

REFERENCES

- Agresti, A. (1996). An introduction to categorical data analysis. New York: John Wiley & Sons.
- Agresti, A. (2002). Categorical data analysis. Second Edition. New York: John Wiley & Sons.
- Aitkin, M. (1999). A general maximum likelihood analysis of variance components in generalized linear models. *Biometrics*, 55, 117-128.
- Asparouhov, T. (2005). Sampling weights in latent variable modeling. *Structural Equation Modeling*, 12, 411-434.
- Asparouhov, T. (2006). General multi-level modeling with sampling weights. *Communications in Statistics: Theory and Methods*, 35, 439-460.
- Asparouhov, T. (2007). Wald test of mean equality for potential latent class predictors in mixture modeling. Technical appendix. Los Angeles: Muthén & Muthén.
- Asparouhov, T. (2014). Continuous-time survival analysis in Mplus. Technical appendix. Los Angeles: Muthén & Muthén.
- Asparouhov, T. & Muthén, B. (2005). Multivariate statistical modeling with survey data. Proceedings of the FCMS 2005 Research Conference.
- Asparouhov, T. & Muthén, B. (2006a). Multilevel modeling of complex survey data. Proceedings of the Joint Statistical Meeting in Seattle, August 2006. ASA Section on Survey Research Methods, 2718-2726.
- Asparouhov, T. & Muthén, B. (2006b). Constructing covariates in multilevel regression. *Mplus Web Notes*: No. 11. www.statmodel.com.
- Asparouhov, T. & Muthén, B. (2007). Computationally efficient estimation of multilevel high-dimensional latent variable models. Proceedings of the Joint Statistical Meeting in Salt Lake City, August 2007. ASA section on Biometrics.
- Asparouhov, T. & Muthén, B. (2008a). Multilevel mixture models. In G.R. Hancock, & K.M. Samuelson (eds.), *Advances in latent variable mixture models*. Charlotte, NC: Information Age Publishing, Inc.
- Asparouhov, T. & Muthén, B. (2008b). Auxiliary variables predicting missing data. Technical appendix. Los Angeles: Muthén & Muthén.

- Asparouhov, T. & Muthén, B. (2008c). Chi-square statistics with multiple imputation. Technical appendix. Los Angeles: Muthén & Muthén.
- Asparouhov, T. & Muthén, B. (2009a). Exploratory structural equation modeling. *Structural Equation Modeling*, 16, 397-438.
- Asparouhov, T. & Muthén, B. (2009b). Resampling methods in Mplus for complex survey data. Technical appendix. Los Angeles: Muthén & Muthén.
- Asparouhov, T. & Muthén, B. (2010a). Weighted least squares estimation with missing data. Technical appendix. Los Angeles: Muthén & Muthén.
- Asparouhov, T. & Muthén, B. (2010b). Bayesian analysis using Mplus: Technical implementation. Technical Report. Los Angeles: Muthén & Muthén.
- Asparouhov, T. & Muthén, B. (2012a). General random effect latent variable modeling: Random subjects, items, contexts, and parameters. Technical Report. Los Angeles: Muthén & Muthén.
- Asparouhov, T. & Muthén, B. (2012b). Auxiliary variables in mixture modeling: A 3-step approach using Mplus. *Mplus Web Notes*: No. 15. www.statmodel.com.
- Asparouhov, T. & Muthén, B. (2012c). Using Mplus TECH11 and TECH14 to test the number of latent classes. *Mplus Web Notes*: No. 14. www.statmodel.com.
- Asparouhov, T. & Muthén, B. (2014a). Auxiliary variables in mixture modeling: Three-step approaches using Mplus. *Structural Equation Modeling: A Multidisciplinary Journal*, 21, 329-341.
- Asparouhov, T. & Muthén, B. (2014b). Auxiliary variables in mixture modeling: Using the BCH method in Mplus to estimate a distal outcome model and an arbitrary secondary model. *Mplus Web Notes*: No. 21. www.statmodel.com.
- Asparouhov, T. & Muthén, B. (2014c). Multiple-group factor analysis alignment. *Structural Equation Modeling*, 21, 495-508.
- Asparouhov, T. & Muthén, B. (2014d). Variable-specific entropy contribution. Technical appendix. Los Angeles: Muthén & Muthén.
- Asparouhov, T. & Muthén, B. (2015a). Structural equation models and mixture models with continuous non-normal skewed distributions. *Structural Equation Modeling*, 22, 12-23.

- Asparouhov, T. & Muthén, B. (2015b). Residual associations in latent class and latent transition analysis. *Structural Equation Modeling*, 22, 169-177.
- Asparouhov, T. & Muthén, B. (2016). IRT in Mplus. Technical appendix. Los Angeles: Muthén & Muthén.
- Asparouhov, T., Hamaker, E.L. & Muthén, B. (2017). Dynamic structural equation models. Technical Report. Los Angeles: Muthén & Muthén.
- Asparouhov, T., Masyn, K. & Muthén, B. (2006). Continuous time survival in latent variable models. Proceedings of the Joint Statistical Meeting in Seattle, August 2006. ASA section on Biometrics, 180-187.
- Bakk, Z. & Vermunt, J.K. (2016). Robustness of stepwise latent class modeling with continuous distal outcomes. *Structural Equation Modeling*, 23, 20-31.
- Bauer, D.J. & Curran, P.J. (2005). Probing interactions in fixed and multilevel regression: Inferential and graphical techniques. *Multivariate Behavioral Research*, 40, 373-400.
- Bauer, D.J., Preacher, K.J., & Gil, K.M. (2006). Conceptualizing and testing random indirect effects and moderated mediation in multilevel models: New procedures and recommendations. *Psychological Methods*, 11, 142-163.
- Bernaards, C.A. & Jennrich, R.I. (2005). Gradient projection algorithms and software for arbitrary rotation criteria in factor analysis. *Educational and Psychological Measurement*, 65, 676-696.
- Bijmolt, T.H.A., Paas, L.J., & Vermunt, J.K. (2004). Country and consumer segmentation: Multi-level latent class analysis of financial product ownership. *International Journal of Research in Marketing*, 21, 323-340.
- Bollen, K.A. (1989). *Structural equations with latent variables*. New York: John Wiley & Sons.
- Bollen, K.A. & Stein, R.A. (1992). Bootstrapping goodness-of-fit measures in structural equation models. *Sociological Methods & Research*, 21, 205-229.
- Boscardin, J., Zhang, X., & Belin, T. (2008). Modeling a mixture of ordinal and continuous repeated measures. *Journal of Statistical Computation and Simulation*, 78, 873-886.
- Browne, M.W. (2001). An overview of analytic rotation in exploratory factor analysis. *Multivariate Behavioral Research*, 36, 111-150.

- Browne, M.W. & Arminger, G. (1995). Specification and estimation of mean- and covariance-structure models. In G. Arminger, C.C. Clogg & M.E. Sobel (eds.), *Handbook of statistical modeling for the social and behavioral sciences* (pp. 311-359). New York: Plenum Press.
- Browne, W.J. & Draper, D. (2006). A comparison of Bayesian and likelihood-based methods for fitting multilevel models. *Bayesian Analysis*, 3, 473-514.
- Browne, M.W., Cudeck, R., Tateneni, K., & Mels, G. (2004). CEFA: Comprehensive Exploratory Factor Analysis, Version 2.00 [Computer software and manual]. Retrieved from <http://quantrm2.psy.ohio-state.edu/browne/>.
- Chib, S. & Greenberg, E. (1998). Bayesian analysis of multivariate probit models. *Biometrika*, 85, 347-361.
- Collins, L.M. & Lanza, S.T. (2010). *Latent class and latent transition analysis*. Hoboken, N.J.: John Wiley & Sons.
- Collins, L.M, Schafer, J.L., & Kam, C-H (2001). A comparison of inclusive and restrictive strategies in modern missing data procedures. *Psychological Methods*, 6, 330-351.
- Cook, R.D. (1977). Detection of influential observations in linear regression. *Technometrics*, 19, 15-18.
- Cook, R.D. & Weisberg, S. (1982). *Residuals and influence in regression*. New York: Chapman & Hall.
- Cudeck, R. & O'Dell, L.L. (1994). Applications of standard error estimates in unrestricted factor analysis: Significance tests for factor loadings and correlations. *Psychological Bulletin*, 115, 475-487.
- Duan, N., Manning, W.G., Morris, C.N. & Newhouse, J.P. (1983). A comparison of alternative models for the demand for medical care. *Journal of Business & Economic Statistics*, 1, 115-126.
- Demirtas, H. & Schafer, J.L. (2003). On the performance of random-coefficient pattern-mixture models for non-ignorable drop-out. *Statistics in Medicine*, 22, 2553-2575.
- Dempster, A.P., Laird, N.M., & Rubin, D.B. (1977). Maximum likelihood from incomplete data via the EM algorithm. *Journal of the Royal Statistical Society, Series B*, 39, 1-38.
- Diggle, P.D. & Kenward, M.G. (1994). Informative drop-out in longitudinal data analysis (with discussion). *Applied Statistics*, 43, 49-73.

- Efron, B. & Tibshirani, R.J. (1993). *An introduction to the bootstrap*. New York: Chapman & Hall.
- Enders, C.K. (2002). Applying the Bollen-Stine bootstrap for goodness-of-fit measures to structural equation models with missing data. *Multivariate Behavioral Research*, 37, 359-377.
- Enders, C.K. (2010). *Applied missing data analysis*. New York: Guilford Press.
- Everitt, B.S. & Hand, D.J. (1981). *Finite mixture distributions*. London: Chapman & Hall.
- Fabrigar, L.R., Wegener, D.T., MacCallum, R.C., & Strahan, E.J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods*, 4, 272-299.
- Fay, R.E. (1989). Theoretical application of weighting for variance calculation. *Proceedings of the Section on Survey Research Methods of the American Statistical Association*, 212-217.
- Fox, J. P. (2010). *Bayesian item response modeling. Theory and applications*. New York: Springer.
- Gelman, A. (2006). Prior distributions for variance parameters in hierarchical models. *Bayesian Analysis*, 3, 515-533.
- Gelman, A. & Rubin, D.B. (1992). Inference from iterative simulation using multiple sequences (with discussion). *Statistical Science*, 7, 457-511.
- Gelman, A., Carlin, J.B., Stern, H.S., and Rubin, D.B. (2004). *Bayesian data analysis. Second edition*. New York: Chapman & Hall.
- Graham, J.W. (2003). Adding missing-data relevant variables to FIML-based structural equation models. *Structural Equation Modeling: A Multidisciplinary Journal*, 10, 80-100.
- Granger, C.W.J. & Morris, M.J. (1976). Time series modelling and interpretation. *Journal of the Royal Statistical Society, Series A*, 139, 246-257.
- Hagenaars, J.A. & McCutcheon, A.L. (2002). *Applied latent class analysis*. Cambridge, UK: Cambridge University Press.
- Hayes, A.F. (2013). *Introduction to mediation, moderation, and conditional process analysis. A regression-based approach*. New York: The Guilford Press.
- Hayton, J.C., Allen, D.G., & Scarpello, V. (2004). Factor retention decisions in exploratory factor analysis: A tutorial on parallel analysis. *Organizational Research Methods*, 7, 191-205.

- Hedeker, D. & Gibbons, R.D. (1994). A random-effects ordinal regression model for multilevel analysis. *Biometrics*, 50, 933-944.
- Hedeker, D. & Gibbons, R.D. (1997). Application of random-effects pattern-mixture models for missing data in longitudinal studies. *Psychological Methods*, 2, 64-78.
- Hilbe, J.M. (2011). *Negative binomial regression*. Second edition. New York: Cambridge University Press.
- Hildreth, C. & Houck, J.P. (1968). Some estimates for a linear model with random coefficients. *Journal of the American Statistical Association*, 63, 584-595.
- Hosmer, D.W. & Lemeshow, S. (2000). *Applied logistic regression*. Second edition. New York: John Wiley & Sons.
- Hougaard, P. (2000). *Analysis of multivariate survival data*. New York: Springer.
- Imai, K., Keele, L., & Tingley, D. (2010a). A general approach to causal mediation analysis. *Psychological Methods*, 15, 309-334.
- Imai, K., Keele, L., & Yamamoto, Y. (2010b). Identification, inference and sensitivity analysis for causal mediation effects. *Statistical Science*, 25, 51-71.
- Jedidi, K., Jagpal, H.S. & DeSarbo, W.S. (1997). Finite-mixture structural equation models for response-based segmentation and unobserved heterogeneity. *Marketing Science*, 16, 39-59.
- Jeffries, N.O. (2003). A note on 'testing the number of components in a normal mixture'. *Biometrika*, 90, 991-994.
- Jennrich, R.I. (1973). Standard errors for obliquely rotated factor loadings. *Psychometrika*, 38, 593-604.
- Jennrich, R.I. (1974). Simplified formulae for standard errors in maximum-likelihood factor analysis. *The British Journal of Mathematical and Statistical Psychology*, 27, 122-131.
- Jennrich, R.I. (2007). Rotation methods, algorithms, and standard errors. In R. Cudeck & R.C. MacCallum (eds.). *Factor analysis at 100. Historical developments and future directions* (pp. 315-335). Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc.
- Jennrich, R.I. & Bentler, P.M. (2011). Exploratory bi-factor analysis. *Psychometrika*, 76, 537-549.

- Jennrich, R.I. & Bentler, P.M. (2012). Exploratory bi-factor analysis: The oblique case. *Psychometrika*, 77, 442-454.
- Jennrich, R.I. & Sampson, P.F. (1966). Rotation for simple loadings. *Psychometrika*, 31, 313-323.
- Johnston, J. (1984). *Econometric methods*. Third edition. New York: McGraw-Hill.
- Joreskog, K.G. & Sorbom, D. (1979). *Advances in factor analysis and structural equation models*. Cambridge, MA: Abt Books.
- Kaplan, D. (2008). An overview of Markov chain methods for the study of stage-sequential developmental processes. *Developmental Psychology*, 44, 457-467.
- Kenward, M.G. & Molenberghs, G. (1998). Likelihood based frequentist inference when data are missing at random. *Statistical Science*, 13, 236-247.
- Klein, A. & Moosbrugger, H. (2000). Maximum likelihood estimation of latent interaction effects with the LMS method. *Psychometrika*, 65, 457-474.
- Klein J.P. & Moeschberger, M.L. (1997). *Survival analysis: Techniques for censored and truncated data*. New York: Springer.
- Korn, E.L. & Graubard, B.I. (1999). *Analysis of health surveys*. New York: John Wiley & Sons.
- Kreuter, F. & Muthén, B. (2008). Analyzing criminal trajectory profiles: Bridging multilevel and group-based approaches using growth mixture modeling. *Journal of Quantitative Criminology*, 24, 1-31.
- Langeheine, R. & van de Pol, F. (2002). Latent Markov chains. In J.A. Hagenaars & A.L. McCutcheon (eds.), *Applied latent class analysis* (pp. 304-341). Cambridge, UK: Cambridge University Press.
- Lanza, S.T., Tan, X., & Bray, B.C. (2013). Latent class analysis with distal outcomes: A flexible model-based approach. *Structural Equation Modeling*, 20, 1-26.
- Larsen, K. (2004). Joint analysis of time-to-event and multiple binary indicators of latent classes. *Biometrics* 60, 85-92.
- Larsen, K. (2005). The Cox proportional hazards model with a continuous latent variable measured by multiple binary indicators. *Biometrics*, 61, 1049-1055.

- Lee, S.Y. (2007). *Structural equation modeling. A Bayesian approach*. New York: John Wiley & Sons.
- Little, R.J. (1995). Modeling the drop-out mechanism in repeated-measures studies. *Journal of the American Statistical Association*, 90, 1112-1121.
- Little, R.J. & Rubin, D.B. (2002). *Statistical analysis with missing data*. Second edition. New York: John Wiley & Sons.
- Little, R.J. & Yau, L.H.Y. (1998). Statistical techniques for analyzing data from prevention trials: Treatment of no-shows using Rubin's causal model. *Psychological Methods*, 3, 147-159.
- Lo, Y., Mendell, N.R. & Rubin, D.B. (2001). Testing the number of components in a normal mixture. *Biometrika*, 88, 767-778.
- Lohr, S.L. (1999). *Sampling: Design and analysis*. Pacific Grove, CA: Brooks/Cole Publishing Company.
- Long, J.S. (1997). *Regression models for categorical and limited dependent variables*. Thousand Oaks, CA: Sage Publications, Inc.
- Lüdtke, O., Marsh, H.W., Robitzsch, A., Trautwein, U., Asparouhov, T., & Muthén, B. (2008). The multilevel latent covariate model: A new, more reliable approach to group-level effects in contextual studies. *Psychological Methods*, 13, 203-229.
- MacKinnon, D.P. (2008). *Introduction to statistical mediation analysis*. New York: Lawrence Erlbaum Associates.
- MacKinnon, D.P., Lockwood, C.M., & Williams, J. (2004). Confidence limits for the indirect effect: Distribution of the product and resampling methods. *Multivariate Behavioral Research*, 39, 99-128.
- MacKinnon, D. P., Lockwood, C. M., Brown, C. H., Wang, W., & Hoffman, J. M. (2007). The intermediate endpoint effect in logistic and probit regression. *Clinical Trials*, 4, 499-513.
- Mantel, N. (1966). Evaluation of survival data and two new rank order statistics arising in its consideration. *Cancer Chemotherapy Reports*, 50, 163-170.
- Marlow, A.J., Fisher, S.E., Francks, C., MacPhie, I.L., Cherny, S.S., Richardson, A.J., Talcott, J.B., Stein, J.F., Monaco, A.P., & Cardon, L.R. (2003). Use of multivariate linkage analysis for dissection of a complex cognitive trait. *American Journal of Human Genetics*, 72, 561-570.

- McCutcheon, A.L. (2002). Basic concepts and procedures in single- and multiple-group latent class analysis. In J.A. Hagenars & A.L. McCutcheon (eds.), *Applied latent class analysis* (pp. 56-85). Cambridge, UK: Cambridge University Press.
- McDonald, R.P. (1967). *Nonlinear factor analysis*. Psychometric Monograph Number 15. University of Chicago. Richmond, VA: The William Byrd Press.
- McLachlan, G. & Peel, D. (2000). *Finite mixture models*. New York: John Wiley & Sons.
- McLachlan, G.J., Do, K.A., & Ambrose, C. (2004). *Analyzing microarray gene expression data*. New York: John Wiley & Sons.
- Millsap, R.E. (2011). *Statistical approaches to measurement invariance*. Taylor and Francis Group: New York.
- Mislevy, R.J., Johnson, E.G., & Muraki, E. (1992). Scaling procedures in NAEP. *Journal of Educational Statistics*, 17, 131-154.
- Molenaar, P.C.M. (1985). A dynamic factor model for the analysis of multivariate time series. *Psychometrika*, 50, 181-202.
- Mooijaart, A. (1998). Log-linear and Markov modeling of categorical longitudinal data. In C.C.J.H. Bijleveld & T. van der Kamp, *Longitudinal data analysis: Designs, models, and methods* (pp. 318-370). Newbury Park, CA: Sage Publications.
- Muthén, B. (1978). Contributions to factor analysis of dichotomous variables. *Psychometrika*, 43, 551-560.
- Muthén, B. (1984). A general structural equation model with dichotomous, ordered categorical, and continuous latent variable indicators. *Psychometrika*, 49, 115-132.
- Muthén, B. (1989). Latent variable modeling in heterogeneous populations. *Psychometrika*, 54, 557-585.
- Muthén, B. (1990). Mean and covariance structure analysis of hierarchical data. Paper presented at the Psychometric Society meeting in Princeton, NJ, June 1990. UCLA Statistics Series 62.
- Muthén, B. (1994). Multilevel covariance structure analysis. In J. Hox & I. Kreft (eds.), *Multilevel Modeling, a special issue of Sociological Methods & Research*, 22, 376-398.

- Muthén, B. (1997). Latent variable modeling with longitudinal and multilevel data. In A. Raftery (ed.), *Sociological Methodology* (pp. 453-480). Boston: Blackwell Publishers.
- Muthén, B. (2002). Beyond SEM: General latent variable modeling. *Behaviormetrika*, 29, 81-117.
- Muthén, B. (2004). Latent variable analysis: Growth mixture modeling and related techniques for longitudinal data. In D. Kaplan (ed.), *Handbook of quantitative methodology for the social sciences* (pp. 345-368). Newbury Park, CA: Sage Publications.
- Muthén, B. (2006). Should substance use disorders be considered as categorical or dimensional? *Addiction*, 101 (Suppl. 1), 6-16.
- Muthén, B. (2008). Latent variable hybrids: Overview of old and new models. In Hancock, G. R., & Samuelsen, K. M. (Eds.), *Advances in latent variable mixture models*, pp. 1-24. Charlotte, NC: Information Age Publishing, Inc.
- Muthén, B. (2011). Applications of causally defined direct and indirect effects in mediation analysis using SEM in Mplus. Technical Report. Los Angeles: Muthén & Muthén.
- Muthén, B. & Asparouhov, T. (2002). Latent variable analysis with categorical outcomes: Multiple-group and growth modeling in Mplus. *Mplus Web Notes*: No. 4. www.statmodel.com.
- Muthén, B. & Asparouhov, T. (2006). Item response mixture modeling: Application to tobacco dependence criteria. *Addictive Behaviors*, 31, 1050-1066.
- Muthén, B. & Asparouhov, T. (2007). Non-parametric hierarchical regressions. In preparation.
- Muthén, B. & Asparouhov, T. (2009). Growth mixture modeling: Analysis with non-Gaussian random effects. In Fitzmaurice, G., Davidian, M., Verbeke, G. & Molenberghs, G. (eds.), *Longitudinal Data Analysis*, pp. 143-165. Boca Raton: Chapman & Hall/CRC Press.
- Muthén, B. & Asparouhov, T. (2011). LTA in Mplus: Transition probabilities influenced by covariates. *Mplus Web Notes*: No. 13. www.statmodel.com.
- Muthén, B. & Asparouhov, T. (2012). Bayesian SEM: A more flexible representation of substantive theory. *Psychological Methods*, 17, 313-335.
- Muthén, B. & Asparouhov, T. (2013). BSEM measurement invariance analysis. *Mplus Web Notes*: No. 17. www.statmodel.com.

- Muthén, B. & Asparouhov T. (2015a). Growth mixture modeling with non-normal distributions. *Statistics in Medicine*, 34, 1041–1058.
- Muthén, B. & Asparouhov, T. (2015b). Causal effects in mediation modeling: An introduction with applications to latent variables. *Structural Equation Modeling*, 22, 12-23.
- Muthén, B. & Christoffersson, A. (1981). Simultaneous factor analysis of dichotomous variables in several groups. *Psychometrika*, 46, 407-419.
- Muthén, B. & Masyn, K. (2005). Discrete-time survival mixture analysis. *Journal of Educational and Behavioral Statistics*, 30, 27-28.
- Muthén, L.K. & Muthén, B. (2002). How to use a Monte Carlo study to decide on sample size and determine power. *Structural Equation Modeling*, 4, 599-620.
- Muthén, B. & Satorra, A. (1995). Complex sample data in structural equation modeling. In P. Marsden (ed.), *Sociological Methodology 1995*, 216-316.
- Muthén, B. & Shedden, K. (1999). Finite mixture modeling with mixture outcomes using the EM algorithm. *Biometrics*, 55, 463-469.
- Muthén, B., du Toit, S.H.C. & Spisic, D. (1997). Robust inference using weighted least squares and quadratic estimating equations in latent variable modeling with categorical and continuous outcomes. Unpublished manuscript.
- Muthén, B., Jo., B., & Brown, H. (2003). Comment on the Barnard, Frangakis, Hill, & Rubin article, Principal stratification approach to broken randomized experiments: A case study of school choice vouchers in New York City. *Journal of the American Statistical Association*, 98, 311-314.
- Muthén, B., Asparouhov, T. & Rebollo, I. (2006). Advances in behavioral genetics modeling using Mplus: Applications of factor mixture modeling to twin data. *Twin Research and Human Genetics*, 9, 313-324.
- Muthén, B., Muthén, L.K., & Asparouhov, T. (2016). *Regression and Mediation Analysis using Mplus*. Los Angeles, CA: Muthén & Muthén.
- Muthén, B., Asparouhov, T., Boye, M.E., Hackshaw, M.D., & Naegeli, A.N. (2009). Applications of continuous-time survival in latent variable models for the analysis of oncology randomized clinical trial data using Mplus. Technical Report. www.statmodel.com.

- Muthén, B., Asparouhov, T., Hunter, A., & Leuchter, A. (2011). Growth modeling with non-ignorable dropout: Alternative analyses of the STAR*D antidepressant trial. *Psychological Methods*, 16, 17-33.
- Muthén, B., Brown, C.H., Masyn, K., Jo, B., Khoo, S.T., Yang, C.C., Wang, C.P., Kellam, S., Carlin, J., & Liao, J. (2002). General growth mixture modeling for randomized preventive interventions. *Biostatistics*, 3, 459-475.
- Nagin, D.S. (1999). Analyzing developmental trajectories: A semi-parametric, group-based approach. *Psychological Methods*, 4, 139-157.
- Neale, M.C. & Cardon, L.R. (1992). *Methodology for genetic studies of twins and families*. The Netherlands: Kluwer Academic Publishers.
- Nylund, K. (2007). *Latent transition analysis: Modeling extensions and an application to peer victimization*. Doctoral dissertation, University of California, Los Angeles. www.statmodel.com.
- Nylund, K.L., Asparouhov, T., & Muthén, B.O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling*, 14, 535-569.
- Olsen, M.K. & Schafer, J.L. (2001). A two-part random-effects model for semicontinuous longitudinal data. *Journal of the American Statistical Association*, 96, 730-745.
- Qu, Y., Tan, M., & Kutner, M.H. (1996). Random effects models in latent class analysis for evaluating accuracy of diagnostic tests. *Biometrics*, 52, 797-810.
- Posthuma, D., de Geus, E.J.C., Boomsma, D.I., & Neale, M.C. (2004). Combined linkage and association tests in Mx. *Behavior Genetics*, 34, 179-196.
- Pothoff, R.F., Woodbury, M.A., & Manton, K.G. (1992). "Equivalent sample size" and "equivalent degrees of freedom" refinements for inference using survey weights under superpopulation models. *Journal of the American Statistical Association*, 87, 383-396.
- Preacher, K.J., Rucker, D.D., & Hayes, A.F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research*, 42, 185-227.
- Prescott, C.A. (2004). Using the Mplus computer program to estimate models for continuous and categorical data from twins. *Behavior Genetics*, 34, 17-40.

- Raghunathan, T.E., Lepkowski, J.M., Van Hoewyk, J., & Solenberger, P. (2001). A multivariate technique for multiply imputing missing values using a sequence of regression models. *Survey Methodology*, 27, 85-95.
- Raudenbush, S.W. & Bryk, A.S. (2002). *Hierarchical linear models: Applications and data analysis methods*. Second edition. Newbury Park, CA: Sage Publications.
- Reboussin, B.A., Reboussin, D.M., Liang, K.L., & Anthony, J.C. (1998). Latent transition modeling of progression of health-risk behavior. *Multivariate Behavioral Research*, 33, 457-478.
- Roeder, K., Lynch, K.G., & Nagin, D.S. (1999). Modeling uncertainty in latent class membership: A case study in criminology. *Journal of the American Statistical Association*, 94, 766-776.
- Rousseeuw P.J. & Van Zomeren B.C. (1990). Unmasking multivariate outliers and leverage points. *Journal of the American Statistical Association*. 85, 633-651.
- Rubin, D.B. (1987). *Multiple imputation for nonresponse in surveys*. New York: John Wiley & Sons.
- Schafer, J.L. (1997). *Analysis of incomplete multivariate data*. London: Chapman & Hall.
- Schuurman, N.K., Houtveen, J.H., & Hamaker, E.L. (2015). Incorporating measurement error in n=1 psychological autoregressive modeling. *Frontiers in Psychology*, 6, 1-15.
- Schuurman, N.K., Ferrer, E., de Boer-Sonnenschein, M., & Hamaker, E.L. (2016). How to compute cross-lagged associations in a multilevel autoregressive model. *Psychological Methods*, 21, 206-221.
- Shumway, R.H. & Stoffer, D.S. (2011). *Time series analysis and its applications*. New York: Springer.
- Singer, J.D. & Willett, J.B. (2003). *Applied longitudinal data analysis: Modeling change and event occurrence*. New York: Oxford University Press.
- van Buuren, S. (2007). Multiple imputation of discrete and continuous data by fully conditional specification. *Statistical Methods in Medical Research*, 16, 219-242.
- VanderWeele, T.J. (2015). *Explanation in causal inference. Methods for mediation and interaction*. New York: Oxford University Press.

Verhagen, J. & Fox, J.P. (2012). Bayesian tests of measurement invariance. *British Journal of Mathematical and Statistical Psychology*. Accepted for publication.

Vermunt, J.K. (2003). Multilevel latent class models. In R.M. Stolzenberg (ed.), *Sociological Methodology 2003* (pp. 213-239). Washington, D.C.: ASA.

Vermunt, J.K. (2010). Latent class modeling with covariates: Two improved three-step approaches. *Political Analysis*, 18, 450-469.

von Davier, M., Gonzalez, E., & Mislevy, R.J. (2009). What are plausible values and why are they useful? *IERI Monograph Series*, 2, 9-36.

Wang C-P, Brown CH, Bandeen-Roche K (2005). Residual diagnostics for growth mixture models: Examining the impact of a preventive intervention on multiple trajectories of aggressive behavior. *Journal of the American Statistical Association*, 100, 1054-1076.

Yates, A. (1987). *Multivariate exploratory data analysis: A perspective on exploratory factor analysis*. Albany: State University of New York Press.

Yuan, K.H. & Bentler, P.M. (2000). Three likelihood-based methods for mean and covariance structure analysis with nonnormal missing data. In M.E. Sobel & M.P. Becker (eds.), *Sociological Methodology 2000* (pp. 165-200). Washington, D.C.: ASA.

Zhang, Z. & Nesselroade, J.R. (2007). Bayesian estimation of categorical dynamic factor models. *Multivariate Behavioral Research*, 42, 729-756.

Zhang, Z., Hamaker, E.L., & Nesselroade, J.R. (2008). Comparisons of four methods for estimating a dynamic factor model. *Structural Equation Modeling*, 15, 377-402.

INDEX

- !, 14
- !*, 14
- ", 757
- %BETWEEN%, 783
- %class label%, 782
- %COLUMN, 799
- %OVERALL%, 782
- %ROW, 799
- %TOTAL, 799
- %WITHIN%, 783
- (#), 734–35
- *, 732–33
- *!, 14
- @, 733–34
- [], 729–30
- _MISSING, 643
- _RECNUM, 613–14
- { }, 745–46
- | symbol
 - growth models, 746–53
 - individually-varying times of observation, 753–54
 - latent variable interactions, 757–59
 - random slopes, 754–56
 - random variances, 757
- 3-step mixture analysis
 - Monte Carlo, 880–81
 - real data, 615–18
- ABS, 641–42
- accelerated cohort, 145–49
- ACE, 85–86, 87–88
- ACONVERGENCE, 699
- ACOS, 641–42
- ADAPTIVE, 687–88
- ADDFREQUENCY, 696
- AITERATIONS, 697
- ALGORITHM
 - Bayesian, 703–4
 - frequentist, 685–86
- ALIGNMENT, 672–74
- OUTPUT, 812
- alignment optimization, 694, 697, 699, 700
- ALL
 - CROSSTABS, 799
 - MISSING, 601–2
 - MODINDICES, 804–5
 - REPSAVE, 889
 - USEVARIABLES, 599–600
- ALLFREE, 110–12, 671–72
- alpha, 821
- alpha (c), 822
- alpha (f), 823
- ANALYSIS command, 651–710
- AR(1), 154–56, 157–58, 159–61, 161–62, 162–64, 355–59, 360–62, 366–69, 370–72, 373–74, 378–80, 381–85, 385–88, 389–93
- AR(2), 154–56, 355–59
- arithmetic operators, 641
- ARMA, 366–69
- ASIN, 641–42
- ASTARTS, 694
- AT, 753–54
- ATAN, 641–42
- auto-correlated residuals, 144–45
- automatic labeling, 671–72
- autoregression, 154–56, 157–58, 159–61, 161–62, 162–64, 355–59, 360–62, 366–69, 370–72, 373–74, 378–80, 381–85, 385–88, 389–93
- AUXILIARY
 - Monte Carlo, 880–81
 - real data, 615–18
- B2WEIGHT, 623
- B3WEIGHT, 624
- balanced repeated replication, 683–84
- BASEHAZARD
 - ANALYSIS, 684–85
 - OUTPUT, 811
 - SAVEDATA, 834–35

baseline hazard function, 151–52, 259–60
 BASIC, 659
 Bayes, 668–69, 701–7
 BAYES, 668–69
 Bayes factor, 820
 Bayesian estimation, 668–69, 701–7
 Bayesian plots, 846–48
 Bayesian posterior parameter values, 836, 890–91
 Bayesian structural equation modeling (BSEM)
 bi-factor CFA with two items loading on only the general factor and cross-loadings with zero-mean and small-variance priors, 107–8
 MIMIC model with cross-loadings and direct effects with zero-mean and small-variance priors, 109–10
 multiple group model with approximate measurement invariance using zero-mean and small-variance priors, 110–12
 BCH
 Monte Carlo, 880–81
 real data, 615–18
 BCHWEIGHTS, 842
 BCONVERGENCE, 704–5
 beta, 822
 BETWEEN
 Monte Carlo, 886–87
 real data, 633–35
 between-level categorical latent variable, 404–7, 408–10, 414–16, 420–22, 423–26, 431–33, 439–41
 BI-CF-QUARTIMAX, 678–82
 bi-factor EFA, 52–53
 bi-factor rotations, 678–82
 BI-GEOMIN, 678–82
 BINARY
 DATA MISSING, 588
 DATA SURVIVAL, 591–92
 DATA TWOPART, 586
 birth cohort, 145–49
 BITERATIONS, 705
 bivariate frequency tables, 799
 BLANK, 601
 BOOTSTRAP
 ANALYSIS, 688–89
 REPSE, 683–84
 bootstrap confidence intervals, 759–66
 bootstrap standard errors, 37–38, 688–89, 759–66
 Box data, 679
 BPARAMETERS
 Monte Carlo, 890–91
 real data, 836
 BRR, 683–84
 BSEED, 702
 BSEM, 107–8, 109–10, 110–12
 ALIGNMENT, 672–74
 burnin, 668–69
 BWEIGHT, 623
 BWTSCALE, 624
 BY, 717–22
 confirmatory factor analysis (CFA), 718–19
 exploratory structural equation modeling (ESEM), 719–22
 CATEGORICAL
 Monte Carlo, 874–76
 real data, 604–8
 categorical latent variables, 4–5, 723–24
 categorical mediating variables, 551
 CENSORED
 Monte Carlo, 873–74
 real data, 603–4
 CENTER, 645–49
 CF-EQUAMAX, 678–82
 CF-FACPARSIM, 678–82
 CF-PARSIMAX, 678–82
 CF-QUARTIMAX, 678–82
 CF-VARIMAX, 678–82
 CHAINS, 702
 CHECK, 574–75
 chi-square difference test for WLSMV and MLMV, 507–8, 694–95, 833
 chi-square difference testing, 546–47
 chi-square test of model fit, 809
 CHOLESKY, 685

CINTERVAL, 806–7
 CINTERVAL (BCBOOTSTRAP), 806
 CINTERVAL (BOOTSTRAP), 806
 CINTERVAL (EQTAIL), 806
 CINTERVAL (HPD), 806
 CINTERVAL (SYMMETRIC), 806
 class probabilities, 840
 CLASSES
 Monte Carlo, 879–80
 real data, 627–28
 CLUSTER
 OUTPUT, 799–802
 RESIDUAL, 802–4
 TECH4, 815–16
 VARIABLE, 620–22
 cluster size, 869–71
 CLUSTER_MEAN, 645
 cluster-level factor indicators, 292–96
 cohort, 145–49
 COHORT, 592
 COHRECODE, 593
 COMBINATION, 688
 comment, 14
 COMPLEX, 659
 complex survey data, 619–26
 complier-average causal effect estimation (CACE), 203–5, 205–7
 conditional independence (relaxed), 192–93, 210–11
 conditional probabilities, 820
 confidence intervals, 37–38, 806–7
 CONFIGURAL
 ALIGNMENT, 672–74
 MODEL, 670–71
 configural model, 540–47, 672–74
 confirmatory analysis, 60–61, 188–90
 confirmatory factor analysis (CFA)
 categorical factor indicators, 62
 censored and count factor indicators, 64–65
 continuous and categorical factor indicators, 63
 continuous factor indicators, 60–61
 mixture, 194
 two-level mixture, 411–13
 CONSTRAINT, 618
 constraints, 31–32, 89–90, 91–92, 92–93, 93–94, 187–88, 212–14, 215–17, 766–72
 contextual effect, 275–79
 CONTINUOUS, 586
 continuous latent variables, 3–4
 continuous-time survival analysis, 150–51, 151–52, 153–54, 217–19, 259–60, 320–21, 493–94
 controlled direct effect, 763–66
 convenience features, 730–32
 CONVERGENCE, 697
 convergence problems, 523–25
 COOKS
 PLOT, 852
 SAVEDATA, 841–42
 Cook's distance, 841–42
 COPATTERN, 592–93
 CORRELATION
 ANALYSIS, 701
 DATA, 570
 ROWSTANDARDIZATION, 682
 SAVEDATA, 837
 COS, 641–42
 COUNT
 CROSSTABS, 799
 Monte Carlo, 877–79
 real data, 609–12
 count variable models
 negative binomial, 610–11, 878
 negative binomial hurdle, 611–12, 879
 Poisson, 610, 877
 zero-inflated negative binomial, 611, 878–79
 zero-inflated Poisson, 610, 877–78
 zero-truncated negative binomial, 611, 879
 counterfactually-defined indirect effects, 762–66
 COVARIANCE
 ANALYSIS, 701
 DATA, 570
 DATA IMPUTATION, 578–79
 H1MODEL, 809
 MODEL PRIORS, 777
 ROWSTANDARDIZATION, 682

SAVEDATA, 829, 837
COVERAGE
 ANALYSIS, 695
 MONTECARLO, 888
 Cox regression, 150–51, 259–60, 320–21,
 493–94
CPROBABILITIES, 840
CRAWFER, 678–82
 Crawford family of rotations, 680
 credibility interval, 759–66, 806–7
CROSSCLASSIFIED, 663
 cross-classified modeling
 IRT with random binary items, 345–46
 multiple indicator growth model with random
 intercepts and factor loadings, 347–49
 path analysis with continuous dependent
 variables, 342–44
 regression for a continuous dependent
 variable, 338–42
 cross-lagged, 158–59, 363–66, 375–77
 cross-loadings, 109–10
CROSSTABS, 799
CSIZES, 869–71
CUT, 644–45
CUTPOINT
 DATA SURVIVAL, 591
 DATA TWOPART, 585
CUTPOINTS, 866
DAFS, 159–61
DATA COHORT, 592–95
DATA command, 564–95
 data generation, 863–66
 data imputation, 575–79
DATA IMPUTATION, 575–79
DATA LONGTOWIDE, 582–84
DATA MISSING, 587–90
 data reading
 covariance matrix, 500
 fixed format, 501
 means and covariance matrix, 500–501
DATA SURVIVAL, 590–92
 data transformation, 580–95, 639–50
DATA TWOPART, 584–87
DATA WIDETOLONG, 580–82
DCATEGORICAL
 Monte Carlo, 880–81
 real data, 615–18
DCONTINUOUS
 Monte Carlo, 880–81
 real data, 615–18
DDROPOUT, 587–90
DE3STEP
 Monte Carlo, 880–81
 real data, 615–18
 decomposition, 270–75
 defaults, 516–20
DEFINE command, 639–50
 degree of freedom parameter, 674
 delta, 822
DELTA, 675
 Delta method standard errors, 759–66
 derivatives of parameters, 814–15
DESCRIPTIVE, 589–90
 Deviance Information Criterion, 668–69
 Diagrammer, 10–11
DIC, 668–69
DIFFERENCE, 110–12, 779–80
 difference testing, 546–47
DIFFTEST, 507–8
 ANALYSIS, 694–95
 SAVEDATA, 833
 direct autoregressive factor score model,
 159–61
 direct effects, 109–10, 759–66
 Dirichlet, 774–80
 discrete-time survival analysis, 149–50,
 489–90
 discrete-time survival mixture analysis,
 257–59
 distal outcome, 235–36
DISTRIBUTION, 674
DO
 DEFINE, 650
 MODEL CONSTRAINT, 769–70
 MODEL PRIORS, 777–79
 MODEL TEST, 773–74
 do loop

DEFINE, 650
 MODEL CONSTRAINT, 769–70
 MODEL PRIORS, 777–79
 MODEL TEST, 773–74
 double do loop
 DEFINE, 650
 MODEL CONSTRAINT, 769–70
 MODEL PRIORS, 777–79
 MODEL TEST, 773–74
 dropout, 448–49
 DSEM, 114, 263
 DSURVIVAL, 612
 DU3STEP
 Monte Carlo, 880–81
 real data, 615–18
 dynamic factor model, 159–61
 dynamic structural equation modeling, 114, 263
E
 Monte Carlo, 880–81
 real data, 615–18
 ECLUSTER, 622–23
 EFA, 663–65
 eigenvalues, 682–83
 EM, 685–86
 EMA, 685–86
 ENTROPY, 812
 entropy individual variable, 812
 EQUAL, 684–85
 equalities, 734–35
 ESEM, 95–96, 97–98, 99–100, 101–3, 104–5, 105–6, 106–7, 719–22
 ESTBASELINE, 835
 estimated correlation matrix, 815–16
 estimated covariance matrix
 OUTPUT, 815
 SAVEDATA, 829
 estimated sigma between matrix, 829
 estimated time scores, 128
 ESTIMATES, 832–33
 ESTIMATOR, 665–68
 event history indicators, 489–90
 EXP, 641–42
 EXPECTED, 688
 expected frequencies, 817
 exploratory factor analysis (EFA)
 bi-factor with continuous factor indicators, 52–53
 categorical factor indicators, 46–47
 continuous factor indicators, 45–46
 continuous, censored, categorical, and count factor indicators, 48–49
 factor mixture analysis, 49–50
 parallel analysis, 682–83
 two-level with continuous factor indicators, 50–51
 two-level with individual- and cluster-level factor indicators, 51–52
 exploratory structural equation modeling (ESEM), 719–22
 bi-factor EFA, 105–6
 bi-factor EFA with two items loading on only the general factor, 106–7
 EFA at two timepoints, 99–100
 EFA with covariates (MIMIC), 95–96
 EFA with residual variances constrained to be greater than zero, 104–5
 multiple group EFA with continuous factor indicators, 101–3
 SEM with EFA and CFA factors, 97–98
 exposure variable, 762–66
 external Monte Carlo simulation, 484–87
 factor mixture analysis, 49–50, 210–11
 factor score coefficients, 810
 factor score determinacy, 811
 factor scores, 837–39, 842, 851
FACTORS
 PLOT, 851
 SAVEDATA, 842
 FAY, 683–84
 FBITERATIONS, 705
FILE
 DATA, 567
 SAVEDATA, 826–27
 FINITE, 626–27
 finite population correction factor, 626–27
 FIXED, 672–74
 fixing parameter values, 733–34

FORMAT
 DATA, 567–69
 DATA IMPUTATION, 578
 SAVEDATA, 827
 four-parameter logistic, 65–68, 606
FOURTHRT, 700
FPC, 626–27, 626–27
 frailty, 1
FREE
 ALIGNMENT, 672–74
 DATA, 567–68
 DATA IMPUTATION, 578
 MFORMAT, 844
 SAVEDATA, 827
 freeing parameters, 732–33
 frequency tables, 799
 frequency weights, 614
FREQWEIGHT, 614
FS, 685–86
FSCOEFFICIENT, 810
FSCOMPARISON, 811
FSCORES, 837–39
FSDETERMINACY, 811
FULLCORR, 570
FULLCOV, 570
 functions, 641–42
 gamma, 822
 Gamma, 774–80
 gamma (c), 823
 gamma (f), 823
GAUSSHERMITE, 686–87
 Gelman-Rubin convergence, 704–5
GENCLASSES, 866–67
GENERAL, 657–59
 generalized partial credit, 65–68, 605
GENERATE, 863–66
 generating data, 863–66
 generating missing data, 871–73
GEOMIN, 678–82
GIBBS, 703–4
 Gibbs sampler algorithm, 703–4
GLS, 668
 GPA algorithm, 699
GRANDMEAN, 645–49
 graphics module, 853–57
GROUPING, 612–13
GROUPMEAN, 645–49
 growth mixture modeling
 between-level categorical latent variable, 431–33
 categorical outcome, 231–32
 censored outcome, 230–31
 continuous outcome, 225–28
 distal outcome, 235–36
 known classes (multiple group analysis), 240–42
 negative binomial model, 235
 sequential process, 237–40
 two-level, 427–30
 zero-inflated Poisson model, 232–35
 growth modeling, 746–53
 auto-correlated residuals, 144–45
 categorical outcome, 123–24
 censored outcome, 120–21
 censored-inflated outcome, 121–23
 continuous outcome, 118–19
 count outcome, 125–26
 estimated time scores, 128
 individually-varying times of observation, 132–34
 multiple group multiple cohort, 145–49
 multiple indicators, 137–38, 139–40
 parallel processes, 135–36
 piecewise model, 131–32
 quadratic model, 128–29
 time-invariant covariate, 130–31
 time-varying covariate, 130–31
 two-part (semicontinuous), 140–43
 using the Theta parameterization, 124–25
 with covariates, 130–31
 zero-inflated count outcome, 126–27
H1CONVERGENCE, 697–98
H1ITERATIONS, 696
H1MODEL, 809
H1SE, 809
H1STARTS, 694
H1TECH3, 809
HAZARDC, 871

heritability, 91–92, 92–93, 212–14, 215–17
 hidden Markov model, 245–47
 highest posterior density, 806–7
 identification, 525–26
 identity by descent (IBD), 93–94
IDVARIABLE
 DATA LONGTOWIDE, 583
 DATA WIDETOLONG, 581–82
 VARIABLE, 613–14
 imputation, 575–79
IMPUTATION, 572–73
IMPUTE, 576–77
IND
 conventional indirect effects, 761
 counterfactually-defined indirect effects, 763
 indirect effect plot, 40–42
 indirect effects, 37–38, 77, 759–66
INDIVIDUAL, 570
 individually-varying times of observation,
 132–34, 753–54
INFLUENCE
 PLOT, 852
 SAVEDATA, 841
 influential observations, 852
INFORMATION, 688
 information curves, 846–48
INTEGRATION, 686–87
INTEGRATION setting for **ALGORITHM**,
 685–86
 interaction between latent variables, 78–79,
 757–59
 interactions, 757–59
INTERACTIVE, 707–8
 intercepts, 729–30
INTERRUPT, 707
 inverse Gamma, 774–80
 inverse Wishart, 774–80
IRT models
 four-parameter logistic, 65–68, 606
 generalized partial credit, 65–68, 605
 graded response, 605
 nominal, 604
 partial credit, 65–68
 three-parameter logistic, 65–68, 605–6
 two-parameter logistic, 65–68, 605
 two-parameter normal ogive, 605
 item characteristic curves, 846–48
 item response theory (IRT) models
 factor mixture, 210–11
 random binary items using cross-classified
 data, 345–46
 twin, 215–17
 two-level mixture, 414–16
 two-parameter logistic, 65–68
ITERATIONS, 696
JACKKNIFE, 683–84
JACKKNIFE1, 683–84
JACKKNIFE2, 683–84
K-1STARTS, 692–93
KAISER, 682
KAPLANMEIER, 834
 kappa (κ), 823
 known class, 200–201, 240–42
KNOWNCLASS, 110–12, 628–29
KOLMOGOROV, 706
 Kolmogorov-Smirnov test, 706
 labeling
 baseline hazard parameters, 743
 categorical latent variables, 742–43
 classes, 743
 inflation variables, 743
 nominal variables, 742–43
 parameters, 744–45, 766–67
 thresholds, 742
 lag
 Monte Carlo, 891
 real data, 638
LAGGED
 Monte Carlo, 891
 real data, 638
 Lagrange multiplier tests. *See* modification
 indices
 lambda, 821
 lambda (f), 823
 lambda (u), 822
LATENT, 703
 latent class analysis (LCA)

- binary latent class indicators, 175–77
- binary, censored, unordered, and count latent class indicators, 184–85
- confirmatory, 187–88, 188–90
- continuous latent class indicators, 182–83
- three-category latent class indicators, 179–80
- two-level, 417–19
- two-level with a between-level categorical latent variable, 420–22
- unordered categorical latent class indicators, 180–81
- with a covariate and a direct effect, 186–87
- with a second-order factor (twin analysis), 195–97
- with partial conditional independence, 192–93
- latent class growth analysis (LCGA)
 - binary outcome, 242–43
 - three-category outcome, 243–44
 - two-level, 434–36
 - zero-inflated count outcome, 244–45
- latent response variables, 839, 842–43, 851
- latent transition analysis (LTA)
 - for two time points with a binary covariate influencing the latent transition probabilities, 247–50
 - for two time points with a continuous covariate influencing the latent transition probabilities, 250–53
 - mover-stayer for three time points using a probability parameterization, 253–57
 - two-level, 436–38
 - two-level with a between-level categorical latent variable, 439–41
- latent transition probabilities, 820
- latent variable covariate, 270–75, 275–79
- latent variable interactions, 78–79, 757–59
- liabilities, 1, 87–88, 92–93, 212–14
- likelihood ratio bootstrap draws, 818–20
- likelihood ratio test, 817, 818–20
- linear constraints, 187–88, 766–72
- linear trend, 378–80, 385–88
- LINK, 677
- list function, 736–42
- LISTWISE, 574
- listwise deletion, 574
- local maxima, 521–23
- local solution, 521–23
- LOG, 641–42
- log odds, 553–57
- LOG10, 641–42
- LOGCRITERION, 698
- LOGHIGH, 700
- logical operators, 641
- logistic regression, 553–57
- LOGIT
 - LINK, 677
 - PARAMETERIZATION, 676
- LOGLIKELIHOOD
 - PLOT, 852
 - SAVEDATA, 841
- LOGLINEAR, 676
- loglinear analysis, 191–92, 559–60
- LOGLOW, 700
- lognormal, 774–80
- LOGRANK, 811
- logrank test, 811
- Lo-Mendell-Rubin test, 817
- LONG
 - DATA LONGTOWIDE, 582–83
 - DATA WIDETOLONG, 581
- LOOP, 40–42, 771–72
- loop plots, 40–42
- LRESPONSES
 - PLOT, 851
 - SAVE, 839
 - SAVEDATA, 842–43
- LRTBOOTSTRAP, 690
- LRTSTARTS, 693
- LTA calculator, 11, 250–53
- M, 615–18
- MAHALANOBIS
 - PLOT, 852
 - SAVEDATA, 840
- Mantel-Cox test, 811
- marginal probabilities, 820
- Markov chain Monte Carlo, 701–7
- MATRIX, 701
- MCCONVERGENCE, 698

MCITERATIONS, 697
 MCMC, 668–69
 MCMC chain, 668–69
 MCONVERGENCE, 698
 MCSEED, 687
 MDITERATIONS, 706
 MEAN
 DEFINE, 643–44
 POINT, 701–2
 mean square error (MSE), 472
 mean structure, 72–74, 81–82
 means, 729–30
 MEANS, 570
 measurement error, 366–69
 measurement invariance, 540–47, 670–71,
 672–74, 812
 approximate, 110–12
 MEDIAN, 701–2
 mediation
 bootstrap, 37–38
 categorical variable, 551
 cluster-level latent variable, 282–83
 continuous variable, 32–33
 missing data, 39–40
 moderated, 40–42
 random slopes, 495–97
 MEMBERSHIP, 629–31
 merging data sets, 512–13, 843–45
 METRIC
 ALIGNMENT, 701
 MODEL, 670–71
 metric model, 540–47
 Metropolis-Hastings algorithm, 703–4
 MFILE, 843
 MFORMAT, 844
 MH, 703–4
 MIMIC
 continuous factor indicators, 71–72
 multiple group analysis, 80–81, 81–82, 82–83
 MISSFLAG, 827
 MISSING
 DATA MISSING, 587–90
 MONTECARLO, 872–73
 VARIABLE, 601–3
 missing data, 39–40, 445–47, 448–49, 449–
 51, 451–52, 453, 454–55, 455–58, 458–
 60, 473–77, 477–78, 481–83, 547–51
 missing data correlate, 445–47, 615–18
 missing data generation, 871–73
 missing data patterns, 809–10
 missing data plots, 846–48
 missing value flags, 601–3
 non-numeric, 502
 numeric, 502–3
 MITERATIONS, 696
 MIXC, 699
 MIXTURE, 659–61
 mixture modeling
 confirmatory factor analysis (CFA), 194
 multivariate normal, 201–3
 randomized trials (CACE), 203–5, 205–7
 regression analysis, 170–73
 structural equation modeling (SEM), 198–99
 with known class, 200–201
 zero-inflated Poisson regression analysis,
 174–75
 zero-inflated Poisson regression as a two-class
 model, 207–8
 MIXU, 699
 ML
 ESTIMATOR, 667
 STVALUES, 702–3
 MLF, 668
 MLM, 667–68
 MLMV, 668
 MLR, 668
 MMISSING, 845
 MNames, 843–44
 MOD, 763–66
 MODE, 701–2
 MODEL
 ANALYSIS, 669–72
 DATA IMPUTATION, 578–79
 MODEL command, 713–89
 MODEL command variations, 780–83
 MODEL CONSTRAINT, 766–72
 MODEL COVERAGE, 785–87
 model estimation, 515–29

MODEL INDIRECT, 759–66
 MODEL label, 781–82
 MODEL MISSING, 788–89
 MODEL POPULATION, 783–85
 MODEL PRIORS, 774–80
 MODEL TEST, 772–74
 modeling framework, 1–6
 moderated mediation, 40–42, 771–72
 moderation, 763–66
 moderator, 763–66
 modification indices, 804–5
 MODINDICES, 804–5
 MONITOR, 852
 Monte Carlo simulation studies
 discrete-time survival analysis, 489–90
 EFA with continuous outcomes, 483–84
 external Monte Carlo, 484–87
 GMM for a continuous outcome, 479–81
 growth with attrition under MAR, 477–78
 mediation with random slopes, 495–97
 MIMIC with patterns of missing data, 473–77
 missing data, 473–77, 477–78
 multiple group EFA with measurement invariance, 497–98
 saved parameter estimates, 487–88
 two-level Cox regression, 493–94
 two-level growth model for a continuous outcomes (three-level analysis), 481–83
 two-part (semicontinuous) model, 491–93
 MONTECARLO
 DATA, 571–72
 INTEGRATION, 686–87
 MONTECARLO command, 859–91
 mover-stayer model, 253–57
 moving average, 366–69
 Mplus language, 13–14
 Mplus program
 base, 17
 combination add-on, 18
 mixture add-on, 17
 multilevel add-on, 18
 MSE, 472
 MSELECT, 845
 MUCONVERGENCE, 698–99
 MUITERATIONS, 697
 multilevel mixture modeling
 two-level confirmatory factor analysis (CFA), 411–13
 two-level growth mixture model (GMM), 427–30
 two-level growth mixture model (GMM) with a between-level categorical latent variable, 431–33
 two-level growth model with a between-level categorical latent variable, 423–26
 two-level item response theory (IRT), 414–16
 two-level latent class analysis (LCA), 417–19
 two-level latent class analysis (LCA) with a between-level categorical latent variable, 420–22
 two-level latent class growth analysis (LCGA), 434–36
 two-level latent transition analysis (LTA), 436–38
 two-level latent transition analysis (LTA) with a between-level categorical latent variable, 439–41
 two-level mixture regression, 398–403, 404–7, 408–10
 multilevel modeling
 three-level growth model with a continuous outcome and one covariate on each of the three levels, 335–38
 three-level MIMIC model with continuous factor indicators, two covariates on within, one covariate on between level 2, and one covariate on between level 3 with random slopes on both within and between level 2, 330–35
 three-level path analysis with a continuous and a categorical dependent variable, 327–30
 three-level regression for a continuous dependent variable, 324–27
 two-level confirmatory factor analysis (CFA) with categorical factor indicators, 289–90
 two-level confirmatory factor analysis (CFA) with continuous factor indicators, 286–88, 290–92

- two-level confirmatory factor analysis (CFA)
 - with continuous factor indicators, covariates, and a factor with a random residual variance, 352–54
- two-level growth for a zero-inflated count outcome (three-level analysis), 318–20
- two-level growth model for a categorical outcome (three-level analysis), 306–7
- two-level growth model for a continuous outcome (three-level analysis), 303–6
- two-level MIMIC model with continuous factor indicators, random factor loadings, two covariates on within, and one covariate on between with equal loadings across levels, 322–24
- two-level multiple group confirmatory factor analysis (CFA), 300–302
- two-level multiple indicator growth model, 311–14
- two-level path analysis with a continuous and a categorical dependent variable, 279–81
- two-level path analysis with a continuous, a categorical, and a cluster-level observed dependent variable, 282–83
- two-level path analysis with random slopes, 284–86
- two-level regression analysis for a continuous dependent variable with a random intercept and a random residual variance, 349–51
- two-level regression for a continuous dependent variable with a random intercept, 270–75
- two-level regression for a continuous dependent variable with a random slope, 275–79
- two-level structural equation modeling (SEM), 297–300
- multinomial logistic regression, 553–57
- multiple categorical latent variables, 188–90
- multiple cohort, 145–49
- multiple group analysis
 - known class, 200–201, 240–42
 - MIMIC with categorical factor indicators, 82–83
 - MIMIC with continuous factor indicators, 81–82
 - special issues, 529–40
- multiple imputation, 509, 572–73, 575–79
 - missing values, 453, 454–55, 458–60
 - plausible values, 455–58
- multiple indicators, 137–38, 139–40
- multiple processors, 708–10
- multiple solutions, 521–23
- MULTIPLIER
 - ANALYSIS, 695
 - SAVEDATA, 836
- multivariate normal mixture model, 201–3
- MUML, 668
- NAMES
 - DATA MISSING, 587
 - DATA SURVIVAL, 591
 - DATA TWOPART, 585
 - MONTECARLO, 861
 - VARIABLE, 598
- natural direct effects, 762–66
- natural indirect effects, 762–66
- NCSIZES, 867–68
- NDATASETS, 577
- negative binomial, 28–29, 609–12
- NEW, 766–67
- NGROUPS
 - DATA, 573
 - MONTECARLO, 862
- NOBSERVATIONS
 - DATA, 573
 - MONTECARLO, 861–62
- NOCHECK, 574–75
- NOCHISQUARE, 808
- NOCOVARIANCES, 671–72
- NOMEANSTRUCTURE, 671–72
- NOMINAL
 - Monte Carlo, 876–77
 - real data, 608–9
- non-convergence, 523–25
- non-linear constraints, 31–32, 766–72
- non-linear factor analysis, 70
- non-normal distributions, 674
- non-parametric, 209
- NORMAL, 674
- NOSERROR, 808

not missing at random (NMAR)
 Diggle-Kenward selection model, 449–51
 pattern-mixture model, 451–52
 NREPS, 862
 nu, 821
 numerical integration, 526–29
 OBLIMIN, 678–82
 OBLIQUE, 678–82
 OBSERVED
 INFORMATION, 688
 PREDICTOR, 703
 odds, 553–57
 ODLL, 685–86
 OFF
 ADAPTIVE, 687–88
 BASEHAZARD, 684–85
 CHOLESKY, 685
 LISTWISE, 574
 MONITOR, 852
 ON
 ADAPTIVE, 687–88
 BASEHAZARD, 684–85
 CHOLESKY, 685
 LISTWISE, 574
 MODEL, 722–25
 MONITOR, 852
 optimization history, 816
 OPTSEED, 692
 ORTHOGONAL, 678–82
 outliers, 852
 OUTLIERS, 852
 OUTPUT command, 791–823
 PARALLEL, 682–83
 parallel analysis, 682–83
 parallel computing, 708–10
 parallel processes, 135–36
 parameter constraints. *See* constraints
 parameter derivatives, 815
 parameter extension, 703–4
 parameterization
 delta, 82–83
 logistic, 558–59
 loglinear, 188–90, 191–92, 559–60
 probability, 560–61
 theta, 34, 84, 124–25
 PARAMETERIZATION, 674–76
 parametric bootstrap, 818–20
 parametric proportional hazards, 151–52,
 153–54
 partial credit, 65–68
 path analysis
 categorical dependent variables, 33–34
 combination of censored, categorical, and
 unordered categorical (nominal) dependent
 variables, 36–37
 combination of continuous and categorical
 dependent variables, 35
 continuous dependent variables, 32–33
 PATMISS, 871–72
 PATPROBS, 872
 PATTERN, 618–19
 PATTERNS, 809–10
 PERTURBED, 702–3
 PHI, 641–42
 piecewise growth model, 131–32
 plausible values, 455–58, 837–39, 842, 851
 PLOT, 770
 PLOT command, 845–57
 PLOT1, 846
 PLOT2, 846–48
 PLOT3, 848–49
 plots
 Bayesian, 846–48
 missing data, 846–48
 moderation, 763–66
 survival, 846–48
 time series, 848–49
 PNDE, 762–66
 POINT, 701–2
 Poisson. *See* zero-inflated Poisson
 PON, 725–26
 pooled-within covariance matrix. *See*
 sample covariance matrices
 POPULATION
 FINITE, 626–27
 MONTECARLO, 888
 population size, 626–27
 posterior, 668–69

posterior predictive checks, 668–69
 potential scale reduction, 668–69, 704–5
 PREDICTOR, 703
 PRIOR, 706–7
 priors, 774–80
 PRIORS, 629–31
 PROBABILITIES, 629–31
 PROBABILITY, 676
 probability calculations
 logistic regression, 553–57
 multinomial logistic regression, 553–57
 probit regression, 552–53
 PROBIT, 677
 probit link, 212–14, 677
 PROCESSORS, 708–10
 PRODUCT, 701
 profile likelihood, 151–52, 259–60, 320–21
 PROMAX, 678–82
 PROPENSITY, 839–40
 propensity scores, 839–40
 proportional hazards model, 151–52, 153–54
 psi, 822
 PSR, 704–5
 pure natural direct effects, 762–66
 PWITH, 727
 PX1, 703–4
 PX2, 703–4
 PX3, 703–4
 quadratic growth model, 128–29
 quantitative trait locus (QTL), 93–94
 QUARTIMIN, 678–82
R
 Monte Carlo, 880–81
 real data, 615–18
R3STEP
 Monte Carlo, 880–81
 real data, 615–18
RANDOM, 659
 random AR(1) slope, 355–59, 360–62, 370–72, 373–74, 381–85, 385–88
 random factor loadings, 322–24, 347–49, 756–57
 random items, 345–46
 random residual covariance, 363–66
 random residual variance, 349–51, 352–54, 355–59, 360–62, 363–66, 370–72, 373–74, 378–80, 381–85, 385–88
 random slopes, 29–31, 132–34, 275–79, 284–86, 290–92, 297–300, 308–10, 315–17, 754–56
 random starts, 170–73, 179
 random variance, 349–51, 352–54
 random variances, 757
RANKING, 836–37
RCONVERGENCE, 699
 reading data
 fixed format, 501
RECORDLENGTH, 828
REFGROUP, 701
REGRESSION, 578–79
 regression analysis
 censored inflated regression, 24
 censored regression, 23–24
 linear regression, 22–23
 logistic regression, 25–26
 multinomial logistic regression, 26–27
 negative binomial regression, 28–29
 Poisson regression, 27
 probit regression, 25
 random coefficient regression, 29–31
 zero-inflated Poisson regression, 28
REPETITION
 DATA LONGTOWIDE, 584
 DATA WIDETOLONG, 582
 replicate weights, 513, 514, 624–25
REPSAVE, 889
REPSE, 683–84
REPWEIGHTS
 SAVEDATA, 840
 VARIABLE, 624–25
RESCOVARIANCES, 676–77
RESIDUAL
 BOOTSTRAP, 689
 OUTPUT, 802–4
 residual covariances, 676–77
 residual variances, 728
 residuals, 802–4

RESPONSE, 835–36
 RESULTS
 MONTECARLO, 890
 SAVEDATA, 831
 right censoring, 151–52, 153–54, 320–21
 RITERATIONS, 697
 RLOGCRITERION, 698
 robust chi-square, 668
 robust standard errors, 668
 ROTATION, 678–82
 ROUNDING, 579
 ROWSTANDARDIZATION, 682
 R-square, 799–802
 RSTARTS, 693–94
 RW, 703–4
 SAMPLE, 828
 sample covariance matrices
 pooled-within, 830
 sample, 828
 sigma between, 829
 sample statistics, 798
 sampling fraction, 626–27
 sampling weights, 622
 SAMPSTAT, 798
 SAVE
 DATA IMPUTATION, 577–78
 MONTECARLO, 889–90
 SAVEDATA, 837
 SAVEDATA command, 824–45
 saving data and results, 824–45
 SCALAR, 670–71
 scalar model, 540–47
 scale factors, 745–46
 SDITERATIONS, 696
 SDROPOUT, 587–90
 second-order factor analysis, 68–69
 SEED, 863
 selection modeling, 449–51
 semicontinuous, 140–43, 491–93
 SENSITIVITY, 849
 sensitivity plots, 849
 SEQUENTIAL
 DATA IMPUTATION, 578–79
 H1MODEL, 809
 sequential cohort, 145–49
 sequential regression, 578–79
 SERIES, 849–51
 SFRACTION, 626–27
 sibling modeling, 93–94
 SIGB, 829
 sigma between covariance matrix. *See*
 sample covariance matrices
 SIMPLICITY, 700
 simplicity function, 700
 SIN, 641–42
 skew parameters, 674
 SKEWNORMAL, 674
 SKEWT, 674
 SQRT, 700
 DEFINE, 641–42
 STANDARD
 BOOTSTRAP, 689
 INTEGRATION, 687
 STANDARDIZE, 649
 STANDARDIZED, 799–802
 standardized parameter estimates, 799–802
 STARTING, 889
 starting values
 assigning, 732–33
 automatic, 170–73
 saving, 807–8
 user-specified, 177–78, 229, 732–33
 STARTS, 691–92
 STCONVERGENCE, 692
 STD, 800–801
 STDDISTRIBUTION, 832
 STDEVIATIONS, 570
 STDRESULTS, 831
 STDY, 800–801
 STDYX, 800–801
 STITERATIONS, 692
 STRATIFICATION, 619–20
 structural equation modeling (SEM)
 categorical latent variable regressed on a
 continuous latent variable, 197–98
 continuous factor indicators, 75–76

- with interaction between latent variables, 78–79
- STSCALE, 692
- STSEED, 692
- STVALUES, 702–3
- SUBPOPULATION, 625–26
- SUM, 644
- summary data, 570–72
- SURVIVAL
 - Monte Carlo, 881–83
 - real data, 635–37
- survival analysis. *See* continuous-time survival analysis and discrete-time survival analysis
- survival plots, 846–48
- SVALUES, 807–8
- SWMATRIX
 - DATA, 574
 - SAVEDATA, 830
- TAN, 641–42
- TARGET, 678–82
- tau, 821
- tau (u), 823
- TDISTRIBUTION, 674
- TECH1, 812–14
- TECH10, 817
- TECH11, 817
- TECH12, 818
- TECH13, 818
- TECH14, 818–20
- TECH15, 820
- TECH16, 820
- TECH2, 814–15
- TECH3
 - OUTPUT, 815
 - SAVEDATA, 833
- TECH4
 - OUTPUT, 815–16
 - SAVEDATA, 834
- TECH5, 816
- TECH6, 816
- TECH7, 816
- TECH8, 816
- TECH9, 817
- theta, 821
- THETA, 675
- theta parameterization, 34, 84, 124–25, 675
- THIN
 - ANALYSIS, 706
 - DATA IMPUTATION, 579
- thinning, 579
- threads, 708–10
- THREELEVEL, 662–63
- three-level analysis, 303–6, 306–7, 423–26
- three-parameter logistic, 65–68, 605–6
- three-step mixture analysis
 - Monte Carlo, 880–81
 - real data, 175–77, 615–18
- threshold structure, 74–75
- thresholds, 729–30
- Thurstone's Box data, 679
- time series analysis
 - cross-classified time series analysis with a univariate first-order autoregressive AR(1) confirmatory factor analysis (CFA) model for continuous factor indicators with random intercepts and a factor varying across both subjects and time, 389–93
 - cross-classified time series analysis with a univariate first-order autoregressive AR(1) model for a continuous dependent variable with a covariate, linear trend, and random slope, 385–88
 - cross-classified time series analysis with a univariate first-order autoregressive AR(1) model for a continuous dependent variable with a covariate, random intercept, and random slope, 381–85
 - N=1 time series analysis with a bivariate cross-lagged model for continuous dependent variables, 158–59
 - N=1 time series analysis with a first-order autoregressive AR(1) confirmatory factor analysis (CFA) model with continuous factor indicators, 159–61
 - N=1 time series analysis with a first-order autoregressive AR(1) IRT model with binary factor indicators, 161–62

- N=1 time series analysis with a first-order autoregressive AR(1) structural equation model (SEM) with continuous factor indicators, 162–64
- N=1 time series analysis with a univariate first-order autoregressive AR(1) model for a continuous dependent variable, 154–56
- N=1 time series analysis with a univariate first-order autoregressive AR(1) model for a continuous dependent variable with a covariate, 157–58
- two-level time series analysis with a bivariate cross-lagged model for continuous dependent variables with random slopes, random residual variances, and a random covariance, 363–66
- two-level time series analysis with a bivariate cross-lagged model for two factors and continuous factor indicators with random intercepts and random slopes, 375–77
- two-level time series analysis with a first-order autoregressive AR(1) confirmatory factor analysis (CFA) model for continuous factor indicators with random intercepts, a random AR(1) slope, and a random residual variance, 370–72
- two-level time series analysis with a first-order autoregressive AR(1) factor analysis model for a single continuous indicator and measurement error, 366–69
- two-level time series analysis with a first-order autoregressive AR(1) IRT model for binary factor indicators with random thresholds, a random AR(1) slope, and a random residual variance, 373–74
- two-level time series analysis with a univariate first-order autoregressive AR(1) model for a continuous dependent variable with a covariate, linear trend, random slopes, and a random residual variance, 378–80
- two-level time series analysis with a univariate first-order autoregressive AR(1) model for a continuous dependent variable with a covariate, random intercept, random AR(1) slope, random slope, and random residual variance, 360–62
- two-level time series analysis with a univariate first-order autoregressive AR(1) model for a continuous dependent variable with a random intercept, random AR(1) slope, and random residual variance, 355–59
- TIMECENSORED, 637–38
- time-invariant covariates, 130–31
- TIMEMEASURES, 593–94
- time-to-event variable, 150–51, 259–60, 320–21, 493–94
- time-varying covariates, 130–31
- TINTERVAL, 638–39
- TITLE command, 563
- TNAMES, 594–95
- TNIE, 762–66
- TOLERANCE, 701
- total effect, 759–66
- total natural indirect effects, 762–66
- TRAINING, 629–31
- training data, 203–5
- TRANSFORM, 586–87
- transformation
 - data, 580–95
 - variables, 639–50
- TSCORES
 - Monte Carlo, 883–84
 - real data, 614
- twin analysis, 85–86, 87–88, 91–92, 92–93, 195–97, 212–14, 215–17
- TWOLEVEL, 661–62
- two-parameter logistic, 65–68
- two-part (semicontinuous), 140–43, 491–93, 584–87
- TYPE
 - ANALYSIS, 657–65
 - DATA, 570–73
 - DATA MISSING, 588–89
 - PLOT, 846–49
 - SAVEDATA, 837
- UB, 664–65
- UB*, 664–65

UCELLSIZE, 700
 ULS, 668
 ULSMV, 668
 UNEQUAL, 684–85
 UNPERTURBED, 702–3
 UNSCALED
 BWTSCALE, 624
 WTSCALE, 622–23
 USEOBSERVATIONS, 599
 USEVARIABLES, 599–600
 UW, 664–65
 UW*, 664–65
 VALUES, 579
 VARIABLE command, 595–639
 variables
 dependent, 712
 independent, 712
 latent, 711
 observed, 711
 scale of measurement, 712
 VARIANCE, 700
 variances, 728
 VARIANCES, 574–75
 VARIMAX, 678–82
 VIA, 761
 Wald test, 772–74
 WEIGHT, 622
 white noise factor score model, 159–61
 WIDE
 DATA LONGTOWIDE, 583
 DATA WIDETOLONG, 581
 WITH, 726–27
 WITHIN
 Monte Carlo, 884–86
 real data, 631–33
 WLS, 668
 WLSM, 668
 WLSMV, 668
 WNFS, 159–61
 WTSCALE, 622–23
 XWITH, 757–59
 zero cells, 696
 zero-inflated Poisson, 28–29, 126–27, 207–
 8, 232–35, 244–45, 609–12
 zero-mean and small-variance priors, 107–8,
 109–10, 110–12

MUTHÉN & MUTHÉN
Mplus SINGLE-USER LICENSE AGREEMENT

Carefully read the following terms and conditions before opening the sealed CD sleeve or downloading the software. Opening the CD sleeve or downloading the software indicates your acceptance of the terms and conditions listed below. The Mplus CD and download contains several versions of Mplus. The Mplus Single-User License allows for the use of only one of these programs. Using more than one is a violation of the Mplus Single-User License Agreement.

Muthén & Muthén grants you the non-exclusive right to use the copyrighted computer program Mplus and the accompanying written materials. You assume responsibility for the selection of Mplus to achieve your intended results, and for the installation, use, and results obtained from Mplus.

1. **Copy and Use Restrictions.** Mplus and the accompanying written materials are copyrighted. Unauthorized copying of Mplus and the accompanying written materials is expressly forbidden. One copy of Mplus may be made for backup purposes, and it may be copied as part of a normal system backup. Mplus may be transferred from one computer to another but may only be used on one computer at a time.
2. **Transfer Restrictions.** The Mplus license may be transferred from one individual to another as long as all copies of the program and documentation are transferred, registered, and the recipient agrees to the terms and conditions of this agreement.
3. **Termination.** The license is effective until terminated. You may terminate it at any time by destroying the written materials and all copies of Mplus, including modified copies, if any. The license will terminate automatically without notice from Muthén & Muthén if you fail to comply with any provision of this agreement. Upon termination, you shall destroy the written materials and all copies of Mplus, including modified copies, if any, and shall notify Muthén & Muthén of same.
4. **Limited Warranty.** Muthén & Muthén warrants that for ninety (90) days after purchase, Mplus shall reasonably perform in accordance with the accompanying documentation. Muthén & Muthén specifically does not warrant that Mplus will operate uninterrupted and error free. If Mplus does not perform in accordance with the accompanying documentation, you may notify Muthén & Muthén in writing of the non-performance within ninety (90) days of purchase.
5. **Customer Remedies.** Muthén & Muthén and its supplier's entire liability and your exclusive remedy shall be, at Muthén & Muthén's option, either return of the price paid, or repair or replacement of the defective copy of Mplus and/or written materials after they have been returned to Muthén & Muthén with a copy of your receipt.
6. **Disclaimer of Other Warranties.** Muthén & Muthén and its suppliers disclaim all other warranties, either express or implied, including, but not limited to, any implied warranties of fitness for a particular purpose or merchantability. Muthén & Muthén disclaims all other warranties including, but not limited to, those made by distributors and retailers of Mplus. This license agreement gives you specific legal rights. You may have other rights that vary from state to state.
7. **Disclaimer.** In no event shall Muthén & Muthén or its suppliers be liable for any damages, including any lost profits, lost savings or other incidental or consequential damages arising out of the use or inability to use Mplus even if Muthén & Muthén or its suppliers have been advised of the possibility of such damages. Some states do not allow the limitation or exclusion of liability for incidental or consequential damages so the above limitation or exclusion may not apply to you.
8. **Return Policy:** All sales are final. Software purchased on-line through our website is considered opened at the time of purchase. This also applies to hard copy purchases because downloads are made available at the time of purchase. In rare instances, and only within 30 days of purchase, if due to technical difficulties or platform incompatibilities, the software will not function, we may, at our discretion, issue a refund. In such instances, an LOD (Letter Of Destruction) on company letterhead will be required to process the refund.

This agreement is governed by the laws of the State of California.