svy jackknife — Jackknife estimation for survey data

Description

svy jackknife performs jackknife estimation of specified statistics (or expressions) for a Stata command or a user-written program. The command is executed once for each replicate using sampling weights that are adjusted according to the jackknife methodology. Any Stata estimation command listed in [SVY] svy estimation may be used with svy jackknife. User-written programs that meet the requirements in [P] program properties may also be used.

Quick start

Estimate population mean of v1 using jackknife standard-error estimates with sampling weight wvar1 and sampling units identified by su1

svyset su1 [pweight = wvar1]
svy jackknife _b: mean v1

Same as above, but with jackknife replication weights in variables with prefix rwvar

svyset [pweight = wvar1], vce(jackknife) jkrweight(rwvar*)
svy: mean v1

Jackknife standard error of the difference between the means of v2 and v3 using either svyset command above

svy jackknife (_b[v2]-_b[v3]): mean v2 v3

As above, but name the result diff and save results from each replication to mydata.dta

svy jackknife diff=(_b[v2]-_b[v3]), saving(mydata): mean v2 v3

Note: Any estimation command meeting the requirements specified in the Description may be substituted for mean in the examples above.

Menu

Statistics > Survey data analysis > Resampling > Jackknife estimation
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Syntax

    svy jackknife exp_list [, svy_options jackknife_options eform_option] : command

svy_options

    Description

    if/in
    subpop([varname] [if])    identify a subpopulation

Reporting

    level(#)    set confidence level; default is level(95)
    noheader    suppress table header
    nolegend    suppress table legend
    noadjust    do not adjust model Wald statistic
    nocnsreport do not display constraints
    display_options    control columns and column formats, row spacing, line width, display of omitted variables and base and empty cells, and factor-variable labeling
    coeflegend    display legend instead of statistics

coeflegend is not shown in the dialog boxes for estimation commands.

jackknife_options

    Description

    Main
    eclass    number of observations is in e(N)
    rclass    number of observations is in r(N)
    n(exp)    specify exp that evaluates to number of observations used

    Options
    saving(filename[, ...])    save results to filename; save statistics in double precision; save results to filename every # replications
    keep    keep pseudovalues
    mse    use MSE formula for variance

    Reporting
    verbose    display the full table legend
    nodots    suppress replication dots
    dots(#)    display dots every # replications
    noisily    display any output from command
    trace    trace command
    title(text)    use text as title for jackknife results

Advanced
    nodrop    do not drop observations
    reject(exp)    identify invalid results
    dof(#)    design degrees of freedom
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svy requires that the survey design variables be identified using svyset; see [SVY] svyset.

command defines the statistical command to be executed. The by prefix cannot be part of command.

See [U] 20 Estimation and postestimation commands for more capabilities of estimation commands.

Warning: Using if or in restrictions will often not produce correct variance estimates for subpopulations. To compute estimates for subpopulations, use the subpop() option.

exp_list specifies the statistics to be collected from the execution of command. exp_list is required unless command has the svyj program property, in which case exp_list defaults to _b; see [P] program properties. The expressions in exp_list are assumed to conform to the following:

exp_list contains (name: elist)
  elist contains newvarname = (exp)
  (exp)
  eexp is specname
    [eqno]specname
  specname is _b
    _b[]
    _se
    _se[]
  eqno is ##
  name

exp is a standard Stata expression; see [U] 13 Functions and expressions.

Distinguish between [], which are to be typed, and [ []], which indicate optional arguments.

Options

svy_options; see [SVY] svy.

eclass, rclass, and n(exp) specify where command stores the number of observations on which it based the calculated results. We strongly advise you to specify one of these options.

eclass specifies that command store the number of observations in e(N).

rclass specifies that command store the number of observations in r(N).

n(exp) allows you to specify an expression that evaluates to the number of observations used. Specifying n(r(N)) is equivalent to specifying the rclass option. Specifying n(e(N)) is equivalent to specifying the eclass option. If command stores the number of observations in r(N1), specify n(r(N1)).

If you specify none of these options, svy jackknife will assume eclass or rclass depending upon which of e(N) and r(N) is not missing (in that order). If both e(N) and r(N) are missing, svy jackknife assumes that all observations in the dataset contribute to the calculated result. If that assumption is incorrect, then the reported standard errors will be incorrect. For instance, say that you specify

  . svy jackknife coef=_b[x2]: myreg y x1 x2 x3
where myreg uses \( e(n) \) instead of \( e(N) \) to identify the number of observations used in calculations. Further assume that observation 42 in the dataset has \( x_3 \) equal to missing. The 42nd observation plays no role in obtaining the estimates, but \texttt{svy jackknife} has no way of knowing that and will use the wrong \( N \). If, on the other hand, you specify

\[
. \texttt{svy jackknife coef=_b[x2], n(e(n))}: \texttt{myreg y x1 x2 x3}
\]

Then \texttt{svy jackknife} will notice that observation 42 plays no role. The \( n(e(n)) \) option is specified because \texttt{myreg} is an estimation command, but it stores the number of observations used in \( e(n) \) (instead of the standard \( e(N) \)). When \texttt{svy jackknife} runs the regression omitting the 42nd observation, \texttt{svy jackknife} will observe that \( e(n) \) has the same value as when \texttt{svy jackknife} previously ran the regression by using all the observations. Thus \texttt{svy jackknife} will know that \texttt{myreg} did not use the observation.

**Options**

\texttt{saving( \textit{filename}, \textit{suboptions})} creates a Stata data file (.dta file) consisting of (for each statistic in \textit{exp_list}) a variable containing the replicates.

\texttt{double} specifies that the results for each replication be saved as doubles, meaning 8-byte reals. By default, they are saved as floats, meaning 4-byte reals. This option may be used without the \texttt{saving()} option to compute the variance estimates by using double precision.

\texttt{every(\#)} specifies that results be written to disk every \#th replication. \texttt{every()} should be specified in conjunction with \texttt{saving()} only when \textit{command} takes a long time for each replication. This will allow recovery of partial results should some other software crash your computer. See [P] \texttt{postfile}.

\texttt{replace} specifies that \textit{filename} be overwritten if it exists. This option does not appear in the dialog box.

\texttt{keep} specifies that new variables be added to the dataset containing the pseudovalues of the requested statistics. For instance, if you typed

\[
. \texttt{svy jackknife coef=_b[x2], eclass keep: regress y x1 x2 x3}
\]

Then the new variable \texttt{coef} would be added to the dataset containing the pseudovalues for \_b[x2]. Let \( b \) be defined as the value of \_b[x2] when all observations are used to fit the model, and let \( b(j) \) be the value when the \( j \)th observation is omitted. The pseudovalues are defined as

\[
pseudovalue_j = N \times \{ b - b(j) \} + b(j)
\]

where \( N \) is the number of observations used to produce \( b \).

\texttt{keep} implies the \texttt{nodrop} option.

\texttt{mse} specifies that \texttt{svy jackknife} compute the variance by using deviations of the replicates from the observed value of the statistics based on the entire dataset. By default, \texttt{svy jackknife} computes the variance by using deviations of the pseudovalues from their mean.

**Reporting**

\texttt{verbose} requests that the full table legend be displayed.

\texttt{nodots} and \texttt{dots(\#)} specify whether to display replication dots. By default, one dot character is printed for each successful replication. A red ‘x’ is displayed if \textit{command} returns an error, ‘e’ is displayed if at least one value in \textit{exp_list} is missing, ‘n’ is displayed if the sample size is not correct, and a yellow ‘s’ is displayed if the dropped sampling unit is outside the subpopulation sample.
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nodots suppresses display of the replication dots. dots(#) displays dots every # replications. dots(0) is a synonym for nodots.

noisily requests that any output from command be displayed. This option implies the nodots option.

trace causes a trace of the execution of command to be displayed. This option implies the noisily option.

title(text) specifies a title to be displayed above the table of jackknife results; the default title is “Jackknife results”.

eform_option; see [R] eform_option. This option is ignored if exp_list is not _b.

Advanced

nodrop prevents observations outside e(sample) and the if and in qualifiers from being dropped before the data are resampled.

reject(exp) identifies an expression that indicates when results should be rejected. When exp is true, the resulting values are reset to missing values.

dof(#) specifies the design degrees of freedom, overriding the default calculation, df = N_{psu} − N_{strata}.

Remarks and examples

The jackknife is
• an alternative, first-order unbiased estimator for a statistic;
• a data-dependent way to calculate the standard error of the statistic and to obtain significance levels and confidence intervals; and
• a way of producing measures called pseudovalues for each observation, reflecting the observation’s influence on the overall statistic.

The idea behind the simplest form of the jackknife—the one implemented in [R] jackknife—is to repeatedly calculate the statistic in question, each time omitting just one of the dataset’s observations. Assume that our statistic of interest is the sample mean. Let y_j be the jth observation of our data on some measurement y, where j = 1, ..., N and N is the sample size. If \( \bar{y} \) is the sample mean of y using the entire dataset and \( \bar{y}_{(j)} \) is the mean when the jth observation is omitted, then

\[
\bar{y} = \frac{(N - 1) \bar{y}_{(j)} + y_j}{N}
\]

Solving for \( y_j \), we obtain

\[
y_j = N \bar{y} - (N - 1) \bar{y}_{(j)}
\]

These are the pseudovalues that svy: jackknife calculates. To move this discussion beyond the sample mean, let \( \hat{\theta} \) be the value of our statistic (not necessarily the sample mean) using the entire dataset, and let \( \hat{\theta}_{(j)} \) be the computed value of our statistic with the jth observation omitted. The pseudovalue for the jth observation is

\[
\hat{\theta}_j^* = N \hat{\theta} - (N - 1) \hat{\theta}_{(j)}
\]

The mean of the pseudovalues is the alternative, first-order unbiased estimator mentioned above, and the standard error of the mean of the pseudovalues is an estimator for the standard error of \( \hat{\theta} \) (Tukey 1958, Shao and Tu 1995).
When the jackknife is applied to survey data, primary sampling units (PSUs) are omitted instead of observations. \( N \) is the number of PSUs instead of the sample size, and the sampling weights are adjusted owing to omitting PSUs; see \([SVY]\) Variance estimation for more details.

Because of privacy concerns, many public survey datasets contain jackknife replication-weight variables instead of variables containing information on the PSUs and strata. These replication-weight variables are the adjusted sampling weights, and there is one replication-weight variable for each omitted PSU.

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**Example 1: Jackknife with information on PSUs and strata**

Suppose that we were interested in a measure of association between the weight and height of individuals in the population represented by the NHANES II data (McDowell et al. 1981). To measure the association, we will use the slope estimate from a linear regression of weight on height. We also use `svy jackknife` to estimate the variance of the slope.

```stata
. use https://www.stata-press.com/data/r16/nhanes2
. svyset pweight: finalwgt
    VCE: linearized
Single unit: missing
Strata 1: strata
SU 1: psu
FPC 1: <zero>
. svy jackknife slope = _b[height]: regress weight height
    (running regress on estimation sample)
Jackknife replications (62)
------------------- 1 2 3 4 5
.................................................. 50
............
        Linear regression
Number of strata = 31 Number of obs = 10,351
Number of PSUs = 62 Population size = 117,157,513
Replications = 62 Design df = 31
command: regress weight height
slope: _b[height]
    n(): e(N)

<table>
<thead>
<tr>
<th></th>
<th>Jackknife</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coef.</td>
</tr>
<tr>
<td>slope</td>
<td>.8014753</td>
</tr>
</tbody>
</table>
```

---

**Example 2: Jackknife replicate-weight variables**

`nhanes2jknife.dta` is a privacy-conscious dataset equivalent to `nhanes2.dta`; all the variables and values remain, except that `strata` and `psu` are replaced with jackknife replicate-weight variables. The replicate-weight variables are already `svyset`, and the default method for variance estimation is `vce(jackknife)`.
Here we perform the same analysis as in the previous example, using jackknife replication weights.

```
. svy jackknife slope = _b[height], nodots: regress weight height
```

The `mse` option causes `svy jackknife` to use the MSE form of the jackknife variance estimator. This variance estimator will tend to be larger than the previous because of the addition of the familiar squared bias term in the MSE; see [SVY] Variance estimation for more details. The header for the column of standard errors in the table of results is `Jknife *` for the jackknife variance estimator, which uses the MSE formula.

```
. svy jackknife slope = _b[height], mse nodots: regress weight height
```

| Coef.  | Std. Err. | t    | P>|t|   | [95% Conf. Interval] |
|--------|-----------|------|-------|---------------------|
| slope  | .8014753  | .0160281 | 50.00 | 0.000               | .7687852 .8341654 |

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Stored results

In addition to the results documented in [SVY] svy, svy jackknife stores the following in e():

Scalars

- \( e(N_{\text{reps}}) \) number of replications
- \( e(N_{\text{misreps}}) \) number of replications with missing values
- \( e(k_{\text{exp}}) \) number of standard expressions
- \( e(k_{\text{seexp}}) \) number of _b/_se expressions
- \( e(k_{\text{extra}}) \) number of extra estimates added to _b

Macros

- \( e(cmdname) \) command name from command
- \( e(cmd) \) same as \( e(cmdname) \) or jackknife
- \( e(vce) \) jackknife
- \( e(exp#) \) #th expression
- \( e(jkrweight) \) jkrweight() variable list

Matrices

- \( e(b_{\text{jk}}) \) jackknife means
- \( e(V) \) jackknife variance estimates

When \( exp\_list \) is _b, svy jackknife will also carry forward most of the results already in e() from command.

Methods and formulas

See [SVY] Variance estimation for details regarding jackknife variance estimation.

References


Also see

[SVY] svy postestimation — Postestimation tools for svy
[SVY] svy bootstrap — Bootstrap for survey data
[SVY] svy brr — Balanced repeated replication for survey data
[SVY] svy sdr — Successive difference replication for survey data
[SVY] Calibration — Calibration for survey data
[SVY] Poststratification — Poststratification for survey data
[SVY] Subpopulation estimation — Subpopulation estimation for survey data
[SVY] Variance estimation — Variance estimation for survey data
[R] jackknife — Jackknife estimation
[U] 20 Estimation and postestimation commands