META-ANALYSIS/STRUCTURAL EQUATIONS MODELING

When

T 4:30 – 7:10 Office Hours by appointment or, more likely, whenever I am around, which is usually. 3074 DK. Ph# 993-1347. email: jcortina@gmu.edu

Purpose of course

The purpose of this course is, as you may have gathered from the title, twofold. Indeed, there has never been a class with more divaricated purposes. The first six weeks of the course will be spent on meta-analysis. This portion of the course will be largely mechanical, that is, because meta-analysis is conceptually simple but operationally difficult, we will spend more time covering the application side of things and less time on the justifications for the applications.

The second portion of the course will deal with structural equations modeling. Unlike meta-analysis, SEM is conceptually difficult, but thanks to recent advances, it is mechanically fairly simple. Thus, we will spend the bulk of our time on conceptual bases for computations. In both cases, however, we will spend time on various philosophical issues pertaining to the appropriate/inappropriate application of the procedures.

Requirements for the class

There are certain knowledges and skills that I expect you to have coming in to the course. First, although Psychology 754 is not an official requirement for this course, I would not recommend this course to anyone who has not had 754. I will assume the sorts of path analytic knowledge and data analysis knowledge that students who have had that class would possess. If you haven't had 754, I would recommend Chapter 18 of the Pedhazur regression book.

Second, you will need access to Structural Equations software. We now have a site license for LISREL. While you are welcome to use any software you like, I am more familiar with LISREL than with any other program, so I will be more helpful with LISREL than with any other program. You can borrow the LISREL CD from Dave Cerri.

Required Texts

Hunter, J.E. & Schmidt, F.L. (latest edition). Methods of meta-analysis: Correcting error and bias in research findings. Newbury Park, CA: Sage.

Schumacker, R.E. & Lomax, R.G. (2010). A Beginner's Guide to Structural Equation Modeling. Mahwah, NJ: Erlbaum.

Format

The format will be largely lecture based, although there will be some time set aside for discussion of readings. There will also be at least one class devoted to student presentations. Grades will be based on projects.

Projects

Over the course of the semester, you will be required to complete a variety of projects. The first will be a comprehensive meta-analysis in an area of your choosing. It will be due on the date of the final exam (May 15, my birthday, when you will bestow upon me the gift of your wisdom) and will be worth 35% of your course grade. I will want to schedule times with each of you to discuss your progress on this project over the course of the semester. This project may be done alone or with one other person, although I would strongly recommend pairing up with someone in order to share the workload. Another 10% of your grade will be based on the presentation that you give on

After we have covered the relevant material, I will ask each of you to generate spreadsheet files that allow you to meta-analyze data. This is not as complicated as it sounds and will be worth 5% of your course grade.

The remainder of the projects will be SEM-related. As a set, they will constitute 50% of your class grade. Also, after a given project is graded, you will be allowed to revise and resubmit. Therefore, there is no excuse for anything less than a perfect grade on a project. HOWEVER, if it appears that people are turning in a half-hearted effort so that they can get the feedback to be able to finish the project without having to struggle over difficult issues, then I will change the rules so that you're grade on a project will in some way be limited by the quality of your initial effort. Also, you are free to consult with one another about these projects, but I expect everyone to do most of their work independently and I expect a separate project to be turned in by everyone.

Course Outline

Week 1, Jan 23 - Introduction to meta-analysis

Readings: Hunter & Schmidt (2004), Chapter 1; 3-32

Schmidt, F.L. (1992), What do data really mean? Research findings, meta-analysis, and cumulative knowledge in psychology. American Psychologist, 47, 1173-1181.

Hedges,L.V. (1987), How hard is hard science, How soft is soft science. American Psychologist, 42, 443-455.

1. Introductions/syllabus
2. Description of meta-analysis project
3. Intro to meta-analysis
    a. The narrative review
    b. A quantitative review (meta-analysis)
    c. Using the best of both
4. Keys to a publishable meta-analysis
5. Choosing a topic/ gathering studies
6. Paring down the list

Week 2, Jan 30 - Study coding and artifacts

Readings: Hunter & Schmidt (2004) pp. 33-71 and 243-271;

Glass, G.V. (1976). Primary, secondary, and meta-analysis of research. Educational Researcher, 5, 3-8;

Schmidt, F.L. & Hunter, J.E. (1977). Development of a general solution to the problem of validity generalization. Journal of Applied Psychology, 62, 529-540.

Huffcutt, A.I. & Arthur, W. (1994). Hunter and Hunter (1984) revisited: Interview validity for entry-level jobs. Journal of Applied psychology, 79, 184-190.

7. What must the relevant studies contain/report?
8. Artifacts
9. Coding of study characteristics
10. Things we often forget
11. Analysis and reporting
12. Follow up analyses

Weeks 3 and 4, Feb 6 and 13 - Computations in depth

Readings: Hunter & Schmidt (2004) pp. 73-98; 103-111; 137-169; 273-312;

Dunlap, W.P., Cortina, J.M., Vaslow, J., & Burke, M.J. (1996). Meta-analysis of experiments with matched groups or repeated measures designs. Psychological Methods, 1, 170-177.

Cortina & Nouri (1999). pp. 1-39.

Cohen, J. (1977). Statistical power analysis for the behavioral sciences, pp. 18-25.

Cortina, J.M. (2003). Apples and oranges (and pears, Oh My!): The search for moderators in meta-analysis. Organizational Research Methods 415-439

1. Mean r and variance of r
2. Correcting the variance of r for sampling error
3. Sampling error variance and confidence intervals
4. Correcting for other artifacts
5. The variance of ρ and credibility intervals
6. Mean d and variance of d
7. Correcting the variance of d for sampling error
8. Correcting for other artifacts
9. Correction using artifact distributions
10. Unconventional effect size computations
11. Moderators in meta-analysis

Week 5, Feb 20 - Other issues in meta-analysis

Readings: Wanous, J.P., Sullivan, S.E., & Malinak, J. (1989). The role of judgment calls in meta-analysis. Journal of Applied Psychology, 74, 259-264.

Slavin, R.E. (1984). Meta-analysis in education: How has it been used? Educational Researcher, 13, 6-15.

Carlberg et al. (1984). Meta-analysis in education: A reply to Slavin. Educational

Researcher, 13, 16-23.
Slavin, R.E. (1984). A rejoinder to Carlberg et al. Educational Researcher, 13, 24-27
Orwin, R.G. & Cordray, D.S. (1985). Effects of deficient reporting on meta-analysis" A conceptual framework and reanalysis. Psychological Bulletin, 97, 134-147.
Rind, B., Tromovitch, P., & Bauserman, R. (1998). A meta-analytic examination of assumed properties of child sexual abuse using college samples. Psychological Bulletin, 124, 22-53.
APA Science Directorate (1999). Science, politics, and pedophilia. Psychological Science Agenda, Sept., 2-3.

1. Limitations, both potential and real
2. Pitfalls

Week 6, Feb 27 - Presentations of ideas for meta-analyses

Each person or pair will give a 15-20 minute presentation of their meta-analysis topic. This will be followed by a few minutes of question and answer.

Week 7, March 5 - Intro to SEM

Readings: Schumacker & Lomax (2004) pp. 1-10 (should be review); 37-57; 61-75; 149-162
Hayduk, L.A. (1987). Structural equation modeling with LISREL. Baltimore, MD: Johns Hopkins University Press. pp. 88-103.

1. Uses of SEM
    a. Exploratory factor analysis
    b. Path analysis/regression
    c. Confirmatory factor analysis
    d. Causal modeling

2. Background topics
    a. Path analysis (review)
    b. Factor analysis
    c. LISREL matrix language vs. SIMPLIS

We will use the SIMPLIS language, but I will ask that you keep track of which matrices we are estimating and modifying. Also, in general, I will teach the basics in chronological order. That is, we will begin with data preparation and go from there to some initial considerations that come up for SEM models. Next, we will discuss measurement models and CFA models. We will then go through structural models. We will finish up with moderated SEM and some philosophical issues. While we are going through these general topics, I will point out any programming issues that arise and will offer some things to watch out for.

If you are looking for additional reference materials, I would suggest Hayduk, 1987; Bollen, 1989; the LISREL 8 Reference Guide, SIMPLIS Guide, and PRELIS guide, and Scott Long's green Sage books on CFA and Covariance Structures Models.

Week 8, Spring Break

Week 9, March 19

- Preparing the data for analysis
    1. LISREL can analyze many different kinds of matrices.
        a. covariance
        b. PPM correlation
        c. PM
    2. There are various options re: handling the matrices
        a. They can be typed into the LISREL program file
        b. They can be put into a separate file by hand (or by EXPORT in SPSS) and called on in the program file
        c. They can be generated in PRELIS and called on in the program file
    3. If all variables are continuous and typical estimation procedures are desired, then it doesn't really matter which you use.
        a. If some variables are noncontinous (i.e., fewer than 16 categories), but ordinal (or renderable into ordinal variables), then either Pearson correlations or polyserial/polychoric correlations can be computed.
        b. If other specifications are not made, PRELIS automatically computes polychoric/serial correlations for all variables with fewer than 16 values, and it automatically computes Pearson correlations for all variables with 16 or more values.
        c. The problem is that these alternative correlations values violate the assumptions of ML and GLS estimation. Thus, a weighted least squares estimation such as WLS or DWLS is recommended.
        d. In order for LISREL to estimate parameter values with WLS or DWLS, it needs a weight matrix in addition to the covariance/correlation matrix.
        e. In addition to interrelationship matrices, PRELIS will also generate vectors of means and sd's
        f. Finally, the format of the file to be read can be specified with Fortran commands, and new variables can be computed and included in the output matrices.
        g. Remember that PRELIS and LISREL will only use files that are in the same directory as the program file.

Week 10, Mar 26 - Initial considerations

Readings: Schumacker & Lomax, 195-210

MacCallum, R. (1986). Specification searches in covariance structures modeling. Psychological Bulletin, 100, 107-120.

1. Specification
2. Identification
3. Different estimation procedures

Week 11 and 12, April 2 and April 9 - Measurement models/ Confirmatory factor analysis

Readings: Schumacker & Lomax (2004) pp. 167-181

Mulaik, S.A., James, L.R. Alstine, J.V., Bennett, N., Lind, S., Stilwell, C.D. (1989). Evaluation of goodness-of-fit indices for structural equation models. Psychological Bulletin, 105, 430-445.

Tanaka, J.S. (1993). Multifaceted conceptions of fit in structural equation models. In K.Bollen & J. Long (Eds.), Testing Structural Equation Models. Newbury Park, CA: Sage.

1. One of the uses of LISREL is confirmatory factor analysis. In CFA, we seek to test an a priori model of the factor structure of a set of items.
2. This is similar to testing a measurement model in SEM
3. The only matrices involved are lambda-x, phi, and theta-delta
4. Defaults for these matrices
5. Thus, factor loadings (i.e., lambda-x values) must be specified as well as any uncorrelated factors (phi) and any correlated errors (theta-delta).
6. Ex.5A
7. Scaling of latent variables
8. Modify 5A
9. For single indicator latents, set error variances to zero unless there is some external estimate for their reliability. In such a case, set the lambda value to the square root of rxx, and set the error theta value to (1-rxx)varX
10. Assessing model fit
    a. There are many fit indicies available in the literature.
    b. We will only discuss some of the more commonly used indices
11. Modification indices
12. Second-order factor analysis

Week 13 – April 16 - Structural models

Readings: Schumacker & Lomax (2004) pp. 323-331; 354-390

Anderson, J.C. & Gerbing, D.W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. Psychological Bulletin, 103, 411-423.

Bagozzi, R.P. & Yi, Y. (1988). On the evaluation of structural equation models. Journal of the Academy of Marketing Science, 16, 74-94.

1. Either a one or two-step approach can be used
2. Anderson & Gerbing suggest one begin by testing the best possible structural model, that is, one that contains the measurement model and all possible paths among latents.

Week 15, April 30 - Testing multiplicative and longitudinal models

Readings: Schumacker & Lomax (2004) pp. 439-451. 390-397;

Kenny, D.A. & Judd, C.M. (1984). Estimating the nonlinear and interactive effects of latent variables. Psychological Bulletin, 96, 201-210.

Cortina, J.M., Chen, G., Dunlap, W.P. (2001). Testing interaction effects in LISREL: Examination and illustration of available procedures. Organizational Research Methods, 4, 324-360.

Willett, J.B. & Sayer, A.G. (1994). Using covariance structure analysis to detect correlates and predictors of individual change over time. Psychological Bulletin, 116, 363-381.

1. How is the testing of multiplicative models different?
2. History: Kenny & Judd to present
3. Testing options
4. Latent Growth Modeling

If there is time - Other issues is SEM

Readings: Spector, P.E., Brannick, M.T., Kelloway, E.K., & Williams, L.J. Point/counterpoint. Journal of Organizational Behavior, 16, 199-233.

Breckler, S.J. (1990). Applications of covariance structure modeling in psychology: Cause for concern? Psychological Bulletin, 107, 260-273.

**MacCallum, R.C., Roznowski, M. & Necowitz, L.B. (1992). Model modifications in covariance structure analysis: The problem of capitalization on chance. Psychological Bulletin, 111, 490-504.

Project 1 - Meta-analysis

35% of your grade in the course will be based on a meta-analysis that you will conduct in the area of your choosing. You may work in groups no larger than two. I would like every group to decide on a topic (this decision should be based not only on your interest and a gap in the literature, but also on the availability of sufficient empirical studies) and describe this topic to me no later than February 2. I plan to devote the last class in February to student presentations of their ideas for meta-analysis (worth another 10%). For this presentation, you must present a review of the literature that covers previous meta-analyses in the area, important questions that have yet to be addressed with meta-analysis, and the reasons that you believe a meta-analysis to be feasible (i.e., there are enough empirical studies to support a meta-analysis.)

The data may be analyzed with any program that you choose, however, I try to teach you to analyze the data yourselves. The meta-analysis should be written as if it were a JAP paper. **It should be no longer than 25 pages (not including tables and ref).** In other words, you should be prepared to submit your paper to a top journal by the end of the calendar year. I will ask everyone to reach an agreement with me as to what will be done when. Specifically, I will ask everyone to specify what will be done by the final exam date. Then, we will all schedule the completion of the projects so that they can be submitted to SIOP (September), Academy (January), or whatever conference is appropriate for you, and that they can then be submitted for publication shortly thereafter. Remember, there is no reason why a competently done meta-analysis shouldn't be publishable in a top-tier journal.

Project Due Date: May 15

Project 2 - Meta-analysis code

5% of your grade will be based on this basic meta-analysis programming project. For this project, you will generate an Excel file that generates all of the basic meta-analytic statistics (mean effect size values, variance values, artifact distribution information, and credibility and confidence interval information). On a separate excel sheet, show the subgroup analyses for the lab vs. field distinction.

Due: Feb 27

Project 3 - CFA - MTMM

Due date: Qui sais?

This project will involve the proj1cor.dat and proj1sd.dat files. There are 15 variables in this file, 300 cases, and no missing data. These data were contrived by me and are, in fact, the data that I used to demonstrate effect size computations in my green Sage book. The variables are 'IC1" for 'Individual Characteristic 1', 'Jobperf', 'goaldif' for 'goal difficulty', 'gender', 'yesno', 'goalcom' for 'goal commitment', and 'var11' - 'var33'. I purposely gave some of these variables nebulous titles so that we can use this data set for different projects with different "variables".

Project 3 will involve var11 - var33. These nine observed variables are meant to represent measures of each of three traits from each of three exercises (e.g. assessment center data). The numbers in these variable labels are meant to indicate the latent variable of which the observed variable is an example. The exercises are group discussion, competitive task, and role play. The traits are problem solving, interpersonal skill, and initiative. This set up is similar to that in Schneider & Schmitt, JAP, 1992, p.32. var11, 12, and 13 are group discussion exercises for problem solving, interpersonal skill, and initiative respectively, var21, 22, and 23 are competitive task exercises for the same traits, etc. The LISREL analysis will involve testing a multitrait-multimethod sort of model with six latent variables corresponding to the three methods and the three traits.

1. First, conduct a confirmatory factor analysis in which each observed variable is caused only by its respective trait (Model 1). In other words, no method effects. Now, conduct a confirmatory factor analysis in which each observed variable is caused by its respective method and trait. Also, although the traits can correlate with one another and the methods can correlate with one another, the traits should not be allowed to correlate with the methods. Be sure to ask for completely standardized solutions. Does this second model (Model 2) improve upon the first? Perhaps more importantly, do all of the results make sense (the answer is no)?
2. In order to deal with the problem that you have just identified, try constraining the rogue value to be equal to the value of a conceptually similar path. Didn't work? Try constraining it to equal the error variance for VAR31 (Model 3). Did this solve your problem? Are we having fun yet? Now try freeing up some of the Trait-Method correlations. Keep fiddling until have no negative thetas and no negative lambdas. Once you get tired of this, go back to the original Model 2 and free up M1-T3, M2-T3, and M3-T2 (Model 4). Whew.
3. Now go back to the modification indices for Model 2. What were the signs that this last fix might have worked (apart from phi)?
4. Back to Model 4.
   a. Are the path coefficients as you would have hoped? What about the standard fit statistics?
   b. Test a modified version of Model 2 in which the correlations among the three traits are fixed to 1 (Model 5). How is this model related to Model 2? Conduct a test of the difference in fit between these two models. What does this test suggest?

Project 4
Testing structural models
Due May 15

For this project, we will use the correlation matrix below and the vector of sd's from project 3.

1.0														
.25	1.0													
.1	.08	1.0												
-.2	.02	.02	1.0											
.46	.25	.06	.06	1.0										
.28	.67	.10	.16	.28	1.0									
.33	.32	.03	.05	.34	.41	1.0								
.16	.00	.13	.01	.14	.03	.14	1.0							
.07	.03	.05	.00	.06	.04	.10	.03	1.0						
.24	.29	.08	.03	.44	.33	.68	.13	.13	1.0					
.15	.15	.09	.15	.20	.06	.21	.51	.03	.16	1.0				
-.38	-.09	.16	.03	-.19	.02	.02	.09	.06	.06	.06	1.0			
.41	.29	.13	.08	.28	.36	.57	.15	.15	.59	.13	.03	1.0		
.09	.10	.06	.09	.08	.15	.12	.49	.08	.16	.66	.06	.16	1.0	
-.29	-.06	.07	.09	-.10	-.14	-.04	.10	.07	.00	.12	.56	.13	.03	1.0

The variables are: Strat1 jobperf1 race GENDER Strat2 jobperf2
g1 open1 VAR13 g2 open2 sitstr1 g3 open3 sitstr2

1) A measure of the extent to which strategies are developed for performing formal job tasks
2) Supervisor rating of performance
3) A dichotomous race variable
4) A dichotomous Gender variable
5) A second measure of the extent to which strategies are developed for performing formal job tasks
6) Peer rating of performance
7) A measure of cognitive ability
8) Openness to Experience score from the NEO-PI
9) A measure of squaddusce
10) A second measure of cognitive ability
11) Openness to Experience from the Hogan PI
12) A measure of situation strength
13) A third measure of cognitive ability
14) Openness to Experience from the CPI
15) A second measure of situation strength

Suppose our theory suggests that strategy development is determined by general mental ability, openness to experience, and situational strength (negative effect), and that strategy then affects job performance.
1.) Use the Anderson & Gerbing two step approach to test this model. Begin by testing the

measurement model via a saturated structural model. Is fit excellent? No, you say? Correct you are! Now look at the modification indices, particularly the standardized expected change values. Which items seem to be creating the problem? Suppose that, on the basis of these data, you decided to modify the first Strategy indicator and collect more data. Suppose that the correlation matrix were identical to the original except that the correlation between Strat1 and the two Sitstr variables were -.19 and -.18 respectively. Now rerun the measurement model. Better? Write two paragraphs explaining what you did and why you did it. In other words, write the relevant portion of the Method section (or whichever section you would put this in).

2.) Once you have settled on a measurement model, test the hypothesized structural model. Then, compare it to the saturated structural model. Write a couple of paragraphs interpreting these tests.

3.) Examine the modification indices for the theoretical model. Choose the modification that is most justifiable/ beneficial and perform that modification (there is one that stands out). Comment on the difference between this model and the original model as well as the difference between this model and the saturated model. Include the justification for the change.

4.) Choose one or two components of the revised model that don’t need to be there (again, there are 2-3 that stand out), remove them, and rerun the model. Then compare it to the hypothesized and null models. Offer commentary. Include justification for the change.