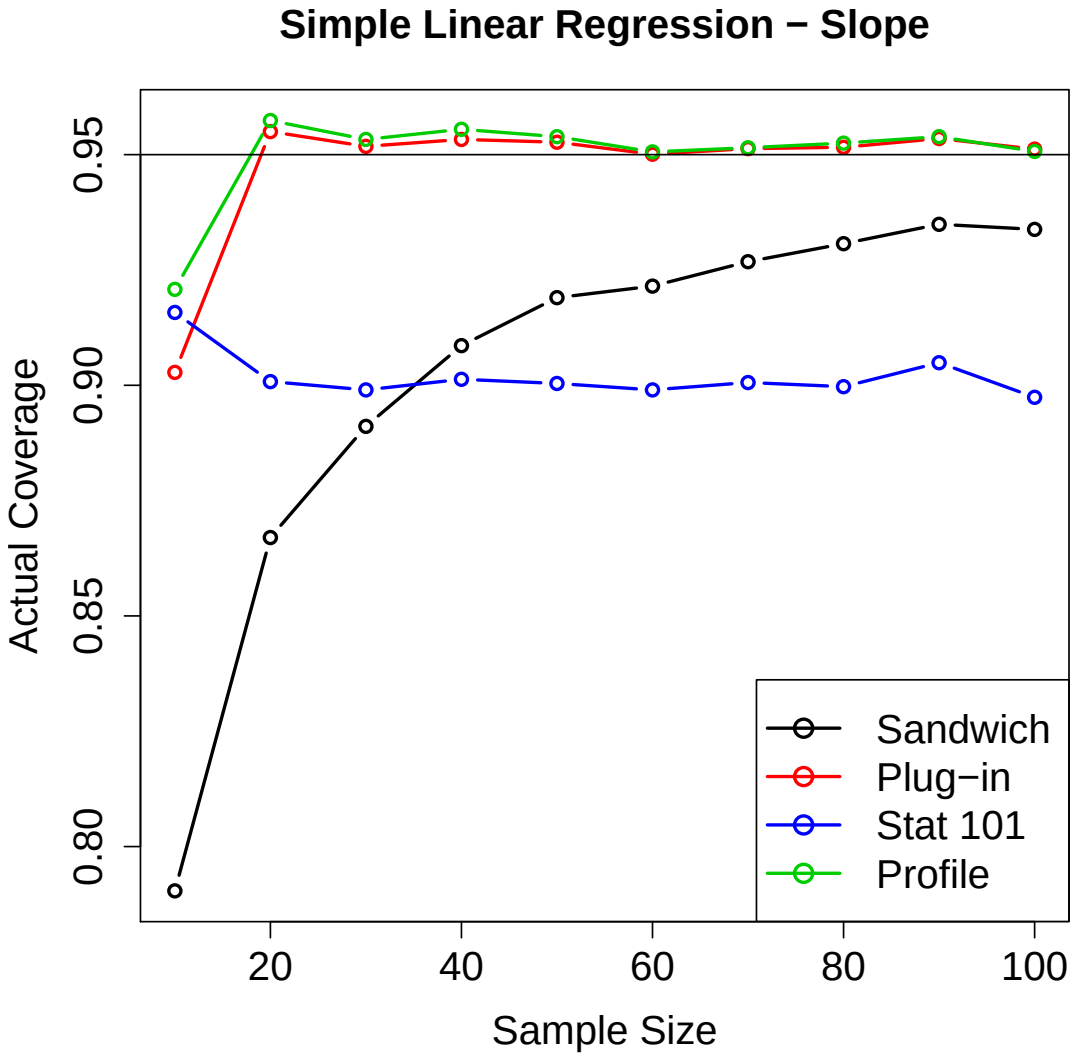
Simulation results - I



Simulation results - II



Simulation results - III



Summary

I have a method that improves on the sandwich in small sample sizes.

I proved that my method and the sandwich are asymptotically equally efficient.

I am extending my pivot work to other models and exploring a Bayesian approach.

THANK YOU!!!

Questions?