Computing Pseudo Margins of Error Using American Community Survey Data

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The Problem

- The American Community Survey (ACS) replaced key parts of the U.S. decennial census in 2005
- As a result, the ACS is now the primary source of demographic data in the U.S.
- However, methodological changes (primarily reduced sample size) has resulted in a steep increase the uncertainty of demographic estimates relative to the decennial census
- Every ACS estimate is accompanied by an MOE, which quantifies the uncertainty in that estimate
- This can help determine if a particular estimate for a particular place is reasonable for use

The table presents ACS Estimates of African-American Median Household Income for selected census tracts in Denver, Colorado. <u>Which of these tracts has the highest income?</u>

Census Tract	Estimate	Margin of Error
Census Tract 41.01	28,864	8,650
Census Tract 41.02	21,021	4,458
Census Tract 41.03	43,021	14,612
Census Tract 41.04	36,092	3,685
Census Tract 41.06	60,592	68,846

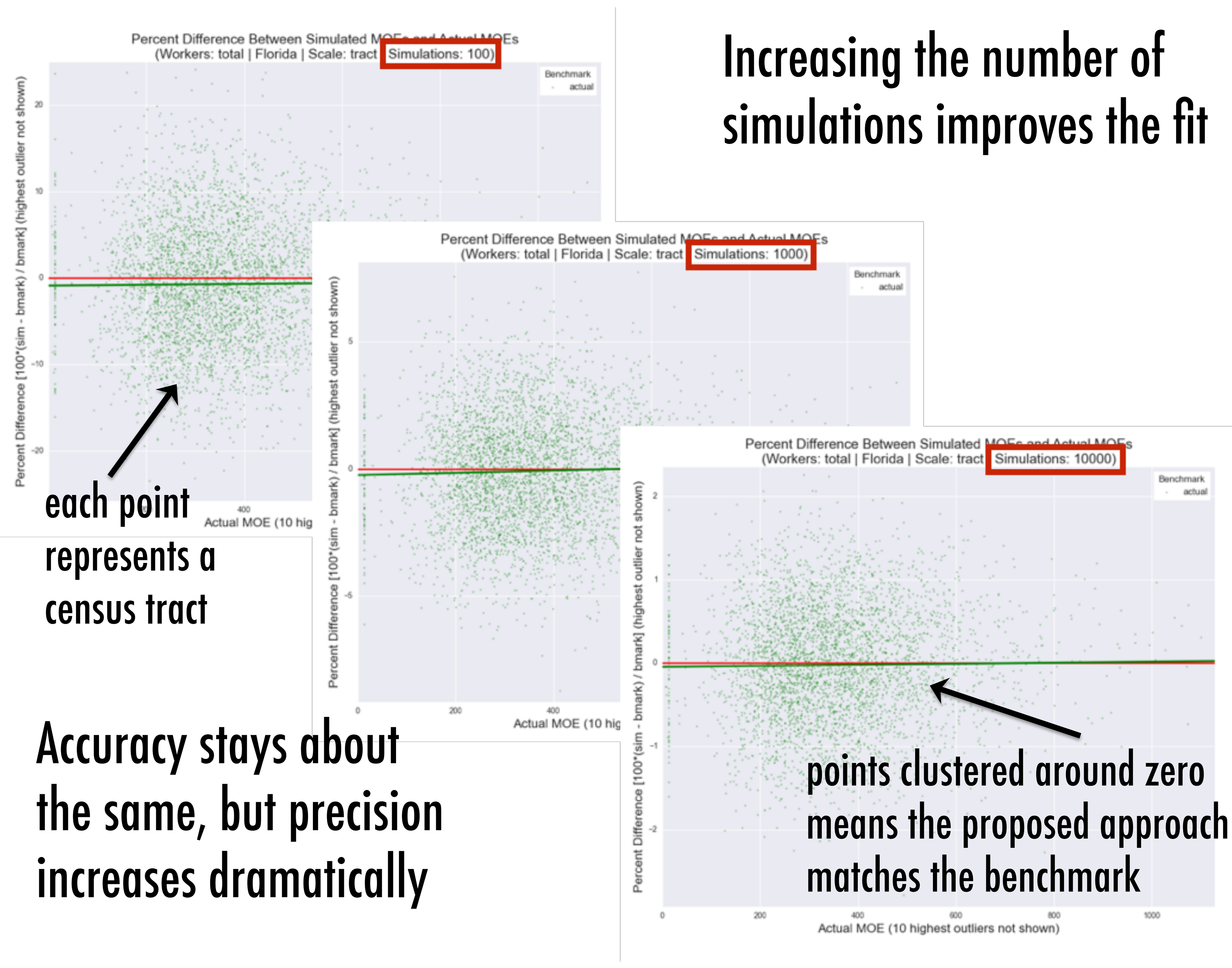
Composite Estimates

- Most social science considers variables in combination, not isolation
- This leads to a question of how to measure the uncertainty on a composite estimate that is made up of ACS estimates, each with its own uncertainty
- The US Census Bureau provides analytic equations to compute the MOE for numbers added together or divided
- The missing piece is how to compute the MOE for complex composites of ACS
- Examples include segregation indices, social vulnerability indicators, etc.

Solution: Pseudo MOE Approach

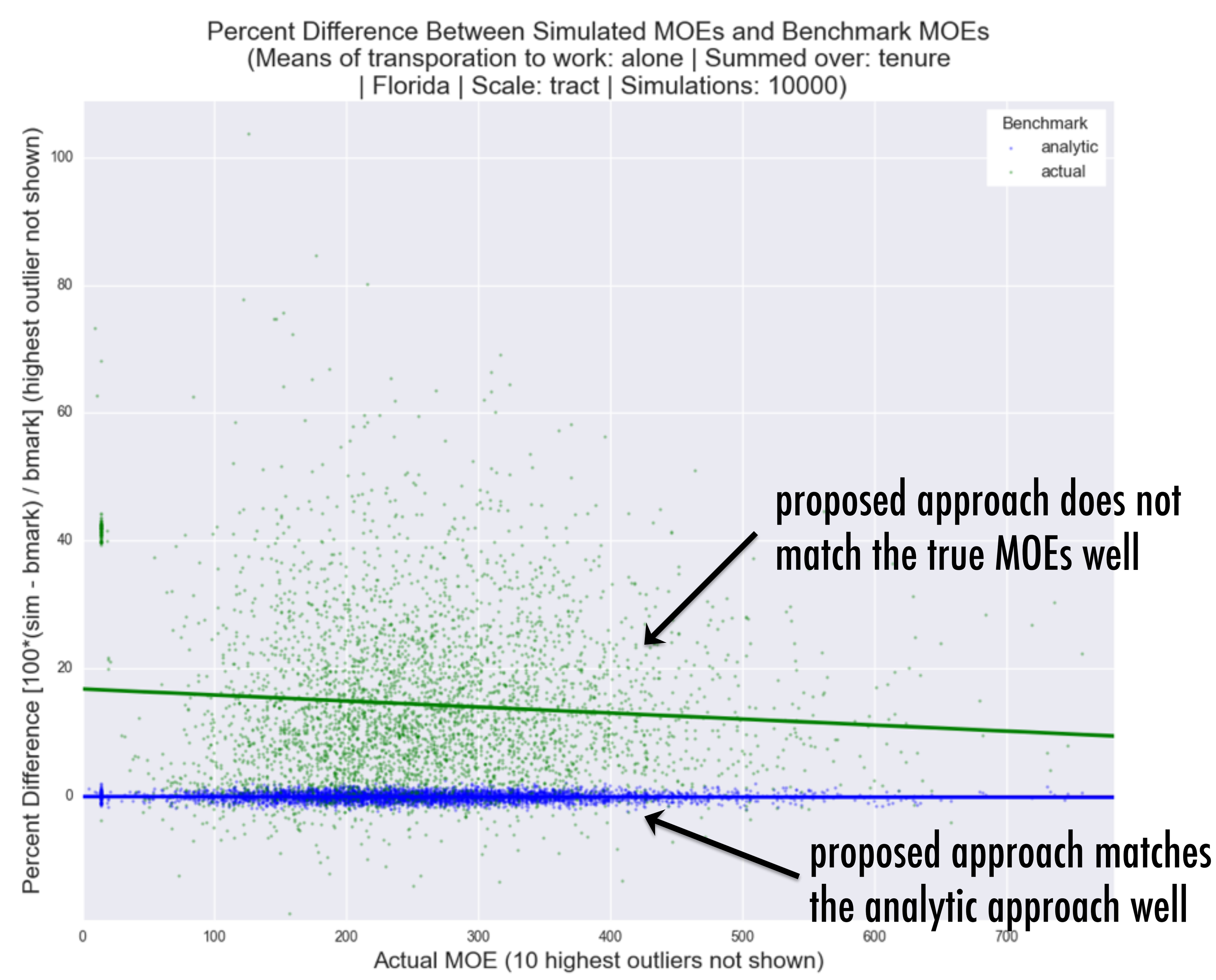
- Use a representative distribution (normal distribution) to randomly draw each constituent estimate used for the composite estimate
- Compute the composite estimate using the randomly drawn constituent estimates
- Repeat the above two steps multiple times, collecting the composite estimate from each simulation
- Compute the variance on the simulated composite estimates
- Convert the variance to MOE

Univariate Tests



Multivariate Tests

- The ACS provides an MOE on all estimates; therefore, if the ACS publishes estimates A, B and C; and if A + B = C, then we can compute the simulated MOE on (A + B) and see if it matches the published MOE on C
- We also have an analytic equation for computing the MOE on a summation $\text{MOE} = \sqrt{\sum_{c} \text{MOE}_c^2}$



Summary

- The proposed approach matches…
  - actual MOEs for univariate estimates
  - analytic MOEs on multivariate estimates
- Overestimating actual MOEs on multivariate estimates is better than underestimating, but the approach needs improvement

Next Steps

- Explore opportunities to get multivariate simulated MOEs to align more closely to actual MOEs
  - Alternate distributions
  - Model covariation in the variables