vce_option — Variance estimators

Description

This entry describes the `vce()` option, which is common to most estimation commands. `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

estimation_cmd ... [, `vce(`*vcetype*`)` ...]

vcetype	Description
Likelihood based	
`oim`	observed information matrix (OIM)
`opg`	outer product of the gradient (OPG) vectors
Sandwich estimators	
`robust`	Huber/White/sandwich estimator
`cluster` *clustvar*	clustered sandwich estimator
Replication based	
`bootstrap` [, *bootstrap_options*]	bootstrap estimation
`jackknife` [, *jackknife_options*]	jackknife estimation

Options

SE/Robust

`vce(oim)` is usually the default for models fit using maximum likelihood. `vce(oim)` uses the observed information matrix (OIM); see [R] **ml**.

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

`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 **[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

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/r19/auto
(1978 automobile data)

. regress mpg turn trunk, vce(jackknife)
(running regress on estimation sample)

Jackknife replications (74): .........10.........20.........30.........40.......
> ..50.........60.........70.... done

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 | Coefficient  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
------------------------------------------------------------------------------
```

```
. jackknife: regress mpg turn trunk
(running regress on estimation sample)
Jackknife replications (74): .........10.........20.........30.........40.......
> ..50.........60.........70.... done
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 | Coefficient  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/r19/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): .........10.........20.........30.........40.......
> ..50.........60...... done
Conditional (fixed-effects) logistic regression         Number of obs =    369
                                                        Replications  =     66
                                                        F(2, 65)      =   4.58
                                                        Prob > F      = 0.0137
Log likelihood = -123.41386                             Pseudo R2     = 0.0355

                                  (Replications based on 66 clusters in id)
------------------------------------------------------------------------------
             |             Jackknife
           y | Coefficient  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/r19/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 coefficient	Bootstrap std. err.	z	P>|z|	Normal-based [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	4.9221	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 coefficient	Bootstrap std. err.	z	P>|z|	Normal-based [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	4.9221	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 χ^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 χ^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

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