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Overview of the Modeling Process

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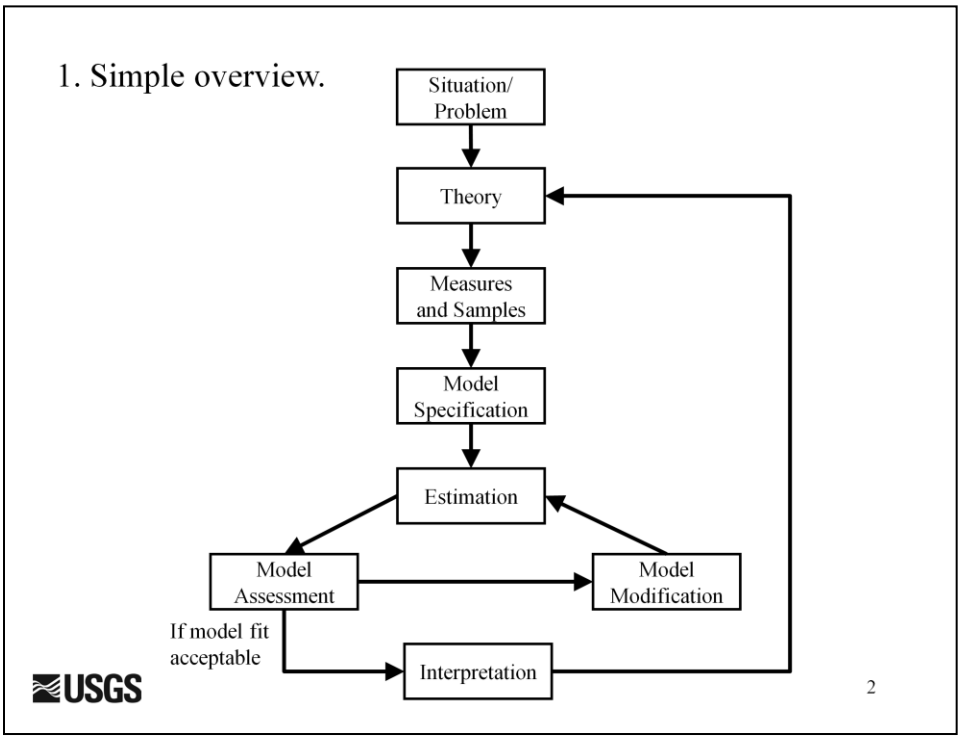
This very brief module provides a very general set of points about the overall modeling process.

An appropriate citation for the material in this tutorial is

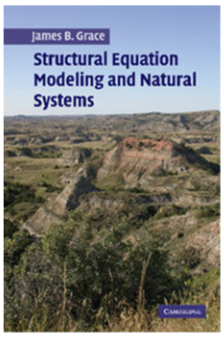
Grace, J.B., Anderson, T.M., Olff, H., and Scheiner, S.M. 2010. On the specification of structural equation models for ecological systems. *Ecological Monographs* 80:67-87.

Notes: IP-056512; Support provided by the USGS Climate & Land Use R&D and Ecosystems Programs. I would like to acknowledge formal review of this material by Jesse Miller and Phil Hahn, University of Wisconsin. Many helpful informal comments have contributed to the final version of this presentation. The use of trade names is for descriptive purposes only and does not imply endorsement by the U.S. Government. Last revised 20141216. Questions about this material can be sent to sem@usgs.gov.

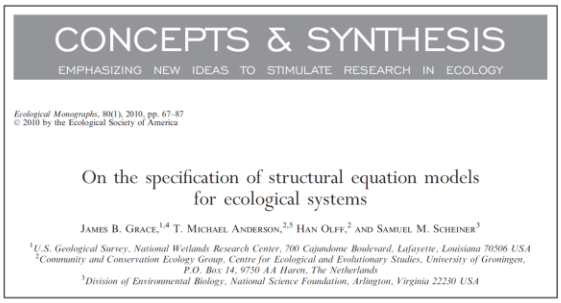


Here is the simple overview presented in the SEM Essentials-Summary Points module. The other modules provide a variety of illustrations of the various parts of the process.

2. A workflow progression supports the SEM process.



Grace (2006)
Chapter 10


CONCEPTS & SYNTHESIS

EMPHASIZING NEW IDEAS TO STIMULATE RESEARCH IN ECOLOGY

Ecological Monographs, 80(1), 2010, pp. 67–87
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On the specification of structural equation models for ecological systems

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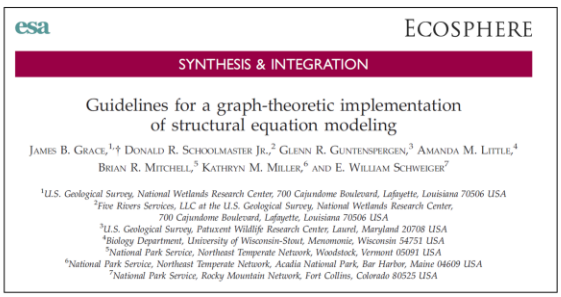
esa ECOSPHERE

SYNTHESIS & INTEGRATION

Guidelines for a graph-theoretic implementation of structural equation modeling

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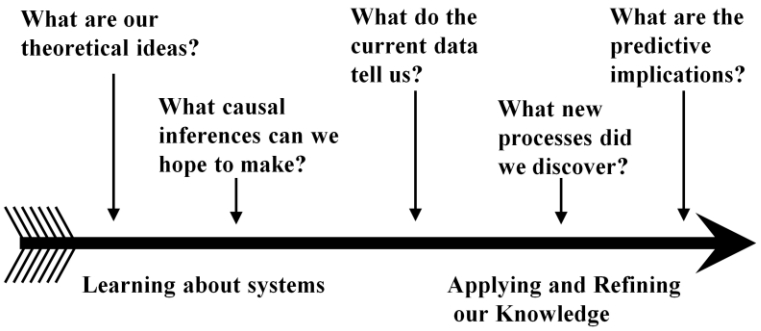
I have published three different treatments of the SEM workflow process. In my book, I walk through an example to illustrate the intent of sequential learning about a problem. In 2010, we expounded on model specification choices and the grounding needed for decisions in the field of ecology. In 2012, we proposed a 3rd-generation implementation for SEM and some additional steps in the process.

3. We have been striving to expand the guidance.



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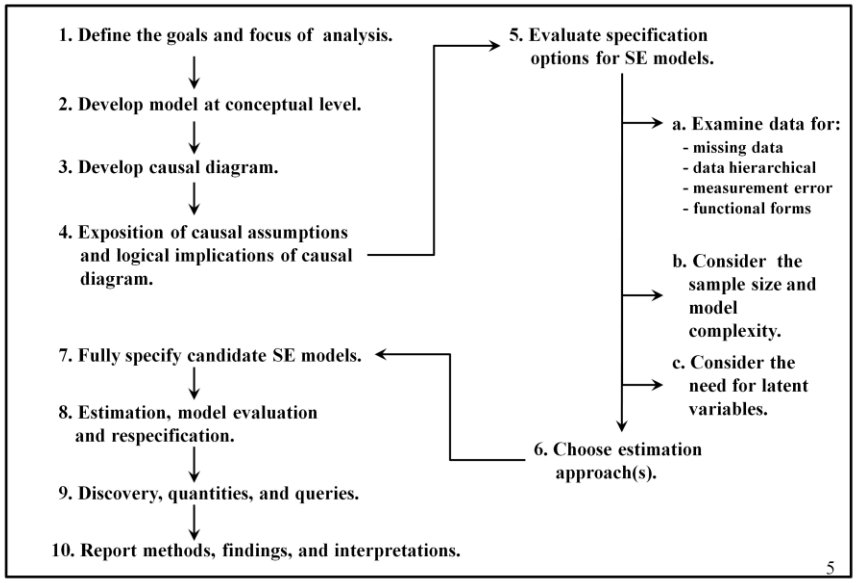
From a science perspective, one of our objectives has been to expand the advice given, as well as the procedures that link questions to answers. There has been a substantial gap in the literature on SEM dealing with the ends of the process. On the front-end, how do we formally translate theoretical ideas into models in a "revealed" fashion. On the back-end, there are many possible uses for our hard-earned parameter estimates. This potential is largely untapped because of a lack of attention by SEMers to issues that are bread-and-butter of "modelers".

What we aspire to is a comprehensive system for quantitatively examining general theoretical ideas.

4. Expanded view.



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These are the guidelines given in the Ecosphere paper. They are also elaborated on in a new book chapter my colleagues and I have coming out*.

*Grace, J.B., Scheiner, S.M., Schoolmaster, D.R. Jr. 2015. Structural equation modeling: building and evaluating causal models. Chapter 8 In: Fox, G.A., Negrete-Yanlelevich, S., and Sosa, V.J. (eds.) *Ecological Statistics: From Principles to Applications*. Oxford University Press. (accepted and in production)

A digression on sample size.

Rules of thumb for sample size –

- First, there are problems with any guidance on sample size.
- Second, simulations show we would really like to have huge sample sizes (see Model Evaluation module)
- People often talk about absolute sample sizes (e.g., 200 best, 100 OK, 50 minimal). But, it depends on model complexity (and signal-to-noise ratios)

(1) We would love to have 20 samples per parameter
(2) It would be helpful to have 10 samples per parameter
(3) We hope to have a minimum of at least 5 samples per estimated parameter
(4) It is claimed that Bayesian estimates are stable with as few as 2.5 samples per parameter.

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Here is just a very little bit about sample size.