APSTA 2094: Factor Analysis and Structural Equation Modeling

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Office Hours: TBA  
Credits: 3

Class Meeting Time / Room: Thursdays 2:00 - 4:45pm.

Course Goals and Orientation: The course provides students with the software skills and theoretical knowledge required to apply structural equation modeling (SEM). First, we review multiple regression and basic concepts from matrix algebra. Next, path analysis and confirmatory factor analysis are developed, leading to more advanced topics, including strategies for translating theory into models, dealing with poor fitting specifications, categorical data, and issues in multigroup and multilevel analysis. The course focuses on cross-sectional applications of SEM, with examples drawn from education and psychology.

The course is conceptually oriented and grounded in examples. While we rely on path diagrams, students will be expected to understand their relation to linear models and covariance structures. There are many software products and associated notations for SEM. The course material will mainly use Mplus (a free demo version is available at https://www.statmodel.com/demo.shtml), but students are also free to utilize other software (e.g., the SEM module in Stata; the lavaan package in R). Lecture and lab are integrated so that a portion of class time is devoted to gaining practical experience with software. The final project requires students to write up an analysis in a manner appropriate for publication in their field of study and present their results to the class. Some class time is devoted to obtaining an appropriate data set for the final project. Students are also invited to use data from their own research, if appropriate, and are encouraged to consult NYU Library Data Services (http://guides.nyu.edu/dataservices).

Prerequisites: Multiple regression at the level of APSTA-GE 2003. APTA-GE 2016 is recommended but not required.

Website: The course uses NYU Classes for lecture notes, handouts, readings, homework assignments, and general information.

Course Text: Students may optionally purchase one or both of the following texts from the NYU Bookstore. Kline is less mathematical and written for applied researchers. Kaplan is written for audiences with a statistics / mathematics background (linear algebra and calculus). Both texts are optional.


**Grading:**
10% Class attendance and participation
40% Three computer-based homework projects
25% Final project presentations (3 presentations: 5%, 5%, 10%; feedback: 5%)
25% Final project write-up

**Participation:** During the first 11 weeks of class each student receives two participation points per class -- one point for showing up, and another for contributing to the classroom discussion. The final participation grade is based on the average over the classes.

**Homework:** Three computer-based homework projects are assigned. Students have two weeks to complete assignments, and class time is dedicated to conducting analyses and answering questions. Students can work together, but each person must hand in their own work. Additional homework is assigned.

**Final Project:** The project involves (a) specification of a theoretically motivated model, (b) running the analysis (c) writing-up and interpreting the analysis. Progress on each of these phases is evaluated through a short presentation to the class, given in each of the last three weeks of semester. The final written project is due one week after class ends. Students are encouraged to work together, and may optionally be evaluated in small groups.

**Time line:** This time line is approximate and may be altered during the semester.

<table>
<thead>
<tr>
<th>Week</th>
<th>Homework</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td></td>
<td>Overview, review of multiple regression and a “primer” on matrix algebra.</td>
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<tr>
<td>2</td>
<td>HW1 distributed</td>
<td>Path analysis 1: the path diagram; mediation; direct, indirect, and total effects.</td>
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<td>3</td>
<td></td>
<td>Path analysis 2: identification; estimation; statistical power; goodness of fit (overlap with week 5)</td>
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<td>DS Tutorial: using publicly available databases for your research.</td>
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<td>4</td>
<td>HW1 due</td>
<td>Factor analysis 1: confirmatory versus exploratory factor analysis; interpretation of model parameters.</td>
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<td>HW2 distributed</td>
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<tr>
<td>5</td>
<td>HW1 returned</td>
<td>Factor analysis 2: identification; estimation; statistical power; goodness of fit (overlap with week 3)</td>
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<td>Week</td>
<td>Homework</td>
<td>Topic</td>
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<td>6</td>
<td>HW2 due</td>
<td>Basic SEM 1: model specification; the role of theory; integrating measurement and structural components.</td>
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<td>HW3 distributed</td>
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<td>7</td>
<td>HW2 returned</td>
<td>Basic SEM 2: testing nested models; applications and examples.</td>
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<td>8</td>
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<td>Spring break</td>
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<td>9</td>
<td>HW3 due</td>
<td>Advanced SEM 1: categorical and censored data; relations with item response theory</td>
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<td>10</td>
<td>HW3 returned</td>
<td>Advanced SEM 2: multi-group analysis; testing model invariance</td>
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<td>11</td>
<td>Prepare Presentation 1</td>
<td>Advanced SEM 3: complex samples (stratification, clustering, and sampling weights); multilevel modeling</td>
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<td>12</td>
<td>Prepare Presentation 2</td>
<td>Final project short presentations: theory and model specification</td>
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<tr>
<td>13</td>
<td>Prepare Final Presentation</td>
<td>Final project short presentations: analysis and results</td>
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<td>14</td>
<td>Final project write-up due in 1 week</td>
<td>Final project full presentations: the final product</td>
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**Bibliography (*denotes assigned reading provided by instructor*)


