Title

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pcorr — Partial and semipartial correlation coefficients

Syntax

`pcorr` *varname*$_1$ *varlist* [*if*] [*in*] [*weight*]

varname$_1$ and *varlist* may contain time-series operators; see **[U] 11.4.4 Time-series varlists**.

`by` is allowed; see **[D] by**.

`aweight`s and `fweight`s are allowed; see **[U] 11.1.6 weight**.

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Description

`pcorr` displays the partial and semipartial correlation coefficients of *varname*$_1$ with each variable in *varlist* after removing the effects of all other variables in *varlist*. The squared correlations and corresponding significance are also reported.

Remarks and examples

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Assume that y is determined by $x_1, x_2, \ldots, x_k$. The partial correlation between y and x_1 is an attempt to estimate the correlation that would be observed between y and x_1 if the other x's did not vary. The semipartial correlation, also called part correlation, between y and x_1 is an attempt to estimate the correlation that would be observed between y and x_1 after the effects of all other x's are removed from x_1 but not from y.

Both squared correlations estimate the proportion of the variance of y that is explained by each predictor. The squared semipartial correlation between y and x_1 represents the proportion of variance in y that is explained by x_1 only. This squared correlation can also be interpreted as the decrease in the model's R^2 value that results from removing x_1 from the full model. Thus one could use the squared semipartial correlations as criteria for model selection. The squared partial correlation between y and x_1 represents the proportion of variance in y not associated with any other x's that is explained by x_1. Thus the squared partial correlation gives an estimate of how much of the variance of y not explained by the other x's is explained by x_1.

▷ Example 1

Using our automobile dataset (described in **[U] 1.2.2 Example datasets**), we can obtain the simple correlations between `price`, `mpg`, `weight`, and `foreign` from `correlate` (see **[R] correlate**):

```
. use http://www.stata-press.com/data/r13/auto
(1978 Automobile Data)

. correlate price mpg weight foreign
(obs=74)

             |    price      mpg   weight  foreign
-------------+------------------------------------
       price |   1.0000
         mpg |  -0.4686   1.0000
      weight |   0.5386  -0.8072   1.0000
     foreign |   0.0487   0.3934  -0.5928   1.0000
```

Although `correlate` gave us the full correlation matrix, our interest is in just the first column. We find, for instance, that the higher the `mpg`, the lower the `price`. We obtain the partial and semipartial correlation coefficients by using `pcorr`:

```
. pcorr price mpg weight foreign
(obs=74)

Partial and semipartial correlations of price with

               Partial   Semipartial      Partial   Semipartial   Significance
   Variable     Corr.         Corr.      Corr.^2       Corr.^2          Value
------------+--------------------------------------------------------------
        mpg     0.0352        0.0249       0.0012        0.0006         0.7693
     weight     0.5488        0.4644       0.3012        0.2157         0.0000
    foreign     0.5402        0.4541       0.2918        0.2062         0.0000
```

We now find that the partial and semipartial correlations of `price` with `mpg` are near 0. In the simple correlations, we found that `price` and `foreign` were virtually uncorrelated. In the partial and semipartial correlations, we find that `price` and `foreign` are positively correlated. The nonsignificance of `mpg` tells us that the amount in which R^2 decreases by removing `mpg` from the model is not significant. We find that removing either `weight` or `foreign` results in a significant drop in the R^2 of the model.

◁

❑ Technical note

Use caution when interpreting the above results. As we said at the outset, the partial and semipartial correlation coefficients are an *attempt* to estimate the correlation that would be observed if the effects of all other variables were taken out of both y and x or only x. `pcorr` makes it too easy to ignore the fact that we are fitting a model. In the example above, the model is

$$\texttt{price} = \beta_0 + \beta_1\texttt{mpg} + \beta_2\texttt{weight} + \beta_3\texttt{foreign} + \epsilon$$

which is, in all honesty, a rather silly model. Even if we accept the implied economic assumptions of the model—that consumers value `mpg`, `weight`, and `foreign`—do we really believe that consumers place equal value on every extra 1,000 pounds of weight? That is, have we correctly parameterized the model? If we have not, then the estimated partial and semipartial correlation coefficients may not represent what they claim to represent. Partial and semipartial correlation coefficients are a reasonable way to summarize data if we are convinced that the underlying model is reasonable. We should not, however, pretend that there is no underlying model and that these correlation coefficients are unaffected by the assumptions and parameterization.

❑

Stored results

pcorr stores the following in r():

Scalars
- r(N) number of observations
- r(df) degrees of freedom

Matrices
- r(p_corr) partial correlation coefficient vector
- r(sp_corr) semipartial correlation coefficient vector

Methods and formulas

Results are obtained by fitting a linear regression of *varname*$_1$ on *varlist*; see [R] **regress**. The partial correlation coefficient between *varname*$_1$ and each variable in *varlist* is then calculated as

$$\frac{t}{\sqrt{t^2+n-k}}$$

(Greene 2012, 37), where t is the t statistic, n is the number of observations, and k is the number of independent variables, including the constant but excluding any dropped variables.

The semipartial correlation coefficient between *varname*$_1$ and each variable in *varlist* is calculated as

$$\mathrm{sign}(t)\sqrt{\frac{t^2(1-R^2)}{n-k}}$$

(Cohen et al. 2003, 89), where R^2 is the model R^2 value, and t, n, and k are as described above.

The significance is given by $2\Pr(t_{n-k} > |t|)$, where t_{n-k} follows a Student's t distribution with $n-k$ degrees of freedom.

Acknowledgment

The addition of semipartial correlation coefficients to pcorr is based on the pcorr2 command by Richard Williams of the Department of Sociology at the University of Notre Dame.

References

Cohen, J., P. Cohen, S. G. West, and L. S. Aiken. 2003. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. 3rd ed. Hillsdale, NJ: Erlbaum.

Greene, W. H. 2012. *Econometric Analysis*. 7th ed. Upper Saddle River, NJ: Prentice Hall.

Also see

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

[R] **spearman** — Spearman's and Kendall's correlations