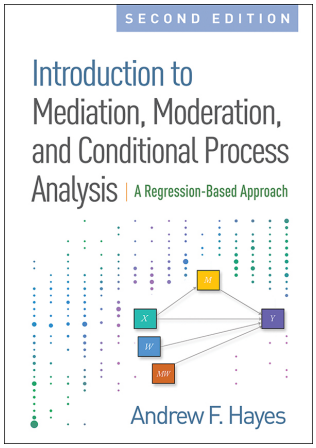


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# Introduction to Mediation, Moderation, and Conditional Process Analysis

*SECOND EDITION*

*A Regression-Based Approach*

**Andrew F. Hayes**

"The book is very readable and conversational, providing many interesting and useful examples….I found this to be a very nice book that is readable enough for the intermediate statistics user but with enough technical detail to appeal to advanced users as well....This book would make an excellent textbook for an advanced graduate-level multiple regression course, or just a great resource for the interested reader."

—***Journal of Educational Measurement*** **(on the first edition)**

"This book elegantly presents both the basic and advanced issues of mediation and moderation analysis…It will be beneficial for graduate students and applied researchers who are interested in causal mechanisms using linear models….[T]his is a very good textbook for applied researchers in social sciences. It covers mediation and moderation analysis using regression techniques quite nicely....I think this book could be very useful for both preliminary and advanced readers."

—***Journal of the American Statistical Association*** **(on the first edition)**

"This second edition is a welcome addition to advanced regression books that can be used in doctoral courses in the social sciences or by social science researchers. Hayes maintains his usual level of clarity while adding coverage of such important topics as multicategorical variables for mediation, moderation, and conditional process models. Enhanced presentation of tabular materials, coupled with new plots, add to the reader's understanding of analyses. Incorporation of R syntax at points in the book is great, as many researchers turn to R for its open access and improved graphics capabilities. I loved the first edition for my first-year doctoral course, and will use the second edition in its place."

—**Ramona L. Paetzold**, DBA, Department of Management, Texas A&M University

"Since I began using the first edition of this text in my graduate statistics classes in 2014, the number of theses and dissertations that include mediation and/or moderation analysis in our department has increased dramatically. Valuable new material in the second edition includes 13 new models, including models with categorical variables and models with both parallel and serial mediation, as well as the recently developed index of moderated mediation. My copy of the first edition is filled with my annotations on the examples of PROCESS output—in the second edition, Hayes has provided useful annotations of his own. I highly recommend this book for statistics classes that include OLS mediation and moderation. It is also a terrific resource for researchers wishing to keep up with advances in moderation and mediation analysis."

—**Karl L. Wuensch**, **PhD**, Department of Psychology, East Carolina University

"This book provides clear instruction that is accessible to graduate students while also useful to seasoned researchers looking to expand their skills for more complex regression-based analyses. The second edition provides increased clarity in interpreting PROCESS output and documents PROCESS v3, which allows for great flexibility in analyzing models. Other useful developments in the second edition include chapters on multicategorical variables, incorporation of the index of moderated mediation, and the appendix of instructions on how to customize PROCESS for models not covered by the templates. Hayes's approach is cutting edge in both philosophy and pragmatics. I've used the first edition extensively as a course text as well as in my own research, and am excited to move to the second edition."

—**Elizabeth J. Kiel**, **PhD**, Department of Psychology, Miami University

"Using lucid prose and abundant, worked-through examples, Hayes walks readers through the promise and potential pitfalls of two of the most essential—yet convoluted—tasks in social science research. Novices will find this book to be a thorough, accessible description of ordinary least squares regression and a smart tutorial on mediation and moderation, but it is also much more. Any seasoned researcher who has slogged through the arcane computation and agonizing decision making related to the estimation and interpretation of direct and indirect effects, or the visualization and presentation of interactions, will find this volume (with the accompanying PROCESS macro) to be a veritable Swiss Army knife, and will return to it time and time again."

—**Jeffrey G. Parker**, **PhD**, Department of Psychology, University of Alabama

"This text is a wonderful combination of traditional mediation and moderation using regression and extensions into more complex variations. Coverage is clear and thorough—perfect for intermediate to advanced regression learners. Updates in the second edition include a new chapter with answers to many very important and common questions, which will be extremely helpful to learners. I can't wait to use this second edition with my students."

—**Jocelyn H. Bolin**, **PhD**, Department of Educational Psychology, Ball State University

Lauded for its easy-to-understand, conversational discussion of the fundamentals of mediation, moderation, and conditional process analysis, this book has been fully revised with 50% new content, including sections on working with multicategorical antecedent variables, the use of PROCESS version 3 for SPSS and SAS for model estimation, and annotated PROCESS v3 outputs. Using the principles of ordinary least squares regression, Andrew F. Hayes carefully explains procedures for testing hypotheses about the conditions under and the mechanisms by which causal effects operate, as well as the moderation of such mechanisms. Hayes shows how to estimate and interpret direct, indirect, and conditional effects; probe and visualize interactions; test questions about moderated mediation; and report different types of analyses. Data for all the examples are available on the companion website (*www.afhayes.com*), along with links to download PROCESS.

Find full information about this title online: www.guilford.com/p/hayes3

The model templates diagramming each model number can be found in Appendix A of the **second edition** of *Introduction to Mediation, Moderation, and Conditional Process Analysis*. The templates for PROCESS version 3 are different than those used in PROCESS version 2, reflecting differences in the labeling of moderators in version 3, the elimination of some models, and the addition of some new models that combine parallel and serial mediation as well as models of moderated serial mediation.

Many of the features available in the syntax version of PROCESS v3 are not available in the dialog box. These include:

- Seeding the random number generator.
- Monte Carlo confidence intervals for indirect effects.
- Linear contrasts of specific indirect effects in multiple mediator models.
- Comparing two conditional effects in moderation models with more than one moderator.
- Customizing and editing models.
- Custom assignment of covariates to equations.
- User-defined coding of multicategorical independent variables and moderators.
- User-defined values for conditioning the estimates of effects on moderator values.
- Production of standard errors and confidence intervals of estimates of outcome variables derived from a model equation.
- Specification of the number of iterations or convergence criterion for models with a dichotomous Y

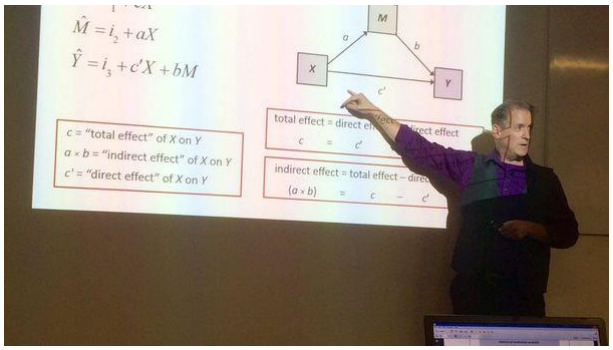
Many questions you may have about PROCESS are answered on the FAQ page at processmacro.org

**Some important changes to PROCESS implemented in version 3**

- X, W, and Z can be multicategorical for all models PROCESS can estimate.
- Only percentile bootstrap confidence intervals are available.
- Bootstrap confidence intervals are available for all model coefficients.
- Probing of interactions involving continuous moderators defaults to the $16^{th}$, $50^{th}$, and $84^{th}$ percentiles of the moderator distribution.
- Interactions can be probed and data generated for visualization for any interaction in a model, regardless of where that interaction appears in the model.
- Models can be created from scratch and numbered models can be edited.
- Preprogrammed moderated serial mediation and "Parallel-serial" multiple mediator models.
- Simple implementation of a "slope difference test" for comparing conditional effects in multiple moderator models.
- Heteroscedasticity-consistent inference using the HC0, HC1, HC2, HC3, and HC4 regression coefficient covariance matrix estimators.

Version 3.0 did not allow a dichotomous Y. **Version 3.1 has eliminated this limitation.** PROCESS v3.1 will accept a dichotomous Y, and the model of Y is estimated using logistic regression.

For more information on the use of PROCESS, see the documentation (Appendices A and B) in the second edition of *Introduction to Mediation, Moderation, and Conditional Process Analysis.*




## Take a course taught by Andrew F. Hayes on the use of PROCESS at one of these locations and dates in 2019:

### Statistical Horizons, Ft. Myers, FL, USA, 1-2 February 2019

**Mediation, Moderation, and Conditional Process Analysis .** This 2-day course is offered by Statistical Horizons and will emphasize the use of PROCESS for SPSS and SAS. It will take place in Ft. Myers, Florida, and includes about 13 hours of in-class instructional time. Details and enrollment information will be available at www.statisticalhorizons.com

### GSERM, University of St. Gallen, Switzerland, 10-14 & 17-21 June, 2019

**Mediation, Moderation, and Conditional Process Analysis I.** This 5-day course is offered by the Global School in Empirical Research Methods. It includes about 22 hours of instructional time, with a focus on the use of PROCESS. Exact dates, details and enrollment information will be available at www.gserm.ch/stgallen/ toward the end of 2018.

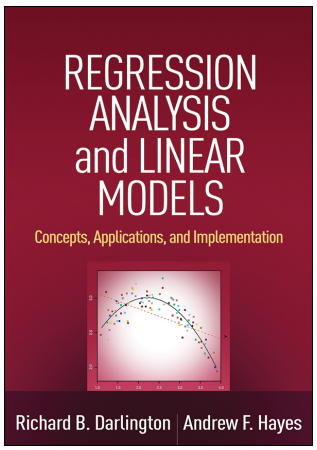
**Mediation, Moderation, and Conditional Process Analysis II.** This 5-day course builds on the material offered in the first course taught a week prior. This course, which includes about 22 hours of in-class instructional time, is also offered by the Global School in Empirical Research Methods. Like the first course, it emphasizes the use of PROCESS for SPSS and SAS. Details and enrollment information are available exact dates, details and enrollment information will be available through at www.gserm.ch/stgallen/ toward the end of 2018.

### Statistical Horizons, Chicago, IL, USA, 15-19 July 2019

**Mediation, Moderation, and Conditional Process Analysis .** This 5-day course is offered by Statistical Horizons and will emphasize the use of PROCESS for SPSS and SAS. It will take place in Chicago and includes about 33 hours of in-class instructional time. Exact dates, details and enrollment information will be available at www.statisticalhorizons.com

The most current schedule is available at www.processmacro.org. If you would like to inquire about scheduling a private workshop at your institution, send an email to workshop@processmacro.org

Photograph taken in Brisbane, Australia by Stefano Verrelli

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# Regression Analysis and Linear Models

*Concepts, Applications, and Implementation*

**Richard B. Darlington and Andrew F. Hayes**

"This is a thorough and accessible introduction to regression analysis as conducted and reported in the psychology research literature. In addition to the basics, there is up-to-date coverage of more advanced topics—for example, interaction effects, path analysis, and mediation. Accompanying examples of statistical software code and output enable students to quickly utilize linear models in the analysis of their own data. This is the right textbook for first-year psychology graduate students, and I plan to continue using it."

—**Daniel Ozer**, **PhD**, Department of Psychology, University of California, Riverside

"This fantastic introduction to the general linear model takes the reader from first principles through to widely used techniques such as mediation and path analysis. The clear writing makes it a pleasure to read. Students will find the book an invaluable resource. There are plenty of insights, too, for even seasoned researchers and data analysts. Instructors and students will appreciate the logical structure and chapters that break the material up into manageable chunks."

—**Andy Field**, **PhD**, Professor of Child Psychopathology, University of Sussex, United Kingdom

"If you want to get the most bang for your buck out of your statistical training, investing in learning regression and linear models is the way to go. Nonetheless, many people find linear modeling to be confusing at first. This book breaks down all walls to mastering this fundamental analysis by providing a complete guide in an approachable, conversational style. The book begins with a comprehensive introduction to linear models and continues on to cover the most useful advanced topics, such as logistic regression and mediation and path analysis. A 'must-have' desk reference for entry-level learners and long-time practitioners alike."

—**Elizabeth Page-Gould**, **PhD**, Canada Research Chair in Social Psychophysiology, University of Toronto

"A terrific addition to the regression literature. I am often asked, 'How do I determine which regressor(s) is/are the most important?' The treatment of this topic is excellent, and the authors have done a fantastic job of bringing important issues to light. The applied nature of the text and the interweaving of software syntax and output are major improvements over similar books. I like the fact that the book has software package information for SPSS, SAS, and STATA. It has a nice balance; not too technical on the statistical side, but not simply a 'how to' on the software side. I could see this book being used as the main text in our department's graduate-level regression course."

—**Scott C. Roesch**, **PhD**, Department of Psychology, San Diego State University

"This is a great textbook for students who have only basic knowledge of statistics yet would like to gain a deep conceptual understanding of regression. The book is up to date in current methods in regression, with strong examples using SAS/SPSS/STATA."

—**Chris Oshima**, **PhD**, Department of Educational Policy Studies, Georgia State University

Ephasizing conceptual understanding over mathematics, this user-friendly text introduces linear regression analysis to students and researchers across the social, behavioral, consumer, and health sciences. Coverage includes model construction and estimation, quantification and measurement of multivariate and partial associations, statistical control, group comparisons, moderation analysis, mediation and path analysis, and regression diagnostics, among other important topics. Engaging worked-through examples demonstrate each technique, accompanied by helpful advice and cautions. The use of SPSS, SAS, and STATA is emphasized, with an appendix on regression analysis using R. The companion website (*www.afhayes.com*) provides datasets for the book's examples as well as the RLM macro for SPSS and SAS.

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