

A Review of 'A Step-by-Step
Approach to Using SAS for Factor
Analysis and Structural Equation
Modeling' (Larry Hatcher)

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Do I recommend this book?

- **Yes** - if you are looking to start performing factor analyses and structural equations modeling (SEM) in SAS, and you do not have extensive experience in other statistics packages, especially if your math/stats background is weak.
- **No** - if you are familiar with factor analysis/SEM in other packages, then you can probably go to the SAS/STAT user's guide, and learn the new syntax (see 'other resources' slide near the end).

What this book is NOT

- A matrix algebra explanation of factor analysis and structural equation modeling (SEM).

What this book IS

- A light regression explanation of factor analysis and SEM.
- A guide on how to perform that in SAS, what the goals are and how to interpret the results.
- (in the appendices) an introduction to how to do things in SAS.
- Approachable with a low level of statistical background.

Outline of this book

- **Principle component analysis** (looking for combinations of observed variables).
- **Factor analysis** (looking for latent variables which explain observed variables).
- **Scale reliability** (a short chapter, need-to-know material only).
- **Path analysis** – manifest (observed) variables only.
- **Measurement models/CFA** (linking manifest with latent variables to evaluate measurement quality).
- **Structural equation analysis** – manifest variables measuring latent variables which are linked to each other; this book also covers model-fitting.
- **Appendices** on how to use SAS, write programs, enter data, and handle output.

What needs supplementing

- Fit indices – they cover a variety of fit indices and helpfully list them by portion of the model being tested (pg 391), but this field is rapidly evolving.
- ODS – this is a pre-ODS book, and I found ODS extremely helpful in getting output into useable form (e.g., into Excel).

What I liked

- Extremely step-by-step.
- Good explanation on how to estimate reliabilities of latent variables. I was able to estimate reliabilities and 'true' correlations of latent factors, comparing them to a more naïve approach.

Comment on SAS Syntax

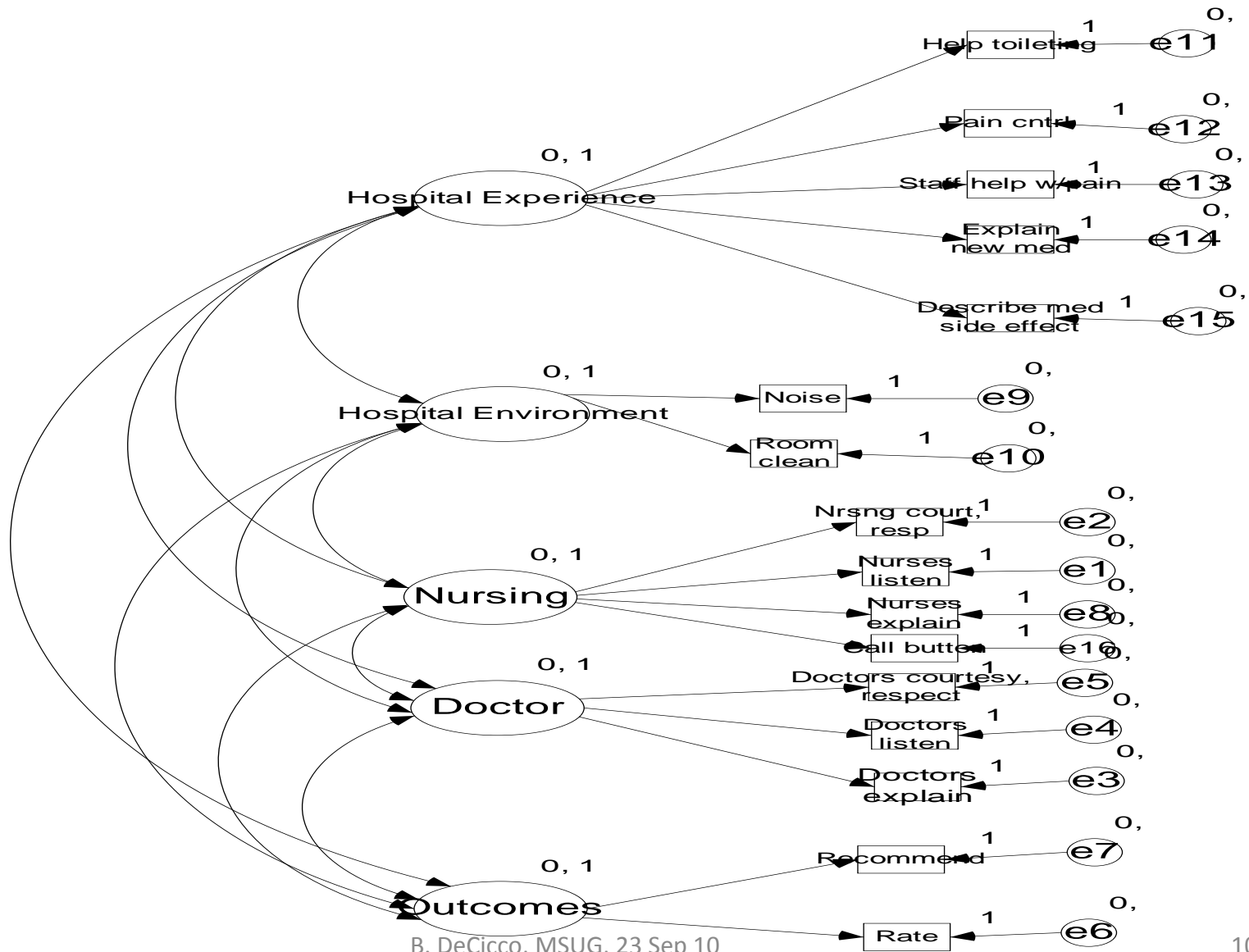
- With SEM, Proc Calis requires multiple long lists of linear equations.
- Using Excel formulae to write them out saves a lot of time:

| Question | Label | Factor | SAS LINEQS Statement | SAS Label |
|----------|---|--------|----------------------------|---|
| 1 | We have the supplies and equipment we need to effectively complete our work. | 1 | Q1=beta_Q1 factor_1 + EQ1, | Q1 ='We have the supplies and equipment we need to effectively complete our work.' |
| 2 | We have a workplace that is pleasant, comfortable, and well-suited to the needs of our employees and our patients or customers. | 1 | Q2=beta_Q2 factor_1 + EQ2, | Q2 ='We have a workplace that is pleasant, comfortable, and well-suited to the needs of our employees and our patients or customers.' |

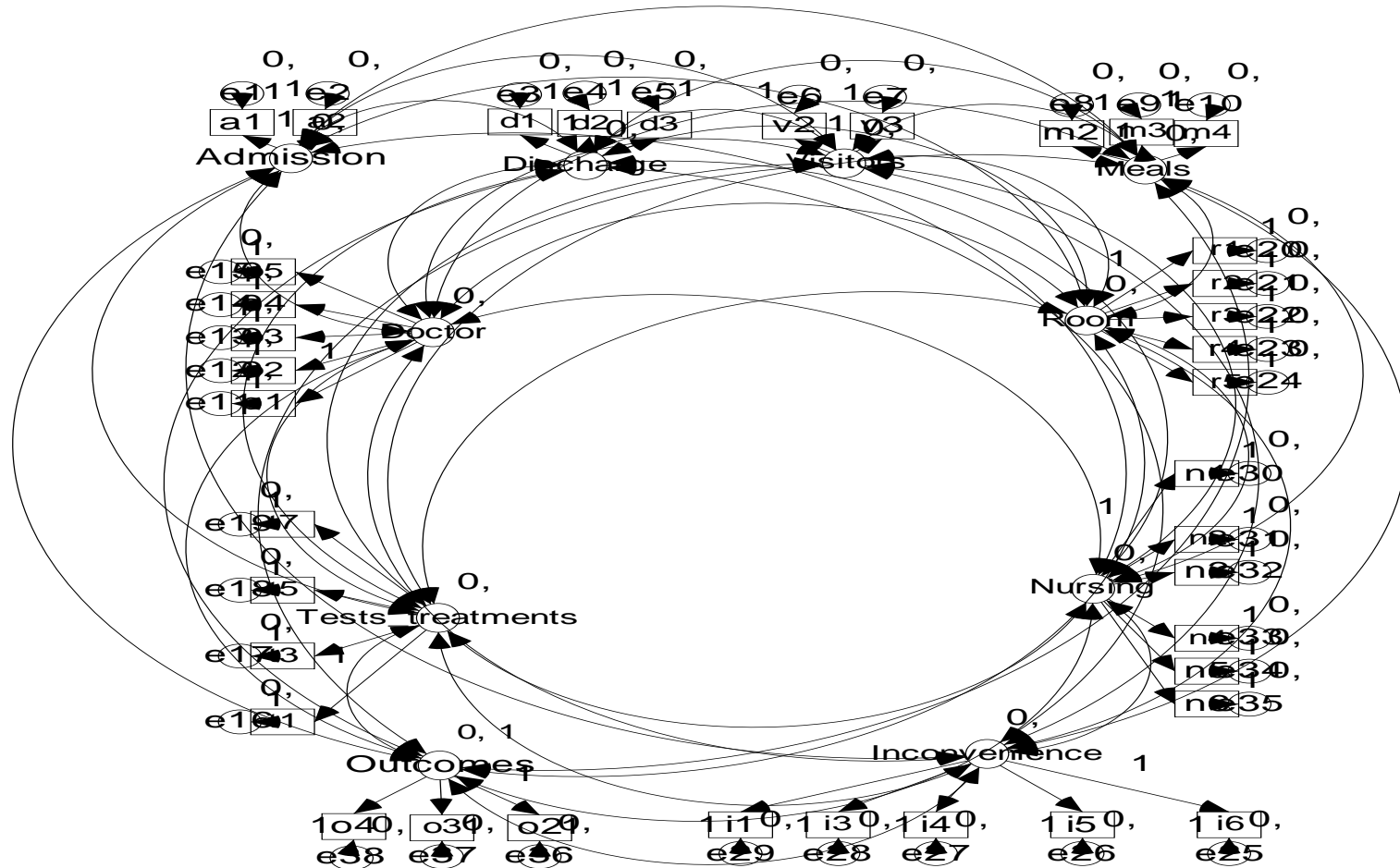
Comment: SAS vs. AMOS

- I worked on learning Proc CALIS (the classic SEM procedure for SAS) with this book at the same time I was learning AMOS, which is the SPSS SEM package.
- AMOS has a graphical user interface.
- This is great; one can draw models, and AMOS can automatically fill in multiple items.
- Sometimes AMOS's 'help' isn't so helpful.
- I was surprised that it was frequently no harder to do things in SAS than in a GUI-driven program.

The Sweet Side of AMOS



The Sour Side of AMOS



Other resources for this topic

- ‘A Handbook of Statistical Analyses with SAS’ has a chapter on factor analysis; nothing on SEM.
- SAS Help documents ‘**The FACTOR Procedure**’, ‘**Introduction to Structural Equation Modeling with Latent Variables**’ and ‘**The CALIS Procedure**’ cover the syntax, and have very condensed introductions to the material.
- <http://www.ats.ucla.edu/stat/sas/default.htm> has a very large body of very well done work on how to use SAS, and how to run statistical analyses.
- Statnotes: Topics in Multivariate Analysis, by G. David Garson (<http://faculty.chass.ncsu.edu/garson/PA765/statnote.htm>) **The best site on the internet** for people who find themselves needing to do a lot of graduate-level statistics, without the graduate degree in statistics. It generally assumes the use of SPSS, but the concepts translate.

Where to get this presentation

- Go to the Ann Arbor ASA website:
<https://sites.google.com/site/annarborasa/>
- Choose 'Presentations and Class Materials' on the left-hand menu:
<https://sites.google.com/site/annarborasa/A2ASA/presentations-and-class-materials>
- Look for the folder 'September 2010 MSUG Presentation'. This presentation and any associated documents will be there.