Description

To demonstrate a multiple-indicators multiple-causes (MIMIC) model with generalized indicators, we use the same data used in [SEM] **Example 35g**:

```
. use https://www.stata-press.com/data/r19/gsem_issp93
(Selection for ISSP 1993)

. describe

Contains data from https://www.stata-press.com/data/r19/gsem_issp93.dta
 Observations:            871                  Selection for ISSP 1993
    Variables:              8                  21 Mar 2024 16:03
                                               (_dta has notes)
```

Variable name	Storage type	Display format	Value label	Variable label
id	int	%9.0g		Respondent identifier
y1	byte	%26.0g	agree5	Too much science, not enough feelings & faith
y2	byte	%26.0g	agree5	Science does more harm than good
y3	byte	%26.0g	agree5	Any change makes nature worse
y4	byte	%26.0g	agree5	Science will solve environmental problems
sex	byte	%9.0g	sex	Sex
age	byte	%9.0g	age	Age (6 categories)
edu	byte	%20.0g	edu	Education (6 categories)

```
Sorted by:

. notes

_dta:
  1.  Source: Data from pages 42-43 of Greenacre, M. J., and J. Blasius. 2006.
      Multiple Correspondence Analysis and Related Methods. Boca Raton, FL:
      Chapman & Hall. Data are part of the International Social Survey Program
      (ISSP) 1993.
  2.  Full text of y1: We believe too often in science, and not enough in
      feelings and faith.
  3.  Full text of y2: Overall, modern science does more harm than good.
  4.  Full text of y3: Any change humans cause in nature, no matter how
      scientific, is likely to make things worse.
  5.  Full text of y4: Modern science will solve our environmental problems
      with little change to our way of life.
```

See *Structural models 10: MIMIC models* in [SEM] **Intro 5** for background.

Remarks and examples

Remarks are presented under the following headings:

Fitting the MIMIC model
Fitting the model with the Builder

Fitting the MIMIC model

For a refresher on MIMIC models, see [SEM] **Example 10**. In the data above, we have ordered categorical indicators. For an explanation on how we are about to treat these indicators with ordered probit, see [SEM] **Example 35g**.

We wish to fit the following model:
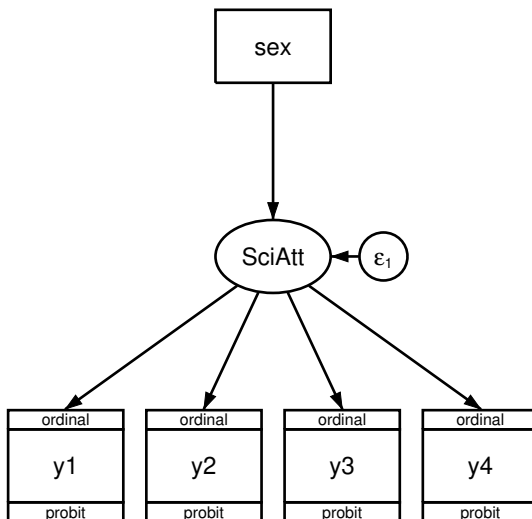
We fit the model in the command language by typing

```
. gsem (y1 y2 y3 y4 <- SciAtt) (SciAtt <- sex), oprobit
Fitting fixed-effects model:
Iteration 0:  Log likelihood = -5227.8743
Iteration 1:  Log likelihood = -5227.8743
Refining starting values:
Grid node 0:  Log likelihood = -5230.8106
Fitting full model:
Iteration 0:  Log likelihood = -5230.8106  (not concave)
Iteration 1:  Log likelihood = -5132.1065  (not concave)
Iteration 2:  Log likelihood = -5066.8481
Iteration 3:  Log likelihood = -5033.2807
Iteration 4:  Log likelihood = -5032.7884
Iteration 5:  Log likelihood = -5032.3837
Iteration 6:  Log likelihood = -5032.3778
Iteration 7:  Log likelihood = -5032.3778
```

```
Generalized structural equation model                    Number of obs = 871
Response: y1
Family:   Ordinal
Link:     Probit
Response: y2
Family:   Ordinal
Link:     Probit
Response: y3
Family:   Ordinal
Link:     Probit
Response: y4
Family:   Ordinal
Link:     Probit
Log likelihood = -5032.3778
 ( 1)  [y1]SciAtt = 1
```

	Coefficient	Std. err.	z	P>|z|	[95% conf. interval]	
y1						
SciAtt	1	(constrained)				
y2						
SciAtt	1.405732	.2089672	6.73	0.000	.9961641	1.8153
y3						
SciAtt	1.246449	.1710771	7.29	0.000	.911144	1.581754
y4						
SciAtt	-.0345517	.0602017	-0.57	0.566	-.1525449	.0834415
SciAtt						
sex	-.2337427	.0644245	-3.63	0.000	-.3600124	-.1074729
/y1						
cut1	-1.469615	.0855651			-1.63732	-1.301911
cut2	-.10992	.0615897			-.2306336	.0107937
cut3	.6729334	.0644695			.5465755	.7992914
cut4	1.879901	.0996675			1.684557	2.075246
/y2						
cut1	-2.16739	.1480596			-2.457582	-1.877199
cut2	-.9912152	.0943091			-1.176058	-.8063727
cut3	-.1118914	.075311			-.2594982	.0357154
cut4	1.252164	.0983918			1.05932	1.445008
/y3						
cut1	-1.412372	.0977772			-1.604012	-1.220733
cut2	-.0230879	.0687432			-.1578221	.1116464
cut3	.8209522	.0771653			.6697109	.9721935
cut4	1.966042	.1196586			1.731515	2.200568
/y4						
cut1	-1.47999	.0650596			-1.607505	-1.352476
cut2	-.4218768	.0443504			-.508802	-.3349516
cut3	.172995	.0432394			.0882473	.2577427
cut4	.9454906	.0507422			.8460376	1.044944
var(e.SciAtt)	.5283629	.0978703			.3675036	.7596315

Notes:

1. Our latent variable measures a negative attitude toward science, just as it did in [SEM] **Example 35g**.

2. In this MIMIC model, we allow males and females to have different underlying attitudes toward science.

3. The coefficient for SciAtt <- sex is −0.234. Variable sex is equal to 1 for females, thus females have a lower mean value for SciAtt by 0.234. Because our SciAtt measure is reversed, this means that females have a more positive attitude toward science. The effect is significant at better than the 1% level.

4. The difference between males and females in SciAtt is −0.234. Is that big or small, practically speaking?

   In the ordered probit specification, predicted agreement with questions is determined by an index into a $N(0, 1)$ distribution. The value of the index is then compared with the cutpoints to determine the probability that the response is 1, 2, 3, 4, or 5.

   For statement 1, the loading on SciAtt is 1, and therefore the average difference in the probit index for males and females is $-0.234 \times 1 = -0.234$ standard deviation units. Females are 0.234 standard deviations to the left of males on average.

   For statement 2, the loading on SciAtt is 1.41, and therefore the average difference in the probit index is $-0.234 \times 1.41 = -0.33$ standard deviation units.

   You can work out the effect size for the other statements. We would say that the effect is medium sized.

Fitting the model with the Builder

Use the diagram in *Fitting the MIMIC model* above for reference.

1. Open the dataset.

   In the Command window, type

   ```
   . use https://www.stata-press.com/data/r19/gsem_issp93
   ```

2. Open a new Builder diagram.

   Select menu item **Statistics > SEM (structural equation modeling) > Model building and estimation**.

3. Put the Builder in gsem mode by clicking on the $\overset{G}{\text{SEM}}$ button.

4. Create the measurement component for SciAtt.

   Select the Add measurement component tool, ♈, and then click in the diagram halfway down and slightly left of the center.

   In the resulting dialog box,

   a. change the *Latent variable name* to SciAtt;

   b. select y1, y2, y3, and y4 by using the *Measurement variables* control;

   c. check *Make measurements generalized*;

   d. select Ordinal, Probit in the *Family/Link* control;

    e. select `Down` in the *Measurement direction* control;

    f. click on **OK**.

  If you wish, move the component by clicking on any variable and dragging it.

5. Create the variable for the formative indicator of `SciAtt`.

    a. Select the Add observed variable tool, □ , and then click in the diagram directly above the oval for `SciAtt` and about one-fourth of the way down from the top. After adding it, you can click inside the rectangle to move the variable if you wish.

    b. In the Contextual Toolbar, select `sex` with the *Variable* control.

6. Create the path from the formative indicator to `SciAtt`.

    a. Select the Add path tool, � .

    b. Click in the bottom of the `sex` rectangle (it will highlight when you hover over it), and drag a path to the top of the `SciAtt` oval (it will highlight when you can release to connect the path).

7. Clean up the direction of the error.

  The error on `SciAtt` is likely to have been created below the oval for `SciAtt`. Choose the Select tool, ▶ , and then click in the `SciAtt` oval. Click on one of the **Error rotation** buttons, ↶↷ , in the Contextual Toolbar until the error is where you want it.

8. Clean up the location of the path.

  If you do not like where the path between `sex` and `SciAtt` has been connected to its variables, use the Select tool, ▶ , to click on the path, and then simply click on where it connects to a rectangle or oval and drag the endpoint.

9. Estimate.

  Click on the **Estimate** button, ▶ , in the Standard Toolbar, and then click on **OK** in the resulting *GSEM estimation options* dialog box.

  You can open a completed diagram in the Builder by typing

    . webgetsem gsem_mimic

Reference

Greenacre, M. J. 2006. "From simple to multiple correspondence analysis". In *Multiple Correspondence Analysis and Related Methods*, edited by M. J. Greenacre and J. Blasius. Boca Raton, FL: Chapman and Hall.

Also see

[SEM] **Example 10** — MIMIC model

[SEM] **Example 35g** — Ordered probit and ordered logit

[SEM] **Intro 5** — Tour of models

[SEM] **gsem** — Generalized structural equation model estimation command

For suggested citations, see the FAQ on citing Stata documentation.