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A First Look at the lavaan R Package for Classical Structural Equation Modeling

Objective of this tutorial (Tutorial #1)

The objective in this tutorial is to introduce first-time lavaan users to the basic resources for the package.

In addition to providing some links to on-line resources, this tutorial illustrates a few of the most basic lavaan commands and output.

This tutorial requires preexisting knowledge of R, but the lavaan syntax is both familiar and largely stand-alone, so one does not have to be an expert to start using lavaan quickly.

A first look at lavaan

“lavaan” is an R package for classical structural equation modeling. The basic description of the package at the R website can be found at:

<http://cran.r-project.org/web/packages/lavaan/lavaan.pdf>

The developer’s website for lavaan is:

<http://lavaan.ugent.be/?q=node/2>

At the developer’s website you will find a number of useful resources. In addition to those items, there is a Google Group where you can usually get quick answers to your coding issues.

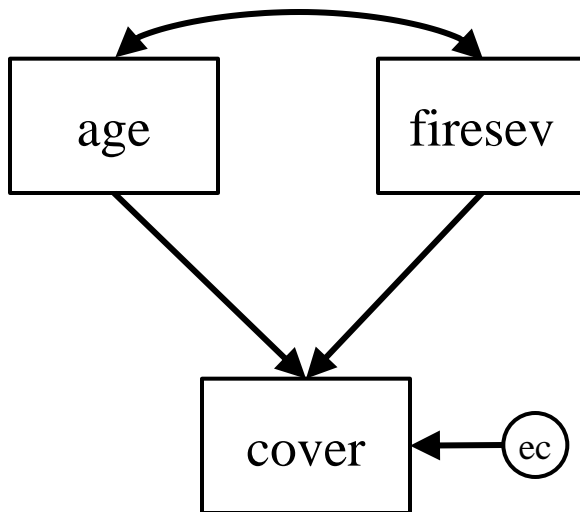
<https://groups.google.com/forum/#!forum/lavaan>

A first look at lavaan syntax

In addition to this tutorial, you will want to download R code and data for tutorial #1 at the following url:

<http://www.structuralequations.com/LavaanTutorials.html>

Our first model:



The lavaan equation for this model is:

```
'cover ~ age + firesev'
```

“A_First_Look_at_lavaan.R*”

*note: you can open .R files (or .r files) with any text reader.

```
### A FIRST LOOK AT LAVAAN
# from www.structuralequations.org
# This code accompanies tutorial "Lavaan_FirstLook.pdf"

# DATA and example used in this demonstration from
# Grace and Keeley (2006) Ecol. Apps. 16:503-514.
# download: (http://www.werc.usgs.gov/OLDSitedata/seki/pdfs
# /k2006_grace_sem_ea.pdf)

# Note: comments are in regular font, commands in bold.
# Set your working directory
setwd("F:/Documents/LavaanTutorials")

# Load data and name file "k.dat"
k.dat<-read.csv("./Keeley_rawdata_select4.csv")

# Examine contents of keeley data file
names(k.dat)
head(k.dat)
```

“A_First_Look_at_lavaan.R” (cont.)

R code continued . . .

```
### Load Libraries
library(lavaan)

### Lavaan syntax for a single-equation #####

# Write lavaan code for this single equation model
mod1 <- 'cover ~ age + firesev'

# Fit the model (i.e. est. parameters)
mod1.fit <- sem(mod1, data=k.dat)

# Output a summary of the computed results
summary(mod1.fit, rsq=T) # rsq=T means output the r-sqr

#####
```

Note: exogenous variables are automatically allowed to freely intercorrelate in lavaan.

Output from single-equation model

R output

Warning message:

```
In getDataFull(data = data, group = group, group.label =  
group.label, :  
lavaan WARNING: some observed variances are (at least) a  
factor 100 times larger than others; please rescale
```

```
# Fix the data  
summary(k.dat$cover); summary(k.dat$age);  
summary(k.dat$firesev)  
  
k.dat$age <- k.dat$age/100 # scale age variable  
k.dat$firesev <- k.dat$firesev/10 # scale firesev  
# then rerun the above model
```

Output from single-equation model

lavaan (0.5-12) converged normally after 1 iterations

Number of observations 90

Estimator ML

Minimum Function Test Statistic 0.000

Degrees of freedom 0

P-value (Chi-square) 1.000

	Estimate	Std.err	Z-value	P(> z)
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Regressions:

cover ~

age	-0.483	0.264	-1.833	0.067
-----	--------	-------	--------	-------

firesev	-0.672	0.201	-3.353	0.001
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Variances:

cover	0.078	0.012
-------	-------	-------

R-Square:

cover	0.220
-------	-------

Output from single-equation model (annotated in red)

lavaan (0.5-12) converged normally after 1 iterations

Number of observations 90

Estimator ML

Minimum Function Test Statistic (i.e. chi-sqr) 0.000

Degrees of freedom (model is saturated) 0

P-value (Chi-square) 1.000

	Estimate (raw est.)	Std.err	Z-value (ML t-value)	P(> z)
Regressions:				
cover ~				
age	-0.483	0.264	-1.833	0.067
firesev	-0.672	0.201	-3.353	0.001

Variances: (for endogenous vars, these are error variances)

cover 0.078 0.012

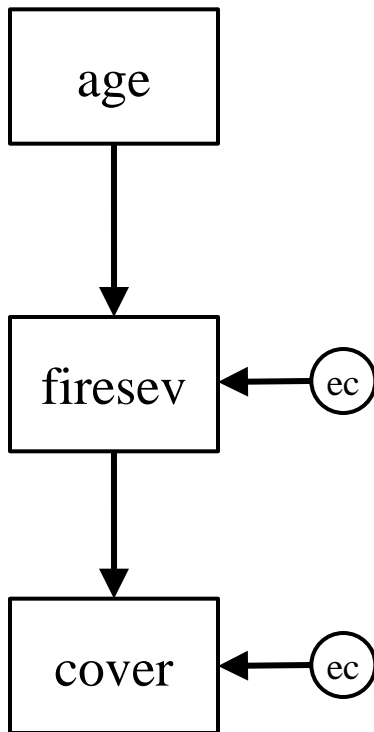
R-Square:

cover 0.220

A second look at lavaan syntax

Here we look at a model that requires two equations, one for each endogenous variable.

Our second model:



The lavaan equation for this model is:

```
'cover ~ firesev  
firesev ~ age'
```

A second look at lavaan syntax

```
### Lavaan multi-equation model #####  
# Lavaan model: separate line for each equation;  
# whole model is enclosed in quotes.  
  
# Model code  
mod2 <- 'cover ~ firesev  
          firesev ~ age'  
  
# Fit model  
mod2.fit <- sem(mod2, data=k.dat)  
  
# Output results  
summary(mod2.fit, rsq=T)
```

Output from two-equation model (fit measures)

lavaan (0.5-12) converged normally after 19 iterations

Number of observations 90

Estimator ML

Minimum Function Test Statistic 3.297

Degrees of freedom 1

P-value (Chi-square) 0.069

Output from two-equation model (parameter estimates)

Parameter estimates:

Information Standard Errors				Expected Standard
	Estimate	Std.err	Z-value	P(> z)
Regressions:				
cover ~ firesev	-0.839	0.182	-4.611	0.000
firesev ~ age	0.597	0.124	4.832	0.000
Variances:				
cover	0.081	0.012		
firesev	0.021	0.003		
R-Square:				
cover	0.191			
firesev	0.206			

End of First Look.