Tutorial for MQAssessor

Contents

Before running MQAssessor

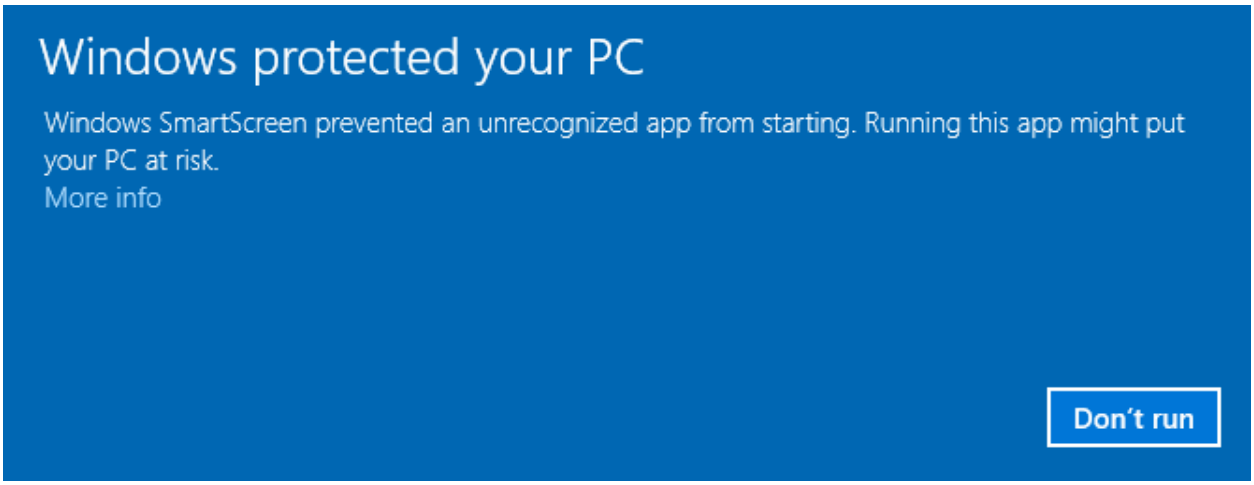
Where can I get an MQAssessor?

The source of MQAssessor is written in Python3 and is publicly available. Anyone can freely distribute and use this software. You can find the source through the following link: https://github.com/eunscho/MQAssessor. Files that can be run directly on the Windows OS can be downloaded from the following link: https://github.com/eunscho/MQAssessor/releases

Users using other operating systems must compile the source file themselves. Some users are unfamiliar with this process, so we are looking for volunteers to make files executable on Mac or Linux OS.

Problems when running MQAssessor on Windows

The Windows OS considers MQAssessor.exe to be unapproved software and can prevent it from running. For example, depending on your OS version, you might see a screen similar to the following:



We recommend that you turn off Windows protection only with MQAssessor.exe. The specific method depends on the version of Windows and can be easily searched on Google.

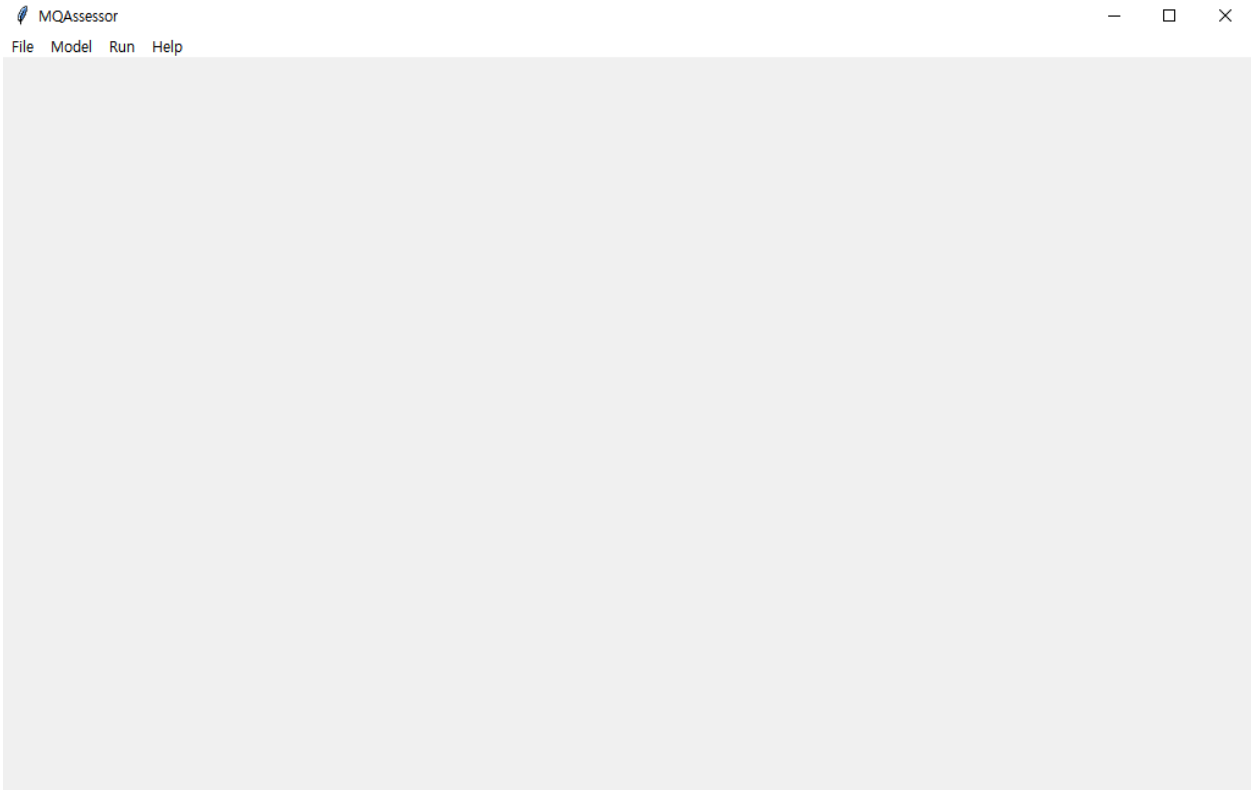
Data for the Tutorial

This tutorial uses the following csv file:

https://github.com/eunscho/MQAssessor/blob/master/TutorialData.csv

Procedure for first time analysis

There are four menus in the MQAssessor: File, Model, Run, and Help.

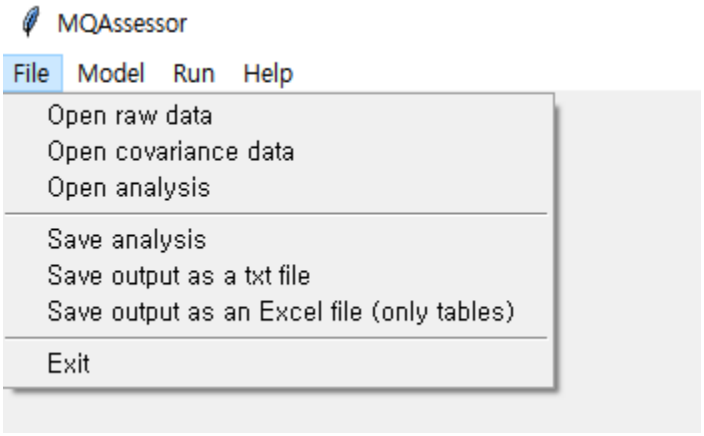


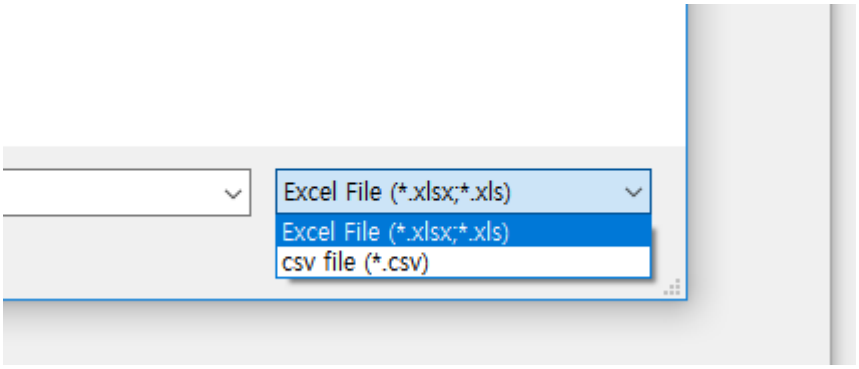
Step 1. Open existing data

There are two types of data. Probably most users will use raw data, which is an asymmetric matrix consisting of samples in rows and observed variables in columns. The data used in the tutorial are also raw data. Covariance data are a symmetric matrix in which both rows and columns are variables.

Two data formats are supported. Excel files (* .xls, * .xlsx) and csv files (* .csv). csv files are text files with certain rules.

The first row of data must represent the name of each observed variable. All rows except this first row must consist of numbers only. MQAssessor does not have a module to handle missing values. We recommend preprocessing missing values in other statistical software. The input data must not have missing values.

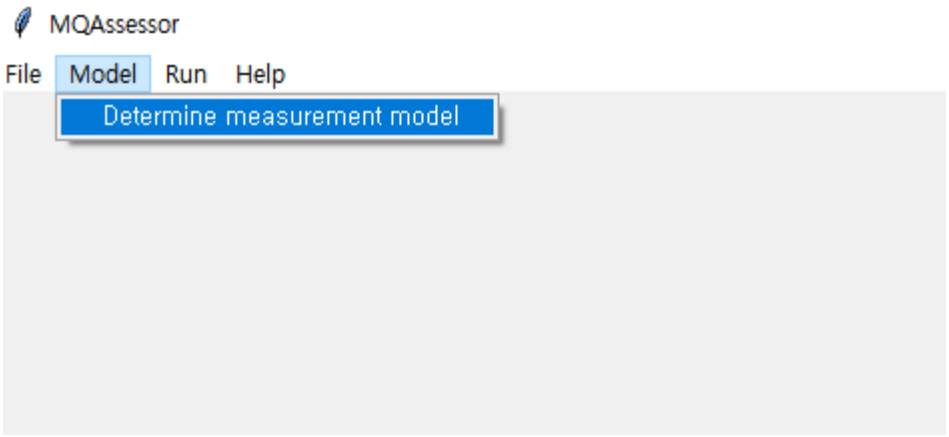


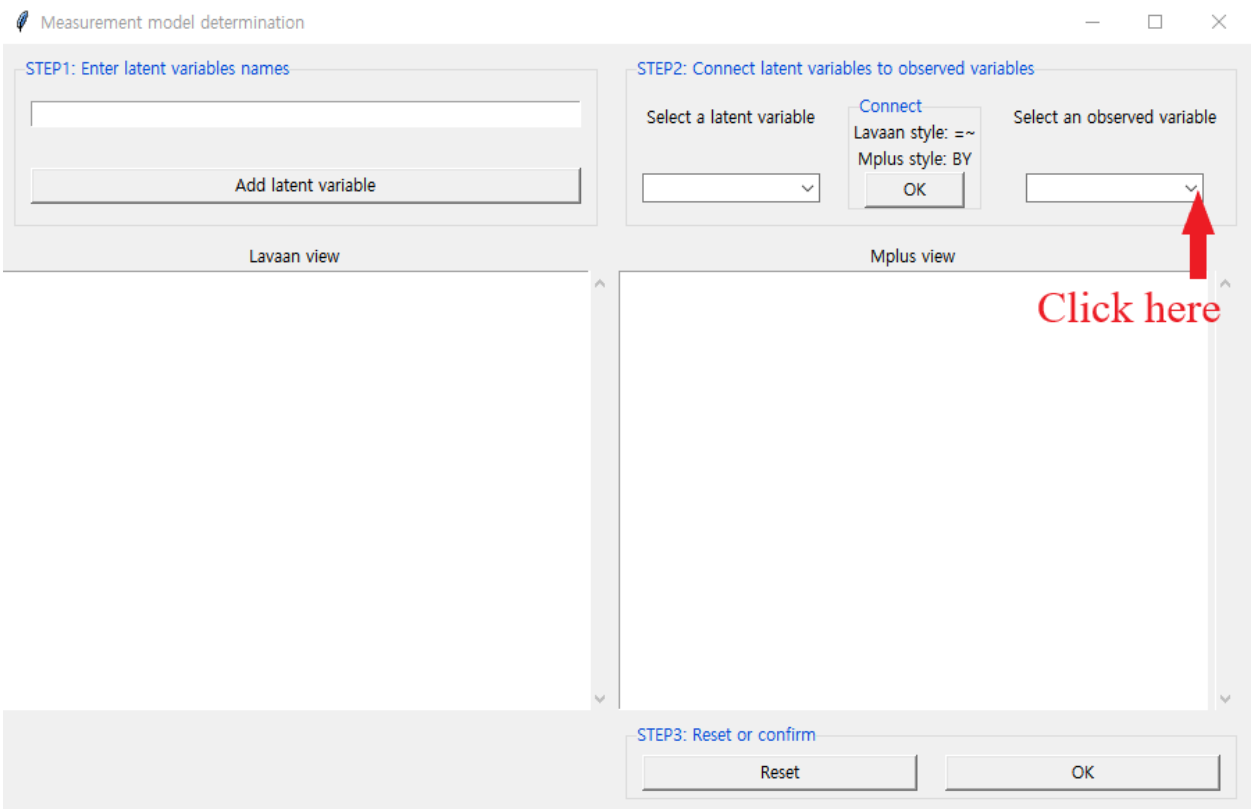


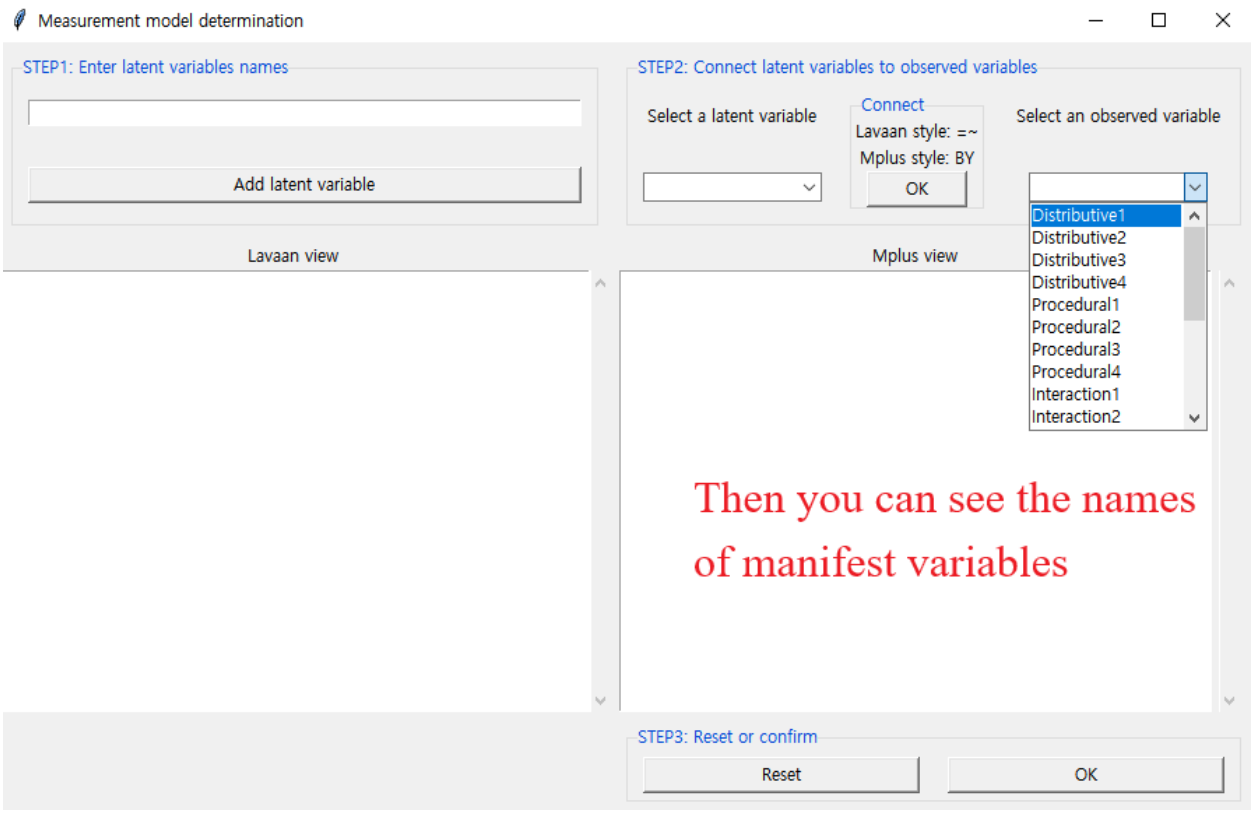
	A	B	C	D	E	F	G
1	Distributive1	Distributive2	Distributive3	Distributive4	Procedural1	Procedural2	Procedura
2	2	2	2	2	3	2	
3	3	3	3	3	3	3	
4	1	1	1	1	1	1	
5	4	4	4	4	4	4	
6	2	2	2	2	2	2	
7	4	4	4	4	4	4	

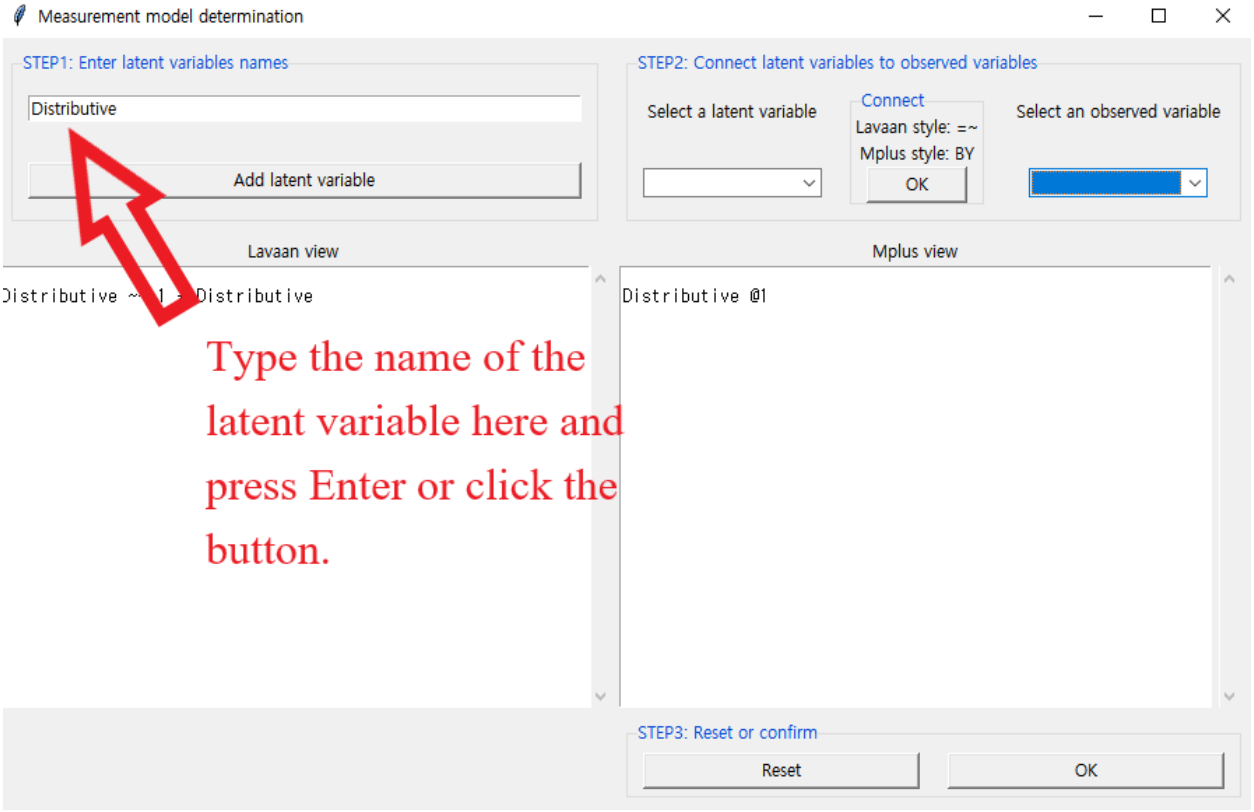
Step 2. Specify the measurement model

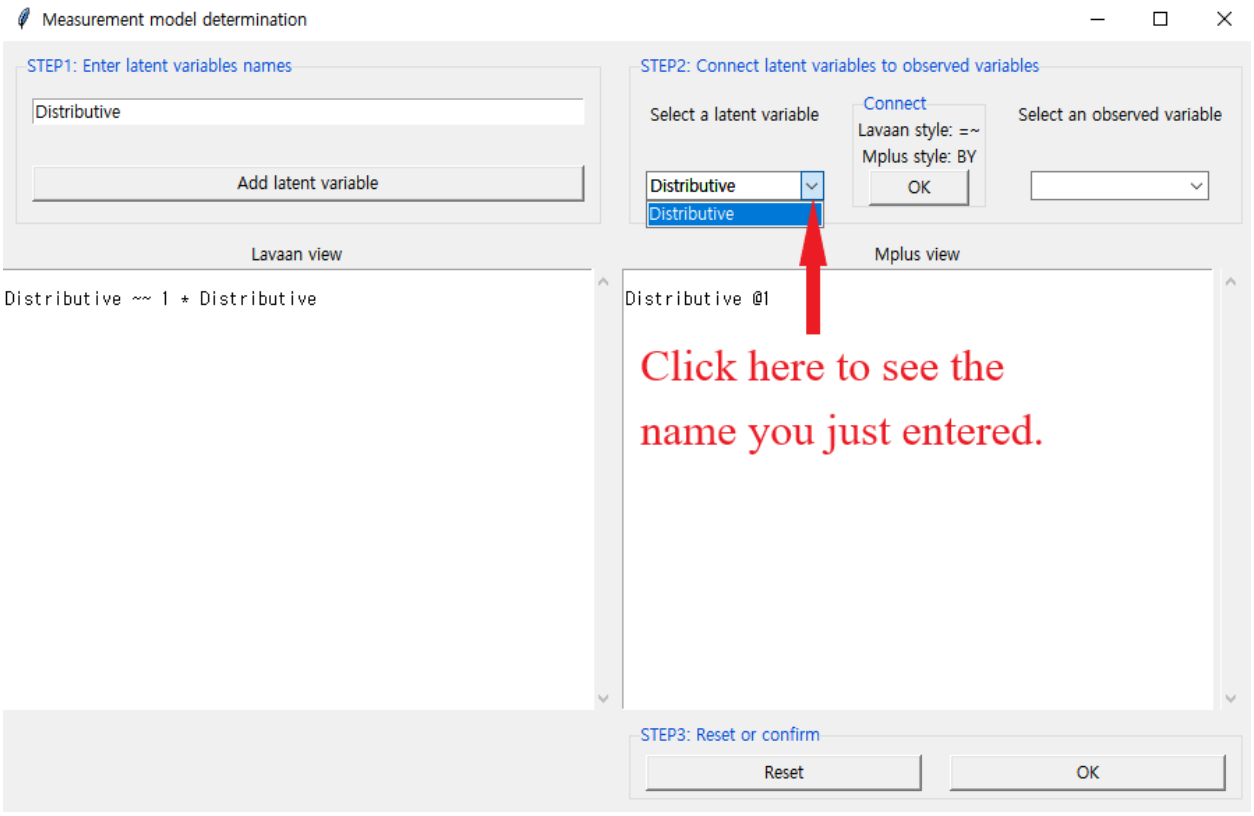
In the Model menu, you can specify a measurement model. This process will be explained through pictures rather than words.

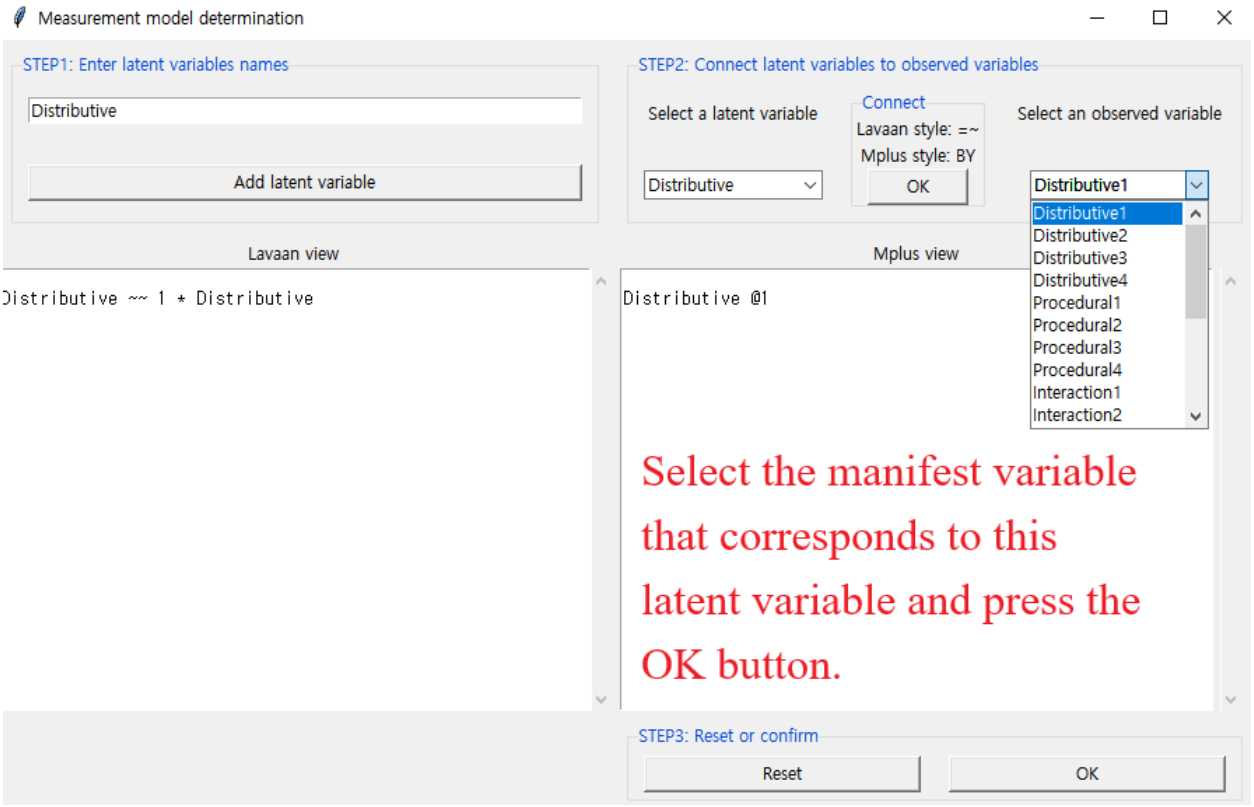

MQAssessor
File
Model
Run
Help
Determine measurement model

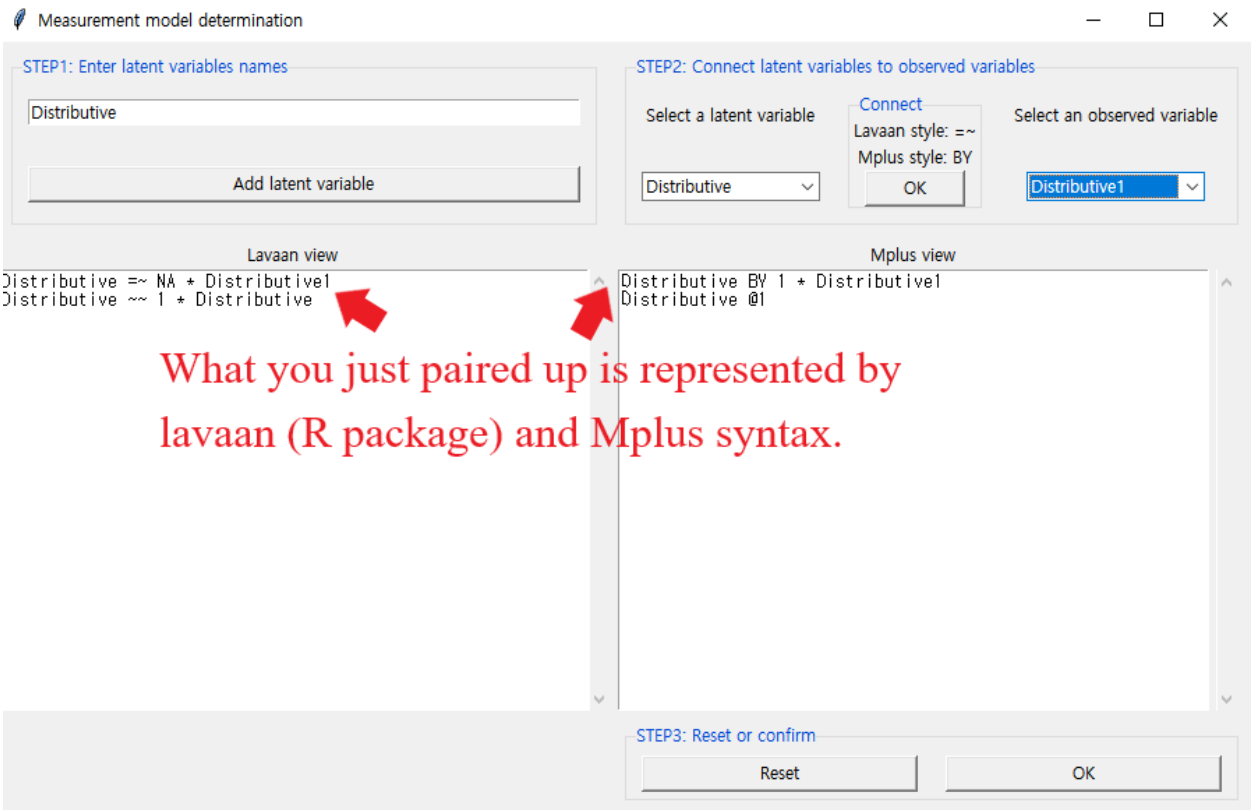

Measurement model determination
STEP1: Enter latent variables names
Add latent variable
STEP2: Connect latent variables to observed variables
Select a latent variable
Connect
Lavaan style: =~
Mplus style: BY
OK
Select an observed variable
Lavaan view
Mplus view
Click here
STEP3: Reset or confirm
Reset
OK

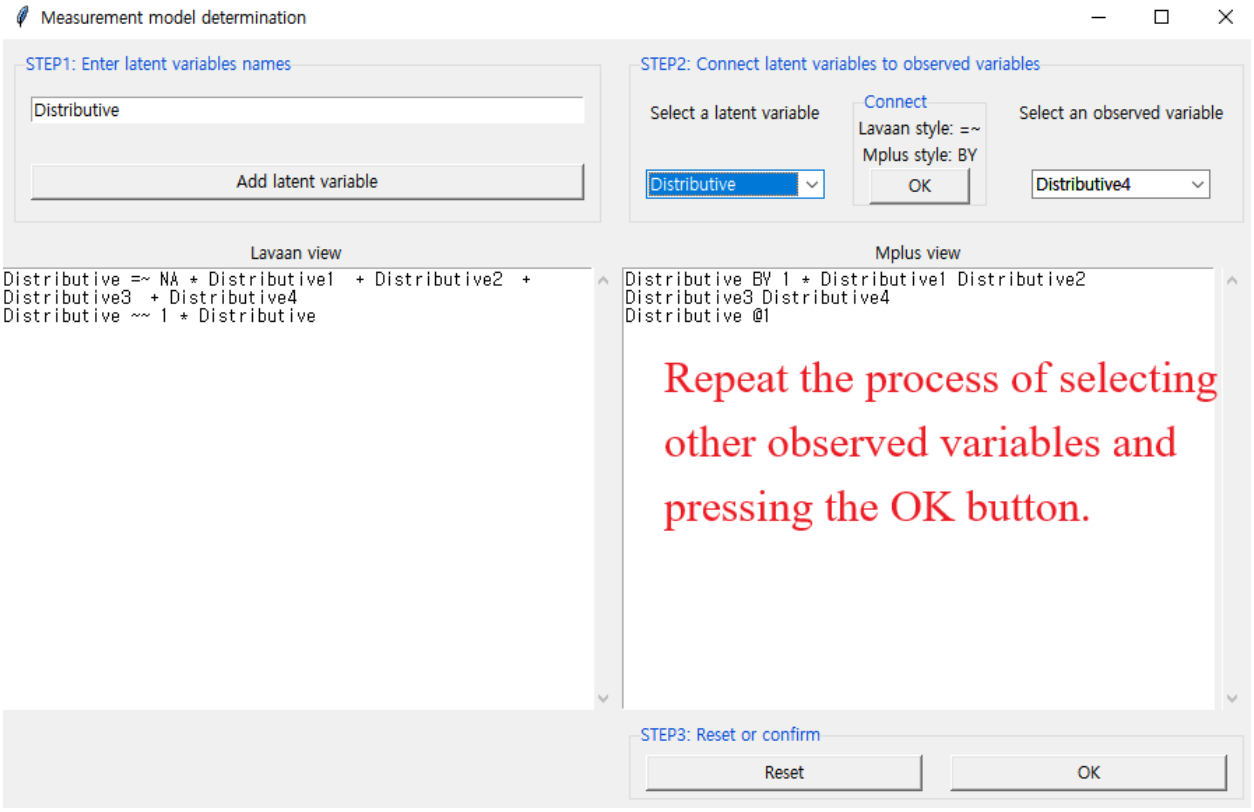

Measurement model determination
STEP1: Enter latent variables names
Add latent variable
STEP2: Connect latent variables to observed variables
Select a latent variable
Connect
Lavaan style: =~
Mplus style: BY
OK
Select an observed variable
Distributive1
Distributive2
Distributive3
Distributive4
Procedural1
Procedural2
Procedural3
Procedural4
Interaction1
Interaction2
Lavaan view
Mplus view
Then you can see the names of manifest variables
STEP3: Reset or confirm
Reset
OK

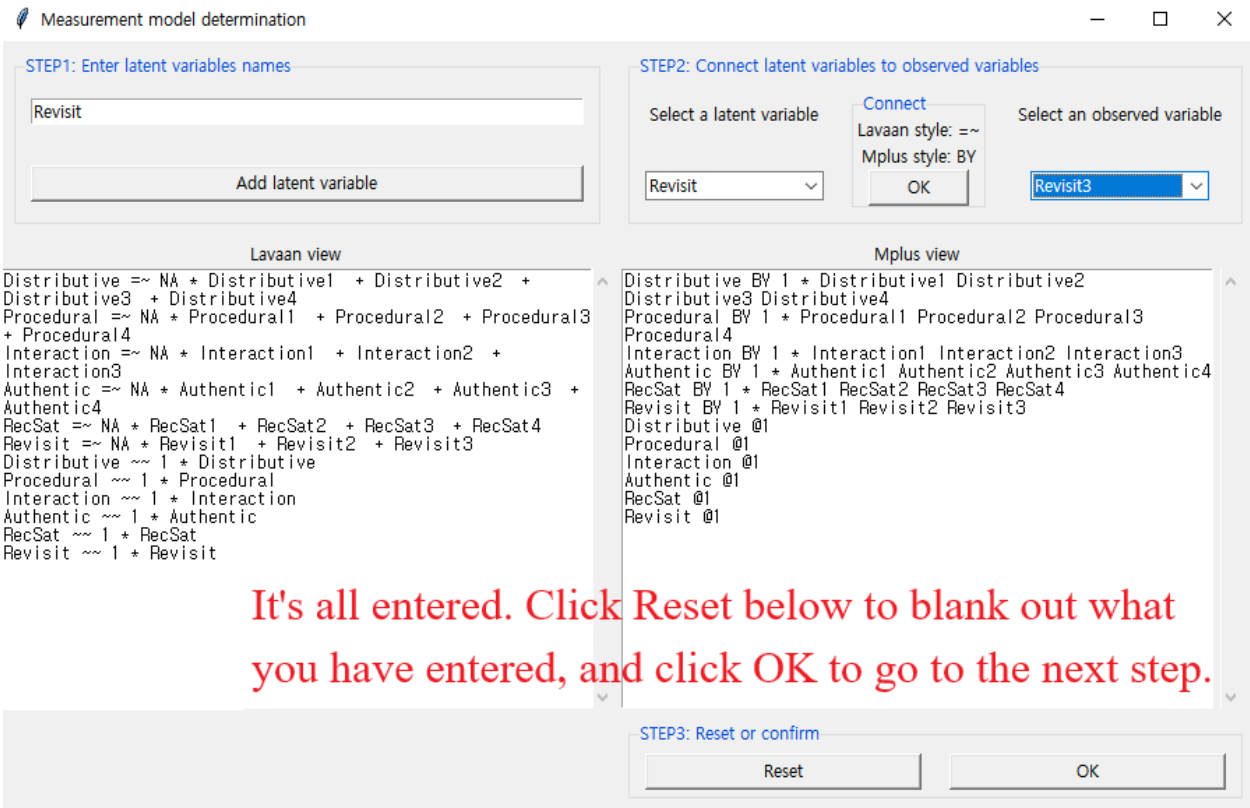

Measurement model determination
STEP1: Enter latent variables names
Distributive
Add latent variable
STEP2: Connect latent variables to observed variables
Select a latent variable
Connect
Lavaan style: =~
Mplus style: BY
OK
Select an observed variable
Lavaan view
Mplus view
Distributive ~ 1 * Distributive
Distributive @1
Type the name of the latent variable here and press Enter or click the button.
STEP3: Reset or confirm
Reset
OK


Measurement model determination
STEP1: Enter latent variables names
Distributive
Add latent variable
STEP2: Connect latent variables to observed variables
Select a latent variable
Connect
Lavaan style: =~
Mplus style: BY
OK
Select an observed variable
Distributive
Distributive
Lavaan view
Distributive ~~ 1 * Distributive
Mplus view
Distributive @1
Click here to see the name you just entered.
STEP3: Reset or confirm
Reset
OK


Measurement model determination
STEP1: Enter latent variables names
Distributive
Add latent variable
STEP2: Connect latent variables to observed variables
Select a latent variable
Connect
Lavaan style: =~
Mplus style: BY
OK
Select an observed variable
Distributive
Distributive1
Distributive1
Distributive2
Distributive3
Distributive4
Procedural1
Procedural2
Procedural3
Procedural4
Interaction1
Interaction2
Lavaan view
Distributive ~~ 1 * Distributive
Mplus view
Distributive @1
Select the manifest variable that corresponds to this latent variable and press the OK button.
STEP3: Reset or confirm
Reset
OK


Measurement model determination
STEP1: Enter latent variables names
Distributive
Add latent variable
STEP2: Connect latent variables to observed variables
Select a latent variable
Connect
Lavaan style: =~
Mplus style: BY
OK
Select an observed variable
Distributive
Distributive1
Lavaan view
Distributive =~ NA * Distributive1
Distributive ~~ 1 * Distributive
Mplus view
Distributive BY 1 * Distributive1
Distributive @1
What you just paired up is represented by lavaan (R package) and Mplus syntax.
STEP3: Reset or confirm
Reset
OK


Measurement model determination
STEP1: Enter latent variables names
Distributive
Add latent variable
STEP2: Connect latent variables to observed variables
Select a latent variable
Connect
Lavaan style: =~
Mplus style: BY
OK
Select an observed variable
Distributive
Distributive4
Lavaan view
Distributive =~ NA * Distributive1 + Distributive2 +
Distributive3 + Distributive4
Distributive ~~ 1 * Distributive
Mplus view
Distributive BY 1 * Distributive1 Distributive2
Distributive3 Distributive4
Distributive @1
Repeat the process of selecting other observed variables and pressing the OK button.
STEP3: Reset or confirm
Reset
OK



Step 3. Run options

There are four run options.

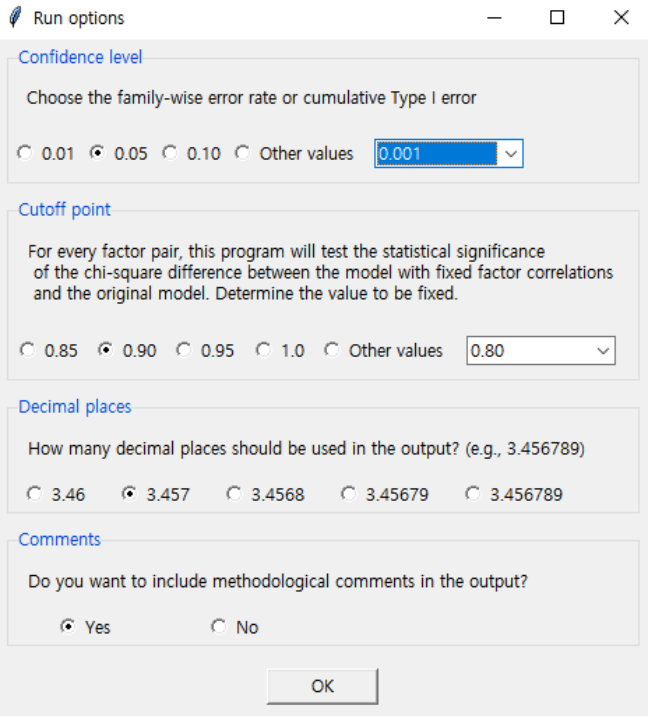
Confidence level: Often referred to as alpha. You can choose a value from .001 to .2. The default option is .05.

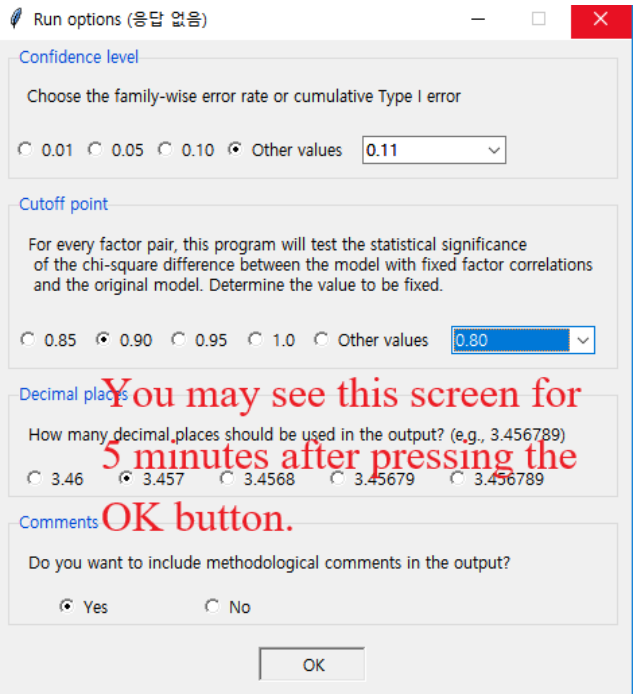
Cutoff point: Asks what value each latent variable pair should be fixed to. You can choose a value from .8 to 1. The default option is .9.

Decimal places: Asks how many decimal places to show the result. You can select a value from 2 to 6 decimal places. The default option is 3 decimal places.

Comments: You can see our commentary on the results. Unlike typical statistical software that shows only results without saying a word, MQAssessor is a bit talkative. We think this explanation can be helpful for non-experts, but you can get bored. You can turn this feature off if you want. The default option is yes.

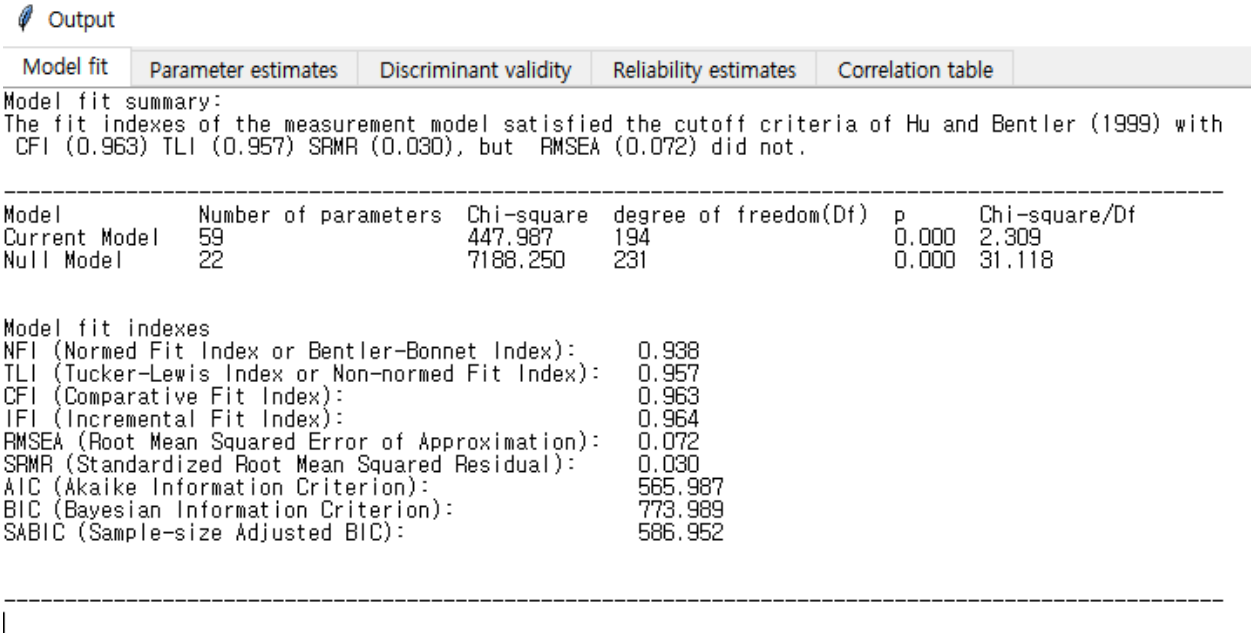
Press the OK button to execute. MQAssessor employs a brute force approach and performs many model estimates for every possible pair. Depending on your computer's performance and the size of the model, it may take a few minutes to run.





Step 4. Interpret the output

After some wait, the output window opens. The output window consists of five tabs. The first is model fit, which shows the model's degrees of freedom, chi-square, and various fit indices.



The second tab shows the parameter estimates.

Output

Model fit | Parameter estimates | Discriminant validity | Reliability estimates | Correlation table

Parameter estimates:
Regression coefficients between observed and latent variables (lambda in the LISREL notation)

	Coeffcient(lambda)	Standardized Coefficient
Distributive1<--Distributive:	1.144	0.937
Distributive2<--Distributive:	1.041	0.914
Distributive3<--Distributive:	0.932	0.805
Distributive4<--Distributive:	1.032	0.889
Procedural1<--Procedural:	0.988	0.873
Procedural2<--Procedural:	1.012	0.932
Procedural3<--Procedural:	0.976	0.917
Procedural4<--Procedural:	0.980	0.878
Interaction1<--Interaction:	1.055	0.896
Interaction2<--Interaction:	1.027	0.936
Interaction3<--Interaction:	1.011	0.928
Authentic1<--Authentic:	0.895	0.915
Authentic2<--Authentic:	0.920	0.932
Authentic3<--Authentic:	0.895	0.920
Authentic4<--Authentic:	0.893	0.854
RecSat1<--RecSat:	1.003	0.944
RecSat2<--RecSat:	1.002	0.931
RecSat3<--RecSat:	0.957	0.926
RecSat4<--RecSat:	0.747	0.826
Revisit1<--Revisit:	0.996	0.923
Revisit2<--Revisit:	0.982	0.958
Revisit3<--Revisit:	0.778	0.815

Error variances of observed variables (delta in the LISREL notation)

Distributive1 :	0.183
Distributive2 :	0.212
Distributive3 :	0.471
Distributive4 :	0.282
Procedural1 :	0.304
Procedural2 :	0.155
Procedural3 :	0.180
Procedural4 :	0.285
Interaction1 :	0.273
Interaction2 :	0.149
Interaction3 :	0.164
Authentic1 :	0.156
Authentic2 :	0.129
Authentic3 :	0.145
Authentic4 :	0.297
RecSat1 :	0.124
RecSat2 :	0.154
RecSat3 :	0.152
RecSat4 :	0.261
Revisit1 :	0.172
Revisit2 :	0.086
Revisit3 :	0.307

Covariances/correlations between latent variables (phi in the LISREL notation)

Distributive <-> Procedural	0.843
Distributive <-> Interaction	0.819
Distributive <-> Authentic	0.747
Distributive <-> RecSat	0.862
Distributive <-> Revisit	0.708
Procedural <-> Interaction	0.902
Procedural <-> Authentic	0.826
Procedural <-> RecSat	0.883
Procedural <-> Revisit	0.775
Interaction <-> Authentic	0.839
Interaction <-> RecSat	0.876
Interaction <-> Revisit	0.737
Authentic <-> RecSat	0.840
Authentic <-> Revisit	0.713
RecSat <-> Revisit	0.785

The third tab shows the discriminant validity assessment, the main purpose of the MQAssessor. Shown at the top is the result of the technique described in Rönkkö and Cho. First, we check that the correlation between the pairs of all possible latent variables is higher than the cutoff set earlier (the default is .9). If there is a higher correlation than this cutoff, the pair has a problem with discriminant validity. Next, we compare the chi-square difference between the model with each correlation fixed to the cutoff and the original model. If the chi-square values of the two models are not significantly different, the pair has a problem with discriminant validity.

Output

Model fit | Parameter estimates | Discriminant validity | Reliability estimates | Correlation table

```
Discriminant valdity summary:
There is a problem with the discrimination validity.
Some of the correlations were larger than the cutoff 0.90 you set.
Procedural <-> Interaction (0.902)
Some of the correlations were not significantly different from the cutoff 0.90 you set.
Procedural <-> RecSat (0.883)
Interaction <-> RecSat (0.876)
```

Fixed pair	Correlation before fixed	Fixed correlation value	Chi-square	CFI
Distributive <-> Procedural	0.843	0.90	478.852	0.959
Distributive <-> Interaction	0.819	0.90	3881.801	0.470
Distributive <-> Authentic	0.747	0.90	465.244	0.961
Distributive <-> RecSat	0.862	0.90	495.567	0.957
Distributive <-> Revisit	0.708	0.90	3889.127	0.469
Procedural <-> Interaction	0.902	0.90	512.187	0.954
Procedural <-> Authentic	0.826	0.90	447.998	0.964
Procedural <-> RecSat	0.883	0.90	462.996	0.961
Procedural <-> Revisit	0.775	0.90	449.104	0.963
Interaction <-> Authentic	0.839	0.90	482.650	0.959
Interaction <-> RecSat	0.876	0.90	458.435	0.962
Interaction <-> Revisit	0.737	0.90	450.057	0.963
Authentic <-> RecSat	0.840	0.90	499.187	0.956
Authentic <-> Revisit	0.713	0.90	458.810	0.962
RecSat <-> Revisit	0.785	0.90	1657.047	0.790
(Original model)	-	-	447.987	0.963

Below that, the evaluation by AVE / SV, HTMT, and cross-loading techniques is shown. We do not recommend the use of these techniques, and they are included only to criticize the problems of each technique.

Output

Model fit | Parameter estimates | Discriminant validity | Reliability estimates | Correlation table

Commonly used but inapprorpriate techniques: AVE/SV

	Shared variance (SV)	AVE1	AVE2	SV < max(AVE1, AVE2)?
Distributive<->Procedural	0.710	0.790	0.809	Pass
Distributive<->Interaction	0.671	0.790	0.845	Pass
Distributive<->Authentic	0.559	0.790	0.817	Pass
Distributive<->RecSat	0.743	0.790	0.835	Pass
Distributive<->Revisit	0.501	0.790	0.819	Pass
Procedural<->Interaction	0.813	0.809	0.845	Pass
Procedural<->Authentic	0.682	0.809	0.817	Pass
Procedural<->RecSat	0.779	0.809	0.835	Pass
Procedural<->Revisit	0.601	0.809	0.819	Pass
Interaction<->Authentic	0.704	0.845	0.817	Pass
Interaction<->RecSat	0.767	0.845	0.835	Pass
Interaction<->Revisit	0.543	0.845	0.819	Pass
Authentic<->RecSat	0.706	0.817	0.835	Pass
Authentic<->Revisit	0.508	0.817	0.819	Pass
RecSat<->Revisit	0.617	0.835	0.819	Pass

AVE / SV is the criterion that the maximum value of the Average Variance Extracted (AVE) of the two latent variables must be greater than the shared variance (SV), the square of the factor correlation (CFA) between two latent variables, . This technique is the most commonly used technique for evaluating discriminant validity in many fields including marketing. However, AVE is UNRELATED with discriminant validity. It is instead an indicator of item reliability. Most studies are applying this criterion differently from the original proposal of Fornell and Larcker (1984). Meeting this criterion is very difficult if it is applied 'correctly'. An irony is that its high false positive rate has been interpreted positively as a sign of the statistical power, and may have contributed to the popularity of this technique.

The fourth tab is reliability, which is the second purpose of creating MQAssessor. Existing SEM softwares do not automatically calculate SEM based reliability. To alleviate this inconvenience, MQAssessor automatically provides several reliability coefficients.

Output

Model fit | Parameter estimates | Discriminant validity | Reliability estimates | Correlation table

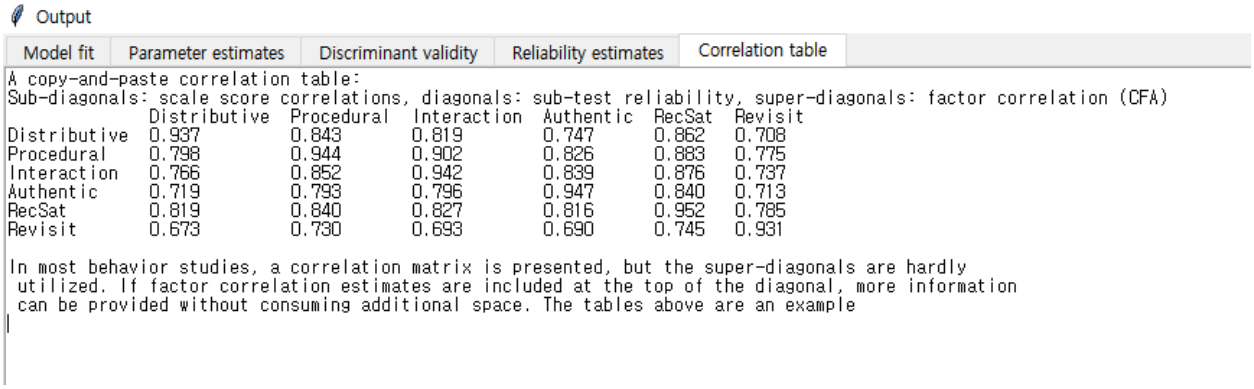
Reliability estimates:
Correlated factors reliability of the model is 0.988.
Various reliability estimates for each latent variable are as follows.

	Subtest reliability	Congeneric reliability	Tau-equivalent reliability	Parallel reliability
Distributive	0.937	0.937	0.936	0.936
Procedural	0.944	0.944	0.943	0.944
Interaction	0.942	0.943	0.942	0.943
Authentic	0.947	0.946	0.946	0.947
RecSat	0.952	0.952	0.948	0.948
Revisit	0.931	0.930	0.924	0.924

Correlated factor reliability is a multidimensional reliability coefficient that is not recommended to be presented alone without subtest reliability coefficients. Subtest reliability and congeneric reliability have analogous formulas, both of which are often referred to as composite reliability. The difference between the two is that the former is calculated from the values obtained from the correlated factors model and the latter is calculated from the values obtained from the unidimimensional model. Tau-equivalent reliability is often referred to as the historically incorrect name Cronbach's alpha. Most experts disagree with its use because it tends to underestimate reliability and is less accurate. Parallel reliability (i.e., standardized alpha) is less accurate than tau-equivalent reliability. See the following article for more information.

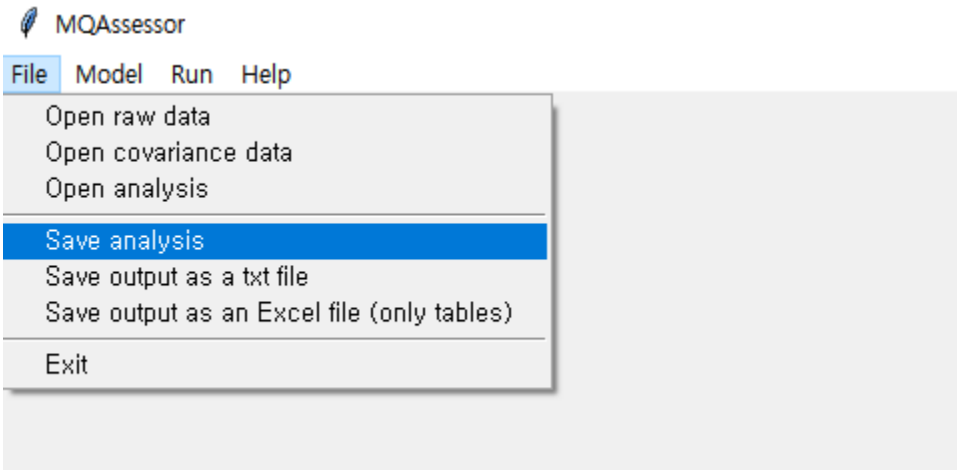
Cho, E. (2016). Making reliability reliable: A systematic approach to reliability coefficients. Organizational Research Methods, 19(4), 651-682.

The fifth tap is a matrix of correlations and reliability coefficents. In applied research, correlation matrices are often presented, typically with reliability coefficients on the diagonal, scale score correlations on the sub-diagonals, and blank on the super-diagonals. Displaying disattenuated correlations in this unused place can be much more useful. MQAssessor automates this matrix because this process can be difficult or error-prone for some users.



Step 5. Save the analysis and results

If you save the analysis, you can run it immediately without specifying a measurement model the next time you run it. MQAssessor uses * .mqa as an analysis file.



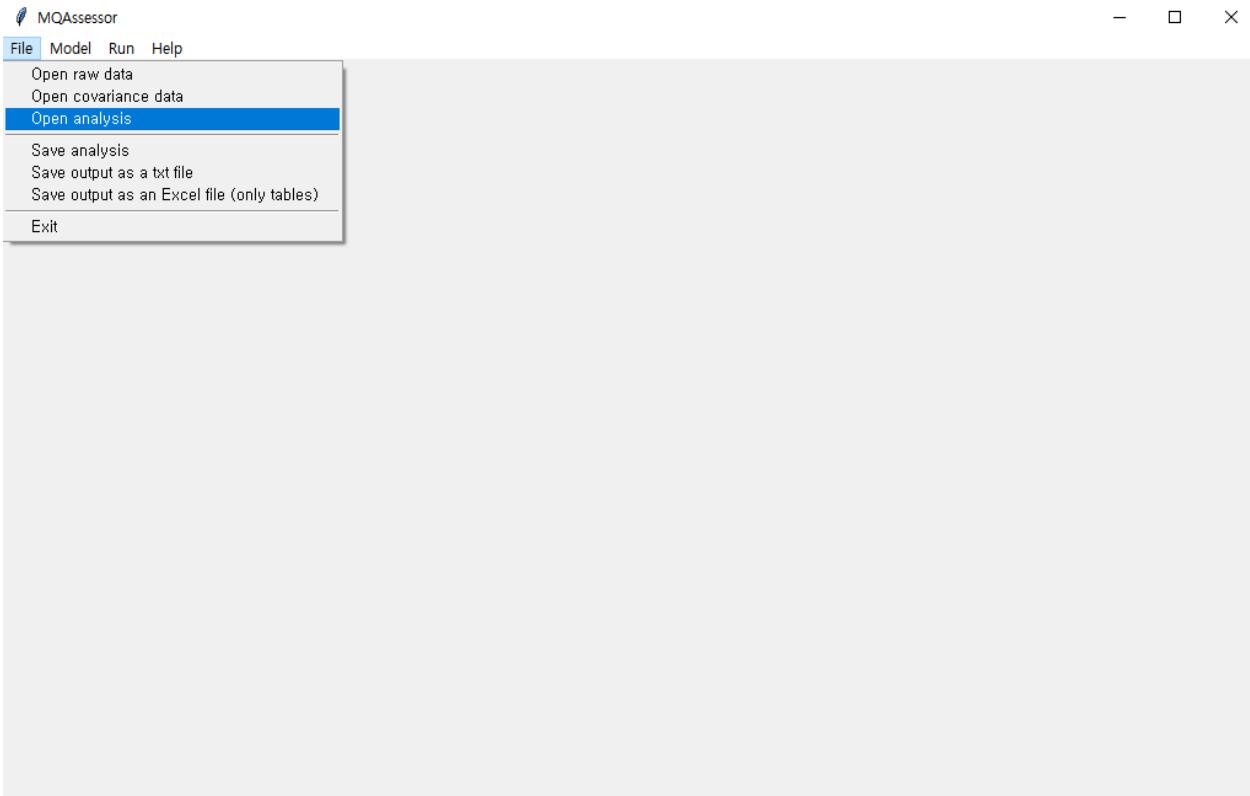
The result can be saved in three ways. First, if you want to save the entire output, choose "Save output as a txt file". Second, if you want to save in Excel format, select "Save output as an Excel

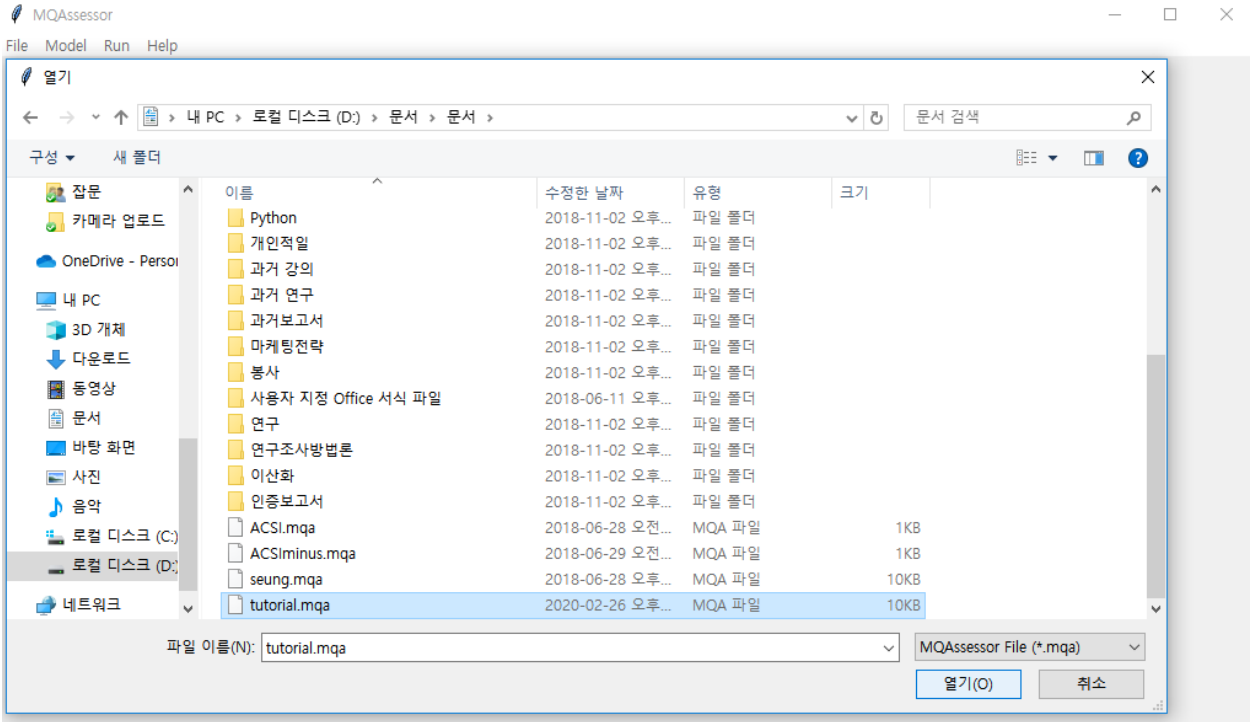
file". In this case, however, only table type results are stored. Third, if you want to save only the parts you need in the output window, you can copy-paste them.

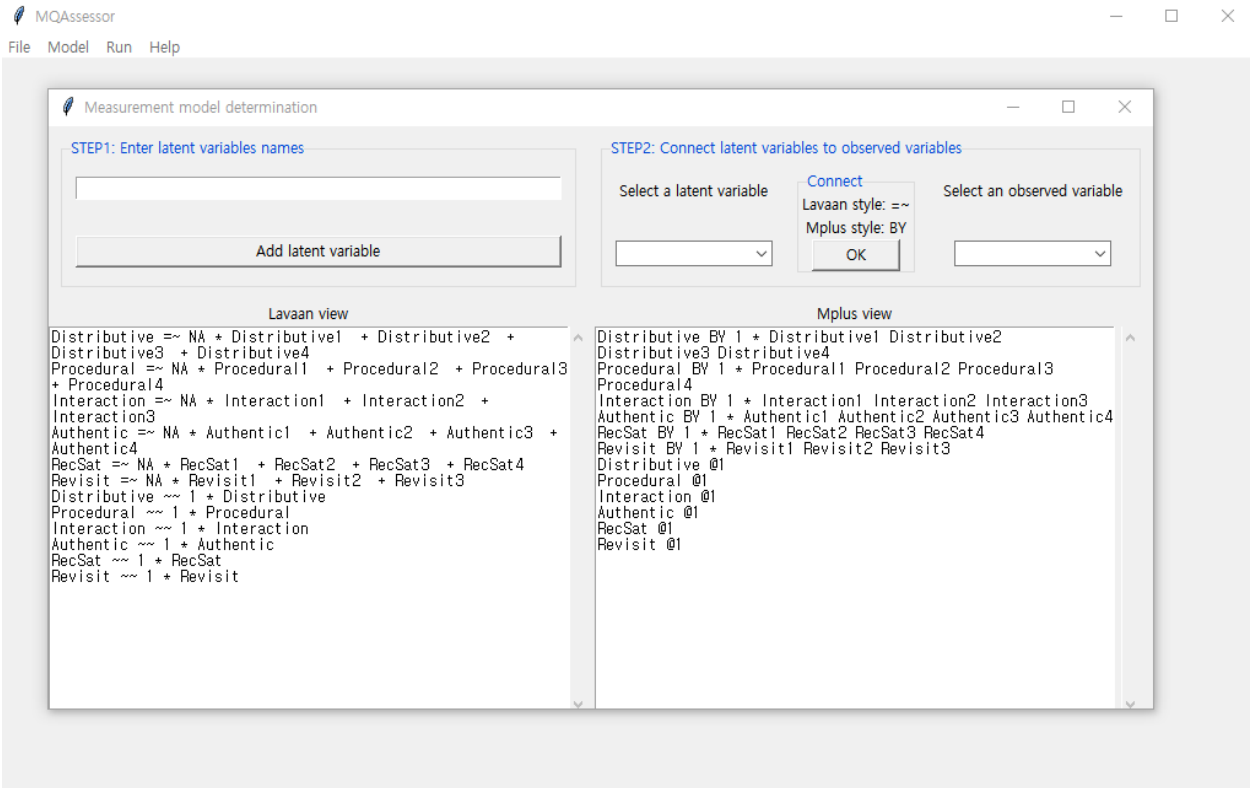
Procedure for

Procedure for reanalyzing an existing saved analysis

Existing analyzes are saved as * .mqa files. Opening an existing analysis allows you to respecify the measurement model.




MQAssessor
File Model Run Help
열기
내 PC › 로컬 디스크 (D:) › 문서 › 문서 ›
문서 검색
구성
새 폴더
잡문
카메라 업로드
OneDrive - Perso
내 PC
3D 개체
다운로드
동영상
문서
바탕 화면
사진
음악
로컬 디스크 (C:)
로컬 디스크 (D:)
네트워크
이름
수정한 날짜
유형
크기
Python 2018-11-02 오후... 파일 폴더
개인적일 2018-11-02 오후... 파일 폴더
과거 강의 2018-11-02 오후... 파일 폴더
과거 연구 2018-11-02 오후... 파일 폴더
과거보고서 2018-11-02 오후... 파일 폴더
마케팅전략 2018-11-02 오후... 파일 폴더
봉사 2018-11-02 오후... 파일 폴더
사용자 지정 Office 서식 파일 2018-06-11 오후... 파일 폴더
연구 2018-11-02 오후... 파일 폴더
연구조사방법론 2018-11-02 오후... 파일 폴더
이산화 2018-11-02 오후... 파일 폴더
인증보고서 2018-11-02 오후... 파일 폴더
ACSI.mqa 2018-06-28 오전... MQA 파일 1KB
ACSIminus.mqa 2018-06-29 오전... MQA 파일 1KB
seung.mqa 2018-06-28 오후... MQA 파일 10KB
tutorial.mqa 2020-02-26 오후... MQA 파일 10KB
파일 이름(N): tutorial.mqa
MQAssessor File (*.mqa)
열기(O)
취소


MQAssessor
File Model Run Help
Measurement model determination
STEP1: Enter latent variables names
Add latent variable
STEP2: Connect latent variables to observed variables
Select a latent variable
Connect
Lavaan style: =~
Mplus style: BY
OK
Select an observed variable
Lavaan view
Distributive =~ NA * Distributive1 + Distributive2 +
Distributive3 + Distributive4
Procedural =~ NA * Procedural1 + Procedural2 + Procedural3
+ Procedural4
Interaction =~ NA * Interaction1 + Interaction2 +
Interaction3
Authentic =~ NA * Authentic1 + Authentic2 + Authentic3 +
Authentic4
RecSat =~ NA * RecSat1 + RecSat2 + RecSat3 + RecSat4
Revisit =~ NA * Revisit1 + Revisit2 + Revisit3
Distributive ~~ 1 * Distributive
Procedural ~~ 1 * Procedural
Interaction ~~ 1 * Interaction
Authentic ~~ 1 * Authentic
RecSat ~~ 1 * RecSat
Revisit ~~ 1 * Revisit
Mplus view
Distributive BY 1 * Distributive1 Distributive2
Distributive3 Distributive4
Procedural BY 1 * Procedural1 Procedural2 Procedural3
Procedural4
Interaction BY 1 * Interaction1 Interaction2 Interaction3
Authentic BY 1 * Authentic1 Authentic2 Authentic3 Authentic4
RecSat BY 1 * RecSat1 RecSat2 RecSat3 RecSat4
Revisit BY 1 * Revisit1 Revisit2 Revisit3
Distributive @1
Procedural @1
Interaction @1
Authentic @1
RecSat @1
Revisit @1