The Thin Reed: Accommodating Weak Evidence for Critical Parameters in Cost-Benefit Analysis

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Methods for Research Synthesis:
A Cross-Disciplinary Workshop

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Questions

- What should analysts do when estimates of key parameters are statistically insignificant?
- More generally, how should analysts use estimates from secondary sources in CBA and CEA?

Three Approaches

1. Treat statistically insignificant estimates (and their standard errors) as if they are zero

2. Use estimates and their standard errors

3. Use shrunk estimates and their standard errors

Shrinkage Estimator for OLS

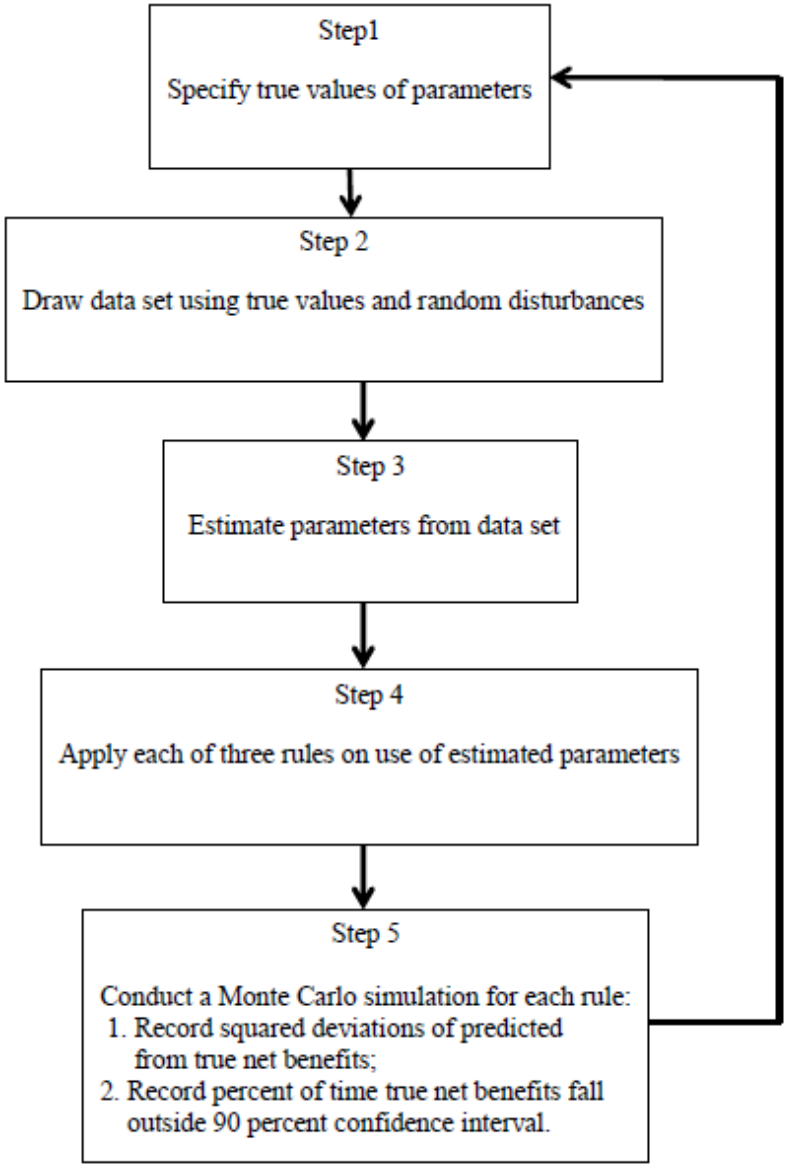
- Derive shrinkage estimator by minimizing means square error:

$$\hat{\beta} = \left[\frac{t^2}{t^2 + 1} \right] \hat{\beta}_{OLS}$$

$$Var(\hat{\beta}) = \left[\frac{(t^8 + 6t^6 + 9t^4}{(t^2 + 1)^4} \right] Var(\hat{\beta}_{OLS})$$

- Depends on t-value, so can be implemented with reported results

Figure 1: Overview of Simulation Procedure



Simulation Assumptions

- NB = I1 + I2 + I3
  - I1: 20 percent chance of zero; 80 percent chance of being uniform between 0 and 1
  - I2: 40 percent chance of zero; 60 percent chance of being uniform between 0 and 1
  - I3: uniform between -.4 and 1
- Range of NB: -.4 to 3
- E[NB] = 1

MSE for Each Method by True Net Benefit Intervals

Significant Coefficients Only
All Coefficients
Shrunk Coefficients
(Number of Trials)

		Interval of True Net Benefits			
		-0.4 to 0	0 to 1	1 to 2	2 to 3
Standard Deviation of Regression Error	0.6	.07 .04 **.03** (496)	.06 **.04** **.04** (4,624)	.05 **.04** .04 (4,309)	.05 **.04** .05 (571)
	0.8	.07 .08 **.05** (524)	.09 .08 **.06** (4,604)	.10 **.08** **.08** (4,291)	.11 **.09** .11 (581)
	1.0	**.07** .12 **.07** (497)	.13 .12 **.10** (4,622)	.17 **.12** .13 (4,309)	.18 **.13** .16 (572)
	1.2	**.09** .18 .11 (508)	.17 .17 **.13** (4,646)	.27 **.16** .18 (4,273)	.29 **.16** .22 (573)
	1.4	**.09** .23 .13 (509)	.22 .24 **.18** (4,654)	.41 **.24** .25 (4,279)	.53 **.23** .34 (558)

Minimum values in red.

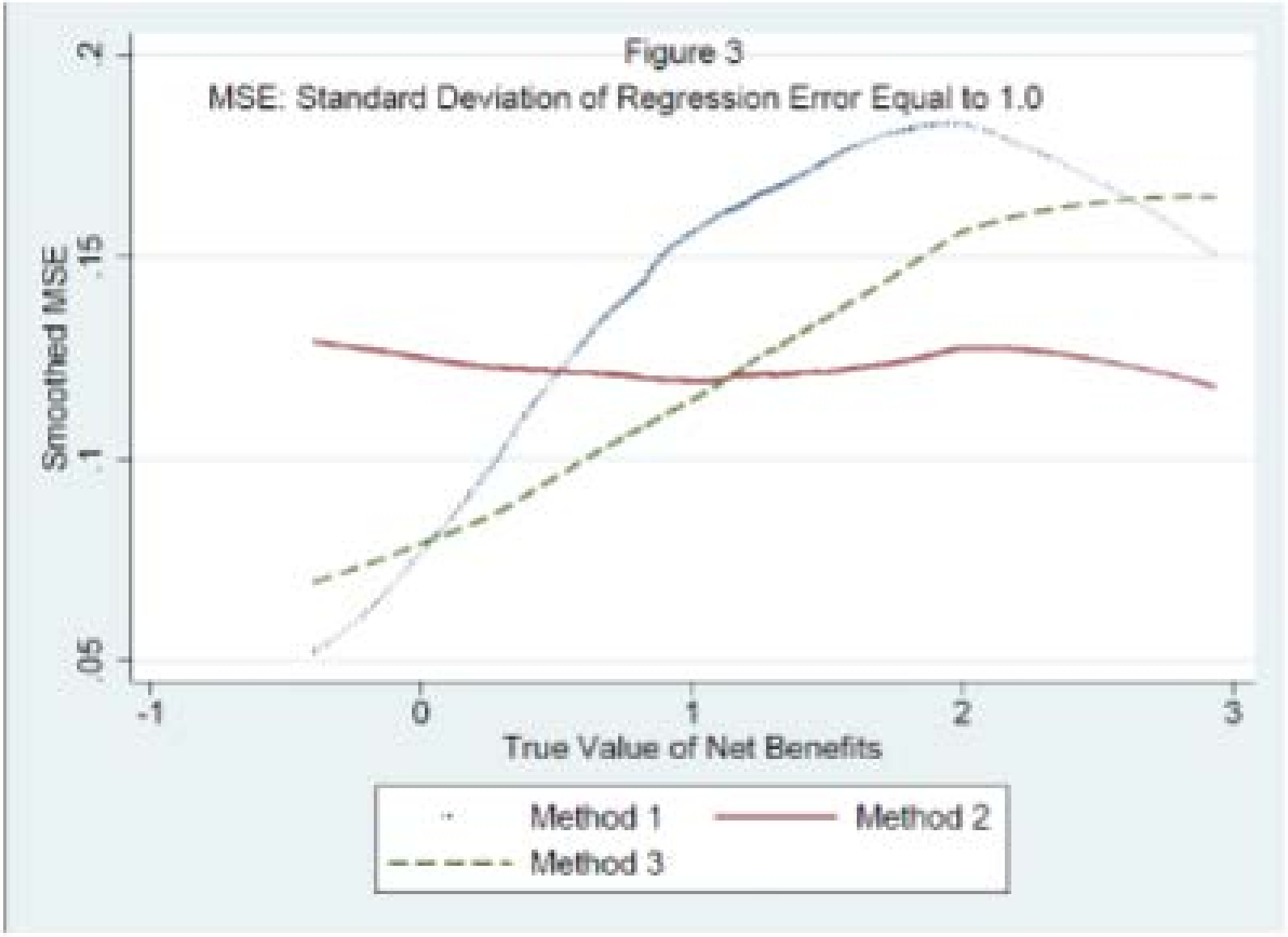


Figure 3
MSE: Standard Deviation of Regression Error Equal to 1.0
Smoothed MSE
.05
.1
.15
-1
0
1
2
3
True Value of Net Benefits
Method 1
Method 2
Method 3

Significant Coefficients Only
All Coefficients
Shrunk Coefficients
(Number of Trials)

		Interval of True Net Benefits			
		-0.4 to 0	0 to 1	1 to 2	2 to 3
Standard Deviation of Regression Error	0.6	1.0 .10 .08 (496)	.42 .10 .11 (4,624)	.21 .10 .11 (4,309)	.14 .12 .11 (571)
	0.8	1.0 .08 .09 (524)	.44 .10 .11 (4,604)	.26 .10 .12 (4,291)	.17 .11 .14 (581)
	1.0	1.0 .10 .08 (497)	.47 .10 .12 (4,622)	.30 .10 .12 (4,309)	.22 .12 .13 (572)
	1.2	1.0 .12 .11 (508)	.51 .09 .11 (4,646)	.35 .09 .13 (4,273)	.24 .11 .13 (573)
	1.4	1.0 .09 .08 (509)	.56 .10 .11 (4,654)	.39 .11 .14 (4,279)	.31 .10 .13 (558)

Conclusions

- Test the right hypothesis
- Don’t make things worse by avoiding sub-group analysis to avoid multiple comparisons
- Use shrinkage estimators to guard against regression to the mean