

## SUMMARY

We have emphasized the importance of understanding the links between substantive theories and empirical tests of those theories. Social scientists often formulate hypotheses that demand some complexity beyond the simple linear-additive model. Multiplicative interaction terms provide one simple means to enhance the match of these complex theories to appropriate empirical statistical analyses.

We conclude with this summary of our recommendations on the use and interpretation of interactive terms in linear-regression models. In order:

- *Theory*: What is the scientific phenomenon to be studied? Does your theory suggest that the effects of some variable(s)  $x$  depend on some other variable(s)  $z$  (implying the converse that the effect(s) of  $z$  depend(s) on  $x$ )? Does it imply anything more specific about the manner in which the effects of  $x$  and of  $z$  depend on each other?
- *Model*: What is the appropriate mathematical model to express your theory? Write the formal mathematical expression that encapsulates your theory. In the case where the theory implies that the effect(s) of  $x$  depend(s) on  $z$  and vice versa, (a) simple multiplicative interaction(s) will often suffice to express that (those) proposition(s). If the theory implies something more specific, ideally one would specify that more specific (perhaps nonlinear) form of the interactions.
- *Estimation*: Estimate the model with an appropriate estimation strategy; OLS (or nonlinear regression model) with appropriately “robust” standard errors typically suffices.

- *Interpretation:* What are the substantive effects of interest? Conduct appropriate hypothesis tests that match your substantive theoretical propositions. Calculate marginal effects using derivatives to describe the effects of the variable(s) of interest,  $x$  and/or  $z$ , at various, meaningful levels of the other variables. Calculate changes in the predicted values of  $y$  induced as some variable(s) of interest,  $x$  and/or  $z$ , change(s) at various, meaningful levels of the other variables. Also calculate the standard errors of these estimated effects and/or confidence intervals.
- *Presentation:* Present tables or graphs including both marginal effects or differences and accompanying measures of uncertainty or including both predicted values and accompanying measures of uncertainty. Plot or tabulate these effects across a range of meaningful levels of the other variables.