Web-based Analysis with R-sem

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2018-08-07 13:01:07

Contents

Chapter 1

Where to test

http://r-meta.org:3838/r-sem

Chapter 2

Getting Started

Welcome to the "Structural Equation Modeling(SEM) with R". In this chapter, you can perform the first `structural equation modeling` of your own using the sample data in a minute.

Perform SEM In A Minute

The first screen : Select language

When you load the SEM app, you can see this screen. Currently, this app support English and Korean. You can select your preferred language(arrow).

Steps for SEM

Performing SEM with sample data is very simple. You can finish in five steps.

1. Select/Upload Data

... `HolzingerSwineford1939` was selected as a default data.

If you want to know about the data, press the `show help Data` button.

In the popup window, the informations about the data will be displayed.

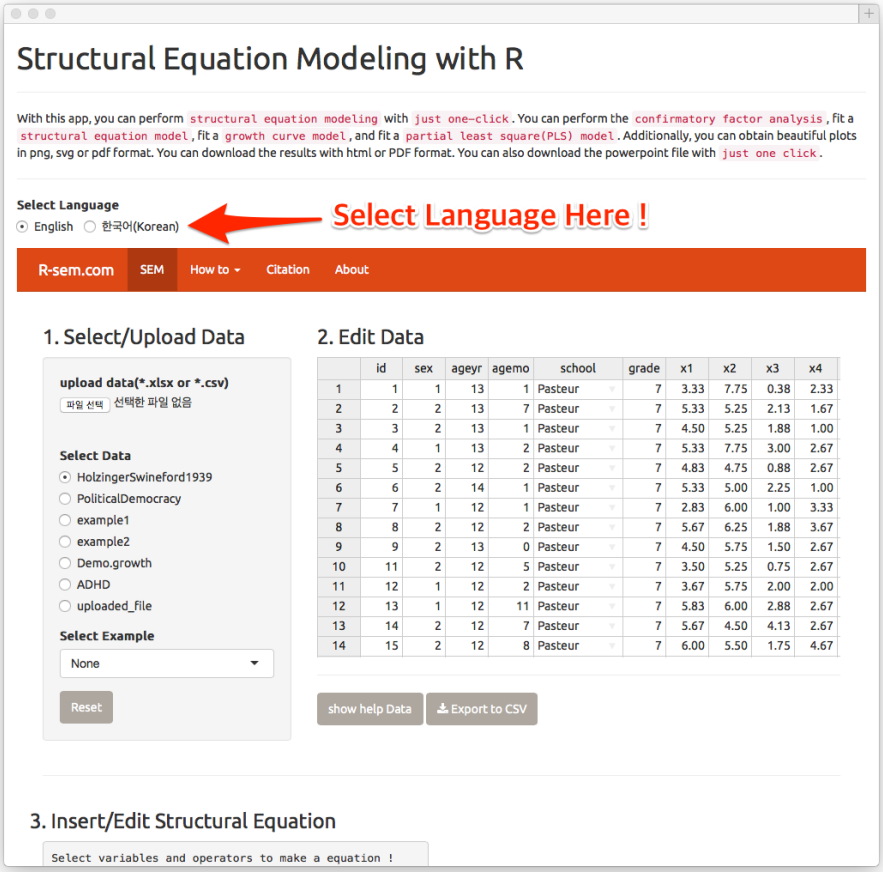


Figure 2.1: 1.png

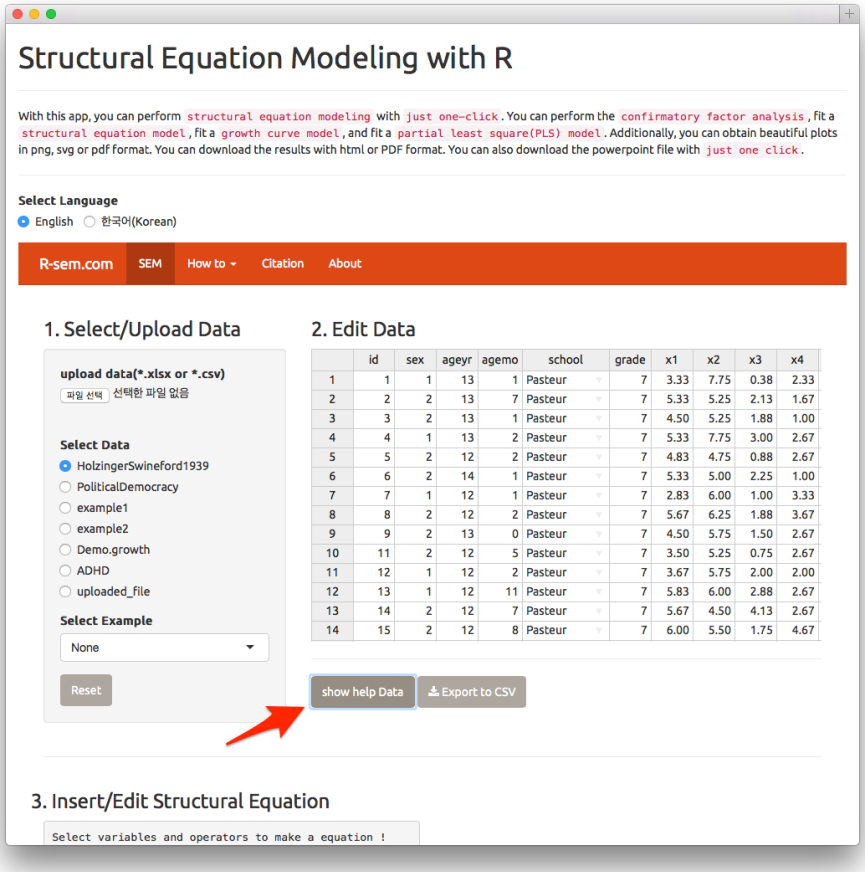


Figure 2.2: 2.png

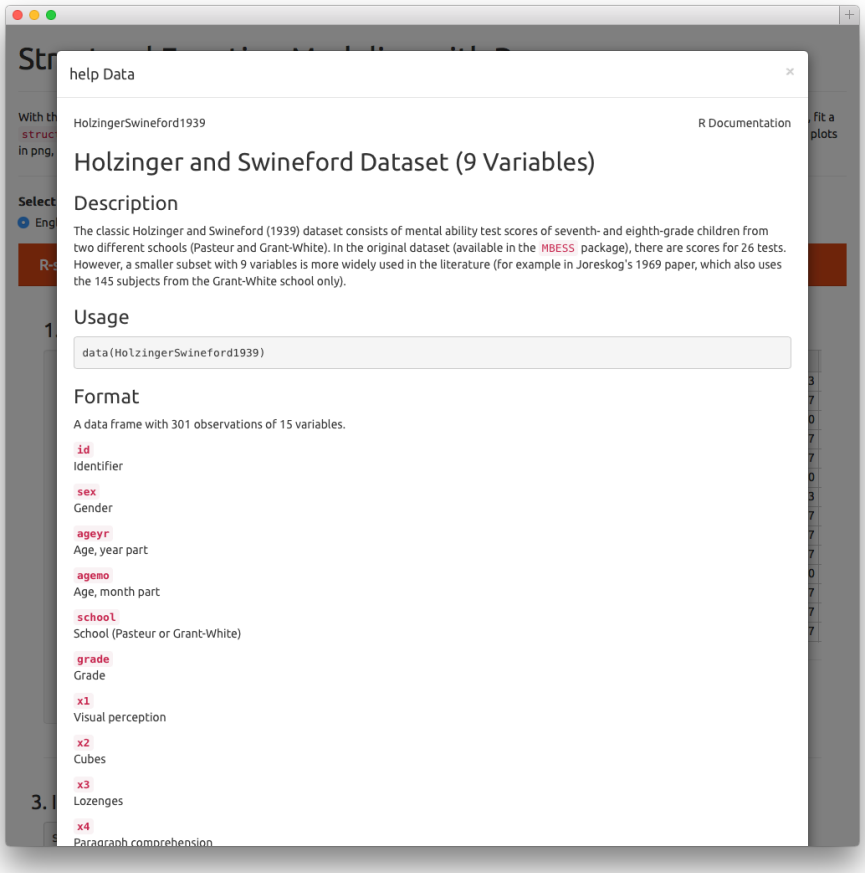


Figure 2.3: 3.png

2. Edit Data

... No action required.

3. Insert/Edit Structural Equation

The classic Holzinger and Swineford (1939) dataset consists of mental ability test scores of seventh- and eighth-grade children from two different schools (Pasteur and Grant-White). In the original dataset (available in the MBESS package), there are scores for 26 tests. However, a smaller subset with 9 variables is more widely used in the literature. A Confirmatory Factor Analysis(CFA) model that is often proposed for these 9 variables consists of three latent variables (or factors), each with three indicators:

- a `visual` factor measured by 3 variables: x1, x2 and x3
- a `textual` factor measured by 3 variables: x4, x5 and x6
- a `speed` factor measured by 3 variables: x7, x8 and x9

You can insert/edit the structural equation easily by the following steps.

1. Choose left side variable(s) or enter the latent variable
2. Select operator
3. Choose right side variable(s)

(1) First, please enter the latent variable `visual` in the text input(arrow).

As you enter the latent variable `visual`, the left side of equation will be made and the operator `=~` will be added(arrow). The operator `=~` is used for latent variable definition which means `is measured by`.

The current set of operators is summarized in the table below.

formula type	operator	mnemonic
latent variable selection	`=~`	is measured by
regression	`~`	is regressed on
(residual) (co)variance	`~~`	is correlated with
intercept	`~1`	intercept
defined parameter	`:=`	is predefined as
equality constriant	`==`	equals
non-equalty constraint	`<`	is less than
non-equalty constraint	`>`	is greater than

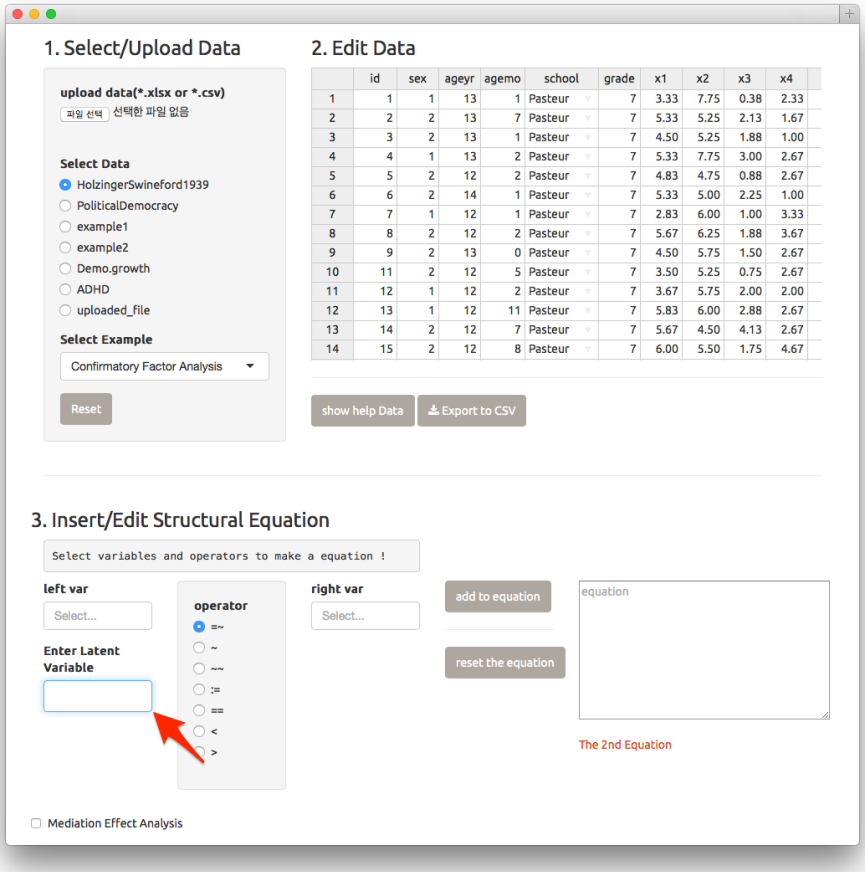


Figure 2.4: 4.png

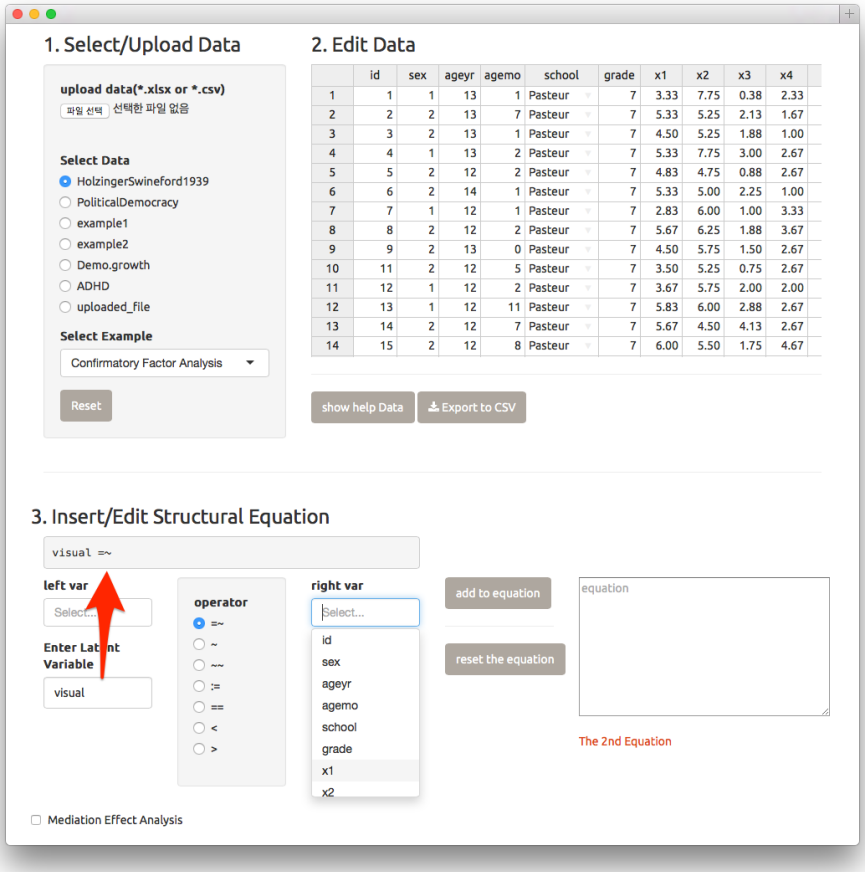
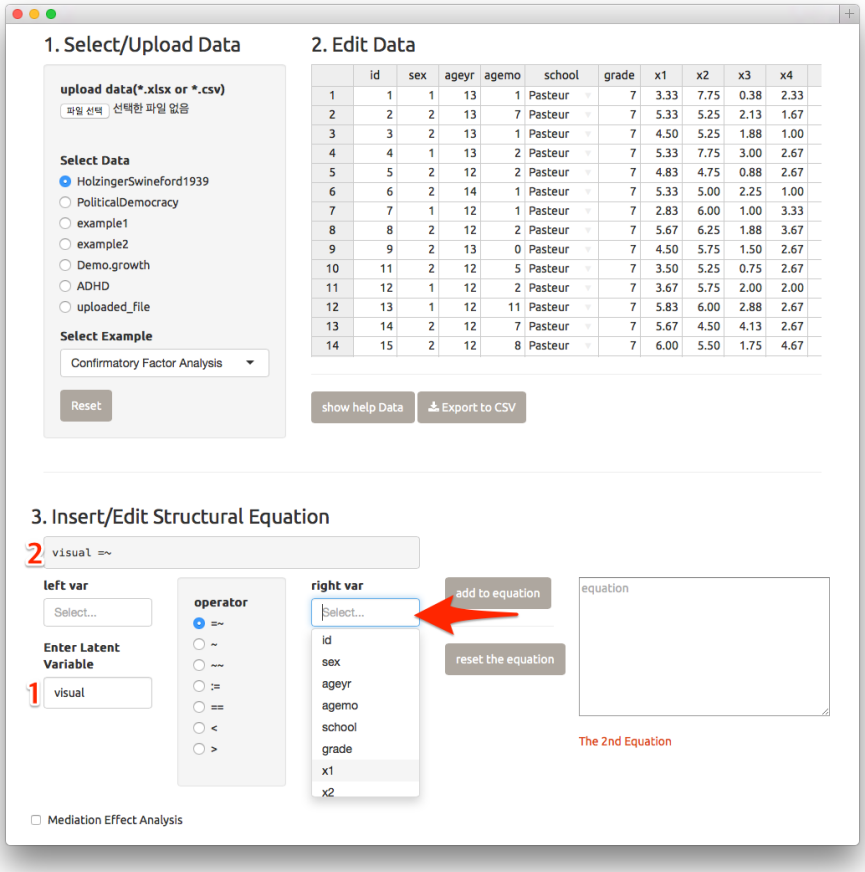


Figure 2.5: 5.png



	id	sex	ageyr	agemo	school	grade	x1	x2	x3	x4
1	1	1	13	1	Pasteur	7	3.33	7.75	0.38	2.33
2	2	2	13	7	Pasteur	7	5.33	5.25	2.13	1.67
3	3	2	13	1	Pasteur	7	4.50	5.25	1.88	1.00
4	4	1	13	2	Pasteur	7	5.33	7.75	3.00	2.67
5	5	2	12	2	Pasteur	7	4.83	4.75	0.88	2.67
6	6	2	14	1	Pasteur	7	5.33	5.00	2.25	1.00
7	7	1	12	1	Pasteur	7	2.83	6.00	1.00	3.33
8	8	2	12	2	Pasteur	7	5.67	6.25	1.88	3.67
9	9	2	13	0	Pasteur	7	4.50	5.75	1.50	2.67
10	11	2	12	5	Pasteur	7	3.50	5.25	0.75	2.67
11	12	1	12	2	Pasteur	7	3.67	5.75	2.00	2.00
12	13	1	12	11	Pasteur	7	5.83	6.00	2.88	2.67
13	14	2	12	7	Pasteur	7	5.67	4.50	4.13	2.67
14	15	2	12	8	Pasteur	7	6.00	5.50	1.75	4.67

Figure 2.6: 6.png

(2) And then, please select the rigth side variables - `x1`,`x2` and `x3` - among the variables displayed in the selectInput.

(3) After selection of three variables, press the `add to equation` button.

The temporary equation just made will be added to the equation. The latent variable input box(1), temporary equation(2) and the selectInput(for rigth side variables) will be initialized.

Please repeat the step (1)-(3) to add the equation:

```
textual =~ x4 + x5 + x6
```

```
speed =~ x7 + x8 + x9
```

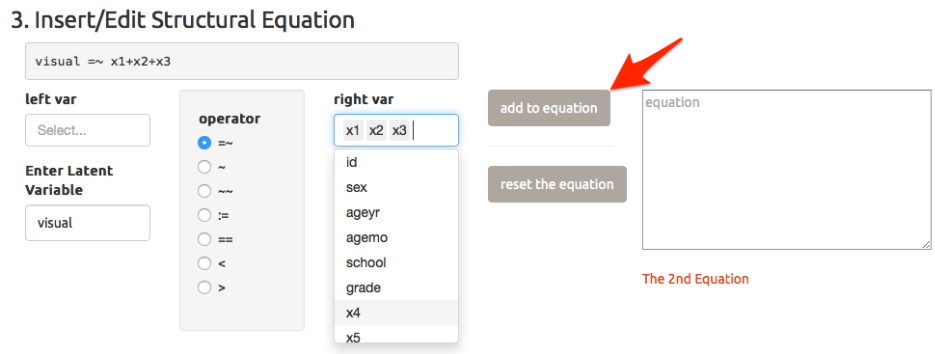


Figure 2.7: 7.png

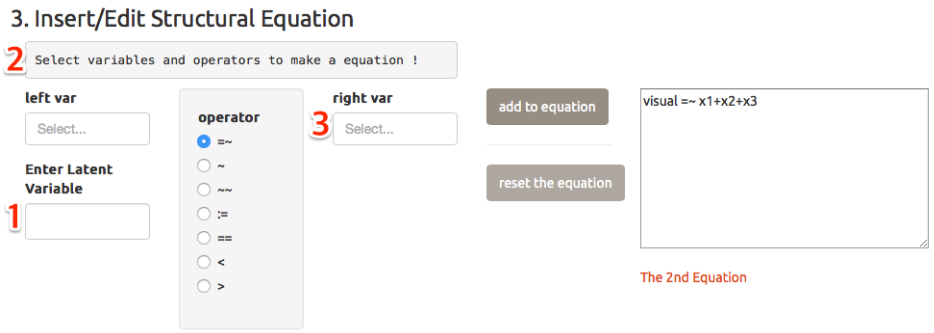


Figure 2.8: 8.png

4. Analysis/Summary options

... No action required.

5. Plot options

... No action required.

6. Press the `Do anlaysis` button(arow).

You can get the analysis results followed by the plot(s) representing SEM.

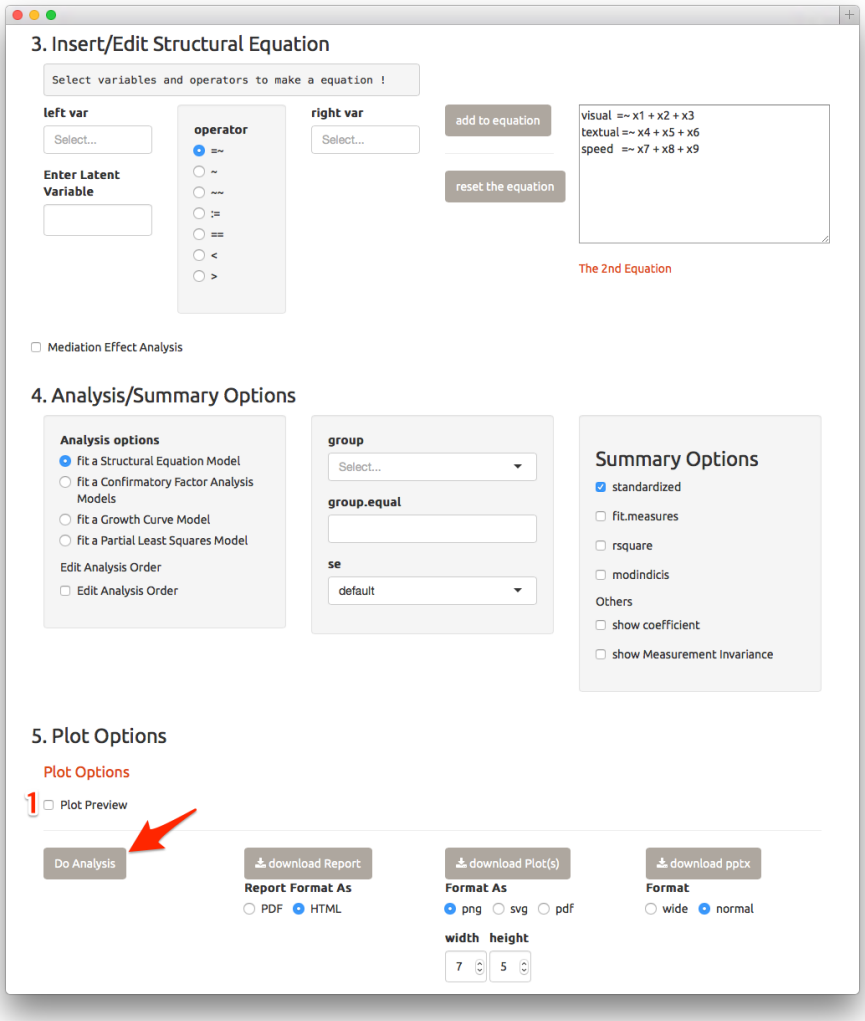
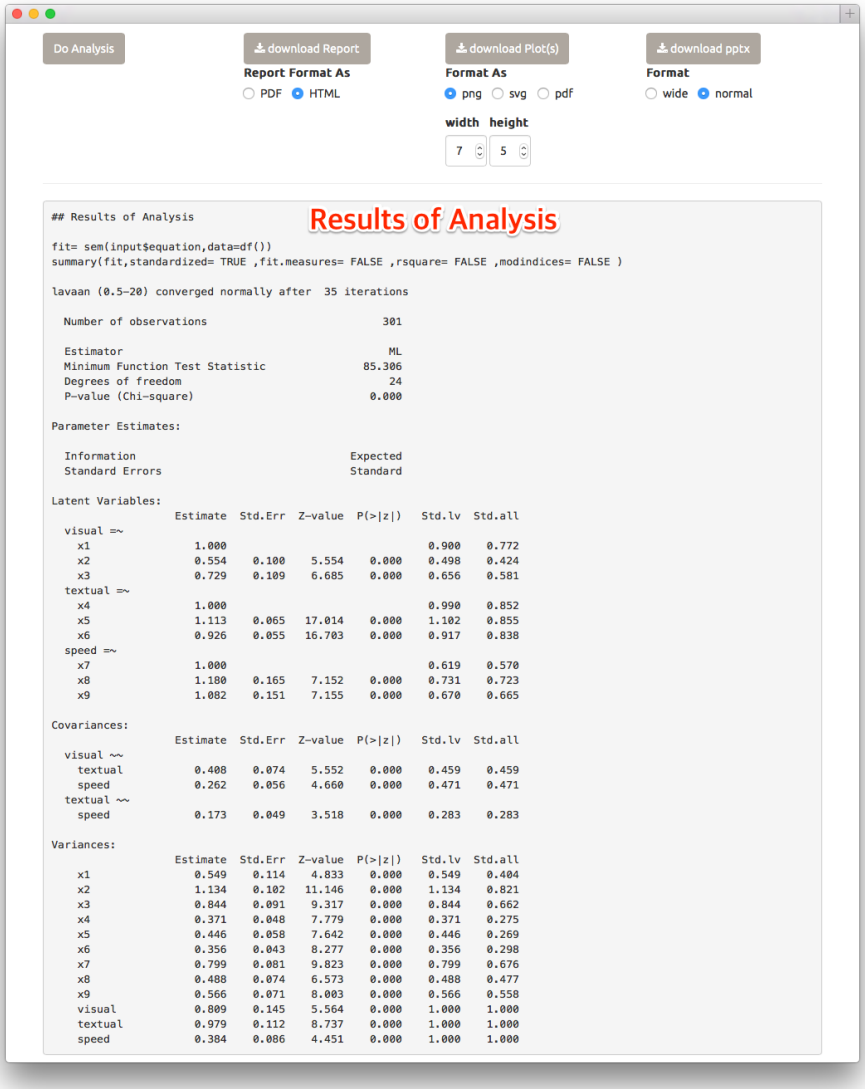
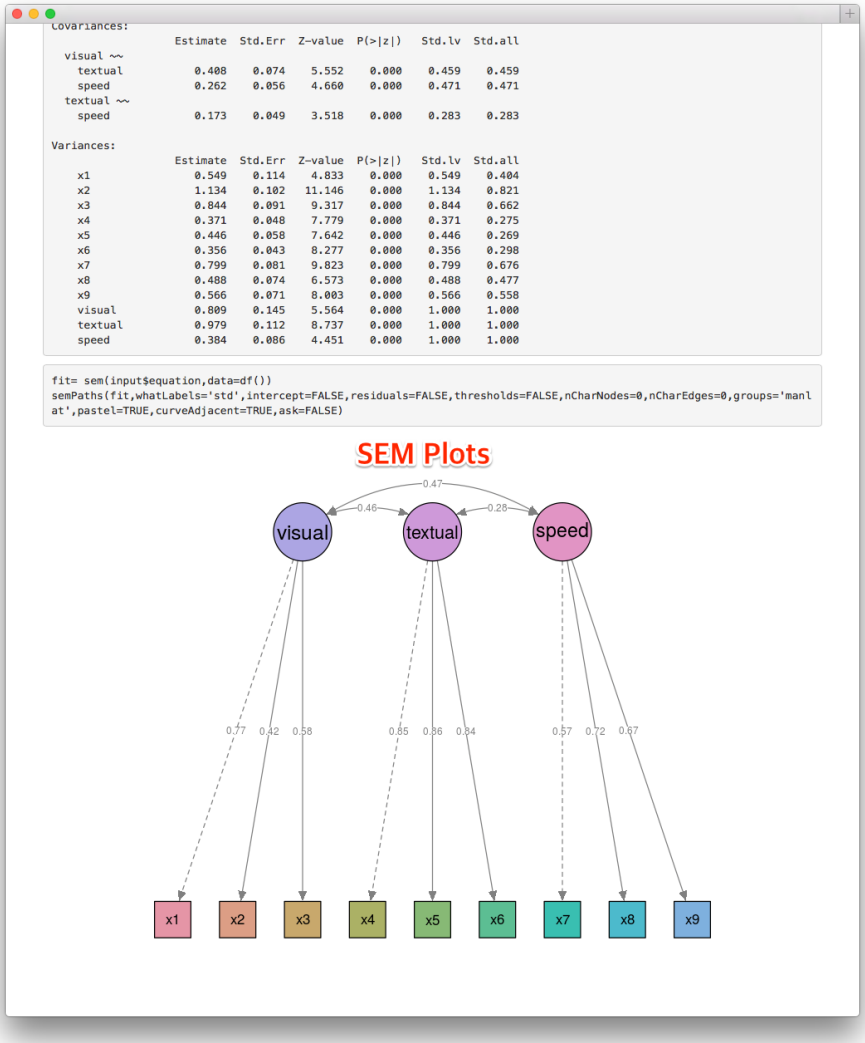


Figure 2.9: 9.png


Do Analysis
download Report
Report Format As
PDF
HTML
download Plot(s)
Format As
png
svg
pdf
width
height
7
5
download pptx
Format
wide
normal
Results of Analysis
Results of Analysis
fit= sem(input$equation,data=df())
summary(fit,standardized= TRUE ,fit.measures= FALSE ,rsquare= FALSE ,modindices= FALSE)
lavaan (0.5-20) converged normally after 35 iterations
Number of observations 301
Estimator ML
Minimum Function Test Statistic 85.306
Degrees of freedom 24
P-value (Chi-square) 0.000
Parameter Estimates:
Information Expected
Standard Errors Standard
Latent Variables:
Estimate Std.Err Z-value P(>|z|) Std.lv Std.all
visual =~
x1 1.000 0.900 0.772
x2 0.554 0.100 5.554 0.000 0.498 0.424
x3 0.729 0.109 6.685 0.000 0.656 0.581
textual =~
x4 1.000 0.990 0.852
x5 1.113 0.065 17.014 0.000 1.102 0.855
x6 0.926 0.055 16.703 0.000 0.917 0.838
speed =~
x7 1.000 0.619 0.570
x8 1.180 0.165 7.152 0.000 0.731 0.723
x9 1.082 0.151 7.155 0.000 0.670 0.665
Covariances:
Estimate Std.Err Z-value P(>|z|) Std.lv Std.all
visual ~~
textual 0.408 0.074 5.552 0.000 0.459 0.459
speed 0.262 0.056 4.660 0.000 0.471 0.471
textual ~~
speed 0.173 0.049 3.518 0.000 0.283 0.283
Variances:
Estimate Std.Err Z-value P(>|z|) Std.lv Std.all
x1 0.549 0.114 4.833 0.000 0.549 0.404
x2 1.134 0.102 11.146 0.000 1.134 0.821
x3 0.844 0.091 9.317 0.000 0.844 0.662
x4 0.371 0.048 7.779 0.000 0.371 0.275
x5 0.446 0.058 7.642 0.000 0.446 0.269
x6 0.356 0.043 8.277 0.000 0.356 0.298
x7 0.799 0.081 9.823 0.000 0.799 0.676
x8 0.488 0.074 6.573 0.000 0.488 0.477
x9 0.566 0.071 8.003 0.000 0.566 0.558
visual 0.809 0.145 5.564 0.000 1.000 1.000
textual 0.979 0.112 8.737 0.000 1.000 1.000
speed 0.384 0.086 4.451 0.000 1.000 1.000



Easier step

You can bypass all the steps by `select Example`. If you choose the example `Confirmatory Factor Anlaysis`, the equation will be made automatically. And then, you can press the `do Anlaysis` button.

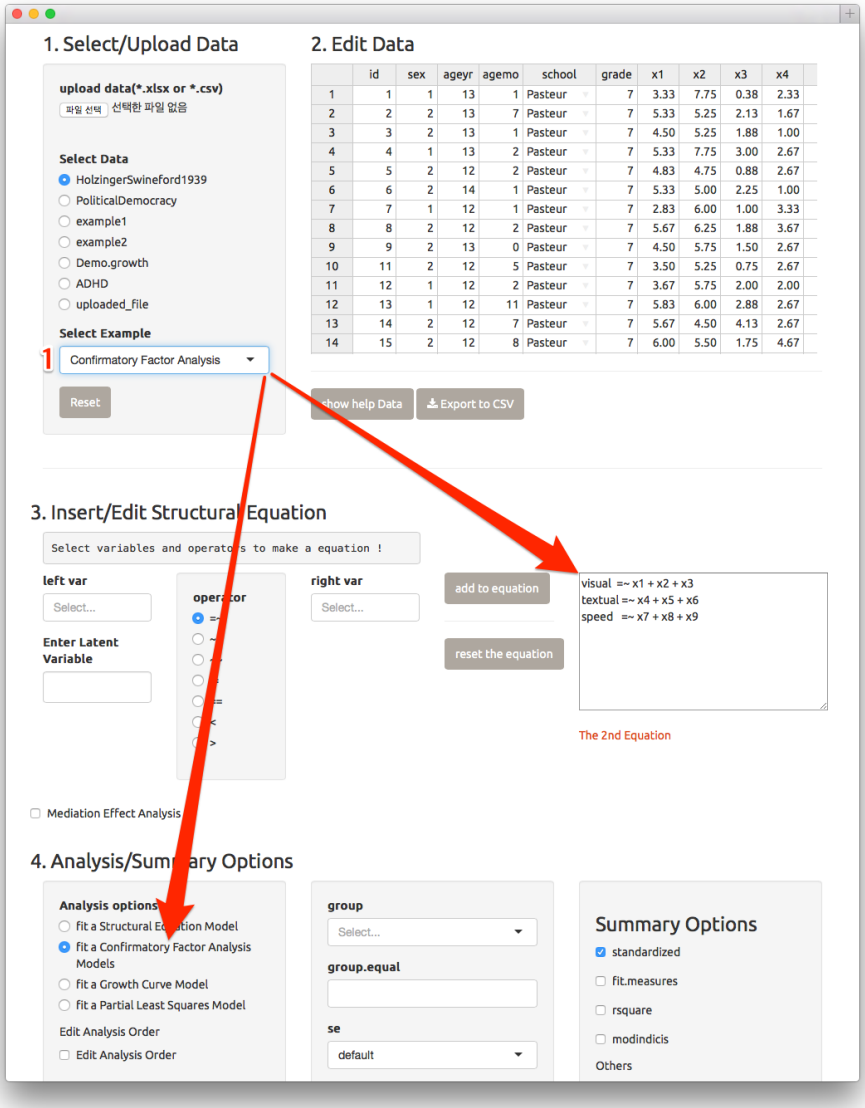


Figure 2.10: 12.png

Download Results

You can download Report(1) as PDF(*.pdf), HTML(*.html,default) format. You can download plots(2) with png, svg or pdf format. You can download plot(s) as a powerpoint file(*.pptx)(3).

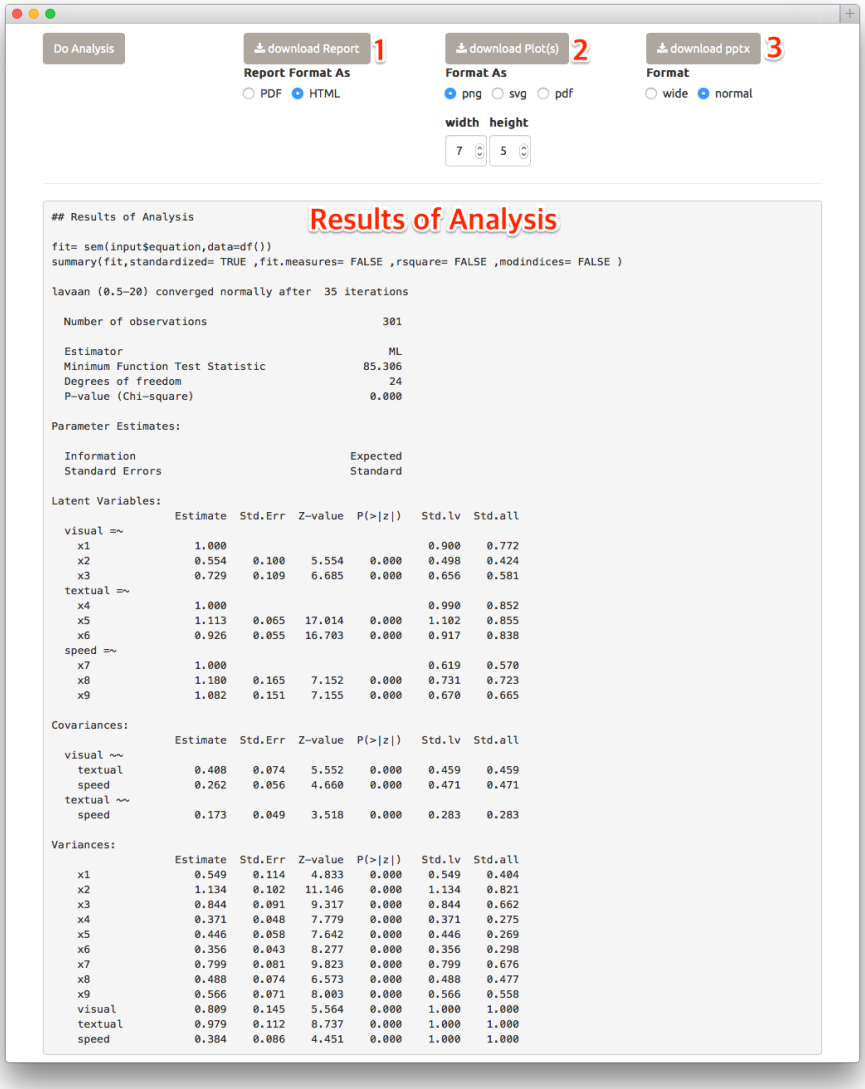


Figure 2.11: 13.png

Chapter 3

Analyze Your Own Data

In this chapter, I will discuss how to upload your own data to the `Structural Equation Modeling(SEM) with R` app and edit the data.

Upload data

You can upload your own data by clicking the `choose file` button(1). In the popup window, you can select your own data file(2). A data file with Microsoft excel format(*.xlsx) or comma-separate value format(*.csv) is allowed. Because an excel file contains calculations, functions or macros may cause error, the *.csv format is preferred. You can save an excel file with a *.csv format by "save as..." menu on excel. The limitation of file size is 30 MB. After selection of you data file, press `choose` button(3).

After a few seconds, the upload completed.You should select the uploaded_file(1) among the `Select Data` radio buttons. Your file is displayed at `Edit Data` window.

Edit data

You can edit your data by click a cell in the table. You can use your data table as a spreadsheet.

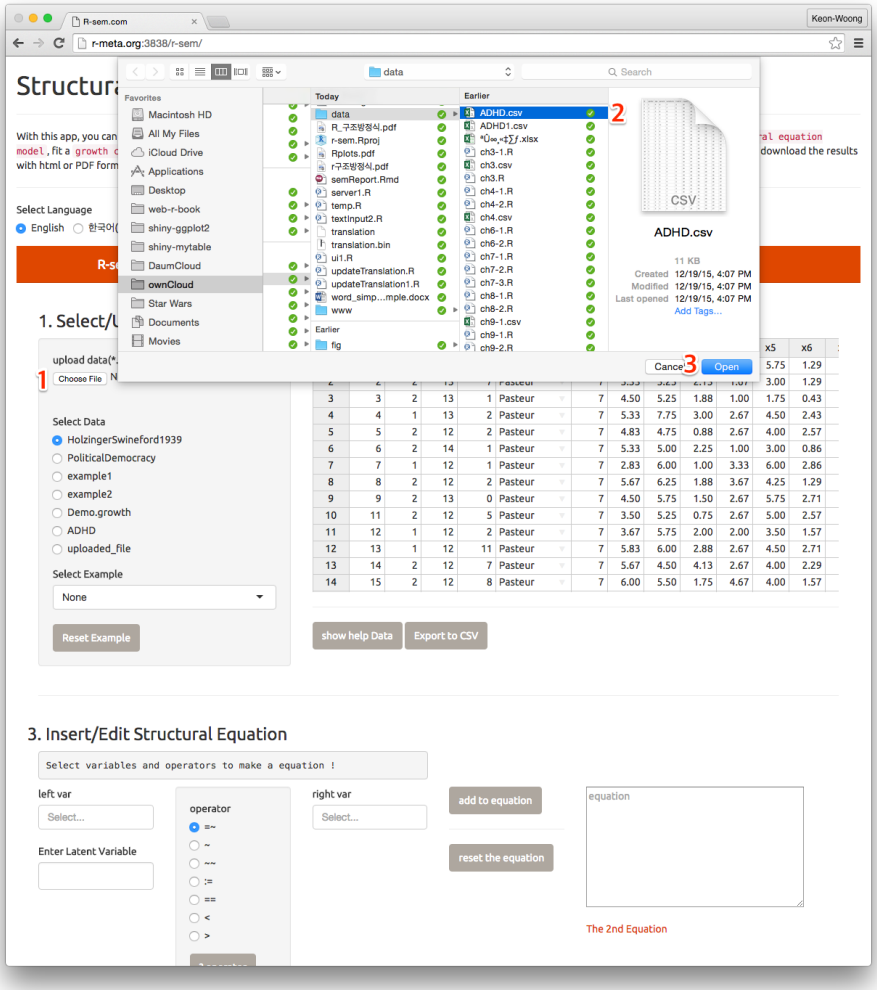


Figure 3.1: 14.png

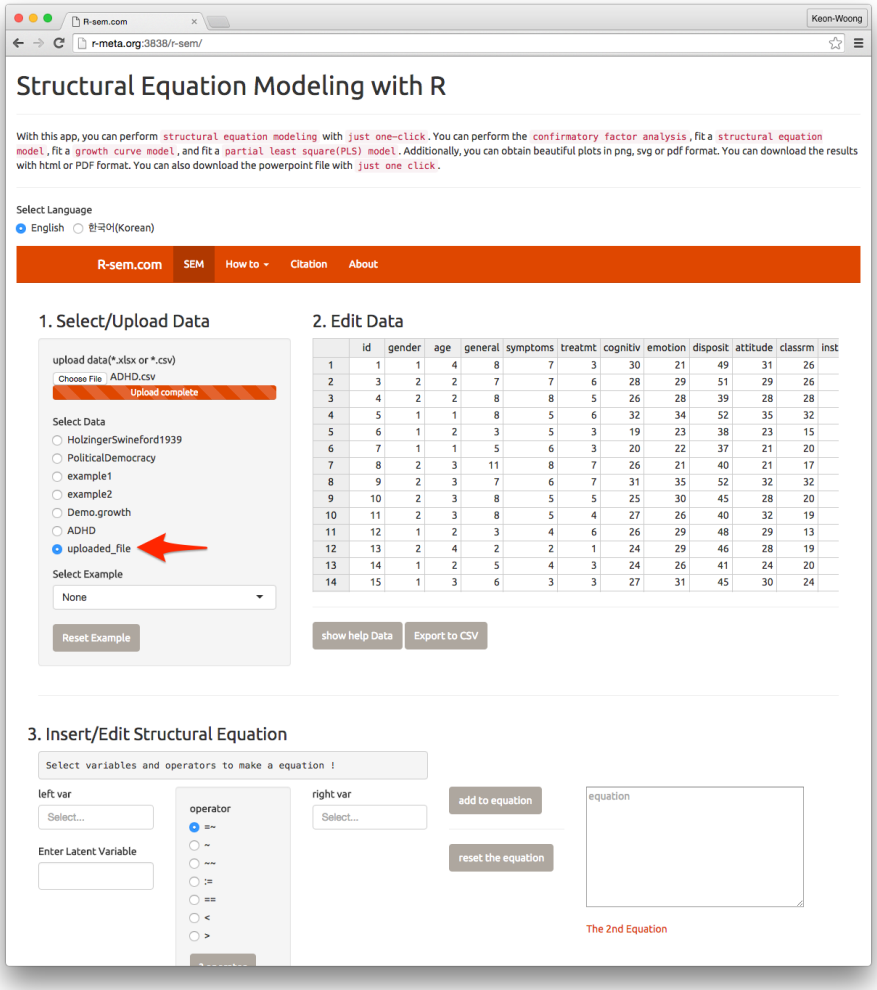


Figure 3.2: 15.png

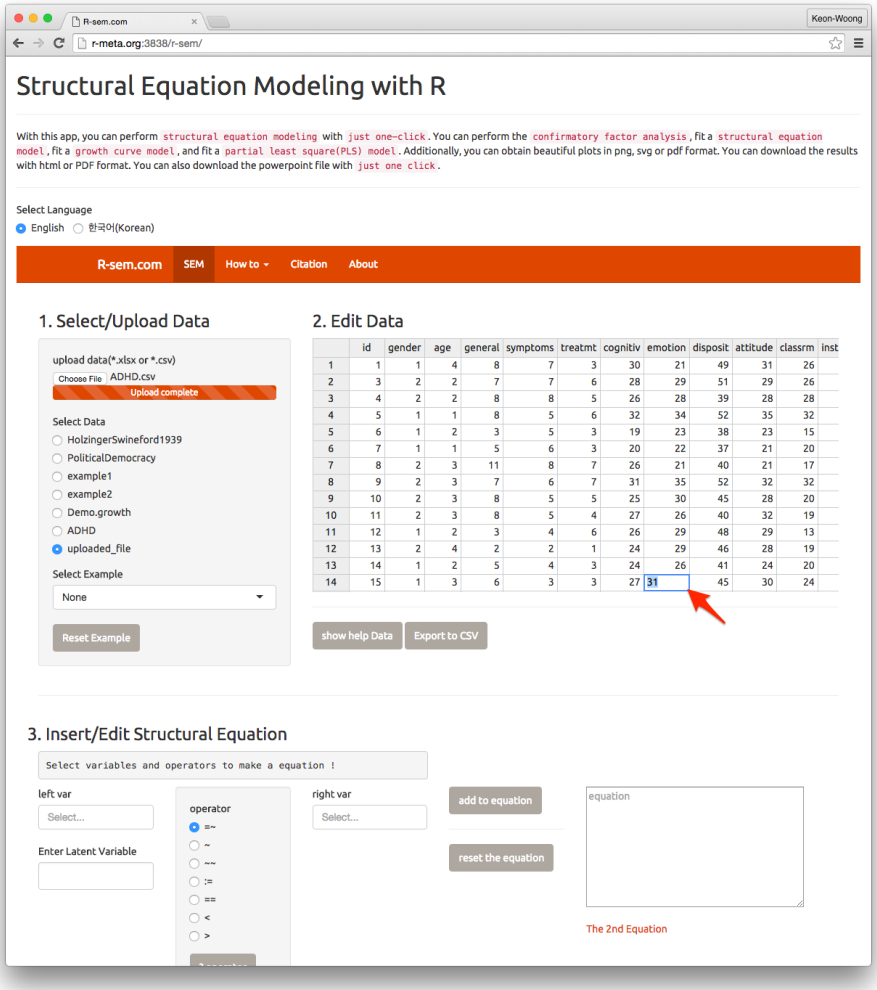


Figure 3.3: 16.png

Insert/remove row

By right click the table, you can insert row or remove row.

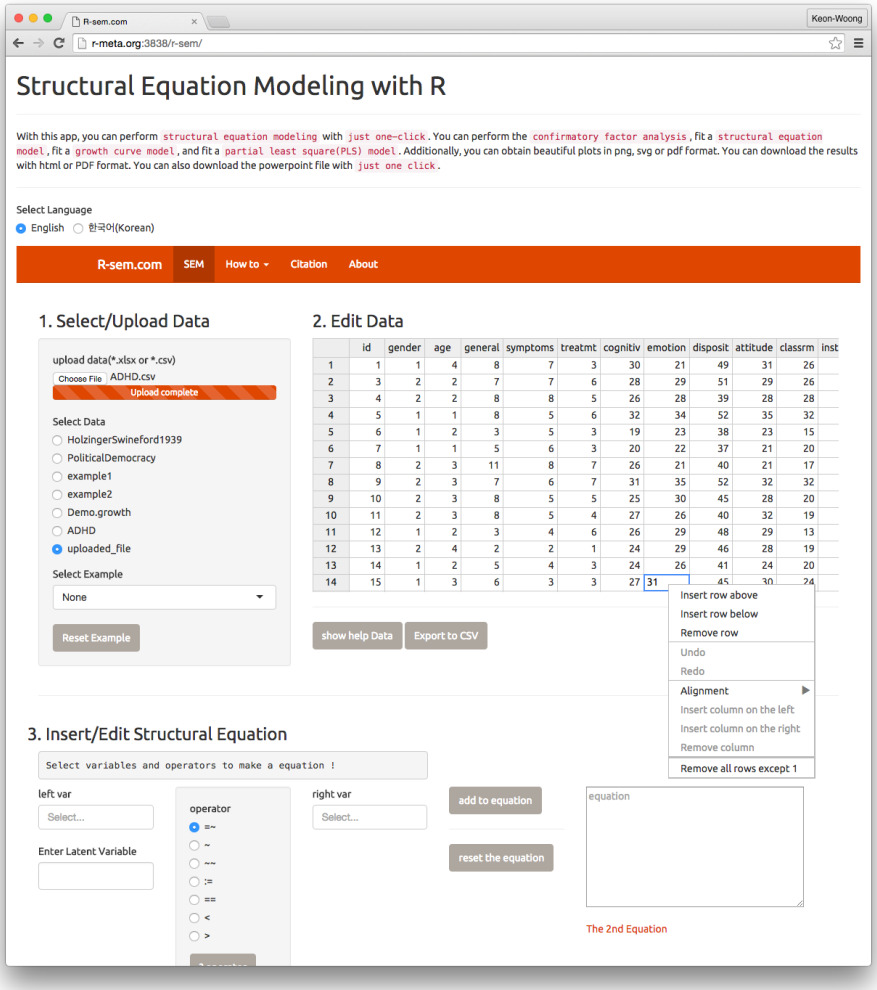


Figure 3.4: 17.png

Chapter 4

Insert/Edit Structural Equation

The classic Holzinger and Swineford (1939) dataset consists of mental ability test scores of seventh- and eighth-grade children from two different schools (Pasteur and Grant-White). In the original dataset (available in the MBESS package), there are scores for 26 tests. However, a smaller subset with 9 variables is more widely used in the literature. A Confirmatory Factor Analysis(CFA) model that is often proposed for these 9 variables consists of three latent variables (or factors), each with three indicators:

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You can insert/edit the structural equation easily by the following steps.

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(1) First, please enter the latent variable `visual` in the text input(arrow).

As you enter the latent variable `visual`, the left side of equation will be made and the operator `=~` will be added(arrow). The operator `=~` is used for latent variable definition which means `is measured by`.

The current set of operators is summarized in the table below.

formula type	operator	mnemonic

formula type	operator	mnemonic
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defined parameter	`:=`	is predefined as
equality constriant	`==`	equals
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non-equalty constraint	`>`	is greater than

(2) And then, please select the rigth side variables - `x1`,`x2` and `x3` - among the variables displayed in the selectInput.

(3) After selection of three variables, press the `add to equation` button.

The temporary equation just made will be added to the equation. The latent variable input box(1), temporary equation(2) and the selectInput(for rigth side variables) will be initialized.

Please repeat the step (1)-(3) to add the equation:

```
textual =~ x4 + x5 + x6
```

```
speed =~ x7 + x8 + x9
```

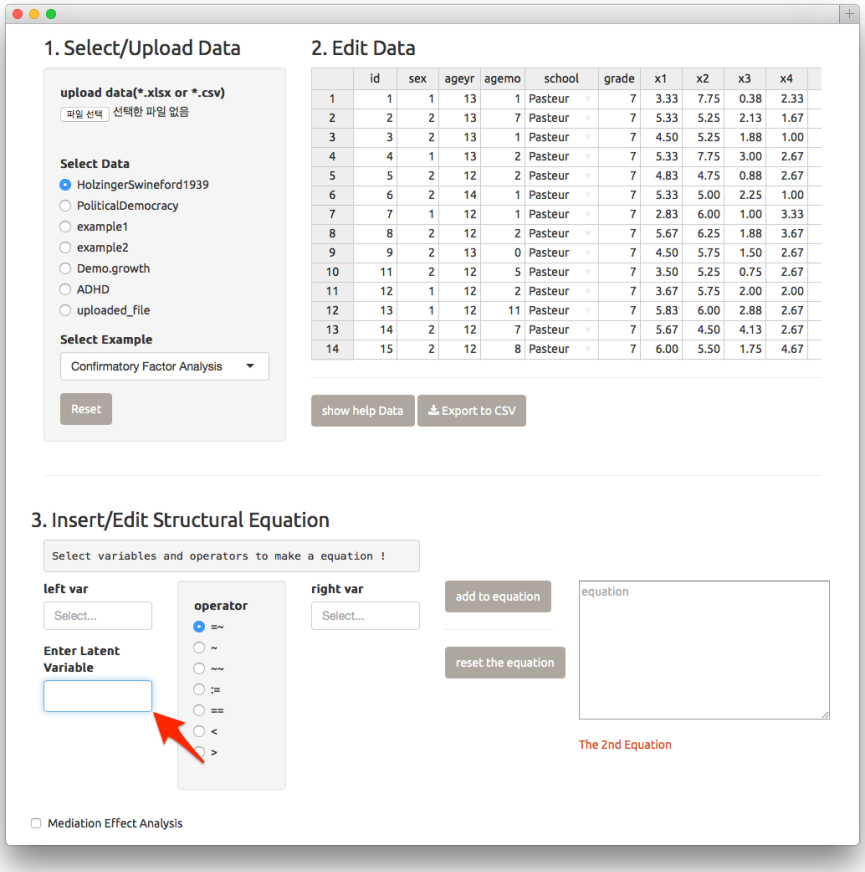


Figure 4.1: 4.png

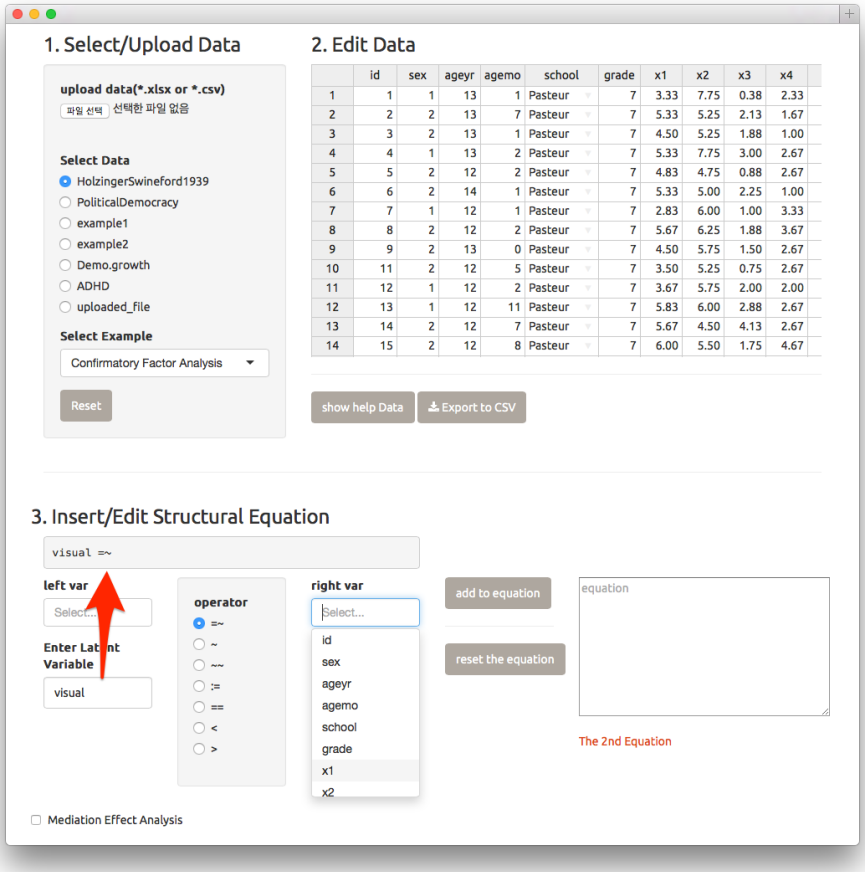


Figure 4.2: 5.png

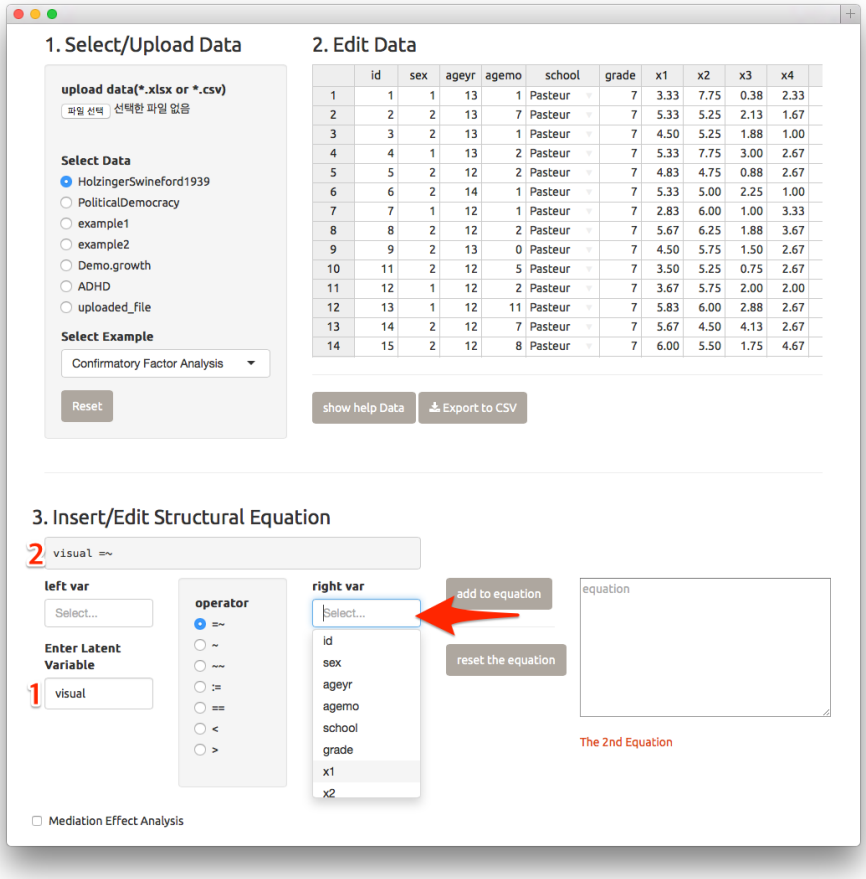


Figure 4.3: 6.png

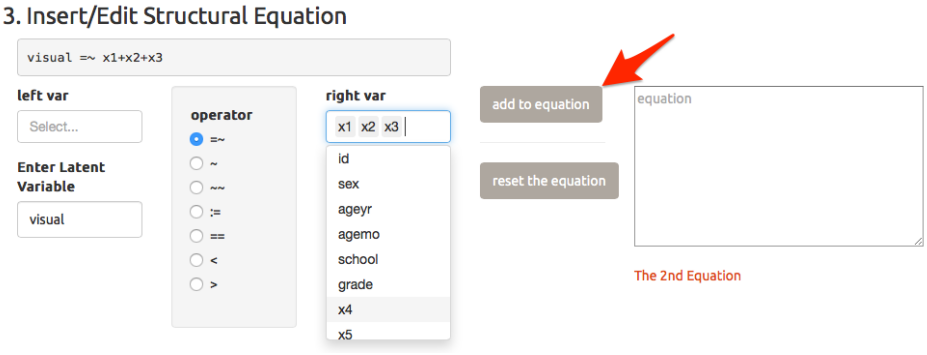


Figure 4.4: 7.png

Figure 4.5: 8.png

Chapter 5

Direct edit the equation

You can directly type the equation in the equation window just as a word processor.

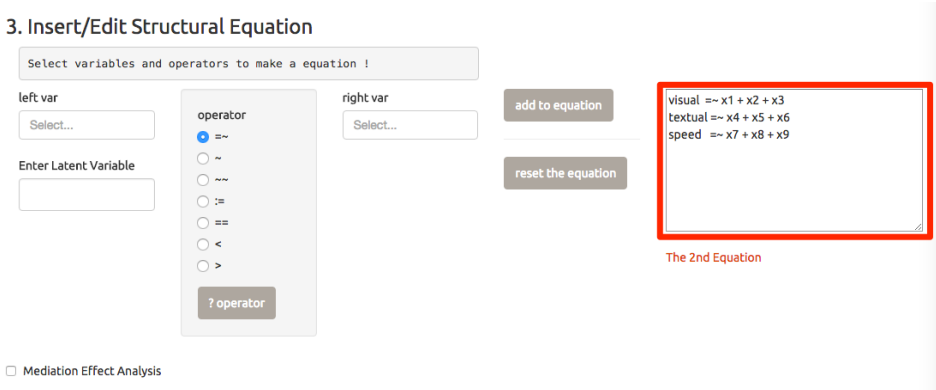


Figure 5.1: 18.png

Chapter 6

Edit A Mediation Effect Equation

In this chapter, I will use the data and explanation described in lavaan homepage(http://lavaan.ugent.be/tutorial/mediation.html).

Consider a classical mediation setup with three variables: Y is the dependent variable, X is the predictor, and M is a mediator. For illustration, we create a toy dataset containing these three variables, and fit a path analysis model that includes the direct effect of X on Y and the indirect effect of X on Y via M.

Please select `example2` among the `select Data` radio buttons(1). If we wanted to konw how the data be made, just click the `show data Help` button(arrow).

check the `Mediation Effect Analysis`

To insert the mediation effect easily, please select the `Mediation effect Analysis` checkbox(arrow).

Select variables

Please select `X` as a independent variable, select `M` as a mediator and select `Y` as a response variable. Press `Make Equation` button and you can get the mediation

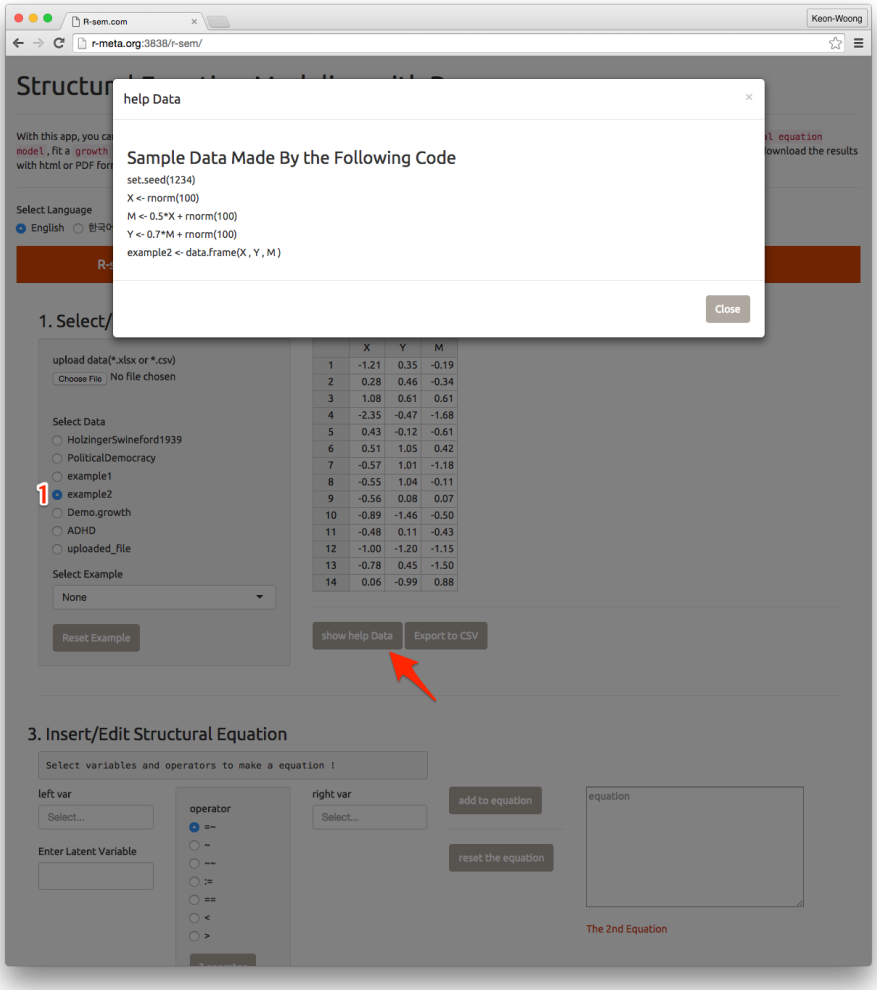


Figure 6.1: 19.png

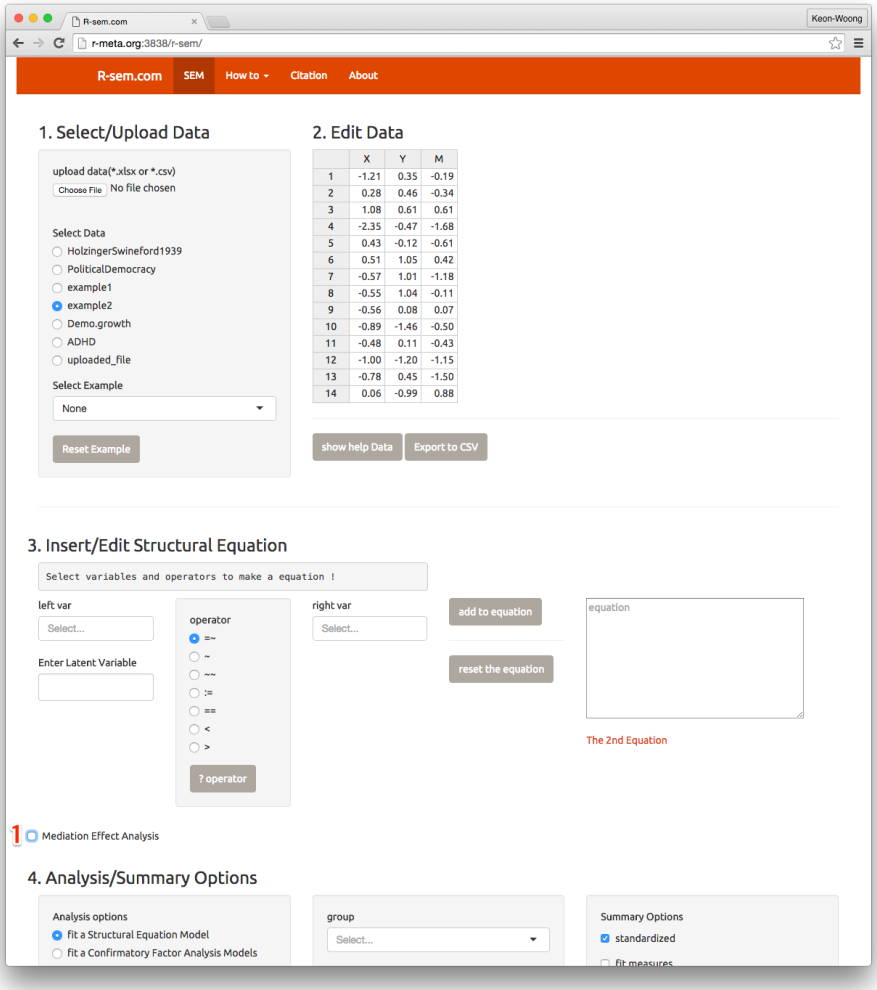


Figure 6.2: 20.png

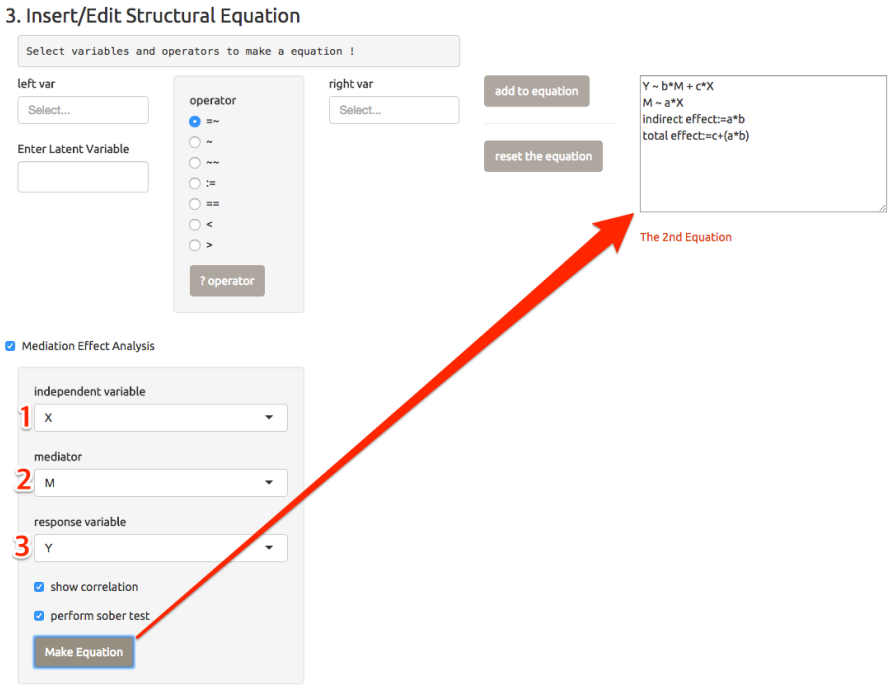


Figure 6.3: 21.png

equation(arrow).

Of course, you can type the equation directly in the `equation` textbox.

Do analysis

Press the `do Analysis` button and you can get the analysis result. You can can result of the total effect and indirect effect(1) as well as the result of so-called Sobel test for the mediation effect(2).

You can also get the plot for mediation effect.

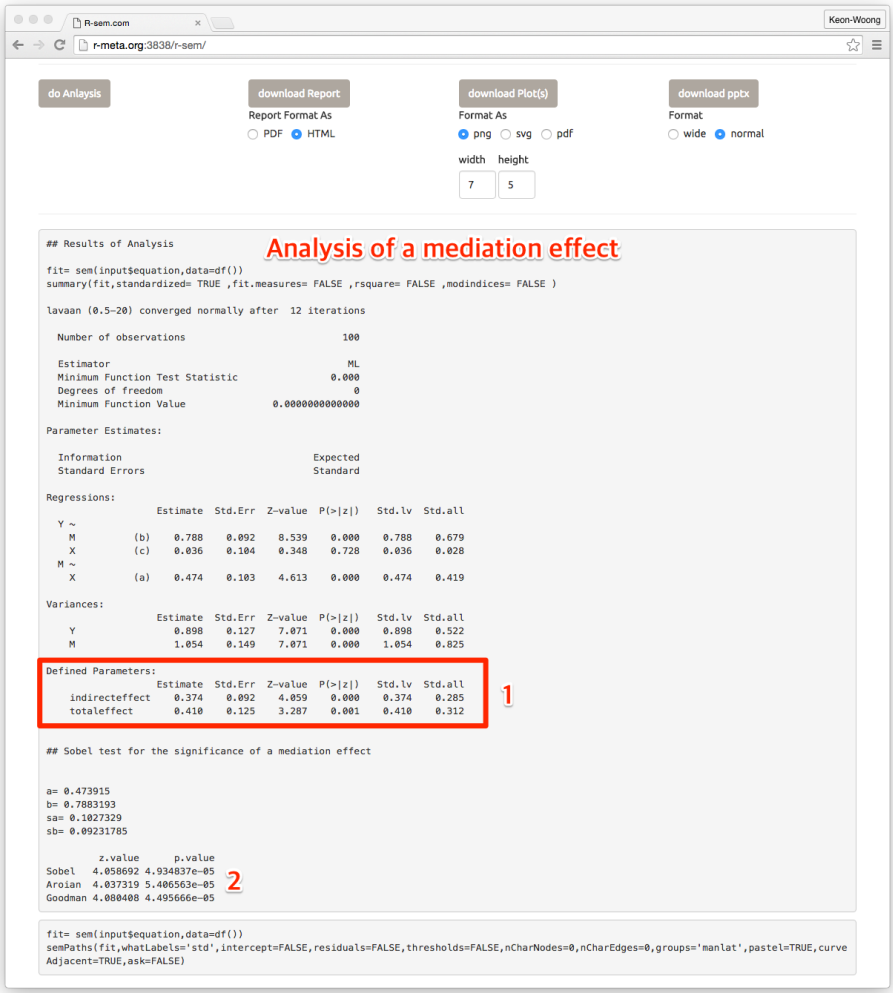


Figure 6.4: 22.png

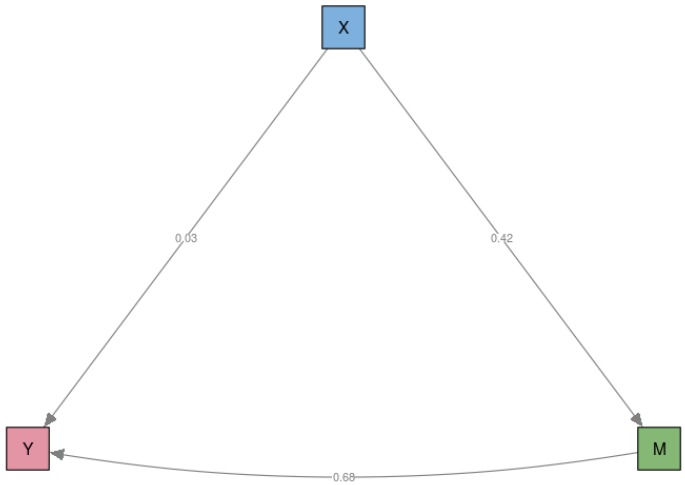


Figure 6.5: 23.png

Chapter 7

A complete example

In this chapter, I will show the complete example using the ADHD data. This data is a dataset contains measures about the 334 teacher's knowlege, empathy and intervention about attention-deficit hyperactivity disorder(ADHD).The figure below contains a graphical representation of the model that we want to fit.

Do it at once

You can finish the analysis using above model at once. Select `ADHA data` among `Select Example` select Input. By selecting the example, the data will be changed to `ADHD` and the equation will be made automatically(arrows).

Press the `do Analysis` button and you will be able to get the anlaysis results and plot.

Press the `reset example` button to reset the equation. I will show you how to make the structural equations in this study.

Step 1. Define latent variables

First of all, let's start from defining the latent variables.

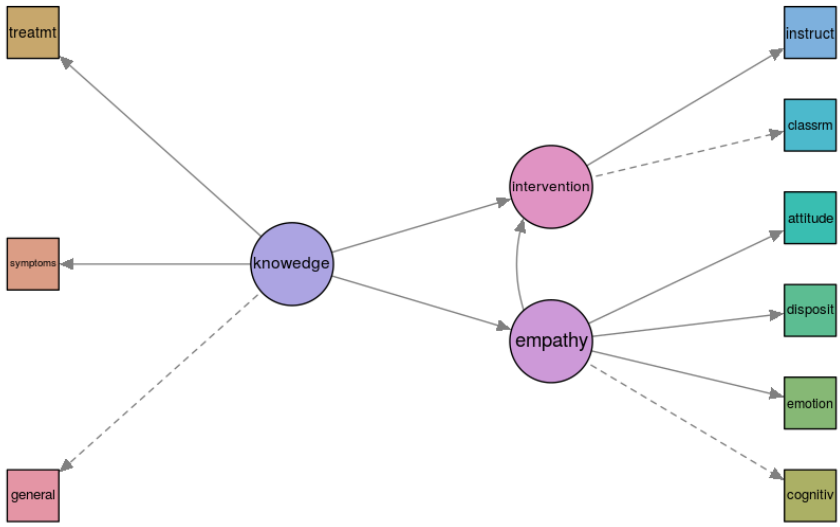


Figure 7.1: ADHD2.png

Define the latent variable `knowledge`

Please type the `knowledge` in the `Enter latent variable` textbox. The operator `=~` will be added to the left variable.

Select the `general`,`symptoms` and `treatmt` among the `rigth var` select input. The right var(s) you selected is added to the temporary equation. Press the `add to equation` button(arrow).

The temporary equation is added to equation.

Define latent variables - `empathy` and `intervention`

Please define the latent variable `empathy`. The `empathy` is measured by attitude, disposit, emotion and cognitiv. The `intervention` is measured by classrm and instruct.

```
empathy =~ cognitiv + emotion + disposit + attitude
intervention =~ classrm + instruct
```

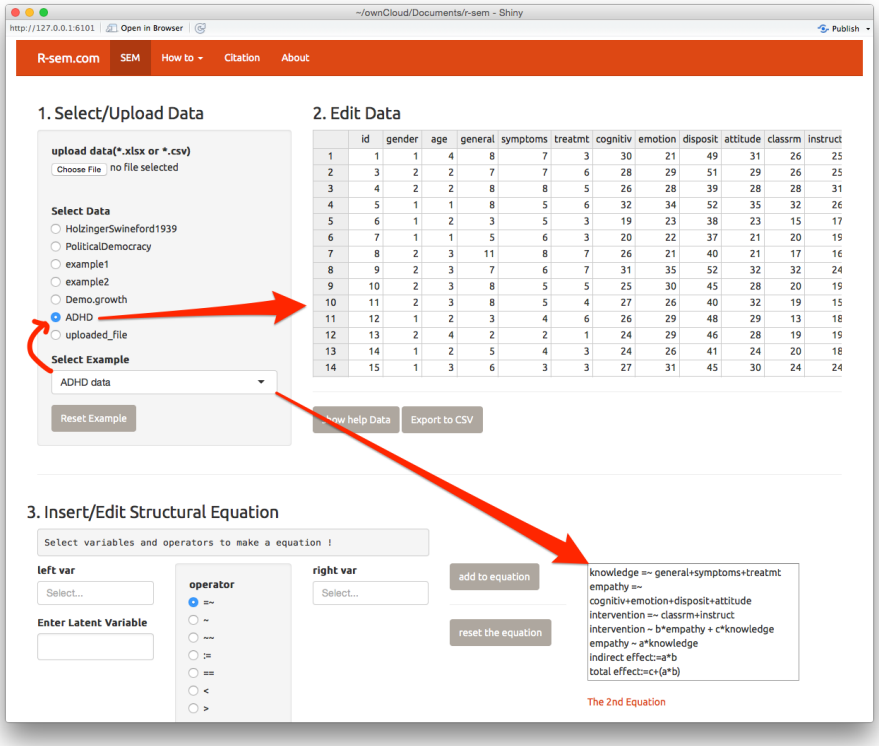


Figure 7.2: 24.png

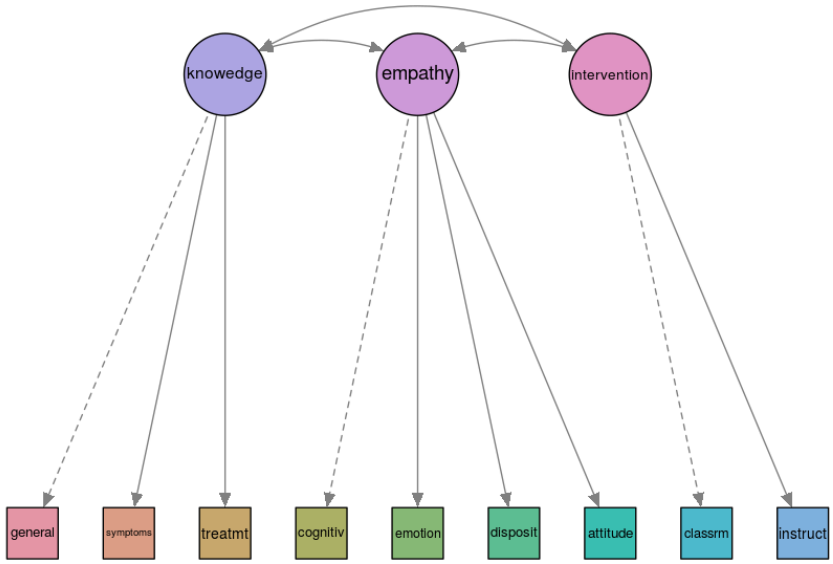


Figure 7.3: ADHD1.png

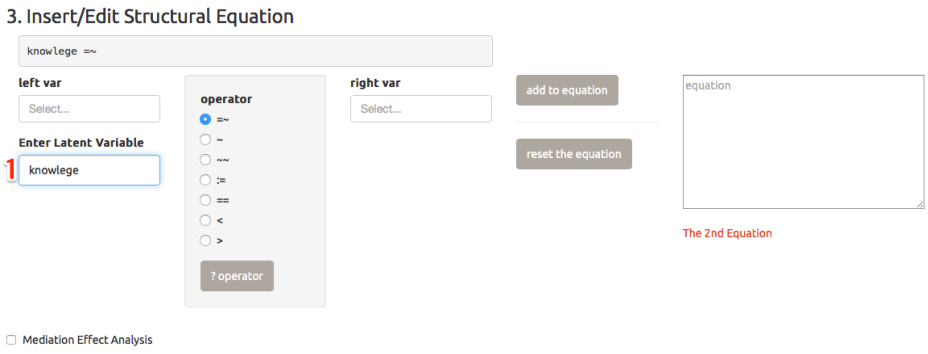


Figure 7.4: 25.png

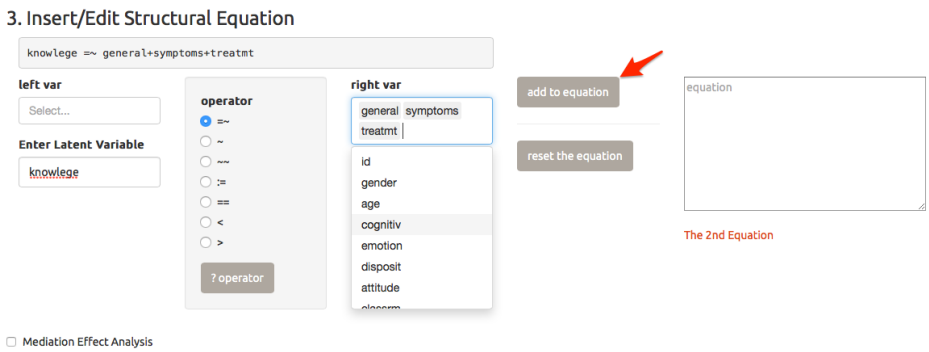


Figure 7.5: 26.png

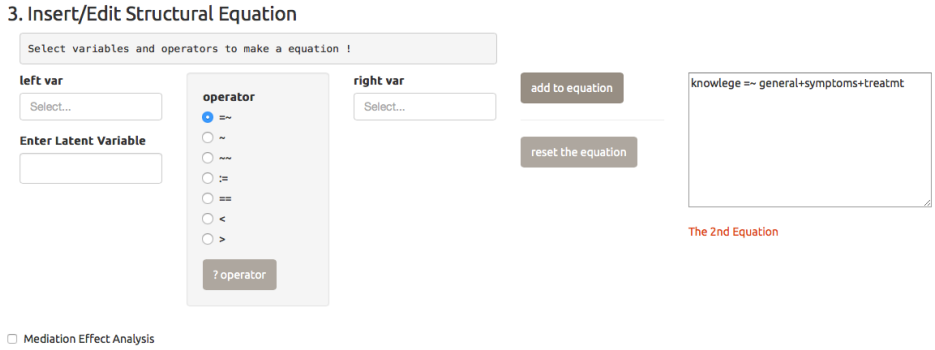


Figure 7.6: 27.png

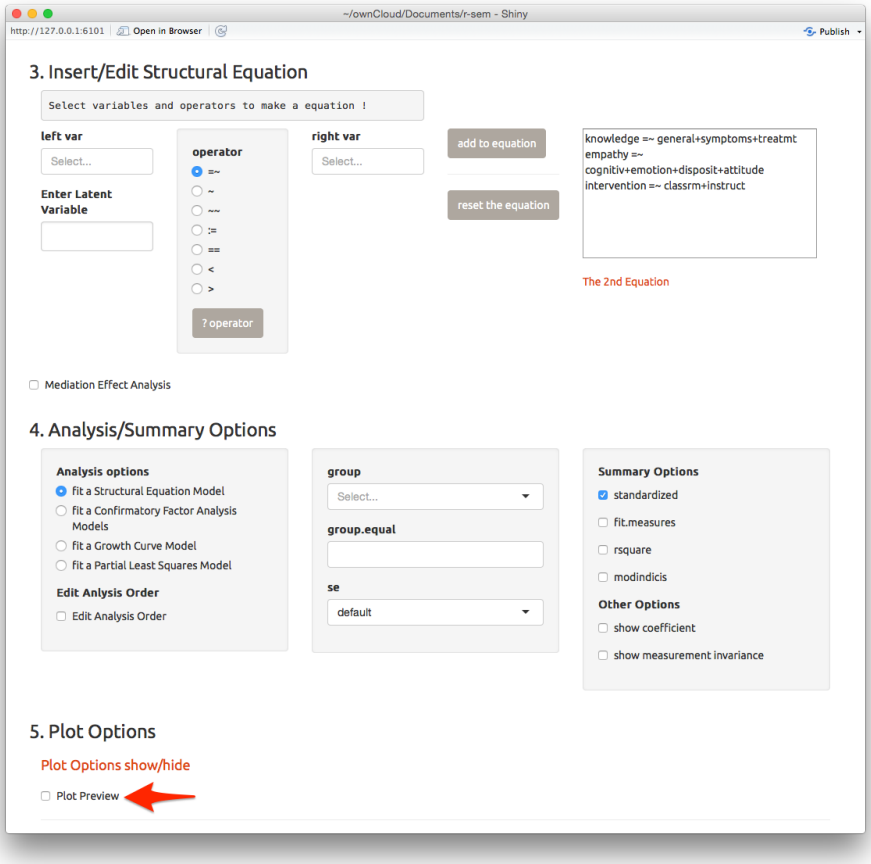


Figure 7.7: 28.png

After completion of defining the latent variables, the equation should be like as follows.

If you select the plot preview checkbox(arrow), you will be able to get the following plot.

Step 2. Define the mediation effect

Please select the `Mediation Effect Analysis` checkbox(1). Select `knowledge` as the independent variable(2), select `empathy` as mediator(3) and select `intervention` as the response variable(4). Adn press the `Make Equation` button.

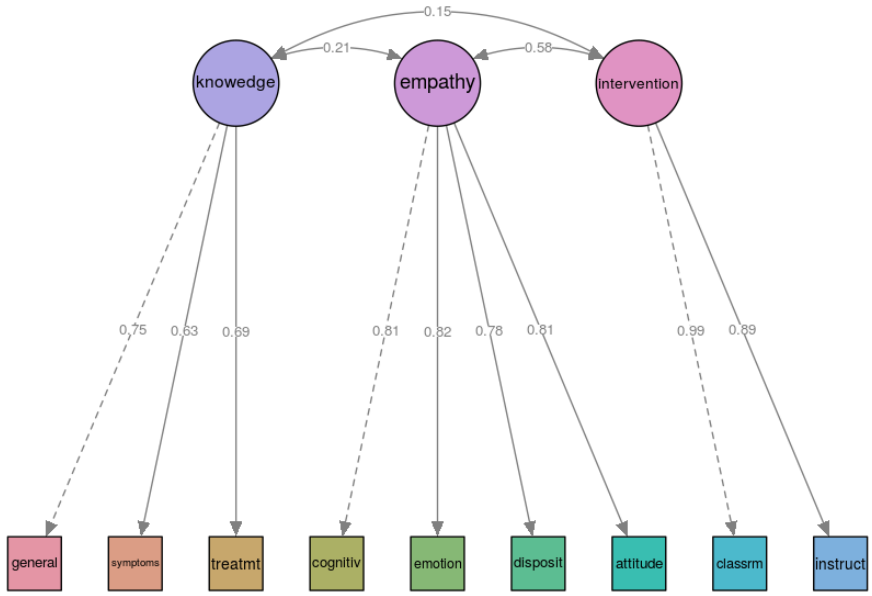


Figure 7.8: 29.png

The mediation effect equation will be aded to the equation. The final equation will be as follows.

```
knowledge =~ general+symptoms+treatmt
empathy =~ cognitiv+emotion+disposit+attitude
intervention =~ classrm+instruct

intervention ~ b*empathy + c*knowledge
empathy ~ a*knowledge
indirect effect:=a*b
total effect:=c+(a*b)
```

By press the `do Analysis` button, you will get the results of analysis as well as the following plot.

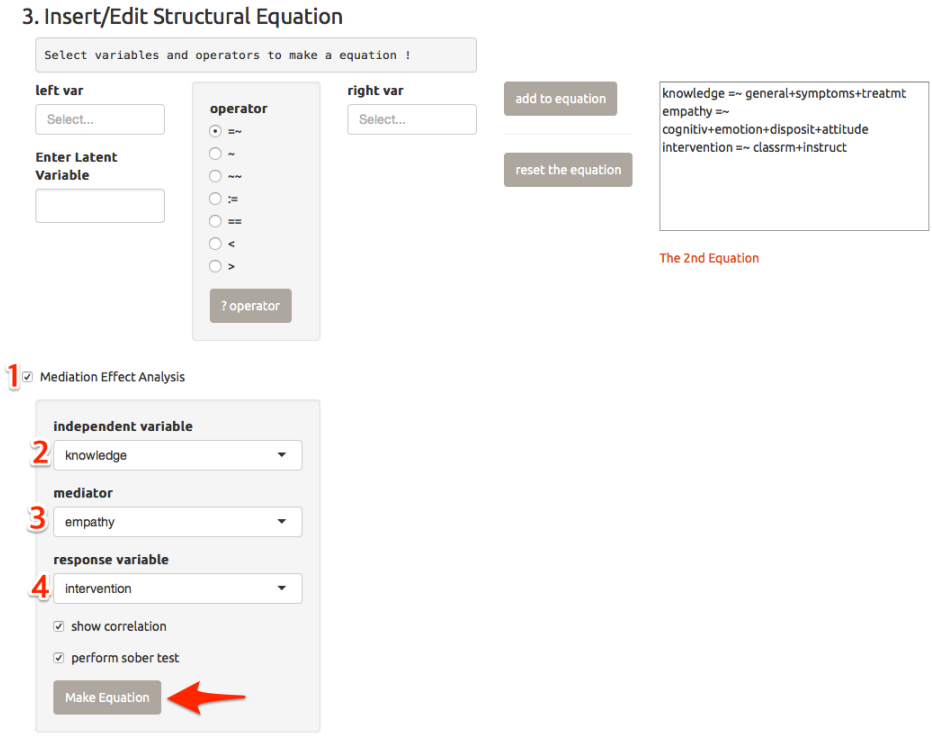
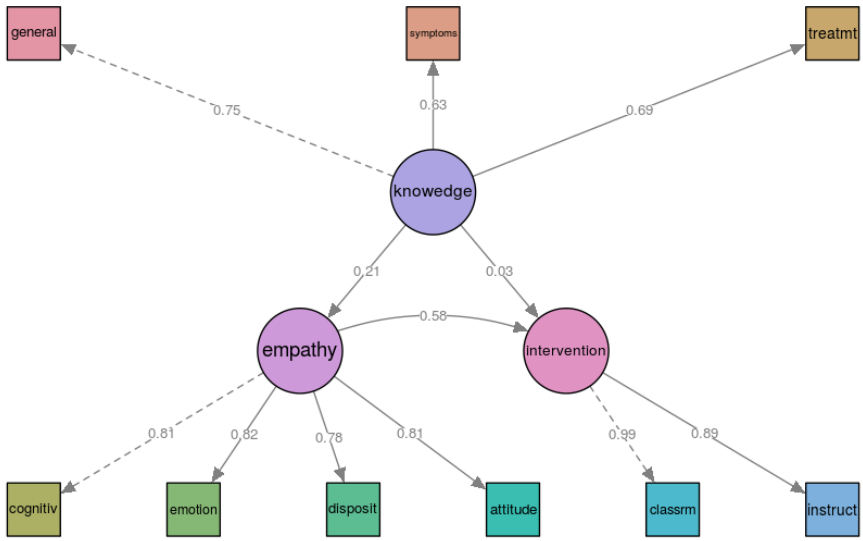


Figure 7.9: 30.png

```
summary(fit,standardized= TRUE ,fit.measures= FALSE ,rsquare= FALSE ,modindices= FALSE )

lavaan (0.5-20) converged normally after  68 iterations

  Number of observations                           334

  Estimator                                         ML
  Minimum Function Test Statistic               31.185
  Degrees of freedom                                24
  P-value (Chi-square)                           0.149

Parameter Estimates:

  Information                                 Expected
  Standard Errors                             Standard

Latent Variables:
                   Estimate  Std.Err  Z-value  P(>|z|)   Std.lv  Std.all
  knowledge =~
    general           1.000                               1.850    0.748
    symptoms          0.582    0.068    8.508    0.000    1.077    0.635
    treatmt           0.746    0.086    8.631    0.000    1.380    0.692
  empathy =~
    cognitiv          1.000                               2.693    0.812
    emotion           0.950    0.058   16.371    0.000    2.558    0.821
    disposit          1.401    0.091   15.396    0.000    3.772    0.781
    attitude          0.964    0.060   16.155    0.000    2.595    0.812
  intervention =~
    classrm           1.000                               5.782    0.990
    instruct          0.853    0.046   18.628    0.000    4.934    0.886

Regressions:
                   Estimate  Std.Err  Z-value  P(>|z|)   Std.lv  Std.all
  intervention ~
    empathy    (b)    1.241    0.120   10.356    0.000    0.578    0.578
    knowledge  (c)    0.106    0.174    0.608    0.543    0.034    0.034
  empathy ~
    knowledge  (a)    0.304    0.100    3.033    0.002    0.209    0.209

Variances:
                   Estimate  Std.Err  Z-value  P(>|z|)   Std.lv  Std.all
    general           2.691    0.405    6.649    0.000    2.691    0.440
    symptoms          1.718    0.179    9.626    0.000    1.718    0.597
    treatmt           2.076    0.252    8.244    0.000    2.076    0.522
    cognitiv          3.735    0.386    9.683    0.000    3.735    0.340
    emotion           3.162    0.334    9.466    0.000    3.162    0.326
    disposit          9.110    0.882   10.330    0.000    9.110    0.390
    attitude          3.480    0.359    9.692    0.000    3.480    0.341
    classrm           0.652    1.504    0.433    0.665    0.652    0.019
    instruct          6.638    1.209    5.488    0.000    6.638    0.214
    knowledge         3.423    0.549    6.240    0.000    1.000    1.000
    empathy           6.934    0.812    8.542    0.000    0.956    0.956
    intervention     21.955    2.353    9.331    0.000    0.657    0.657

Defined Parameters:
                   Estimate  Std.Err  Z-value  P(>|z|)   Std.lv  Std.all
    indirecteffect    0.377    0.128    2.952    0.003    0.121    0.121
    totaleffect       0.483    0.202    2.393    0.017    0.154    0.154


## Sobel test for the significance of a mediation effect


a= 0.7458043
b= 1
sa= 0.0864117
sb= 0

         z.value      p.value
Sobel   8.630826 6.091075e-18
Aroian  8.630826 6.091075e-18
Goodman 8.630826 6.091075e-18
```



To customize your plot, please read the `customize you plot` chapter.

In this chapter, I will show you how to customize your plot. Please select the `Structural Equation Model` among the `Select Example` selectInput. This selection will set the data to `Political Democracy`(arrow) and make the structural equation as follows(arrow).

```
# measurement model
ind60 =~ x1 + x2 + x3
dem60 =~ y1 + y2 + y3 + y4
dem65 =~ y5 + y6 + y7 + y8
# regressions
dem60 ~ ind60
dem65 ~ ind60 + dem60
# residual correlations
y1 ~~ y5
y2 ~~ y4 + y6
y3 ~~ y7
y4 ~~ y8
y6 ~~ y8
```

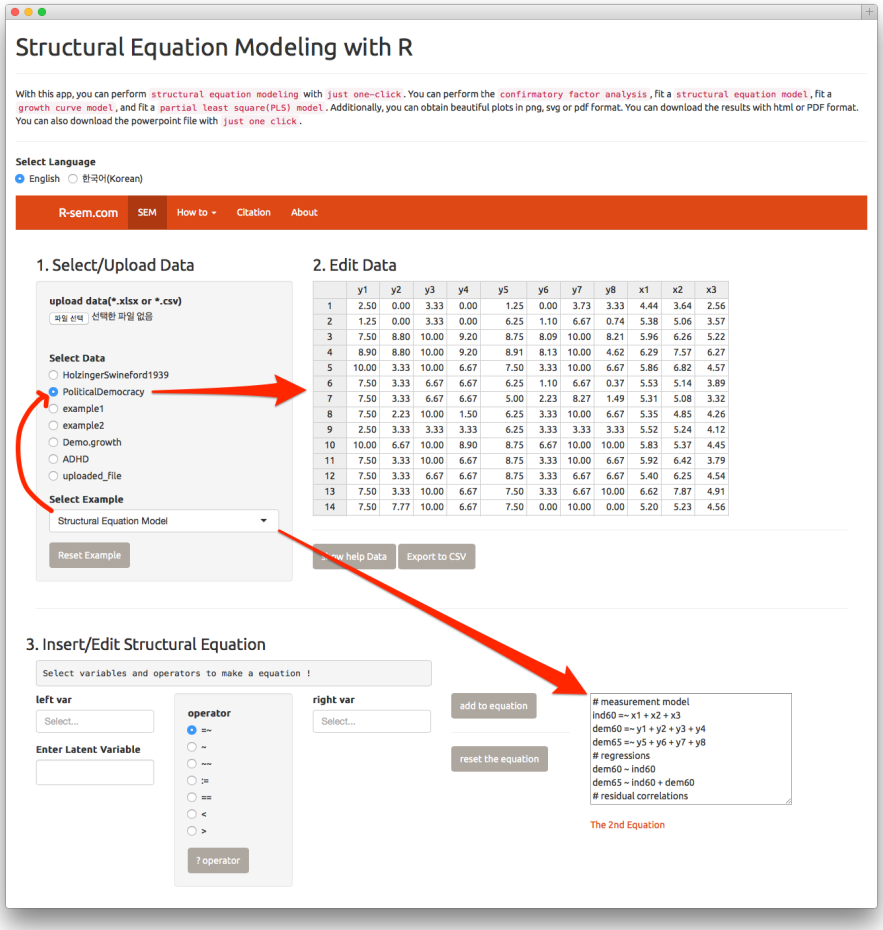


Figure 7.10: 33.png

Chapter 8

Select Plot Preview

Please Select the `Plot Preview` checkbox. You can see the Plot. To customize your plot, Press the `Plot Options show/hide`(arrow).

In the `Plot Options` window, you can adjust all about the plots.

If you wanted your plot in black and white, just delete the groups(7) selectInput. To rotate your plot, please select the rotation(6) from 1 to 2. Ratation is an integer indicating the rotation of the layout when "tree" or "tree2" layout is used. 1, 2, 3 and 4 indicate that exogenous variables are placed at the top, left side, bottom and right side respectively.

Again, select the `manlat` among groups selectInput(1). You can hide your label by select `hide` among wahtLabels selectInput(2).

You can select `col` among what selectInput and `est` among whatLabels selectInput to label unstandardized estimates.

You can select `std` and `col` among what selectInput(1) and select `std` among whatLabel selectInput(2) to label standardized estimate. In this example, the `tree2` layout was selected(3).

Other possible layouts are circle, spring and circle2. In this example, `circle` layout was selected(1) and `residual` checkbox was selected(3).

In this chapter, I will show you how to perform multiple group analysis.

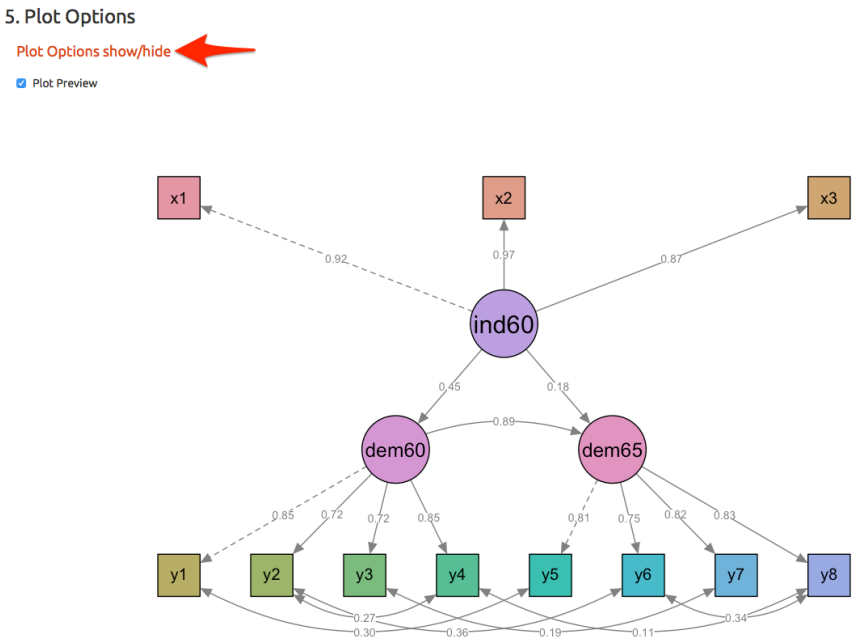


Figure 8.1: 34.png

Select Data and Edit Structural Equation

Please select the `Confirmatory Factor Analysis` among the `Select Example` selectInput. This selection will set the data to `HolzingerSwineford1939`(arrow) and make the structural equation as follows(arrow).

```
visual  =~ x1 + x2 + x3
textual =~ x4 + x5 + x6
speed   =~ x7 + x8 + x9
```

Select `group` option

Among the Analysis/Summary Options, please select `school` as a group variable(1). Press `do Analysis` button(arrow).

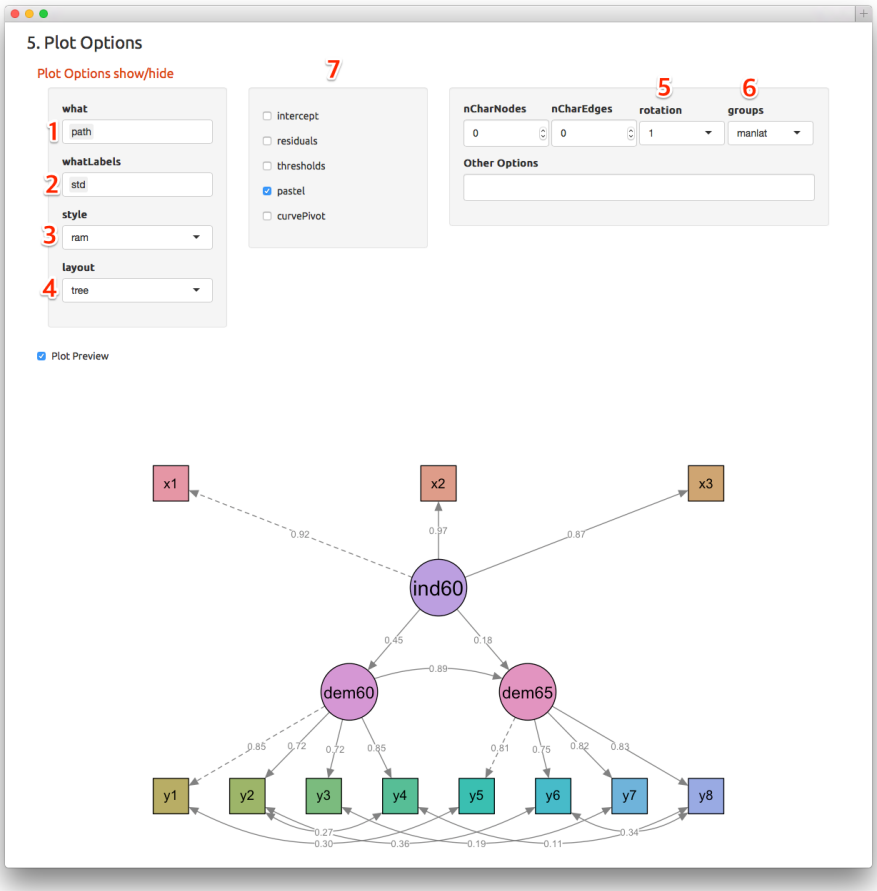


Figure 8.2: 35.png

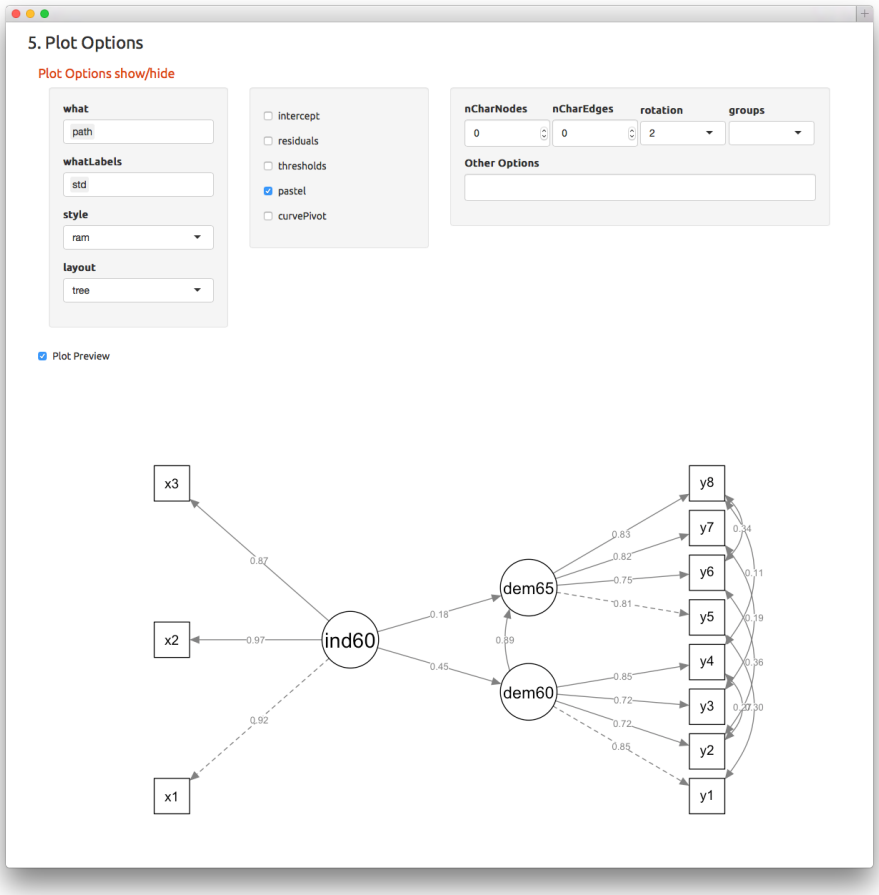


Figure 8.3: 36.png

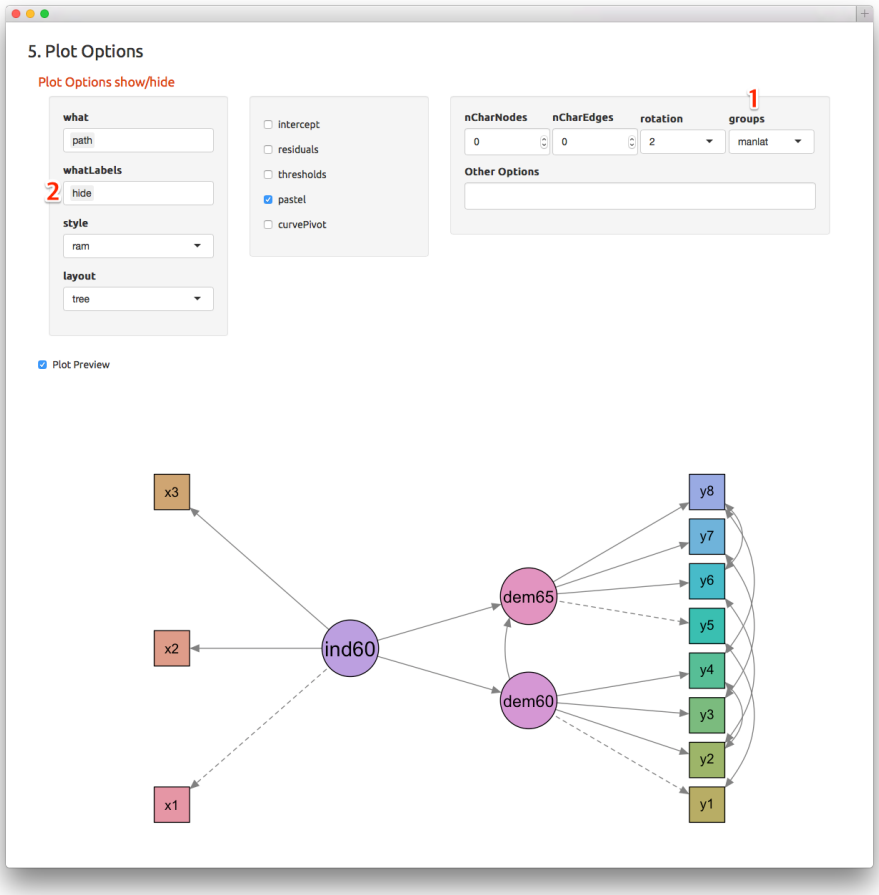


Figure 8.4: 37.png

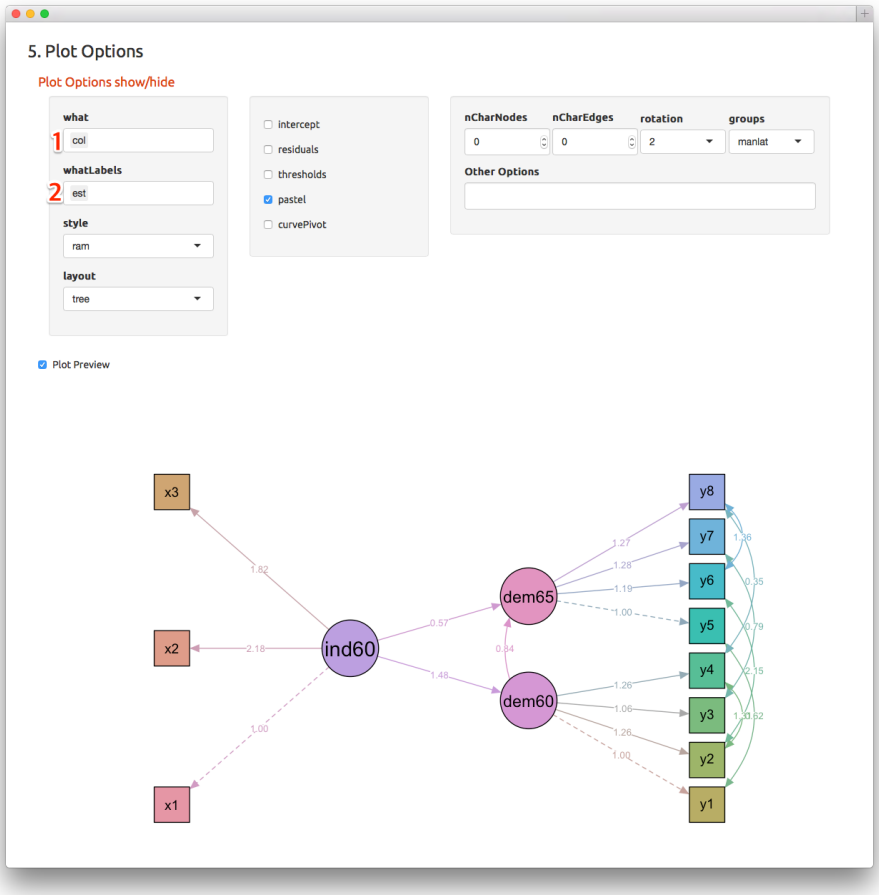


Figure 8.5: 38.png

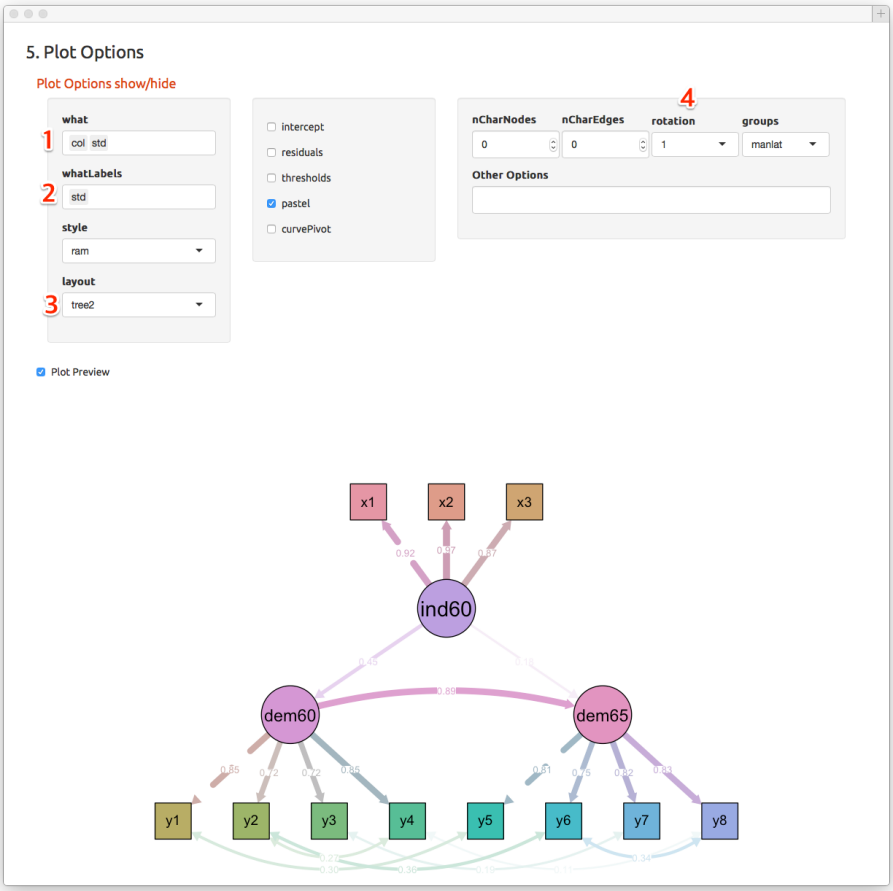


Figure 8.6: 39.png

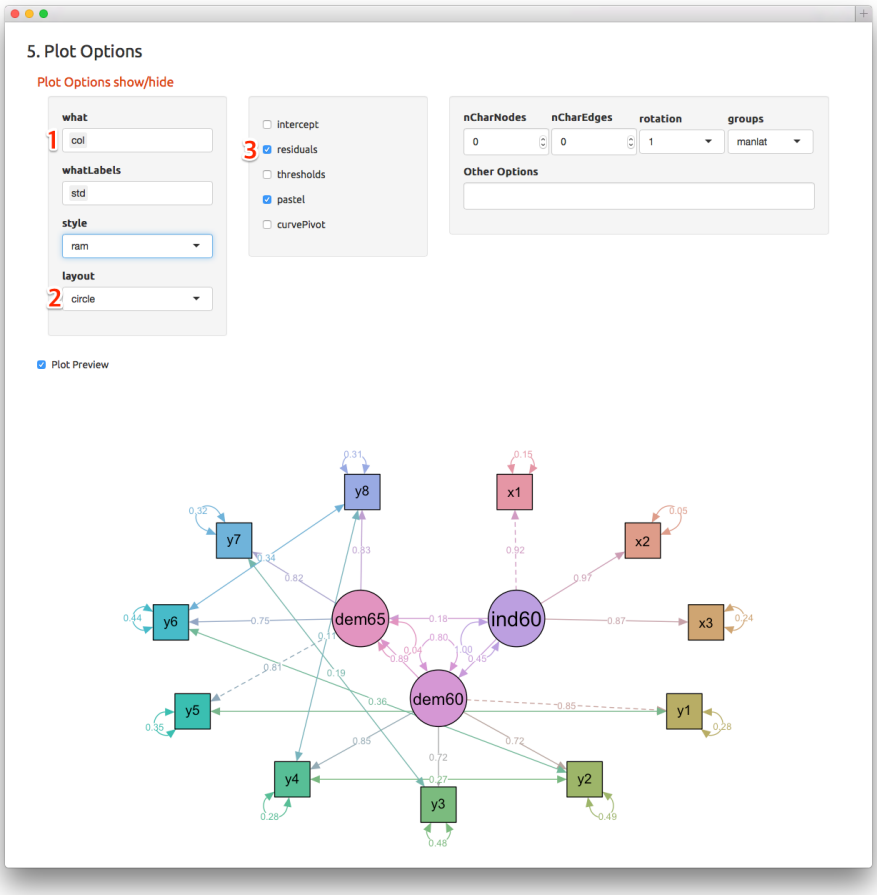


Figure 8.7: 40.png

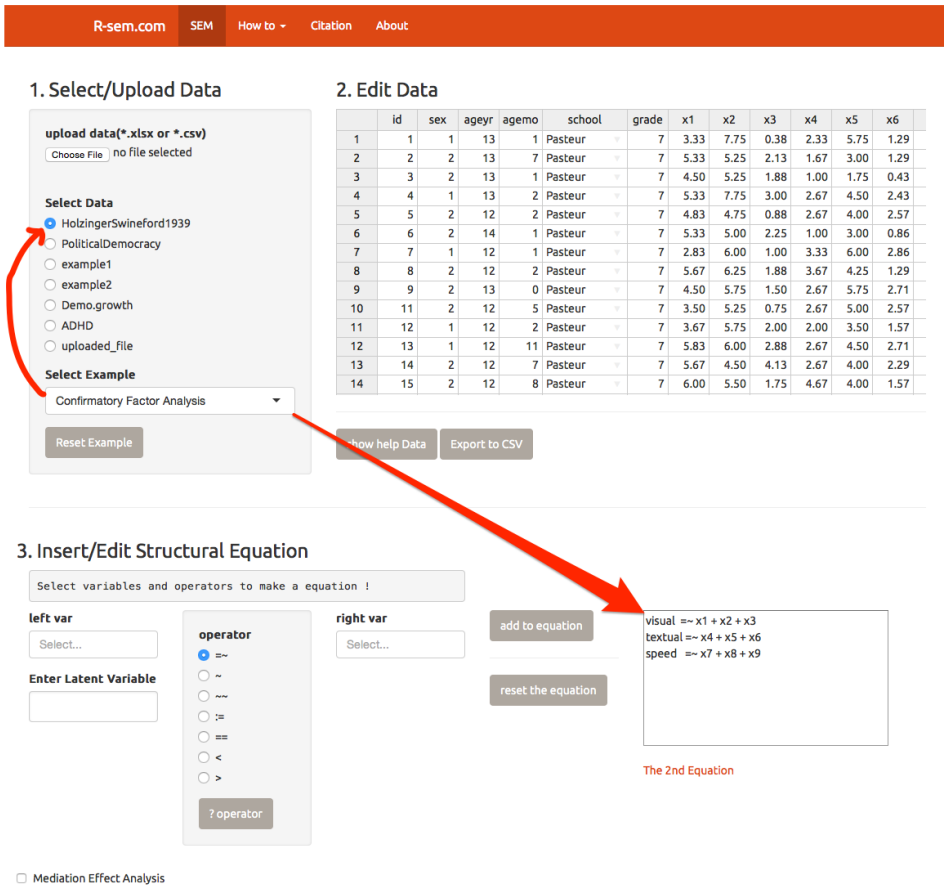


Figure 8.8: 41.png

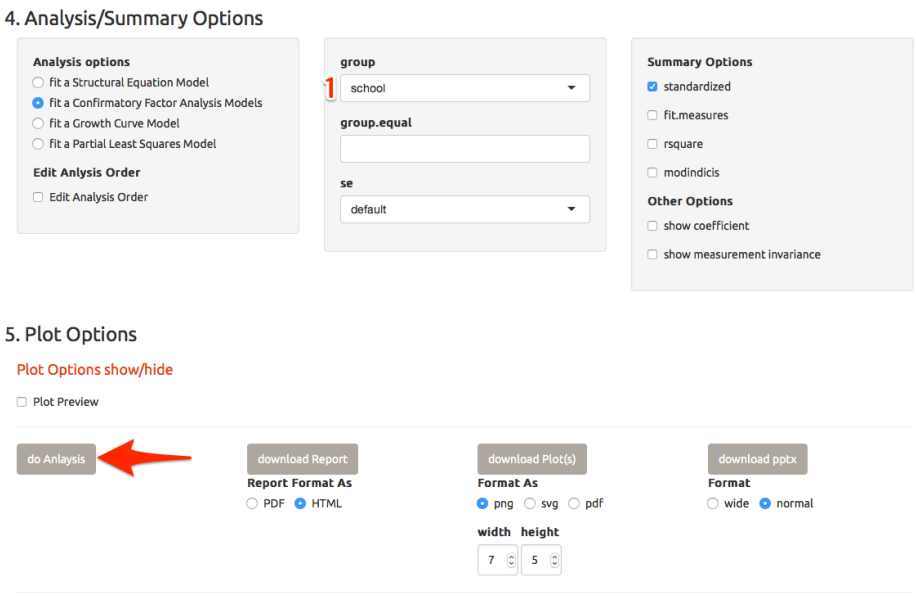


Figure 8.9: 42.png

Results of Analysis(1)

You can get the results of analysis followed by results for group 1 and group 2 seperately.

Results of Analysis(2)

Results of Analysis(3)

Plots for Multiple Groups

You can also get the resultant plots separately(In this example, you will be able to get 2 plots).

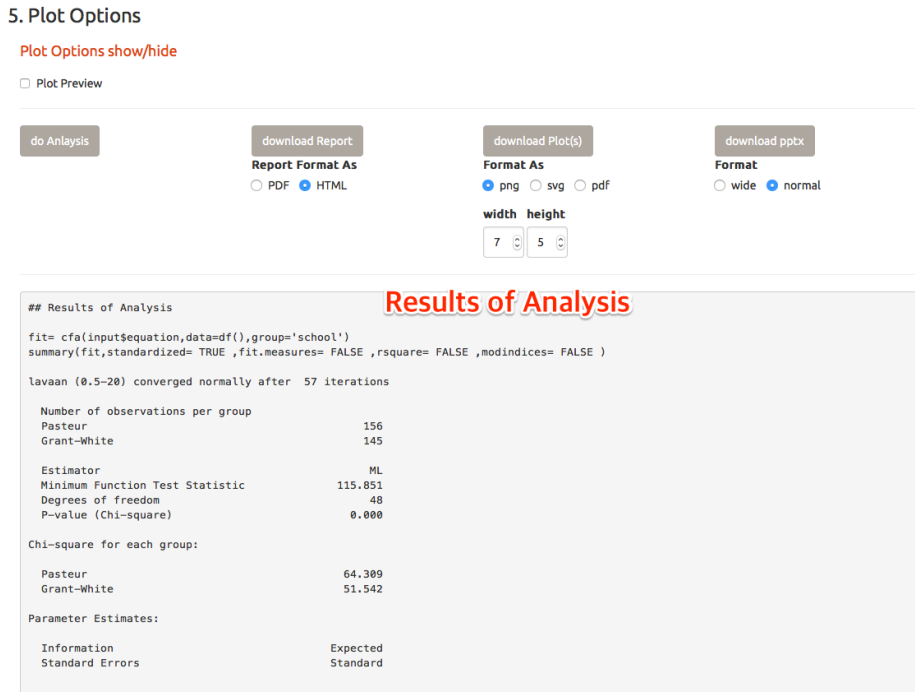
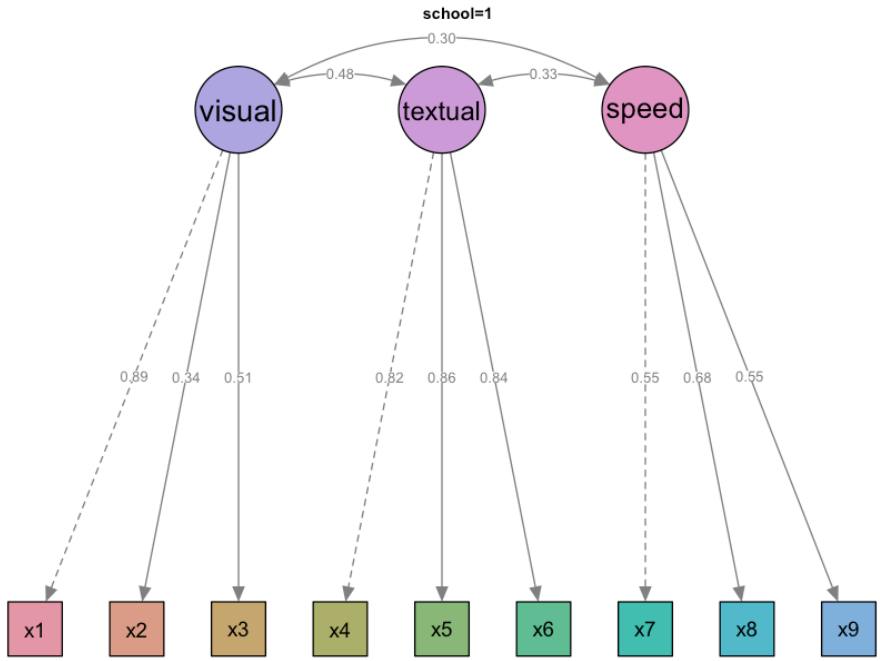
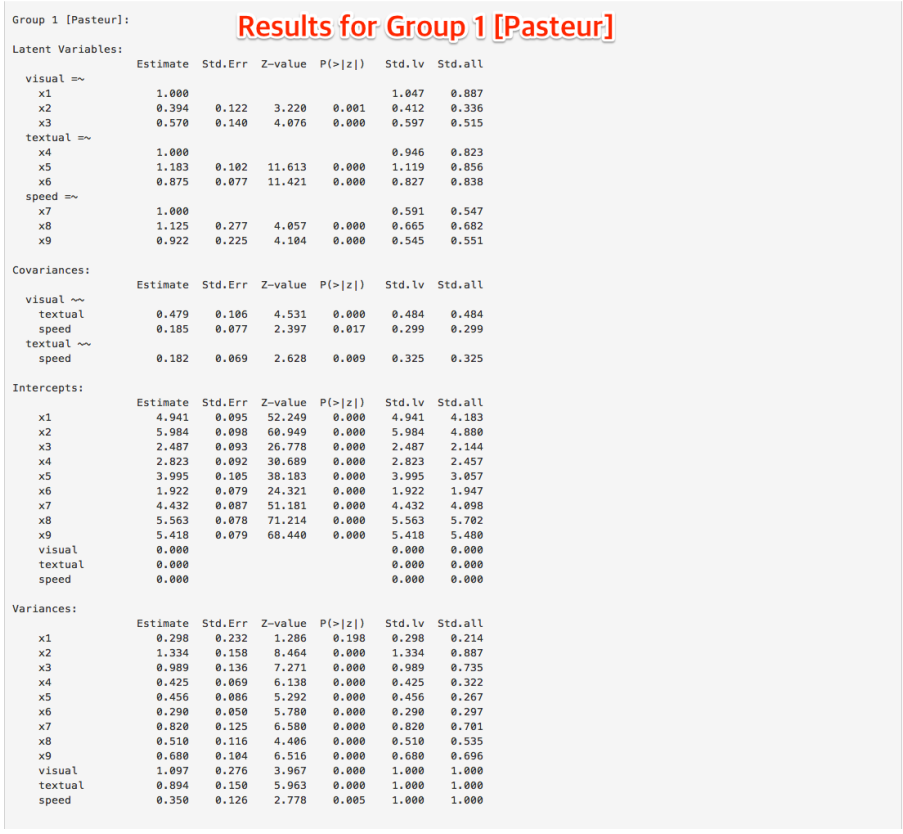


Figure 8.10: 43.png






```
Group 1 [Pasteur]:

Latent Variables:
                   Estimate  Std.Err  Z-value  P(>|z|)   Std.lv  Std.all
  visual =~
    x1                1.000                               1.047    0.887
    x2                0.394    0.122    3.220    0.001    0.412    0.336
    x3                0.570    0.140    4.076    0.000    0.597    0.515
  textual =~
    x4                1.000                               0.946    0.823
    x5                1.183    0.102   11.613    0.000    1.119    0.856
    x6                0.875    0.077   11.421    0.000    0.827    0.838
  speed =~
    x7                1.000                               0.591    0.547
    x8                1.125    0.277    4.057    0.000    0.665    0.682
    x9                0.922    0.225    4.104    0.000    0.545    0.551

Covariances:
                   Estimate  Std.Err  Z-value  P(>|z|)   Std.lv  Std.all
  visual ~~
    textual           0.479    0.106    4.531    0.000    0.484    0.484
    speed             0.185    0.077    2.397    0.017    0.299    0.299
  textual ~~
    speed             0.182    0.069    2.628    0.009    0.325    0.325

Intercepts:
                   Estimate  Std.Err  Z-value  P(>|z|)   Std.lv  Std.all
    x1                4.941    0.095   52.249    0.000    4.941    4.183
    x2                5.984    0.098   60.949    0.000    5.984    4.880
    x3                2.487    0.093   26.778    0.000    2.487    2.144
    x4                2.823    0.092   30.689    0.000    2.823    2.457
    x5                3.995    0.105   38.183    0.000    3.995    3.057
    x6                1.922    0.079   24.321    0.000    1.922    1.947
    x7                4.432    0.087   51.181    0.000    4.432    4.098
    x8                5.563    0.078   71.214    0.000    5.563    5.702
    x9                5.418    0.079   68.440    0.000    5.418    5.480
    visual            0.000                               0.000    0.000
    textual           0.000                               0.000    0.000
    speed             0.000                               0.000    0.000

Variances:
                   Estimate  Std.Err  Z-value  P(>|z|)   Std.lv  Std.all
    x1                0.298    0.232    1.286    0.198    0.298    0.214
    x2                1.334    0.158    8.464    0.000    1.334    0.887
    x3                0.989    0.136    7.271    0.000    0.989    0.735
    x4                0.425    0.069    6.138    0.000    0.425    0.322
    x5                0.456    0.086    5.292    0.000    0.456    0.267
    x6                0.290    0.050    5.780    0.000    0.290    0.297
    x7                0.820    0.125    6.580    0.000    0.820    0.701
    x8                0.510    0.116    4.406    0.000    0.510    0.535
    x9                0.680    0.104    6.516    0.000    0.680    0.696
    visual            1.097    0.276    3.967    0.000    1.000    1.000
    textual           0.894    0.150    5.963    0.000    1.000    1.000
    speed             0.350    0.126    2.778    0.005    1.000    1.000
```

Figure 8.11: 44.png

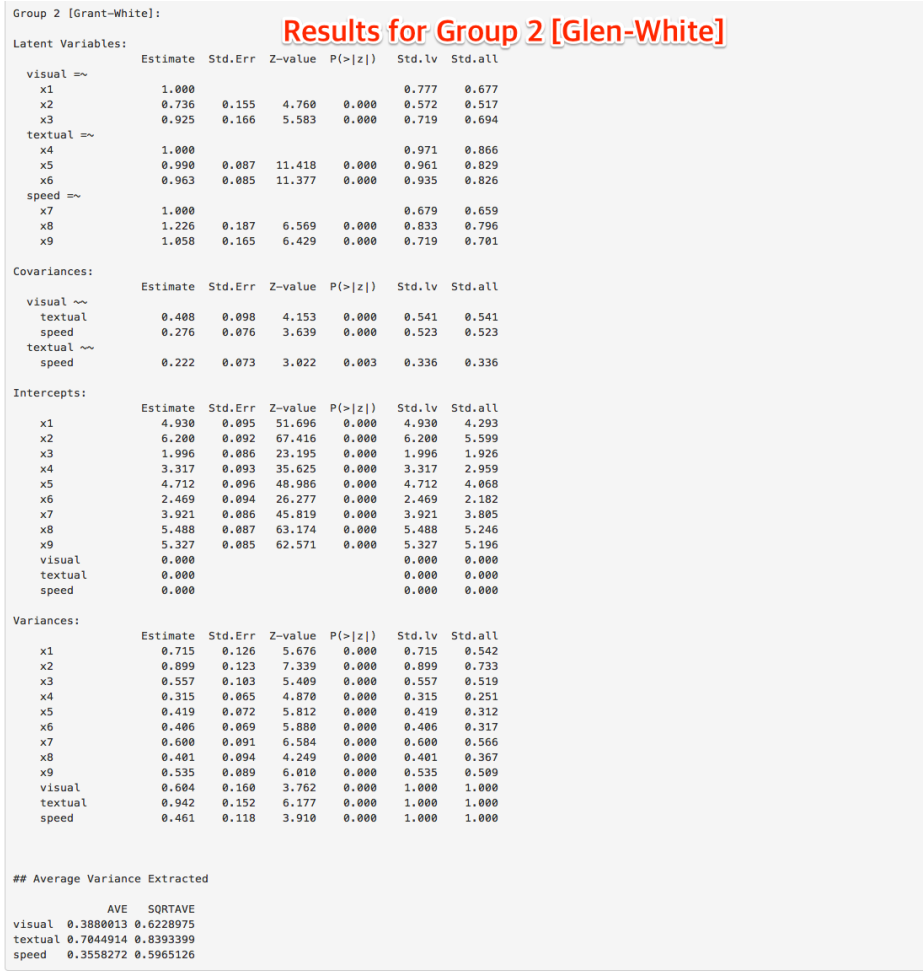
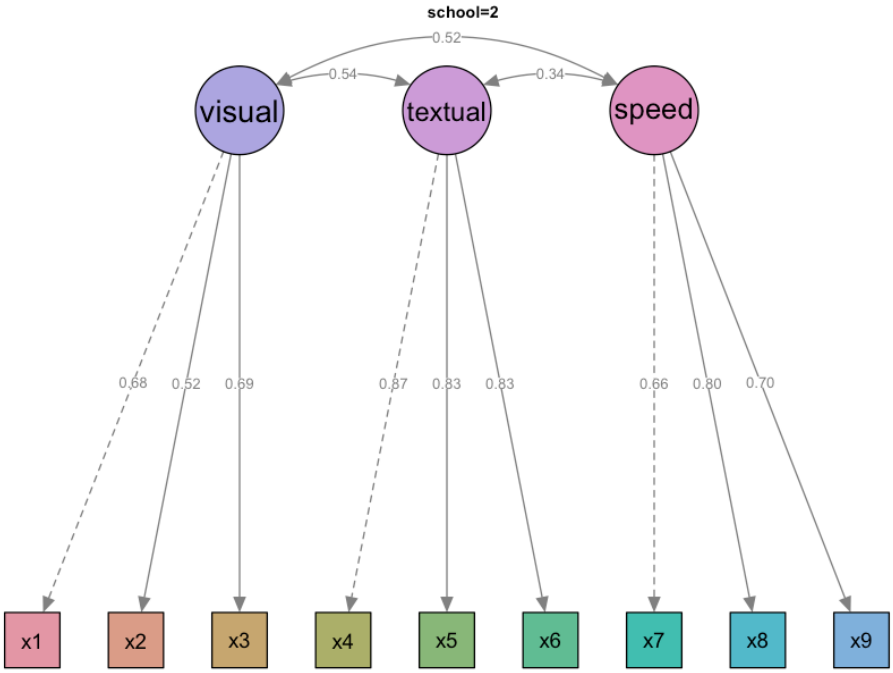


Figure 8.12: 45.png



Measurement Invariance

If you are interested in testing the measurement invariance of a CFA model across several groups, select the measurementInvariance checkbox and press the `do Analysis` button.

You can get the results of measurementInvariance function of semTools package.

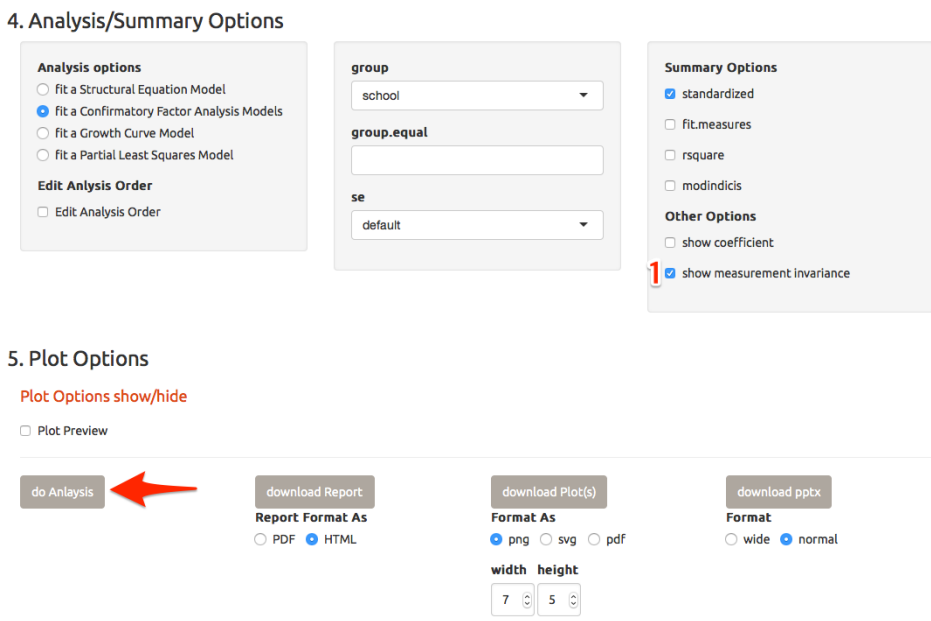
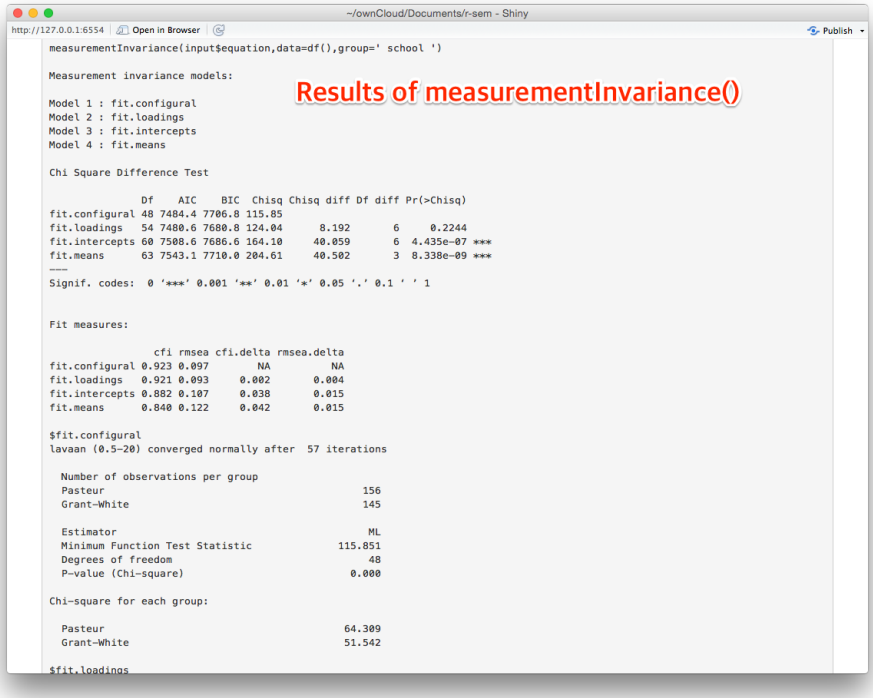
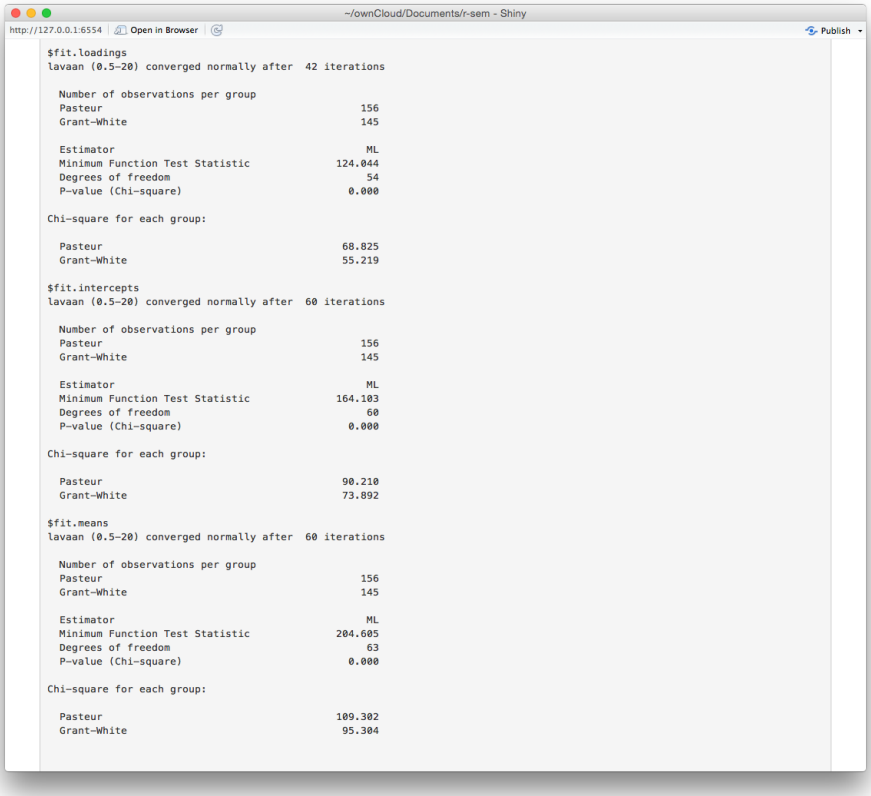


Figure 8.13: 48.png



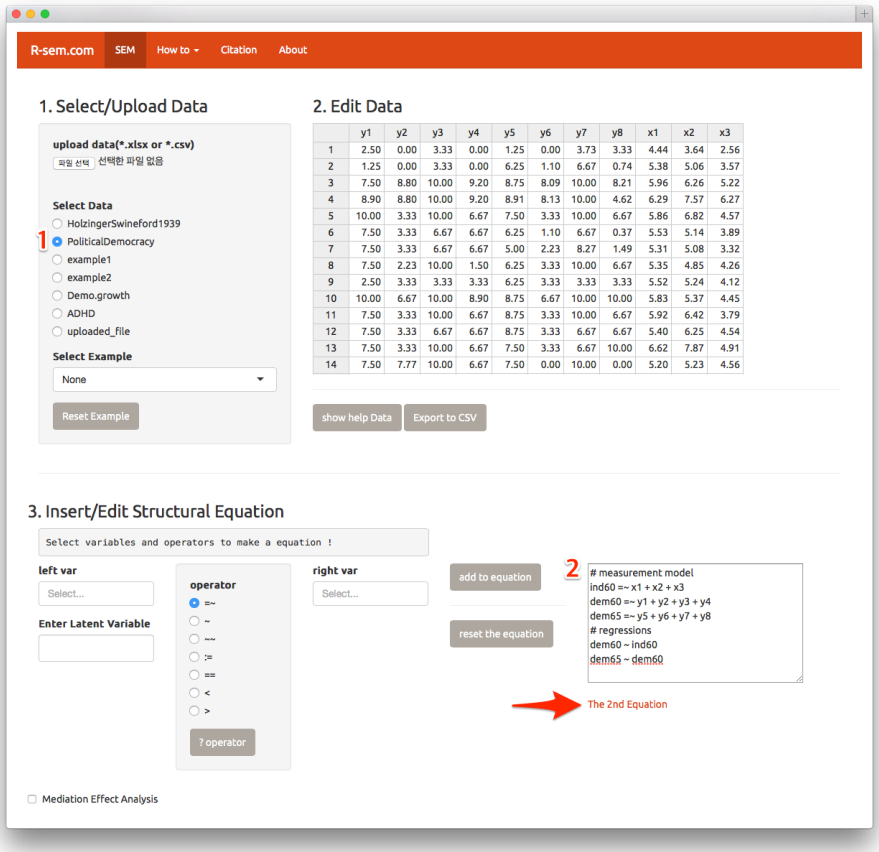


In this chapter, I will show you how to compare two models using different structural equation.

Select Data and Edit Structural Equation

Please select the `PoliticalDemocracy` among the `Select Data` radio buttons(1). Make the structural equation as follows(2).

```
# measurement model
ind60 =~ x1 + x2 + x3
dem60 =~ y1 + y2 + y3 + y4
dem65 =~ y5 + y6 + y7 + y8
# regressions
dem60 ~ ind60
dem65 ~dem60
```



	y1	y2	y3	y4	y5	y6	y7	y8	x1	x2	x3
1	2.50	0.00	3.33	0.00	1.25	0.00	3.73	3.33	4.44	3.64	2.56
2	1.25	0.00	3.33	0.00	6.25	1.10	6.67	0.74	5.38	5.06	3.57
3	7.50	8.80	10.00	9.20	8.75	8.09	10.00	8.21	5.96	6.26	5.22
4	8.90	8.80	10.00	9.20	8.91	8.13	10.00	4.62	6.29	7.57	6.27
5	10.00	3.33	10.00	6.67	7.50	3.33	10.00	6.67	5.86	6.82	4.57
6	7.50	3.33	6.67	6.67	6.25	1.10	6.67	0.37	5.53	5.14	3.89
7	7.50	3.33	6.67	6.67	5.00	2.23	8.27	1.49	5.31	5.08	3.32
8	7.50	2.23	10.00	1.50	6.25	3.33	10.00	6.67	5.35	4.85	4.26
9	2.50	3.33	3.33	3.33	6.25	3.33	3.33	3.33	5.52	5.24	4.12
10	10.00	6.67	10.00	8.90	8.75	6.67	10.00	10.00	5.83	5.37	4.45
11	7.50	3.33	10.00	6.67	8.75	3.33	10.00	6.67	5.92	6.42	3.79
12	7.50	3.33	6.67	6.67	8.75	3.33	6.67	6.67	5.40	6.25	4.54
13	7.50	3.33	10.00	6.67	7.50	3.33	6.67	10.00	6.62	7.87	4.91
14	7.50	7.77	10.00	6.67	7.50	0.00	10.00	0.00	5.20	5.23	4.56

Figure 8.14: 51.png

Click `The 2nd Equation` text(arrow).

Enter the 2nd Equation

Insert the 2nd equation as follows. You can copy the 1st equation(1) and paste it to the 2nd equation(2) and insert `ind60 +` into the last line(box).

```
# measurement model
ind60 =~ x1 + x2 + x3
dem60 =~ y1 + y2 + y3 + y4
dem65 =~ y5 + y6 + y7 + y8
# regressions
dem60 ~ ind60
dem65 ~ ind60 + dem60
```

Please make sure that the `Compare Models` checkbox in selected(arrow). Press `Do Analysis` button.

Results of Analysis(1)

You can get the results of analysis using the 1st equation followed by that using the 2nd equation and result of comparing two models.

Results of Analysis(2)

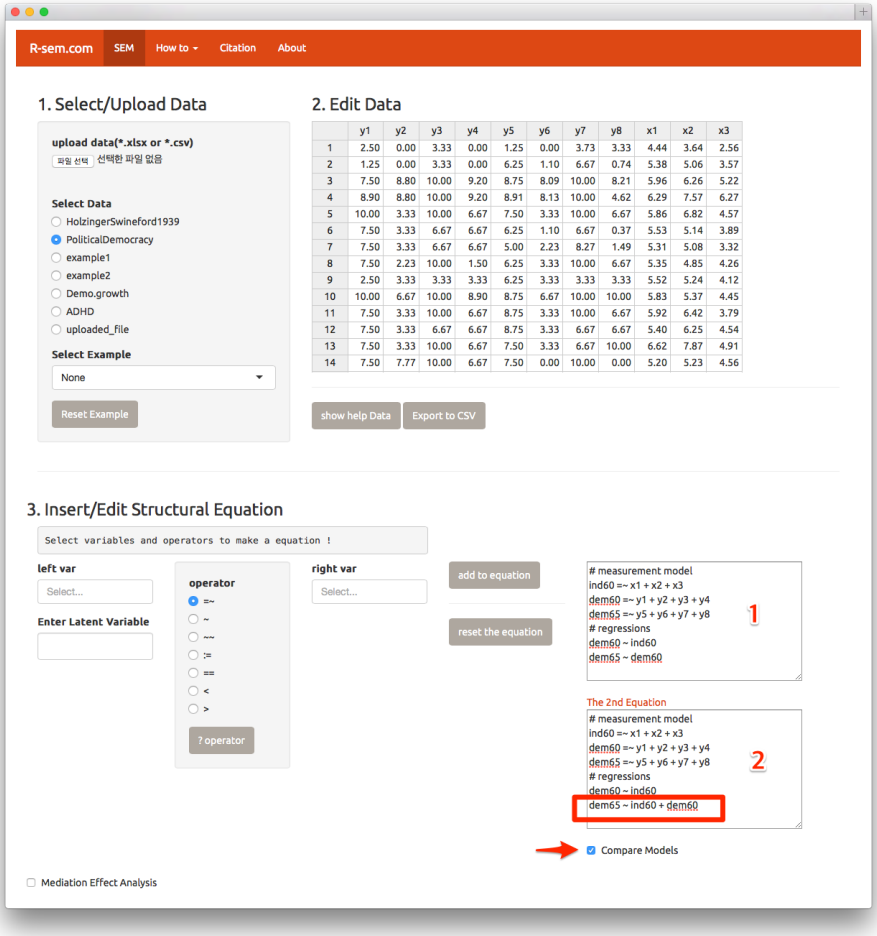


Figure 8.15: 52.png

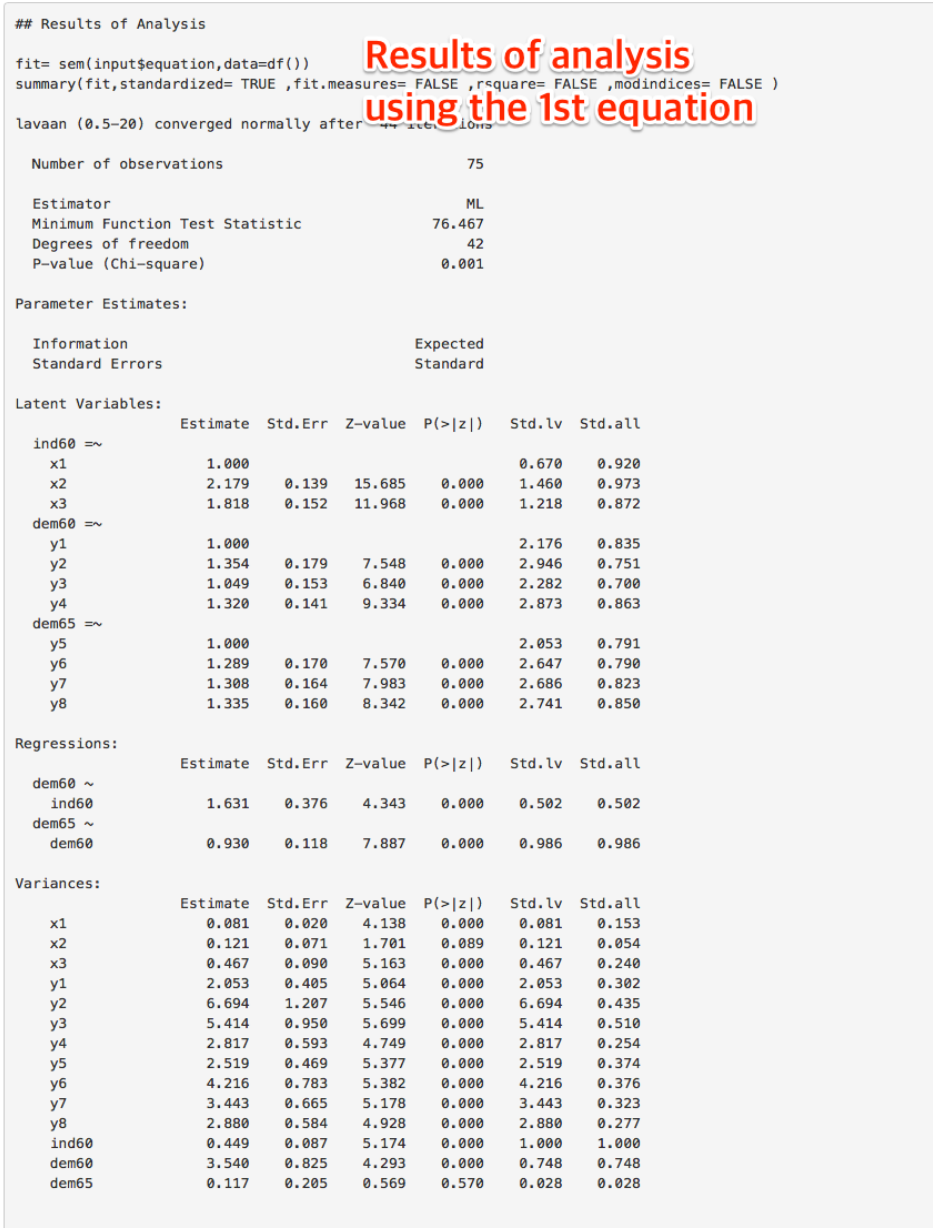


Figure 8.16: 53.png

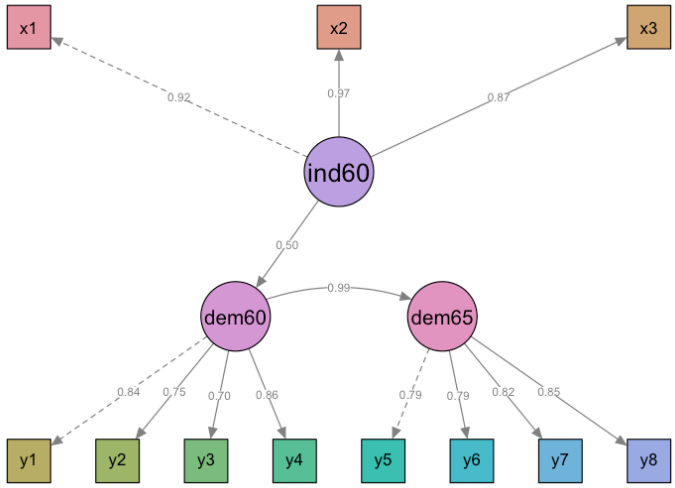
```
## Results of Analysis using equation2

fit2= sem(input$equation2,data=df())
summary(fit2,standardized= TRUE ,fit.measures= FALSE ,rsquare= FALSE ,modindices= FALSE )

lavaan (0.5-20) converged normally after  42 iterations

  Number of observations                            75

  Estimator                                         ML
  Minimum Function Test Statistic              72.462
  Degrees of freedom                               41
  P-value (Chi-square)                          0.002

Parameter Estimates:

  Information                                 Expected
  Standard Errors                             Standard

Latent Variables:
                   Estimate  Std.Err  Z-value  P(>|z|)   Std.lv  Std.all
  ind60 =~
    x1                1.000                               0.669    0.920
    x2                2.182    0.139   15.714    0.000    1.461    0.973
    x3                1.819    0.152   11.956    0.000    1.218    0.872
  dem60 =~
    y1                1.000                               2.201    0.845
    y2                1.354    0.175    7.755    0.000    2.980    0.760
    y3                1.044    0.150    6.961    0.000    2.298    0.705
    y4                1.300    0.138    9.412    0.000    2.860    0.860
  dem65 =~
    y5                1.000                               2.084    0.803
    y6                1.258    0.164    7.651    0.000    2.623    0.783
    y7                1.282    0.158    8.137    0.000    2.673    0.819
    y8                1.310    0.154    8.529    0.000    2.730    0.847

Regressions:
                   Estimate  Std.Err  Z-value  P(>|z|)   Std.lv  Std.all
  dem60 ~
    ind60             1.474    0.392    3.763    0.000    0.448    0.448
  dem65 ~
    ind60             0.453    0.220    2.064    0.039    0.146    0.146
    dem60             0.864    0.113    7.671    0.000    0.913    0.913

Variances:
                   Estimate  Std.Err  Z-value  P(>|z|)   Std.lv  Std.all
    x1                0.082    0.020    4.180    0.000    0.082    0.154
    x2                0.118    0.070    1.689    0.091    0.118    0.053
    x3                0.467    0.090    5.174    0.000    0.467    0.240
    y1                1.942    0.395    4.910    0.000    1.942    0.286
    y2                6.490    1.185    5.479    0.000    6.490    0.422
    y3                5.340    0.943    5.662    0.000    5.340    0.503
    y4                2.887    0.610    4.731    0.000    2.887    0.261
    y5                2.390    0.447    5.351    0.000    2.390    0.355
    y6                4.343    0.796    5.456    0.000    4.343    0.387
    y7                3.510    0.668    5.252    0.000    3.510    0.329
    y8                2.940    0.586    5.019    0.000    2.940    0.283
    ind60             0.448    0.087    5.169    0.000    1.000    1.000
    dem60             3.872    0.893    4.338    0.000    0.799    0.799
    dem65             0.115    0.200    0.575    0.565    0.026    0.026



## Compare Models

## call: anova(fit,fit2)
Chi Square Difference Test

     Df    AIC    BIC  Chisq Chisq diff Df diff Pr(>Chisq)
fit2 41 3179.9 3237.9 72.462
fit  42 3181.9 3237.5 76.467     4.0052       1    0.04536 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```


Figure 8.17: 54.png

Plots for Two Models

```
fit= sem(input$equation,data=df())
semPaths(fit,what='path',whatLabels='std',intercept=FALSE,residuals=FALSE,thresholds=FALSE,nCharNodes=0,nCharEdges=0,
groups='manlat',pastel=TRUE,title=TRUE,curveAdjacent=TRUE,ask=FALSE)
```

Plot for the model using the 1st equation




```
fit= sem(input$equation2,data=df())
semPaths(fit,what='path',whatLabels='std',intercept=FALSE,residuals=FALSE,thresholds=FALSE,nCharNodes=0,nCharEdges=0,
groups='manlat',pastel=TRUE,title=TRUE,curveAdjacent=TRUE,ask=FALSE)
```

Plot for model using the 2nd equation