

## BOOK REVIEW

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*Regression Analysis for Categorical Moderators*, by Herman Aguinis (2004). New York: Guilford, 202 pages. ISBN 1-5723-0969-5.

As the saying goes, “everything in moderation,” or nearly so, as the method of moderated multiple regression is one of considerable importance to many organizational and social science researchers. Aguinis’s text provides the researcher and student with a comprehensive and cogent discussion of key topics to consider in the planning, conduct, and interpretation of moderated multiple regression (MMR) analysis. The text integrates the vast technical literature that has developed over many decades surrounding issues in the proper use and interpretation of this methodology. As such, this is more than a simple how-to-do-it book because it also explores why, whether, and how under different conditions to best conduct MMR analysis.

The book is composed of 10 chapters. The first two chapters are very brief, descriptive introductory accounts geared primarily toward students and those new to the method. The third chapter provides a walkthrough of computer analysis steps based on using SPSS with an example data set the user can download from a Web site. The author makes clear important connections to issues more fully described in other chapters, as otherwise the novice/student eager to try out an application might stop reading here! Clearly, to do that would be a big mistake.

Chapter 4 is devoted to the homogeneity assumption, and a clear case is made regarding why this assumption is critical though often neglected at great peril. Although I am not usually receptive to rules of thumb, it is better to consider the assumption at least at this level rather than just ignore it. Other options for assessing violation are described, and the author makes available a program to aid the researcher in determining if violation compromises interpretation. The same program also provides alternative test criteria to use when violation occurs. This program should be useful to, and used by, researchers.

Chapter 5 details factors that have led to low power in MMR analyses. Historically, most MMR research has been underpowered, and noting that the median effect size for the moderation effect in MMR research is 0.002, or 1/10th of what Cohen (1988) called a small effect size, is sobering if not also daunting in implication for sample size needed. Clearly, other factors besides  $N$  affect power, and the most important factors are addressed. Power is an important consideration at the design phase of research that will involve MMR. This warning is consistent with recent work on power in multiple regression models in general, of which MMR is a special case (Maxwell, 2000).

Chapter 6 is aimed at solving the low-power problem, but it seems to be a mixture of solutions as suggestions and further frustrations given our current state of knowledge. In the concurrent employment test design, there is no solution offered. For example, in the section (pp. 88-89) on reduction of variance in predictor variables, there is no solution given, just recognition of limitations in this context. It is noted that oversampling at the extremes of score distribution (within each given moderator group) can lead to increased power (when effects are linear). But that too may bias results as to size of

moderator effect. However, an additional biasing effect of oversampling at the extremes could be the failure to account for higher order polynomial moderation owing to truncation in the middle range of scores. The true value of this chapter is to clearly focus attention on factors that affect power. As such, the researcher and student alike should find Table 6.1 a valuable aid in conceptualizing facets of an MMR design to maximize detection of an effect.

Chapter 7 presents ways to compute power for MMR and offers three approaches. The author provides a separate computer program for each of the three types of power estimation, although the last program, MMRPOWER, is perhaps the most potentially useful of the three because it handles the larger number of factors known to influence power in MMR research designs.

Chapter 8 extends the basic two-group MMR model to cover more than two groups and additional predictors, including powers (as nonlinear functions) of a predictor. This is grounded in a discussion of available coding schemes with sufficient detail, so someone with cursory knowledge can understand what these choices imply. Choice of coding dictates just what interpretation can be given to effects obtained. The discussion here also considers that moderation might sometimes be confused with a quadratic term in  $X$ . The issue is raised regarding the order of inclusion of terms when considering moderation in conjunction with a quadratic predictor term. The author states that inclusion of the quadratic term “hierarchically *before* the product term in the MMR model” is warranted only when predictors are highly correlated and not highly reliable (or if theory should dictate this order of consideration). Because reliability sets a ceiling on degree of correlation, these two features seem at odds with one another and would coexist only in special circumstances. And, as mentioned earlier regarding chapter 6 under use of extreme groups, it is plausible that moderation itself may involve the quadratic term, for example, in differential tolerance to risk across moderator groups in decision-making contexts, in which theory might dictate such a term. This just adds additional complexity to an already complex issue; however, reality need not be simple. Also, there is an error in chapter 8 (p. 129) as pertains to the discussion of Lubinski and Humphreys’s (1990) research on spurious moderators. The error is assuming  $Z$  in Equation 8.10 was given as gender. This is not consistent with the equations presented in the original work, in which both predictor variables, there as  $M$  and  $S$ , were continuous (mathematics and spatial reasoning task performances, respectively). Clearly, gender, when treated either as dummy coded or as unweighted effects coding, would produce a singular matrix if the square of such gender coding were also included in a regression analysis ( $Z = Z^2$  or  $Z^2 = \text{intercept}$ ). The quadratic impact of gender was not considered in Lubinski and Humphreys (1990); rather, they considered equations involving moderation ( $M \times S$  product) and powers separately by gender group. One final point regarding material in this chapter pertains to discussion of the “targeted” testing of lower order interactions (pp. 134–135). Given all the concern for power in MMR research, it might have been useful to note that an alternative strategy would be to focus attention on a smaller number of two-way interactions than the total number possible. The problem with what I would call the “protected  $F$ ” approach by requiring an omnibus test as advocated in this section is that it diminishes power if there is only theoretical justification, say, for one of three possible two-way interactions.

Chapter 9 deals with the often-neglected topic of interpretation. This chapter should be revisited after the researcher has her or his—it is hoped—positive results in

hand and is in the sense-making process. The admonition about use of the common statistical package standardized coefficients for interpretation of the moderator effect (p. 144) should have appeared in bold italics. Clearly, it is user beware!

Finally, in chapter 10, the book closes with a plea, “Let this book make a difference.” It already has with this reviewer, and it will to others who use MMR. Time and again, the text emphasizes the important role of theory in identifying and justifying choice of variables in MMR analysis and does so in closing. Moderation itself is often a weak theoretical form; by this, I mean a particular moderating variable may serve as proxy for underlying processes that, when considered as a mediating or intervening variable, may account for the difference(s) at the moderated group level (cf. Baron & Kenny, 1986). The discovery of a moderator should force us to think about features of the individuals within groups that underlie the difference(s) obtained.

I must comment on one additional feature of this text I found particularly appealing and useful. The subject index is a treasure trove in its comprehensiveness for so short a book. It would seem to capture the various ways each one of us might construe a particular topic and thus narrow our search. My hat is off to the person(s) responsible for making this useful text far more useful. This book would be an excellent supplemental text for a course in general regression methods and a very useful sourcebook for practitioners and researchers alike.

Dr. Aguinis has presented us with a state-of-the-art text detailing important considerations in MMR analysis and provided access to useful tools to enable better understanding of issues and their implications. We will have no excuse to repeat mistakes of the past and especially not in moderation.

### References

- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology*, *51*, 1173-1182.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum.
- Lubinski, D., & Humphreys, L. G. (1990). Assessing spurious “moderator effects”: Illustrated substantively with hypothesized (“synergistic”) relations between spatial and mathematical ability. *Psychological Bulletin*, *107*, 385-393.
- Maxwell, S. E. (2000). Sample size and multiple regression analysis. *Psychological Methods*, *5*, 434-458.

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