Bootstrapping in Amos

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What's bootstrapping and why we need it?

- ✓ It's a resampling method
  - Creating an sampling distribution to estimate standard errors, and create the confidence intervals.
- ✓ It's important for mediation analysis
  - To confirm the mediation effect
    - Because of its accuracy for computing confidence intervals for mediation effect when the mediation effect is nonzero.
  - As an aid to nonnormal data
    - The assumption of SEM is the data has a multivariate normal distribution, but many empirical studies failed.
    - The resampling method has more accurate Type I error rates and power than single sample method that assumes a normal distribution.

Benefits of bootstrap procedure

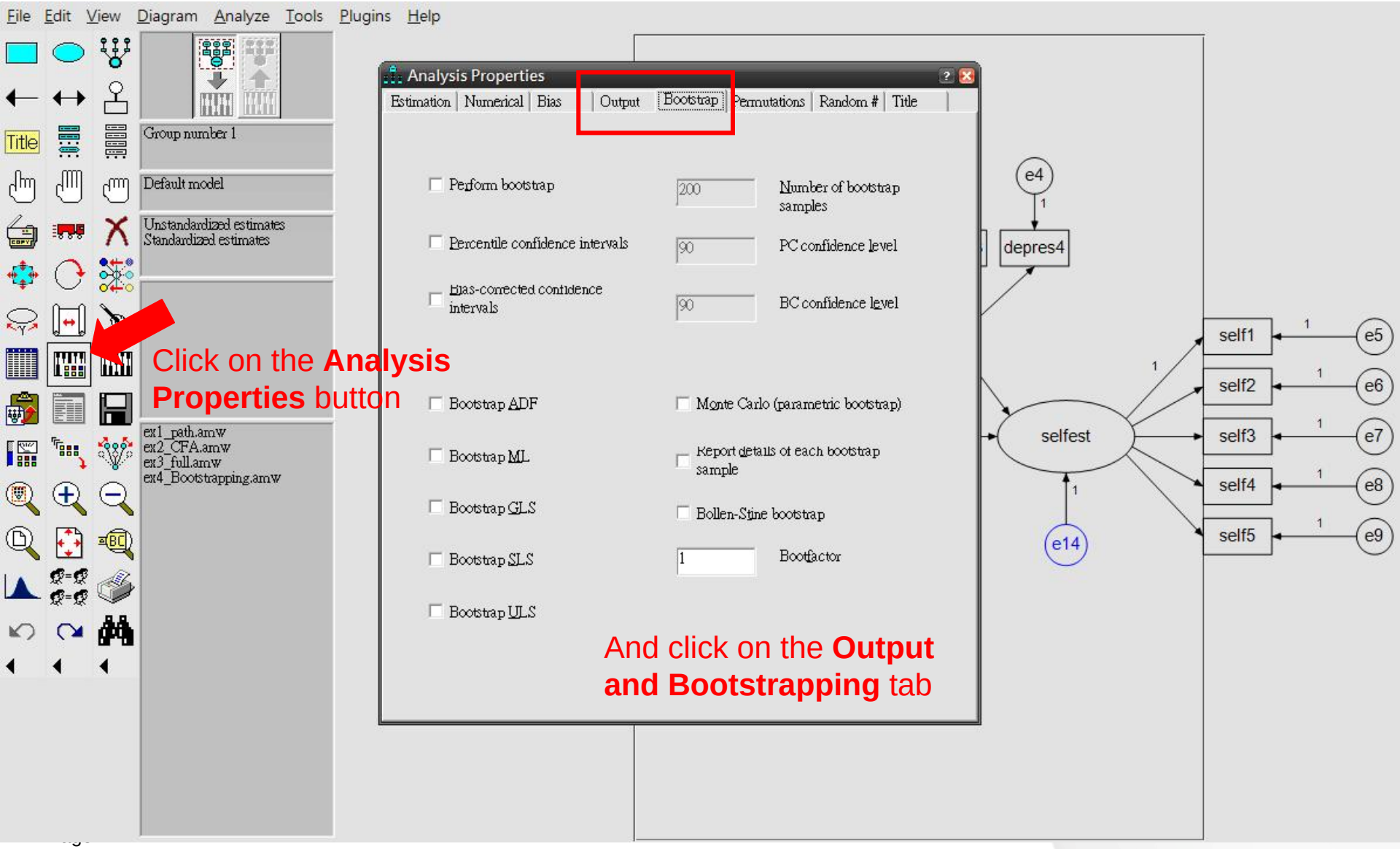
✓ SEM approach

- If the variables have measurement errors, the significance of the mediation effect is likely to be underestimated.
  - Using SEM can deal with the measurement error problem.

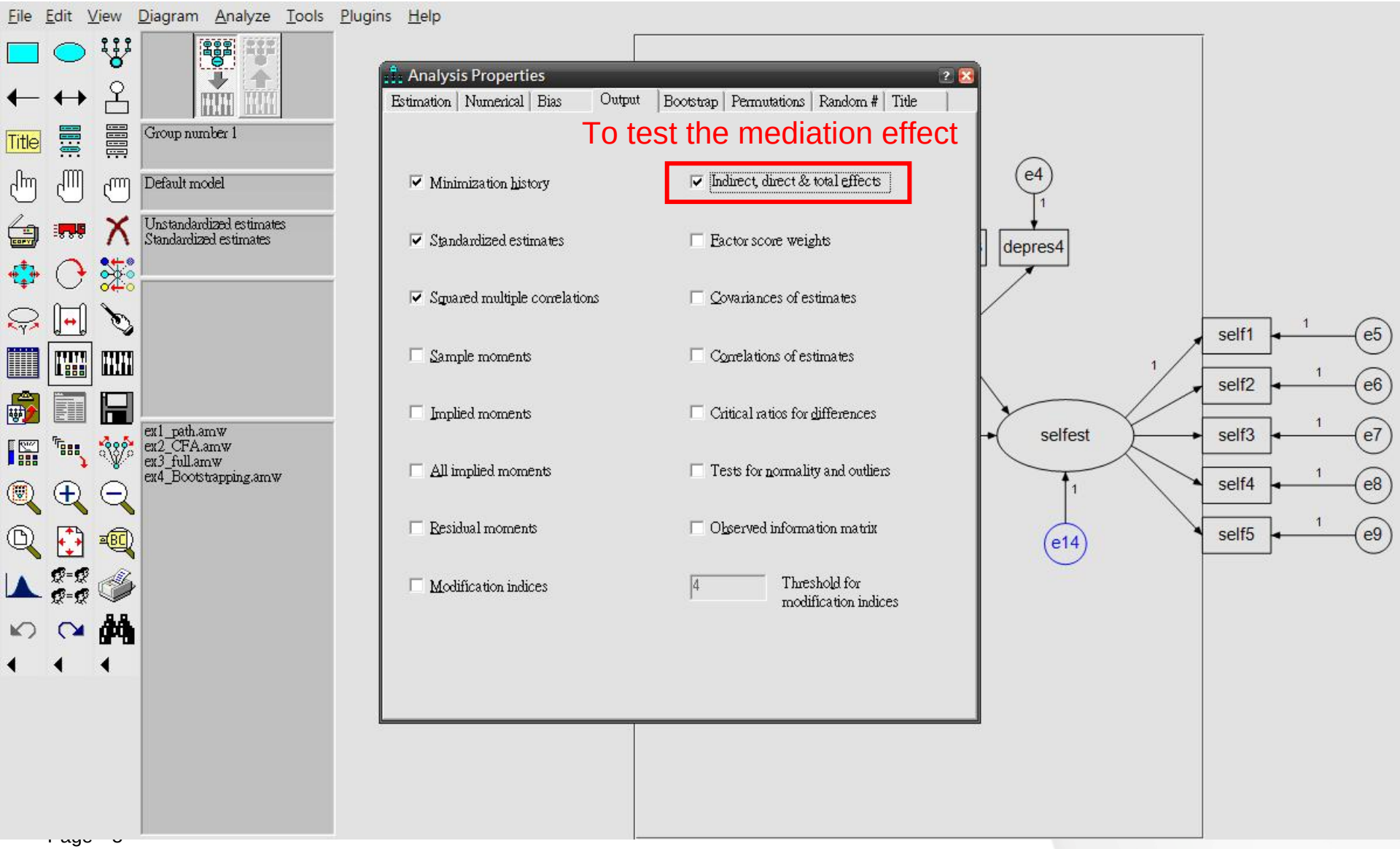
✓ Benefits

- It allows researchers to assess the stability of parameter estimates
- It can be applied when the assumptions of large sample size and multivariate normality may not hold.
  - Needs at least moderate sample sizes

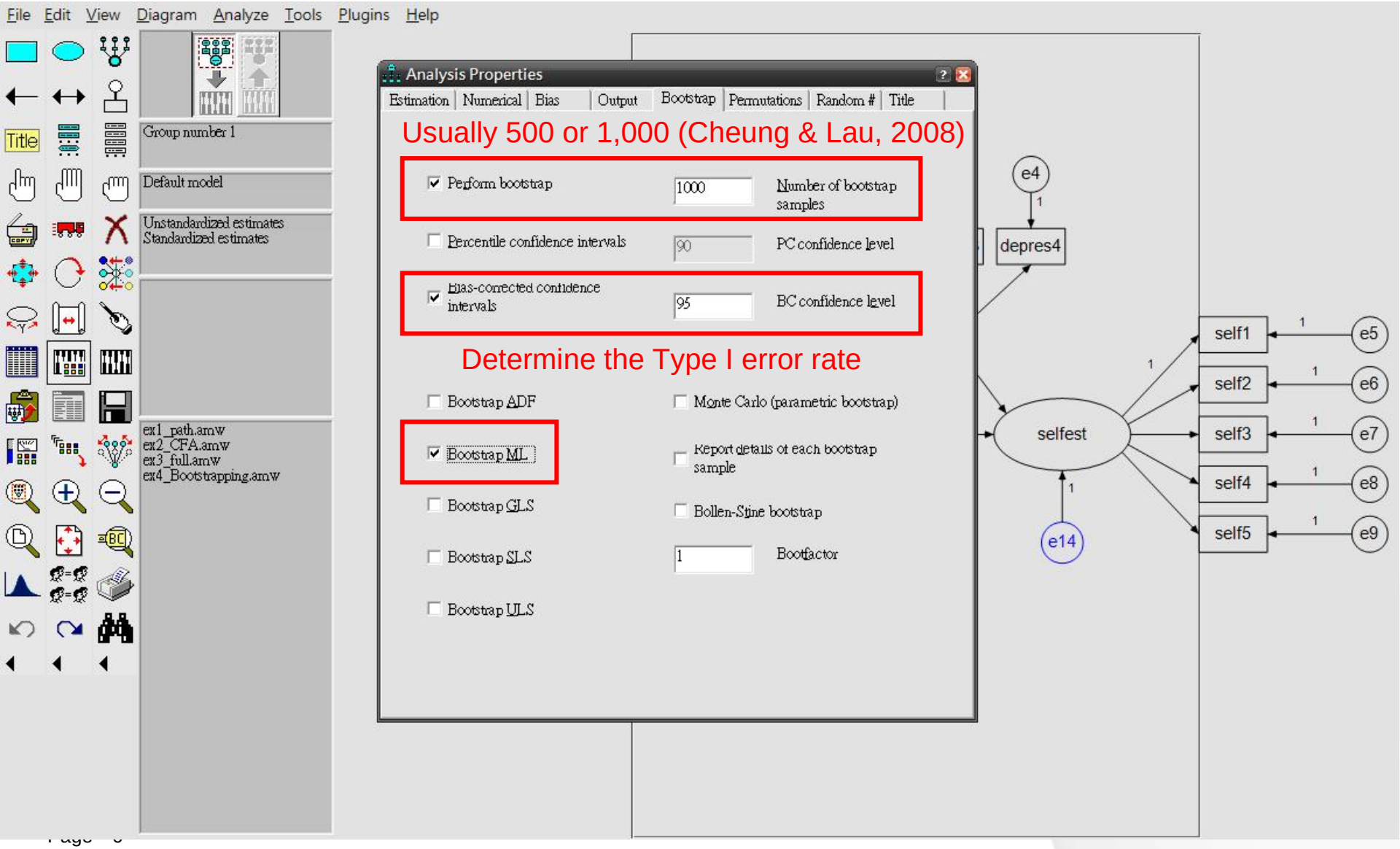
The procedure of bootstrapping in Amos



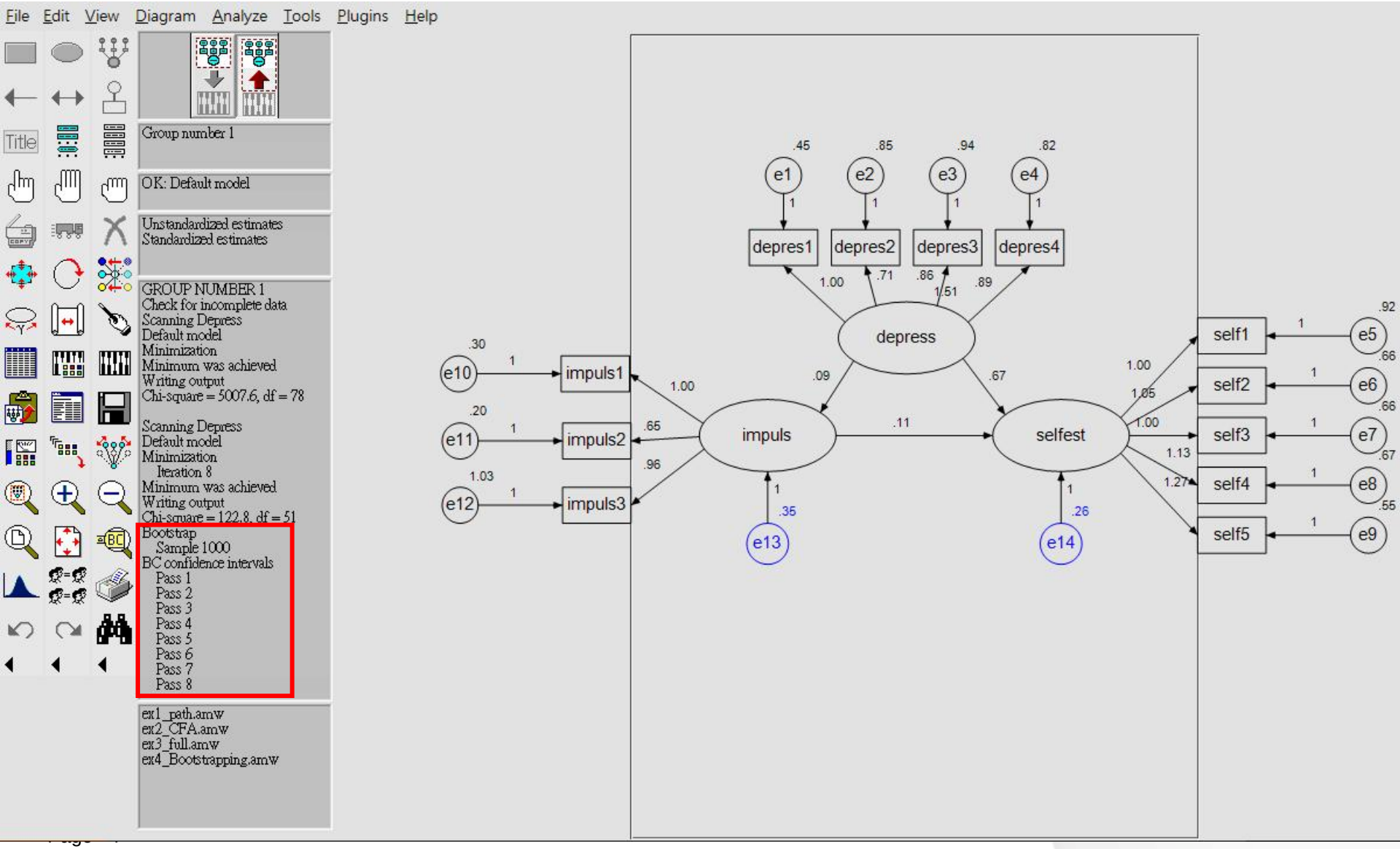
The procedure of bootstrapping in Amos



The procedure of bootstrapping in Amos



The result of bootstrapping in Amos



The result of bootstrapping in Amos

Amos Output

ex4_Bootstrapping.amw
- Analysis Summary
- Notes for Group
- Variable Summary
- Parameter summary
- Notes for Model
- Estimates
  - Scalars
    - Regression Weigh
    - Standardized Regn
    - Variances:
    - Squared Multiple
  - Matrices
- Minimization History
- Summary of Bootstrap I
- Bootstrap Distributions

Estimates/Bootstrap
- Estimates
- Bootstrap standard errors
- Bootstrap Confidence

Group number 1

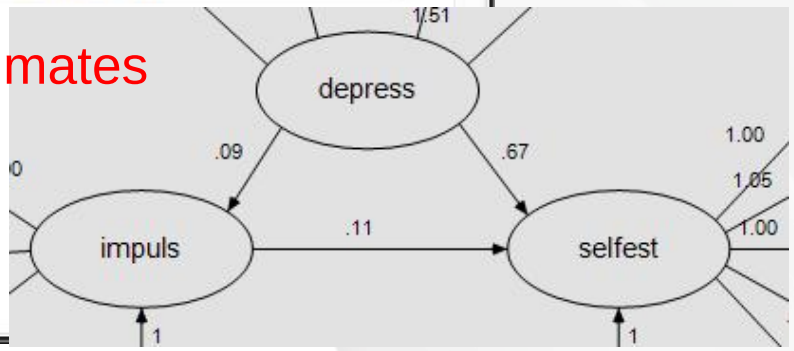
Default model

Regression Weights: (Group number 1 - Default model)

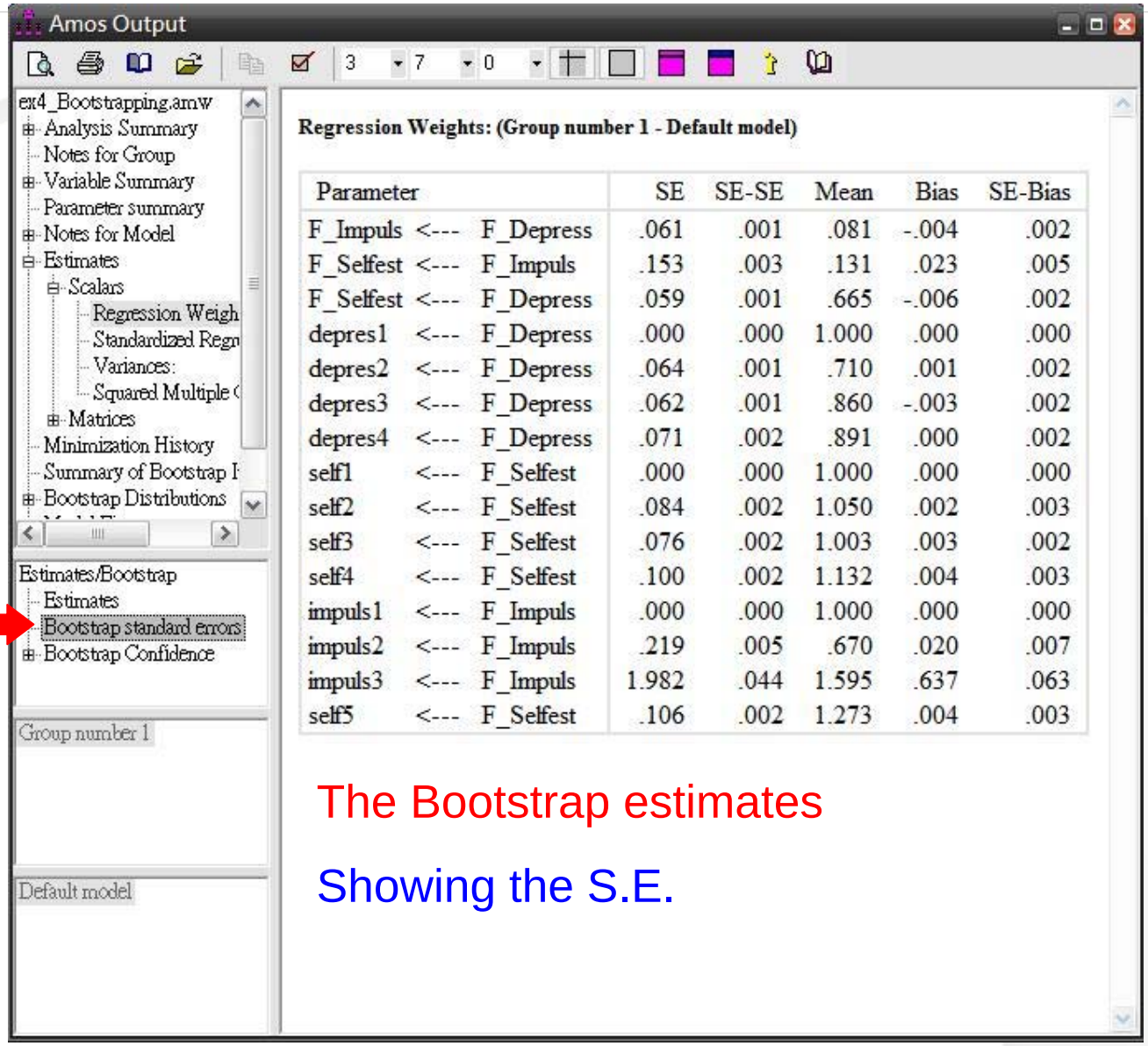
			Estimate	S.E.	C.R.	P	Label
F_Impuls	<---	F_Depress	.085	.044	1.920	.055	
F_Selfest	<---	F_Impuls	.108	.099	1.090	.276	
F_Selfest	<---	F_Depress	.670	.068	9.913	***	
depres1	<---	F_Depress	1.000				
depres2	<---	F_Depress	.710	.065	10.968	***	
depres3	<---	F_Depress	.863	.071	12.130	***	
depres4	<---	F_Depress	.892	.069	12.946	***	
self1	<---	F_Selfest	1.000				
self2	<---	F_Selfest	1.048	.098	10.689	***	
self3	<---	F_Selfest	1.000	.095	10.476	***	
self4	<---	F_Selfest	1.127	.103	10.926	***	
impuls1	<---	F_Impuls	1.000				
impuls2	<---	F_Impuls	.650	.128	5.067	***	
impuls3	<---	F_Impuls	.958	.197	4.860	***	
self5	<---	F_Selfest	1.269	.109	11.643	***	

The original ML estimates

No mediation effect



The result of bootstrapping in Amos



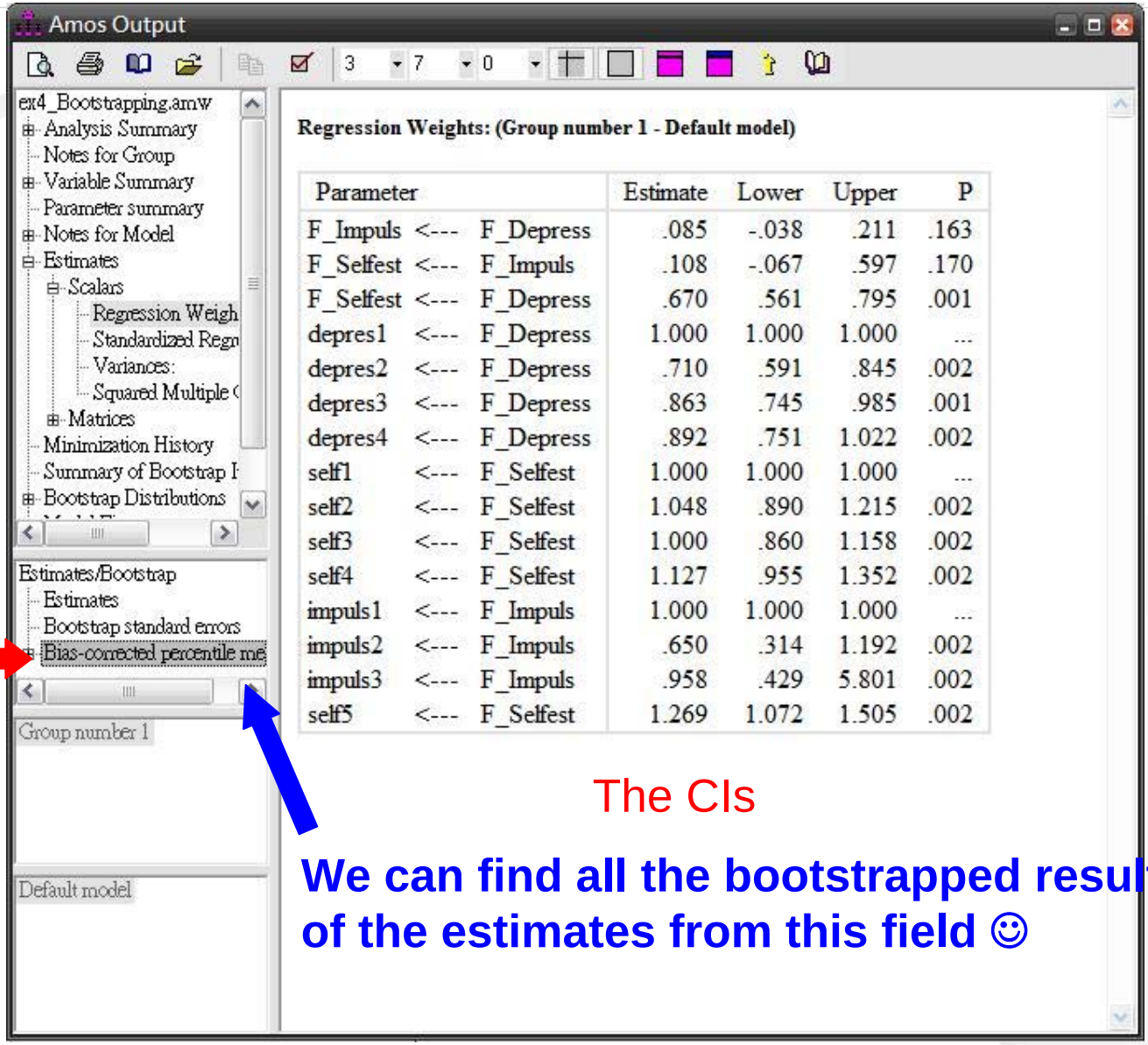
Regression Weights: (Group number 1 - Default model)

Parameter			SE	SE-SE	Mean	Bias	SE-Bias
F_Impuls	<---	F_Depress	.061	.001	.081	-.004	.002
F_Selfest	<---	F_Impuls	.153	.003	.131	.023	.005
F_Selfest	<---	F_Depress	.059	.001	.665	-.006	.002
depres1	<---	F_Depress	.000	.000	1.000	.000	.000
depres2	<---	F_Depress	.064	.001	.710	.001	.002
depres3	<---	F_Depress	.062	.001	.860	-.003	.002
depres4	<---	F_Depress	.071	.002	.891	.000	.002
self1	<---	F_Selfest	.000	.000	1.000	.000	.000
self2	<---	F_Selfest	.084	.002	1.050	.002	.003
self3	<---	F_Selfest	.076	.002	1.003	.003	.002
self4	<---	F_Selfest	.100	.002	1.132	.004	.003
impuls1	<---	F_Impuls	.000	.000	1.000	.000	.000
impuls2	<---	F_Impuls	.219	.005	.670	.020	.007
impuls3	<---	F_Impuls	1.982	.044	1.595	.637	.063
self5	<---	F_Selfest	.106	.002	1.273	.004	.003

The Bootstrap estimates

Showing the S.E.

The result of bootstrapping in Amos



Regression Weights: (Group number 1 - Default model)

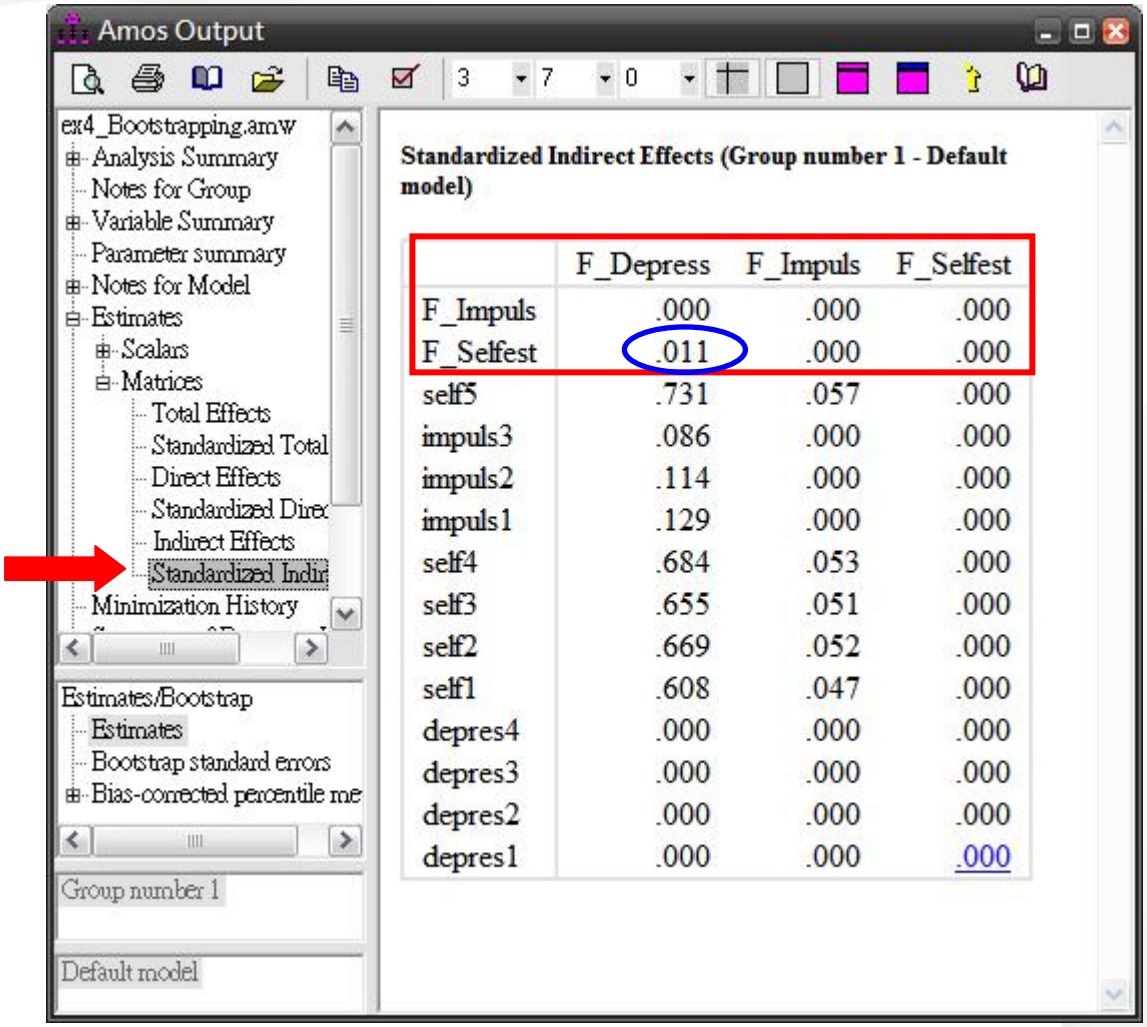
Parameter			Estimate	Lower	Upper	P
F_Impuls	<---	F_Depress	.085	-.038	.211	.163
F_Selfest	<---	F_Impuls	.108	-.067	.597	.170
F_Selfest	<---	F_Depress	.670	.561	.795	.001
depres1	<---	F_Depress	1.000	1.000	1.000	...
depres2	<---	F_Depress	.710	.591	.845	.002
depres3	<---	F_Depress	.863	.745	.985	.001
depres4	<---	F_Depress	.892	.751	1.022	.002
self1	<---	F_Selfest	1.000	1.000	1.000	...
self2	<---	F_Selfest	1.048	.890	1.215	.002
self3	<---	F_Selfest	1.000	.860	1.158	.002
self4	<---	F_Selfest	1.127	.955	1.352	.002
impuls1	<---	F_Impuls	1.000	1.000	1.000	...
impuls2	<---	F_Impuls	.650	.314	1.192	.002
impuls3	<---	F_Impuls	.958	.429	5.801	.002
self5	<---	F_Selfest	1.269	1.072	1.505	.002

The CIs

We can find all the bootstrapped results of the estimates from this field ☺

The result of bootstrapping in Amos

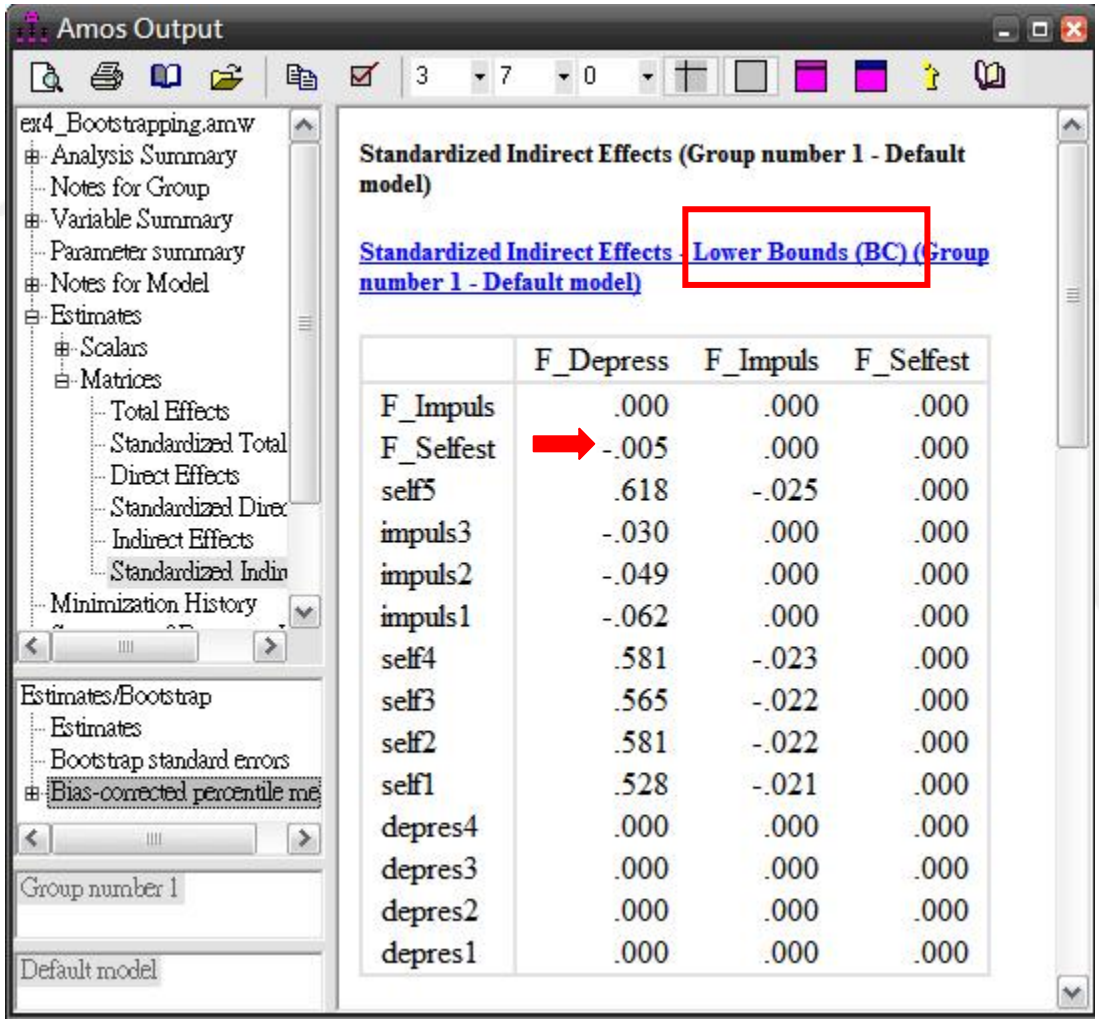
How to check the mediation effect?



Standardized Indirect Effects (Group number 1 - Default model)

	F_Depress	F_Impuls	F_Selfest
F_Impuls	.000	.000	.000
F_Selfest	.011	.000	.000
self5	.731	.057	.000
impuls3	.086	.000	.000
impuls2	.114	.000	.000
impuls1	.129	.000	.000
self4	.684	.053	.000
self3	.655	.051	.000
self2	.669	.052	.000
self1	.608	.047	.000
depres4	.000	.000	.000
depres3	.000	.000	.000
depres2	.000	.000	.000
depres1	.000	.000	.000

The result of bootstrapping in Amos



Standardized Indirect Effects (Group number 1 - Default model)

Standardized Indirect Effects - Lower Bounds (BC) (Group number 1 - Default model)

	F_Depress	F_Impuls	F_Selfest
F_Impuls	.000	.000	.000
F_Selfest	-.005	.000	.000
self5	.618	-.025	.000
impuls3	-.030	.000	.000
impuls2	-.049	.000	.000
impuls1	-.062	.000	.000
self4	.581	-.023	.000
self3	.565	-.022	.000
self2	.581	-.022	.000
self1	.528	-.021	.000
depres4	.000	.000	.000
depres3	.000	.000	.000
depres2	.000	.000	.000
depres1	.000	.000	.000

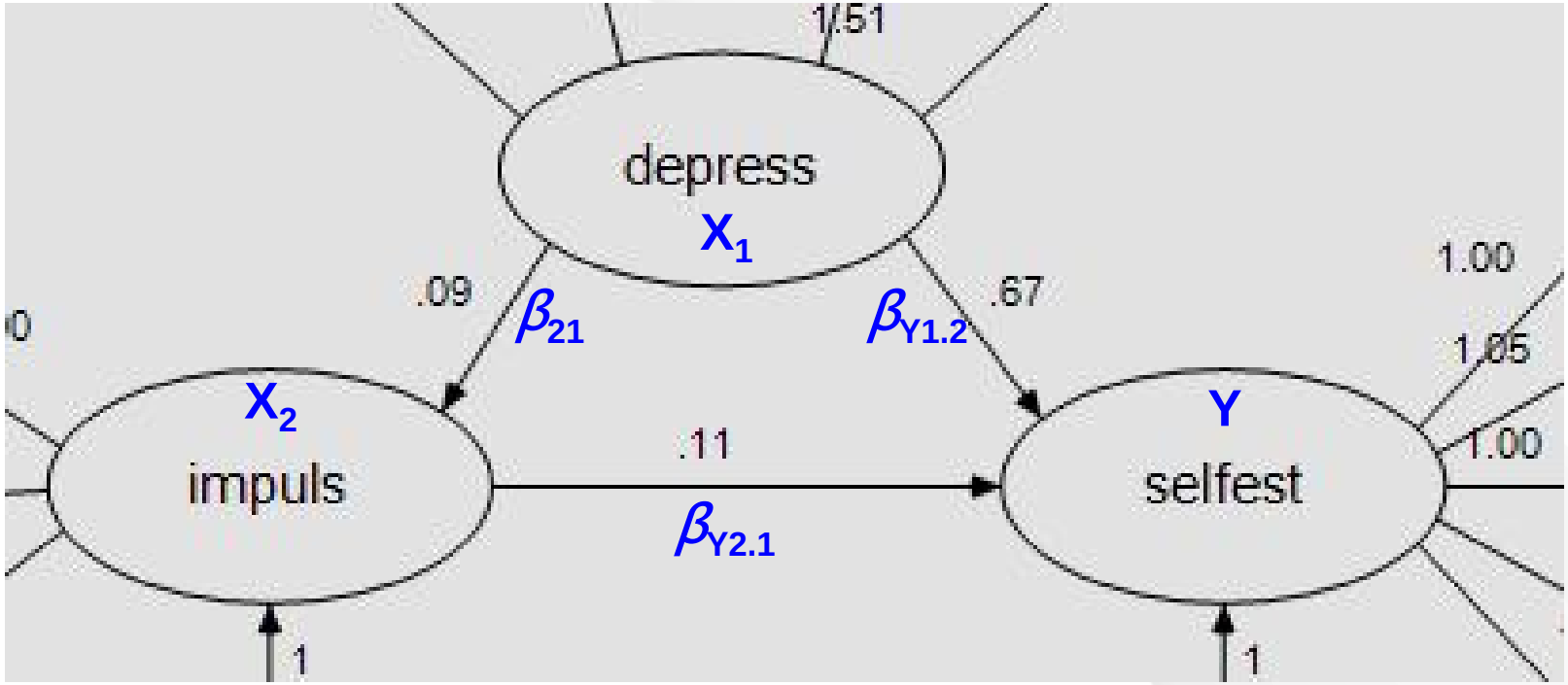
Standardized Indirect Effects - Upper Bounds (BC) (Group number 1 - Default model)

	F_Depress	F_Impuls	F_Selfest
F_Impuls	.000	.000	.000
F_Selfest	.106	.000	.000
self5	.819	.184	.000
impuls3	.502	.000	.000
impuls2	.245	.000	.000
impuls1	.302	.000	.000
self4	.766	.171	.000
self3	.734	.174	.000
self2	.753	.174	.000
self1	.691	.154	.000
depres4	.000	.000	.000
depres3	.000	.000	.000
depres2	.000	.000	.000
depres1	.000	.000	.000

Indirect effect of depress on selfest is: .011 (95% CI: -.005 ~ .106)

The result of bootstrapping in Amos

Indirect effect of depress on selfest is: .011 (95% CI: -.005 ~ .106)



We cannot reject the null hypothesis, H_0: $\beta_{21} * \beta_{Y2.1} = 0$

There is no mediation effect!

(Cheung & Lau, 2008)

References

Cheung, G. W., & Lau, R. S. (2008). Testing mediation and suppression effects of latent variables: Bootstrapping with structural equation models. *Organizational Research Methods, 11*(2), 296-325.

MacKinnon, D. P. (2008). *Introduction to Statistical Mediation Analysis*. New York, NY: Lawrence Erlbaum Associates.

Byrne, B. M. (2001). *Structural equation modeling with AMOS: Basic concepts, applications, and programming.* Mahwah, NJ: Lawrence Erlbaum Associates.

Thank You !