Title

\textbf{\textit{vce} \textit{option} — Variance estimators}

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**Description**

This entry describes the \textit{vce()} option, which is common to most estimation commands. \textit{vce()} specifies how to estimate the variance–covariance matrix (VCE) corresponding to the parameter estimates. The standard errors reported in the table of parameter estimates are the square root of the variances (diagonal elements) of the VCE.

**Syntax**

\[
\text{\textit{estimation\_cmd} \ldots [, \textit{vce(vctype)} \ldots ]}
\]

\textit{vctype} \hspace{2cm} Description

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**Options**

\texttt{SE/Robust} \hspace{2cm} \texttt{vce(oim)} is usually the default for models fit using maximum likelihood. \texttt{vce(oim)} uses the observed information matrix (OIM); see [\textit{R}] \texttt{ml}.

\texttt{vce(opg)} uses the sum of the outer product of the gradient (OPG) vectors; see [\textit{R}] \texttt{ml}. This is the default VCE when the \texttt{technique(bhhh)} option is specified; see [\textit{R}] \texttt{Maximize}.

\texttt{vce(robust)} uses the robust or sandwich estimator of variance. This estimator is robust to some types of misspecification so long as the observations are independent; see [\textit{U}] 20.22 Obtaining robust variance estimates.
If the command allows pweights and you specify them, vce(robust) is implied; see [U] 20.24.3 Sampling weights.

vce(cluster clustvar) specifies that the standard errors allow for intragroup correlation, relaxing the usual requirement that the observations be independent. That is, the observations are independent across groups (clusters) but not necessarily within groups. clustvar specifies to which group each observation belongs, for example, vce(cluster personid) in data with repeated observations on individuals. vce(cluster clustvar) affects the standard errors and variance–covariance matrix of the estimators but not the estimated coefficients; see [U] 20.22 Obtaining robust variance estimates.

vce(bootstrap [, bootstrap_options]) uses a bootstrap; see [R] bootstrap. After estimation with vce(bootstrap), see [R] bootstrap postestimation to obtain percentile-based or bias-corrected confidence intervals.

vce(jackknife [, jackknife_options]) uses the delete-one jackknife; see [R] jackknife.

Remarks and examples

Remarks are presented under the following headings:

Prefix commands
Passing options in vce()

Prefix commands

Specifying vce(bootstrap) or vce(jackknife) is often equivalent to using the corresponding prefix command. Here is an example using jackknife with regress.

```
. use https://www.stata-press.com/data/r16/auto
(1978 Automobile Data)
. regress mpg turn trunk, vce(jackknife)
(running regress on estimation sample)
Jackknife replications (74)
.................................................. 50
.................................................. 50
Linear regression
Number of obs = 74
Replications = 74
F( 2, 73) = 66.26
Prob > F = 0.0000
R-squared = 0.5521
Adj R-squared = 0.5395
Root MSE = 3.9260

Jackknife
mpg

| Coef.     | Std. Err. | t    | P>|t|   | [95% Conf. Interval] |
|-----------|-----------|------|-------|---------------------|
| turn      | -.7610113 | .150726 | -5.05 | 0.000  | -1.061408  | -.4606147 |
| trunk     | -.3161825 | .1282326 | -2.47 | 0.016  | -.5717498 | -.0606152 |
| _cons     | 55.82001  | 5.031107 | 11.09 | 0.000  | 45.79303  | 65.84699  |
```

Prefix commands
. jackknife: regress mpg turn trunk
(running regress on estimation sample)

Jackknife replications (74)

.................................................. 50
........................

Linear regression

| Coef. | Std. Err. | t     | P>|t|   | [95% Conf. Interval] |
|-------|-----------|-------|-------|----------------------|
| turn  | -.7610113 | .150726 | -5.05 | 0.000    | -1.061408 - .4606147 |
| trunk | -.3161825 | .1282326| -2.47 | 0.016    | -.5717498 -.0606152 |
| _cons | 55.82001  | 5.031107| 11.09 | 0.000    | 45.79303  65.84699 |

Here it does not matter whether we specify the vce(jackknife) option or instead use the jackknife prefix.

However, vce(jackknife) should be used in place of the jackknife prefix whenever available because they are not always equivalent. For example, to use the jackknife prefix with clogit properly, you must tell jackknife to omit whole groups rather than individual observations. Specifying vce(jackknife) does this automatically.

. use https://www.stata-press.com/data/r16/clogitid
. jackknife, cluster(id): clogit y x1 x2, group(id)
(output omitted)

This extra information is automatically communicated to jackknife by clogit when the vce() option is specified.

. clogit y x1 x2, group(id) vce(jackknife)
(running clogit on estimation sample)

Jackknife replications (66)

.................................................. 50
........................

Conditional (fixed-effects) logistic regression

| Coef. | Std. Err. | t     | P>|t|   | [95% Conf. Interval] |
|-------|-----------|-------|-------|----------------------|
| x1    | .653363   | .3010608| 2.17  | 0.034    | .052103  1.254623 |
| x2    | .0659169  | .0487858| 1.35  | 0.181    | -.0315151 .1633489 |
Passing options in vce()

If you wish to specify more options to the bootstrap or jackknife estimation, you can include them within the vce() option. Below, we request 300 bootstrap replications and save the replications in bsreg.dta:

```
. use https://www.stata-press.com/data/r16/auto
(1978 Automobile Data)
. regress mpg turn trunk, vce(bootstrap, nodots seed(123) rep(300) saving(bsreg))
```

```
Linear regression
Number of obs = 74
Replications = 300
Wald chi2(2) = 144.17
Prob > chi2 = 0.0000
R-squared = 0.5521
Adj R-squared = 0.5395
Root MSE = 3.9260

mpg |     Observed     Bootstrap Normal-based
      |      Coef.     Std. Err.     z  P>|z|   [95% Conf. Interval]
-----|------------------|------------------|--------|--------|------------------|------------------|--------|--------|
  turn |  -.7610113       .1497877    -5.08   0.000   -1.05459       -.4674329
trunk |  -.3161825       .1286802    -2.46   0.014   -.5683909       -.063974
  _cons |     55.82001     4.92210      11.34   0.000      46.17287       65.46715
```

```
. bstat using bsreg
Bootstrap results
Number of obs = 74
Replications = 300

command:  regress mpg turn trunk
```

```
Observed     Bootstrap Normal-based
command:  regress mpg turn trunk
          |      Coef.     Std. Err.     z  P>|z|   [95% Conf. Interval]
-----|------------------|------------------|--------|--------|------------------|------------------|--------|--------|
  turn |  -.7610113       .1497877    -5.08   0.000   -1.05459       -.4674329
trunk |  -.3161825       .1286802    -2.46   0.014   -.5683909       -.063974
  _cons |     55.82001     4.92210      11.34   0.000      46.17287       65.46715
```

Methods and formulas

By default, Stata’s maximum likelihood estimators display standard errors based on variance estimates given by the inverse of the negative Hessian (second derivative) matrix. If vce(robust), vce(cluster clustvar), or pweights is specified, standard errors are based on the robust variance estimator (see [U] 20.22 Obtaining robust variance estimates); likelihood-ratio tests are not appropriate here (see [SVY] Survey), and the model $\chi^2$ is from a Wald test. If vce(opg) is specified, the standard errors are based on the outer product of the gradients; this option has no effect on likelihood-ratio tests, though it does affect Wald tests.

If vce(bootstrap) or vce(jackknife) is specified, the standard errors are based on the chosen replication method; here the model $\chi^2$ or $F$ statistic is from a Wald test using the respective replication-based covariance matrix. The $t$ distribution is used in the coefficient table when the vce(jackknife) option is specified. vce(bootstrap) and vce(jackknife) are also available with some commands that are not maximum likelihood estimators.
Also see

[R] bootstrap — Bootstrap sampling and estimation
[R] jackknife — Jackknife estimation
[XT] vce_options — Variance estimators
[U] 20 Estimation and postestimation commands