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A Simple Illustration

Consider an ordinal scale measuring “satisfaction”, with the following four categories:

<table>
<thead>
<tr>
<th>“Very Disappointed”</th>
<th>“Disappointed”</th>
<th>“Satisfied”</th>
<th>“Very Satisfied”</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Suppose there are two groups of people:

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>One person is “Very Disappointed”</td>
<td>One person is “Disappointed”</td>
</tr>
<tr>
<td>Another is “Satisfied”</td>
<td>Another is “Very Satisfied”</td>
</tr>
</tbody>
</table>

Question: Which group is more satisfied?

The answer depends on the numerical values assigned to the response categories.

The Misuse of Ordinal Variables

Ordinal variables are used to measure any concept that does not have a direct quantitative unit of measure. Consider, for example, subjective well-being. Suppose an individual’s well-being is characterized by the following underlying relationship:

\[ Y' = X'\beta + \epsilon \]

Here \( Y' \) is unobserved actual well-being. The vector \( X \) represents observable variables and \( \beta \) is a vector of regression coefficients. Since \( Y' \) cannot be directly observed, subjective well-being, \( Y \), is measured via an ordinal variable with various values, \( \mu \), representing threshold points on the ordinal scale:

\[
Y = \begin{cases} 
0 & \text{if } Y' \leq \mu_1 \\
1 & \text{if } \mu_1 < Y' \leq \mu_2 \\
2 & \text{if } \mu_2 < Y' \leq \mu_3 \\
\vdots & \vdots \\
N & \text{if } \mu_{N-1} < Y' 
\end{cases}
\]

The problem is that the values of \( \mu \) are unknown. Estimating the above regression specification using ordinary least squares (OLS) with the observed ordinal scale of \( Y \) as the dependent variable, assumes that the values of \( Y \) have known and fixed intervals.

The Method

Goal: To understand robustness of any empirical finding to a plausible range of transformations.

The main results use the following function:

\[ T(Y) = Y_{\text{Max}} \times \left( \frac{Y}{Y_{\text{Max}}} \right)^{\sigma} \]

In this function, \( Y \) is the linear ordinal scale ranging from zero through the maximum value of the scale. The \( \sigma \) parameter controls the convexity or concavity of the ordinal scale. If \( \sigma = 1 \), the scale remains in its linear form. If \( 0 < \sigma < 1 \), then the scale will be concave to some degree. If \( \sigma > 1 \), then the scale will be convex to some degree.

1. Define a parameterized function that represents all “reasonable” transformations.

2. Run Monte Carlo simulations, randomly picking a parameter within a given finite domain of \( \sigma \).

This method is applied to the results from three existing empirical studies. First, Aghion et al. (2016) on the effect of “creative destruction” on subjective well-being. Second, Nunn and Wantcheckon (2011) on the effect of the slave trade on trust in sub-Saharan Africa. Third, Bond and Lang (2013) on the black-white test score gap in kindergarten through third grade. Additional results and robustness tests are included in the paper, available on my website: www.jeffbloem.wordpress.com.

Subjective Well-Being and Creative Destruction: Aghion et al. (2016)

K-3 Racial Test Score Gap: Bond and Lang (2013)