Title

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example 16 — Correlation

Description Remarks and examples Also see

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
-------------------------------------------------------------------------------
              storage   display    value
variable name   type    format     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

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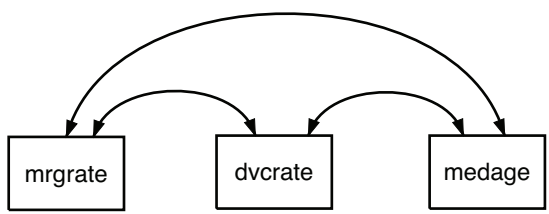
Remarks are presented under the following headings:

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:



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	Coef.	OIM Std. Err.	z	P>|z|	[95% Conf.	Interval]
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