

example 16 — Correlation

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Description

`sem` can be used to produce correlations or covariances between exogenous variables. The advantages of using `sem` over Stata's `correlate` command are that you can perform statistical tests on the results and that you can handle missing values in a more elegant way.

To demonstrate these features, we use

```
. use http://www.stata-press.com/data/r15/census13
(1980 Census data by state)
. describe
Contains data from http://www.stata-press.com/data/r15/census13.dta
obs:                50                1980 Census data by state
vars:                9                2 Dec 2016 14:01
size:                1,250
```

| variable name | storage type | display format | value label | variable label |
|---------------|--------------|----------------|-------------|-----------------|
| state | byte | %13.0g | state1 | State |
| brate | int | %10.0g | | Birth rate |
| pop | long | %12.0gc | | Population |
| medage | float | %9.2f | | Median age |
| division | byte | %8.0g | division | Census division |
| region | byte | %-8.0g | cenreg | Census region |
| mrgrate | float | %9.0g | | Marriage rate |
| dvcrate | float | %9.0g | | Divorce rate |
| medagesq | float | %9.0g | | |

Sorted by:

See [Correlations](#) in [\[SEM\] intro 5](#) for background.

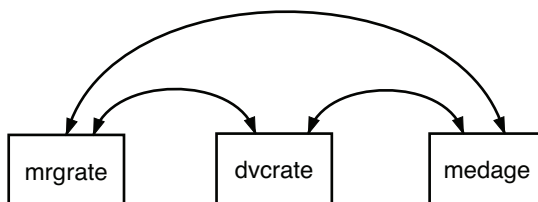
Remarks and examples

Remarks are presented under the following headings:

- [Using sem to obtain correlation matrices](#)
- [Fitting the model with the Builder](#)
- [Testing correlations with estat stdize and test](#)

Using sem to obtain correlation matrices

We fit the following model:



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This model does nothing more than estimate the covariances (correlations), something we could obtain from the `correlate` command by typing

```
. correlate mrgrate dvcrate medage
(obs=50)
```

| | mrgrate | dvcrate | medage |
|---------|---------|---------|--------|
| mrgrate | 1.0000 | | |
| dvcrate | 0.7700 | 1.0000 | |
| medage | -0.0177 | -0.2229 | 1.0000 |

```
. correlate mrgrate dvcrate medage, covariance
(obs=50)
```

| | mrgrate | dvcrate | medage |
|---------|----------|----------|---------|
| mrgrate | .000662 | | |
| dvcrate | .000063 | 1.0e-05 | |
| medage | -.000769 | -.001191 | 2.86775 |

As explained in *Correlations* in [SEM] [intro 5](#), to see results presented as correlations rather than as covariances, we specify `sem`'s `standardized` option:

```
. sem ( <- mrgrate dvcrate medage), standardized
Exogenous variables
Observed: mrgrate dvcrate medage
Fitting target model:
Iteration 0: log likelihood = 258.58985
Iteration 1: log likelihood = 258.58985
Structural equation model          Number of obs    =      50
Estimation method = ml
Log likelihood      = 258.58985
```

| Standardized | OIM | | z | P> z | [95% Conf. Interval] | |
|-----------------------|-----------|-----------|-------|-------|----------------------|----------|
| | Coef. | Std. Err. | | | | |
| mean(mrgrate) | .7332509 | .1593002 | 4.60 | 0.000 | .4210282 | 1.045474 |
| mean(dvcrate) | 2.553791 | .291922 | 8.75 | 0.000 | 1.981634 | 3.125947 |
| mean(medage) | 17.62083 | 1.767749 | 9.97 | 0.000 | 14.15611 | 21.08556 |
| var(mrgrate) | 1 | . | | | . | . |
| var(dvcrate) | 1 | . | | | . | . |
| var(medage) | 1 | . | | | . | . |
| cov(mrgrate, dvcrate) | .7699637 | .0575805 | 13.37 | 0.000 | .6571079 | .8828195 |
| cov(mrgrate, medage) | -.0176541 | .1413773 | -0.12 | 0.901 | -.2947485 | .2594403 |
| cov(dvcrate, medage) | -.222932 | .1343929 | -1.66 | 0.097 | -.4863373 | .0404732 |

```
LR test of model vs. saturated: chi2(0) = 0.00, Prob > chi2 = .
```

Note:

1. The correlations reported are

| | sem | correlate |
|---------------------|------------|-----------|
| mrgrate and dvcrate | 0.7699637 | 0.7700 |
| mrgrate and medage | -0.0176541 | -0.0177 |
| dvcrate and medage | -0.222932 | -0.2229 |

Fitting the model with the Builder

Use the diagram above for reference.

1. Open the dataset.


In the Command window, type

```
. use http://www.stata-press.com/data/r15/census13
```

2. Open a new Builder diagram.

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

3. Create the set of observed variables.

Select the Add observed variables set tool, , and then click in the diagram about halfway down from the top and a quarter of the way in from the left.


In the resulting dialog box,

- a. select the *Select variables* radio button (it may already be selected);
- b. use the *Variables* control to select the variables in this order: `mrgrate`, `dvcrate`, and `medage`;
- c. select **Horizontal** in the *Orientation* control;
- d. select the **Distances** tab;
- e. select `.5` (inch) in the *Distance between variables* control;
- f. click on **OK**.


If you wish, move the set of variables by clicking on any variable and dragging it.

Be sure you select the observed variables in the order indicated above; otherwise, the instructions below for creating covariances will not be correct.

4. Correlate each pair of variables.

- a. Select the Add covariance tool, .
- b. Click in the top of the `mrgrate` rectangle, slightly to the right of the center (it will highlight when you hover over it), and drag a path to the top of the `dvcrate` rectangle, slightly to the left of the center (it will highlight when you can release to connect the covariance).
- c. Click in the top of the `dvcrate` rectangle, slightly to the right of the center, and drag a path to the top of the `medage` rectangle, slightly to the left of the center.
- d. Click in the top of the `mrgrate` rectangle, slightly to the left of the center, and drag a path to the top of the `medage` rectangle, slightly to the right of the center.

5. Clean up.

If you do not like where a covariance has been connected to its variable, use the Select tool, , to click on the covariance, and then simply click on where it connects to an oval and drag the endpoint. You can also change the bow of the covariance by dragging the control point that extends from one end of the selected covariance.

6. Estimate.

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

7. Show standardized estimates.

From the SEM Builder menu, select **View > Standardized estimates**.

You can open a completed diagram in the Builder by typing

```
. webgetsem sem_corr
```

Testing correlations with estat stdize and test

We can test whether the correlations between median age and marriage and divorce rates are equal with `test` by typing

```
. estat stdize: ///
      test _b[/cov(medage,mrgrate)] = _b[/cov(medage,dvcrate)]
```

We must prefix `test` with `estat stdize` because otherwise we would be testing equality of covariances; see *Displaying other results, statistics, and tests (sem and gsem)* in [SEM] [intro 7](#) and see [SEM] [estat stdize](#).

That we refer to the two correlations (covariances) by typing `_b[/cov(medage,mrgrate)]` and `_b[/cov(medage,dvcrate)]` is something nobody remembers and that we remind ourselves of by redisplaying `sem` results with the `coeflegend` option:

```
. sem, coeflegend
Structural equation model           Number of obs   =           50
Estimation method   = ml
Log likelihood      = 258.58985
```

| | Coef. | Legend |
|--------------------------|-----------|---------------------------|
| mean(mrgrate) | .0186789 | _b[/mean(mrgrate)] |
| mean(dvcrate) | .0079769 | _b[/mean(dvcrate)] |
| mean(medage) | 29.54 | _b[/mean(medage)] |
| var(mrgrate) | .0006489 | _b[/var(mrgrate)] |
| var(dvcrate) | 9.76e-06 | _b[/var(dvcrate)] |
| var(medage) | 2.8104 | _b[/var(medage)] |
| cov(mrgrate, dvcrate) | .0000613 | _b[/cov(mrgrate,dvcrate)] |
| cov(mrgrate, medage) | -.0007539 | _b[/cov(mrgrate,medage)] |
| cov(dvcrate, medage) | -.0011674 | _b[/cov(dvcrate,medage)] |

```
LR test of model vs. saturated: chi2(0) = 0.00, Prob > chi2 = .
```

We can now obtain the test:

```
. estat stdize:
>      test _b[/cov(medage,mrgrate)] = _b[/cov(medage,dvcrate)]
( 1)  [/]cov(mrgrate,medage) - [/]cov(dvcrate,medage) = 0
      chi2( 1) =      4.78
      Prob > chi2 =      0.0288
```

Note:

1. We can reject the test at the 5% level.

Also see

[SEM] **test** — Wald test of linear hypotheses

[SEM] **estat stdize** — Test standardized parameters

[R] **correlate** — Correlations (covariances) of variables or coefficients