Assessing Bias in Regression Estimates Using Monte Carlo Simulations: Examples in Criminal Justice Research

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Example 1: Hypothetical Study

We used a subset of real data to conduct a hypothetical study. We analyzed the data with ordinary-least-squares estimation.

Data issue: Residual dependency, which leads to inaccurate standard errors and confidence intervals.

The graph below shows the percent bias of the standard error estimates (\(\frac{SE_{\text{OLS}}-SE_{\text{MCS}}}{SE_{\text{OLS}} \times 100}\)) for the five variables in the regression model.

<table>
<thead>
<tr>
<th>Variable</th>
<th>(\theta_{\text{OLS}}(SE))</th>
<th>(\theta_{\text{MCS}}(SD))</th>
<th>95% Coverage</th>
<th>% Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>-0.03 (.12)</td>
<td>-0.04 (.12)</td>
<td>.95</td>
<td>.06</td>
</tr>
<tr>
<td>Race</td>
<td>.06 (.06)</td>
<td>.04 (.06)</td>
<td>.94</td>
<td>.09</td>
</tr>
<tr>
<td>Age</td>
<td>-0.21 (.02)**</td>
<td>-0.22 (.03)</td>
<td>.92</td>
<td>1.00</td>
</tr>
<tr>
<td>Education</td>
<td>.14 (.03)***</td>
<td>.14 (.03)</td>
<td>.95</td>
<td>1.00</td>
</tr>
<tr>
<td>Income</td>
<td>-0.10 (.03)***</td>
<td>-0.08 (.03)</td>
<td>.90</td>
<td>.84</td>
</tr>
<tr>
<td>Conserv.</td>
<td>.12 (.05)***</td>
<td>.15 (.05)</td>
<td>.90</td>
<td>.83</td>
</tr>
</tbody>
</table>

Example 2: Published Study

We evaluate a published ordinary-least-squares regression model.

Data issue: Unreliable dependent variable, which can result in biased beta coefficients.

Other applications of MCS:
- Forecasting.
- Incorporating data uncertainty into model estimation.
- Theoretical experiments.

Key limitation:
- Results from MCS are valid insofar as the theoretical assumptions underpinning the MCS are valid.

References