

## STRUCTURAL EQUATION MODELLING: HOW DO I CHOOSE THE RIGHT SOFTWARE?

**Nick Shryane and Simon Hunter**

In September 2011, Nick Shryane delivered a training course for AQMeN on Structural Equation Modelling. The practical aspects of the course were run using a trial version of the Mplus software, but many of the students attending the course asked about the alternative AMOS software, and how they should go about choosing the right software for them. We found that there was very little guidance available on choosing software and virtually nothing on the differences between Mplus and AMOS. Therefore, in this short article, Mplus user Nick and AMOS user Simon Hunter have given a short overview of why they use these particular software packages and what some of the pitfalls are. We also provide a range of useful resources, in terms of textbooks and weblinks (including short videos) at the end of the article. We hope you find this helpful in deciding which one is the right package for you.

### **Why I use Mplus, by Dr Nick Shryane**

The attraction of using Mplus for me is the fact that it will run such a wide variety of different statistical models using such a wide variety of input data. No other programme that I'm aware of (with the possible exception of Latent Gold) will run as many different types of models, and handle such different types of data.



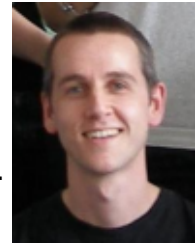
For example, I was recently looking at a model where multi-faceted indicators of individual civic behaviour (electoral turnout, writing letters to MPs, etc.) were used to predict council performance over time. The observed data consisted of binary, categorical, count and continuous data at both the individual and local-area level. The final model seamlessly combined elements of a multilevel structural equation model (SEM) with a latent growth curve model, handling the different data types and extensive missing data. I'm not aware of any other programme that could combine all these elements into a single model.

Even when running simpler models, Mplus is able to construct SEM models using unusual data types, such as zero-inflated counts, multiple responses, etc., which is really handy.

There are some disadvantages to using Mplus. It isn't designed as general data-processing software, which means it can sometimes be a bit fiddly. You have to prepare your data elsewhere (e.g. Stata, SPSS) and then import it into Mplus. It's pretty straightforward to do this though (especially in Stata, using the 'stata2mplus' command) but not seamless like it is in AMOS.

Another thing that some people find lacking is that Mplus doesn't allow users to draw their models, you've got to use syntax or menus to specify what you want. I have to say I prefer syntax, as it's much easier for complex models and leaves a good audit trail of what you have done, but others would disagree no doubt.

## Why I use AMOS, by Dr Simon Hunter



I use AMOS mainly because I've always used AMOS! As a Masters student, in 1999, I wanted to conduct some confirmatory factor analyses and at that time AMOS was offered as a free trial version which was sufficient for my purposes (its only real limitation was model size). This was before IBM / SPSS bought it, and it was still owned by a small, independent company. The graphical interface meant that it was (and is) relatively easy to teach yourself how to conduct things like confirmatory factor analysis (CFA), and even full structural equation models were quite easy to build and test.

The instruction manual it came with wasn't the best in the world, but soon after I started using it, Barbara Byrne published her book "Structural Equation Modeling with AMOS" (2001) and that became my bible. My supervisor at the time (Prof Jim Boyle) also had an interest in using this software, and this meant that we progressed, learned, and solved problems together. I now introduce our MRes students at Strathclyde to this SEM using AMOS, and allow them to build and test both a CFA and a full structural model in a practical session - this only takes them about an hour, and the hands on experience demystifies what can be an intimidating new piece of software.

I think it is a combination of the graphical interface, the ease with which it allows you to build and test models, and just plain old sticking-to-what-you-know which has meant I have continued to use AMOS. As I grew in confidence, I also began to learn more advanced techniques such as multi-group analyses, bootstrapping, and latent growth curve modelling. Though not unique to AMOS, using SEM has helped me to think about possible research questions and aims in a more flexible and creative way than I previously might have

I have, in the past two years or so, gradually come to identify some of the negative points of the software though. These mainly revolve around data sets which have missing values: bootstrapping, critical ratios of differences, modification indices, and tests of normality all require complete data. As I understand it, other programs (e.g. MPLUS) do not have this restriction and so I'm considering learning how to use other software too - I haven't yet because I haven't been able to find the time. Even if I do learn how to use other software though I suspect that I will continue to use AMOS simply by virtue of the ease with which models can be specified and tested (though, of course, my ignorance of other software may mean that I find they are also easy to use!).

## Textbooks and website resources

For SEM generally:

Kline, R.B. (2010) Principles and practice of structural equation modelling. Third Edition. New York: The Guilford press.

Marcoulides, G.A. and Moustaki, I. (2002) Latent variable and latent structure models. Quantitative Methodology Series. New Jersey: Lawrence Erlbaum Associates.

Raykov, T. and Marcoulides, G.A. (2006) A First Course in Structural Equation Modeling. New Jersey: Lawrence Erlbaum Associates.

<http://www.youtube.com/watch?v=0p7fKJE4Hz0>

[http://www.youtube.com/watch?v=ZuX\\_QzZGjf0](http://www.youtube.com/watch?v=ZuX_QzZGjf0)

For Mplus:

Byrne, B.M. (2011). Structural equation modeling with Mplus: Basic concepts, applications, and programming. New York: Routledge, Taylor & Francis Group.

Muthen, B. O. (2002). Beyond SEM: General latent variable modelling. *Behaviormetrika*, 29(1): 81-117.

<http://www.statmodel.com/download/muthen1.pdf>

Muthen, L.K. and Muthen, B.O. (2007). Mplus Statistical Analysis with latent variables: User's Guide. [Manual that comes with the software]

[http://www.ats.ucla.edu/stat/seminars/muthen\\_08/default.htm](http://www.ats.ucla.edu/stat/seminars/muthen_08/default.htm)

<http://www.psypress.com/common/sample-chapters/9781848728394.pdf>

For AMOS:

Blunch, N.L. (2008). Introduction to Structural Equation Modelling using SPSS and AMOS. SAGE: London.

Byrne, B.M. (2010). Structural equation modeling with AMOS: Basic concepts, applications, and programming. Second Edition. New Jersey: LEA.

Keith, T.Z. (2006). Multiple regression and beyond. USA: Pearson.

<http://www.indiana.edu/~statmath/stat/all/cfa/cfa3.html>

<http://www.amosdevelopment.com/video/index.htm>

[http://ssc.utexas.edu/software/faqs/amos#Amos\\_4](http://ssc.utexas.edu/software/faqs/amos#Amos_4)

<http://www.youtube.com/user/Gaskination>

<http://www.youtube.com/watch?v=GA2hco5604M&feature=related>

<http://www.youtube.com/watch?v=6tZFOsp7vfw&feature=related>

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[www.manchester.ac.uk/research/n.shryane](http://www.manchester.ac.uk/research/n.shryane)

[www.scid-project.org](http://www.scid-project.org)

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[www.strath.ac.uk/humanities/courses/psychology/staff/huntersimondr/](http://www.strath.ac.uk/humanities/courses/psychology/staff/huntersimondr/)

<http://aggressionsummary.blogspot.com/>

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