# Problem Set 3: Most Common Problems

POLS 8810

Spring 2025

## Let's Be More Careful Interpreting Model Results

There were a lot of issues with interpreting model results in these problem sets. While some were more significant than others, we want to be sure that we are always interpreting things correctly. A list of specific and, unfortunately common, issues follows.

### Interpreting Coefficient Estimates on Constitutive Terms as Unconditional Effects

This was one of the three major, common error that I spent a significant part of lecture talking about and telling you to avoid. Nonetheless, some of you did this.

You all estimated a model like this:

$$Y_i = \beta_0 + \beta_1 X_i + \beta_2 D_i + \beta_3 X_i D_i + u_i \tag{1}$$

Given the interaction, you CANNOT interpret the coefficients $\beta_1$ and $\beta_2$ as the unconditional effects of $X_i$ and $D_i$, respectively.

### Not Interpreting Coefficient Estimates on Constitutive Terms *Conditionally* (When Possible)

As noted in the last subsection, when estimating Equation (1), we cannot interpret the coefficients $\beta_1$ and $\beta_2$ as the unconditional effects of $X_i$ and $D_i$, respectively. However, what if one, or both, constitutive terms are significant? Can we interpret anything about them? The answer, per my lecture, is yes, we can interpret the effect of the coefficient on one of the constitutive terms as the conditional effect of that variabel when the other constitutive term equals zero. For this specific example, income, as measured in most of your data, can never equal 0, so the constitutive term on the gender variable is not interpretable. However, the gender variable can equal 0. So the coefficient on income, if significant, can be interpreted as the effect of income on Republican support when gender equals 0. (Note: we would not call this variable 0 or interpret it using language like "when gender equals 0." We would name it after the "1" value and interpreted accordingly.)

### Interpreting Effects without Statistical Significance, Generally

We always want statistically significant results. Unfortunately, we do not always get them. When we do not have significance, this means that we cannot dismiss the null hypothesis of no effect. If we cannot draw any inferences regarding a significant effect, it is imperative than we NOT try to interpret coefficient estimates as if they were significant.

This applies equally to graphs of non-significant results. If we graph the effect of an interaction term and the error bars overlap for most/all of the range of $\mathbf{X}$, then there is nothing substantive to interpret.

### Incorrectly Assuming $H_0$ is True

Next, a few of you made the opposite error. What do we do if something is not statistically significant? As noted above, we certainly do not draw any inferences about meaningful relationships. However, we also do NOT say that there is NO effect. A lack of statistical significance means that we fail to reject the null hypothesis, but it does NOT mean that we assume the null to be true any more than statistically significant results allow us to assume the alternative hypothesis is true.

## Make Readable Graphs!

Nearly all of you presented a graphical interpretation of the interaction you modelled. This is good. This is really the only meaningful way to interpret an interaction. However, most of you made unreadable graphs. In most of your graphs, I could not distinguish the lines from each other, where the shaded regions/error bars for each line started and stopped, or both. When you are using greyscale—*which you always should in papers as most people print in black and white*—shades of grey that are not clearly distinct are often hard to differentiate. This is bad enough with just lines alone, but when error bars or shaded regions for confidence intervals are added, the problem is magnified.

How do we fix this? Instead of different colors for the lines and shading, use solid versus dashed lines to differentiate. See the example below from one of last year's write ups for this assignment.

Note that in real life, we would (almost) never plot estimates that were not statistically significant. While you needed to do this for this assignment, you would not do this in a real-life scenario. That said, we often have overlapping confidence regions and even situations

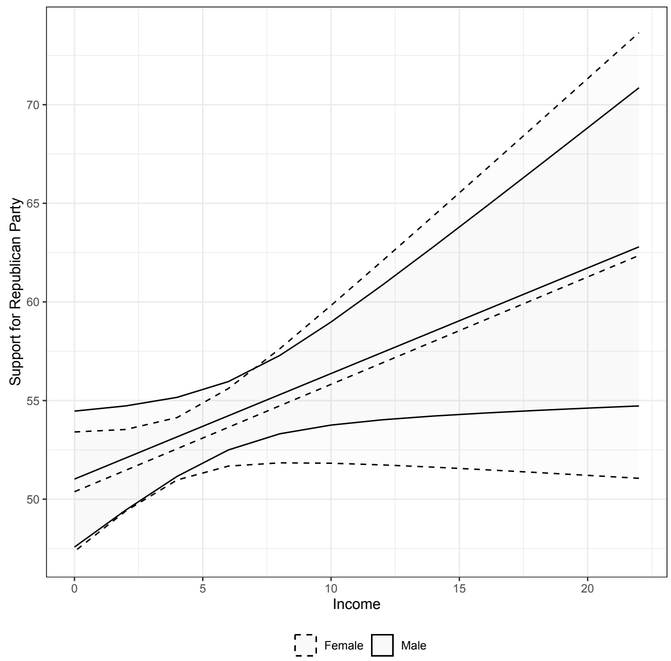


Figure 1: Example Figure

where the confidence regions overlaps with the other line for *part* of the range of **X**. In this case, doing something like this example can prevent confusion that might otherwise result.

## Very Common, But More Minor, Problems

- An interaction term is an independent variable! If you have something like Equation (1), then you have three independent varaibles NOT two!
- Many of you really need to reread the handout on how to write the data, methods, and results section of a paper and the part of the Problem Set 1 errors handout dealing with how to discuss your variables.
- Use `*` not `x` for the multiplication symbol in typesetting math. Using `x` can cause confusion as it appears identical (or close to identical) to $x$ which is a commonly used variable.
- Do NOT say "running" or "ran" a model. This is software language. What you are doing is "estimating" a model.

- Do NOT include commands to save files locally in replication code!
- Multivariate regression is regression with more than one *dependent variable*. When you have more than one *independent variable*, it is multiple regression.
- **Do NOT report multiple levels of statistical significance in a table!!!** Doing so shows a basic failure to understand what statistical significance means conceptually in the context of null hypothesis significance testing! (I'm still seeing this after repeatedly telling you not to do it.)