

**Example 11** — estat framework

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## Description

To demonstrate `estat framework`, which displays results in Bentler–Weeks form, we continue where [\[SEM\] Example 10](#) left off:

```

. use https://www.stata-press.com/data/r18/sem_mimic1
. ssd describe
. notes
. sem (SubjSES -> s_income s_occpres s_socstat)   ///
      (SubjSES <- income occpres)
. estat residuals, normalized
. estimates store mimic1
. sem (SubjSES -> s_income s_occpres s_socstat)   ///
      (SubjSES <- income occpres)               ///
      (s_income <- income)                       ///
      (s_occpres <- occpres)
. lrtest mimic1 .

```

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

## Remarks and examples

[stata.com](#)

If you prefer to see SEM results reported in Bentler–Weeks form, type `estat framework` after estimating with `sem`. Many people find Bentler–Weeks form helpful in understanding how the model is fit.

[\[SEM\] Example 10](#) ended by fitting

```

. sem (SubjSES -> s_income s_occpres s_socstat)   ///
      (SubjSES <- income occpres)               ///
      (s_income <- income)                       ///
      (s_occpres <- occpres)

```

In Bentler–Weeks form, the output appears as

```

. estat framework, fitted
Endogenous variables on endogenous variables

```

| Beta      | Observed | s_income | s_occpres | s_socstat | Latent   |
|-----------|----------|----------|-----------|-----------|----------|
|           |          |          |           |           | SubjSES  |
| Observed  |          |          |           |           |          |
| s_income  | 0        |          | 0         | 0         | 1        |
| s_occpres | 0        |          | 0         | 0         | .783781  |
| s_socstat | 0        |          | 0         | 0         | 1.195539 |
| Latent    |          |          |           |           |          |
| SubjSES   | 0        |          | 0         | 0         | 0        |

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### Endogenous variables on exogenous variables

| Gamma     | Observed |          |
|-----------|----------|----------|
|           | income   | occpres  |
| Observed  |          |          |
| s_income  | .0532425 | 0        |
| s_occpres | 0        | .0045201 |
| s_socstat | 0        | 0        |
| Latent    |          |          |
| SubjSES   | .0538025 | .0034324 |

### Covariances of error variables

| Psi         | Observed   |           |           | Latent    |
|-------------|------------|-----------|-----------|-----------|
|             | e.s_incr~e | e.s_occ~s | e.s_soc~t | e.SubjSES |
| Observed    |            |           |           |           |
| e.s_income  | .2292697   |           |           |           |
| e.s_occpres | 0          | .2773786  |           |           |
| e.s_socstat | 0          | 0         | .1459009  |           |
| Latent      |            |           |           |           |
| e.SubjSES   | 0          | 0         | 0         | .1480275  |

### Intercepts of endogenous variables

| alpha | Observed |           |           | Latent  |
|-------|----------|-----------|-----------|---------|
|       | s_income | s_occpres | s_socstat | SubjSES |
| _cons | .8825314 | 1.06586   | 1.07922   | 0       |

### Covariances of exogenous variables

| Phi      | Observed |          |
|----------|----------|----------|
|          | income   | occpres  |
| Observed |          |          |
| income   | 4.820021 |          |
| occpres  | 13.62431 | 451.6628 |

### Means of exogenous variables

| kappa | Observed |         |
|-------|----------|---------|
|       | income   | occpres |
| mean  | 5.04     | 36.698  |

## Fitted covariances of observed and latent variables

|           | Observed |           |           | Latent   | Observed |
|-----------|----------|-----------|-----------|----------|----------|
| Sigma     | s_income | s_occpres | s_socstat | SubjSES  | income   |
| Observed  |          |           |           |          |          |
| s_income  | .4478609 |           |           |          |          |
| s_occpres | .1614446 | .4086519  |           |          |          |
| s_socstat | .225515  | .1738222  | .392219   |          |          |
| Latent    |          |           |           |          |          |
| SubjSES   | .1886304 | .1453924  | .2060311  | .1723333 |          |
| Observed  |          |           |           |          |          |
| income    | .5627232 | .3014937  | .3659463  | .3060932 | 4.820021 |
| occpres   | 3.008694 | 3.831184  | 2.729776  | 2.283302 | 13.62431 |
|           |          |           |           |          |          |
| Sigma     | Observed |           |           |          |          |
|           | occpres  |           |           |          |          |
| Observed  |          |           |           |          |          |
| occpres   | 451.6628 |           |           |          |          |

## Fitted means of observed and latent variables

|    | Observed |           |           | Latent   | Observed |
|----|----------|-----------|-----------|----------|----------|
| mu | s_income | s_occpres | s_socstat | SubjSES  | income   |
| mu | 1.548    | 1.543     | 1.554     | .3971264 | 5.04     |
|    |          |           |           |          |          |
| mu | Observed |           |           |          |          |
|    | occpres  |           |           |          |          |
| mu | 36.698   |           |           |          |          |

## Notes:

1. Bentler–Weeks form is a vector and matrix notation for the estimated parameters of the model. The matrices are known as  $\beta$ ,  $\Gamma$ ,  $\Psi$ ,  $\alpha$ ,  $\Phi$ , and  $\kappa$ . Those Greek names are spelled out in the labels, along with a header stating what each contains.
2. We specified `estat framework` option `fitted`. That caused `estat framework` to list one more matrix and one more vector at the end:  $\Sigma$  and  $\mu$ . These two results are especially interesting to those wishing to see the ingredients of the residuals reported by `estat residuals`.
3. One of the more useful results reported by `estat framework, fitted` is the  $\Sigma$  matrix, which reports all estimated covariances in a readable format and includes the model-implied covariances that do not appear in `sem`'s ordinary output.
4. `estat framework` also allows the `standardized` option if you want standardized output.

## Also see

[SEM] [Example 10](#) — MIMIC model

[SEM] [estat framework](#) — Display estimation results in modeling framework

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