

**mean** — Estimate means

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## Description

`mean` produces estimates of means, along with standard errors.

## Quick start

Mean, standard error, and 95% confidence interval for `v1`

```
mean v1
```

Also compute statistics for `v2`

```
mean v1 v2
```

As above, but for each level of categorical variable `catvar1`

```
mean v1 v2, over(catvar1)
```

Weighting by probability weight `wvar`

```
mean v1 v2 [pweight=wvar]
```

Population mean using `svyset` data

```
svy: mean v3
```

As above, but for each level of categorical variable `catvar2`

```
svy: mean v3, over(catvar2)
```

Two-group *t* test with `svyset` data if levels of `catvar2` are labeled `c1` and `c2`

```
svy: mean v3, over(catvar2)  
test c1 = c2
```

## Menu

Statistics > Summaries, tables, and tests > Summary and descriptive statistics > Means

## Syntax

```
mean varlist [if] [in] [weight] [, options]
```

<i>options</i>	Description
<b>Model</b>	
<code>stdize(<i>varname</i>)</code>	variable identifying strata for standardization
<code>stdweight(<i>varname</i>)</code>	weight variable for standardization
<code>nostdrescale</code>	do not rescale the standard weight variable
<b>if/in/over</b>	
<code>over(<i>varlist</i> [, <code>no<del>l</del>abel</code> ])</code>	group over subpopulations defined by <i>varlist</i> ; optionally, suppress group labels
<b>SE/Cluster</b>	
<code>vce(<i>vcetype</i>)</code>	<i>vcetype</i> may be <code>analytic</code> , <code>cluster <i>clustvar</i></code> , <code>bootstrap</code> , or <code>jackknife</code>
<b>Reporting</b>	
<code>level(#)</code>	set confidence level; default is level(95)
<code>noheader</code>	suppress table header
<code>nolegend</code>	suppress table legend
<code>display_options</code>	control column formats and line width
<code>coeflegend</code>	display legend instead of statistics
<p>bootstrap, jackknife, mi estimate, rolling, statsby, and svy are allowed; see [U] 11.1.10 Prefix commands. <code>vce(bootstrap)</code> and <code>vce(jackknife)</code> are not allowed with the mi estimate prefix; see [MI] mi estimate. Weights are not allowed with the bootstrap prefix; see [R] bootstrap. <code>aweight</code>s are not allowed with the jackknife prefix; see [R] jackknife. <code>vce()</code> and weights are not allowed with the svy prefix; see [SVY] svy. <code>fweights</code>, <code>aweight</code>s, <code>iweight</code>s, and <code>pweight</code>s are allowed; see [U] 11.1.6 weight. <code>coeflegend</code> does not appear in the dialog box.</p> <p>See [U] 20 Estimation and postestimation commands for more capabilities of estimation commands.</p>	

## Options

### Model

`stdize(varname)` specifies that the point estimates be adjusted by direct standardization across the strata identified by *varname*. This option requires the `stdweight()` option.

`stdweight(varname)` specifies the weight variable associated with the standard strata identified in the `stdize()` option. The standardization weights must be constant within the standard strata.

`nostdrescale` prevents the standardization weights from being rescaled within the `over()` groups. This option requires `stdize()` but is ignored if the `over()` option is not specified.

### if/in/over

`over(varlist [, nolabel ])` specifies that estimates be computed for multiple subpopulations, which are identified by the different values of the variables in *varlist*.

When this option is supplied with one variable name, such as `over(varname)`, the value labels of *varname* are used to identify the subpopulations. If *varname* does not have labeled values (or there are unlabeled values), the values themselves are used, provided that they are nonnegative integers. Noninteger values, negative values, and labels that are not valid Stata names are substituted with a default identifier.

When `over()` is supplied with multiple variable names, each subpopulation is assigned a unique default identifier.

`noLabel` specifies that value labels attached to the variables identifying the subpopulations be ignored.

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#### SE/Cluster

`vce(vcetype)` specifies the type of standard error reported, which includes types that are derived from asymptotic theory (`analytic`), that allow for intragroup correlation (`cluster clustvar`), and that use bootstrap or jackknife methods (`bootstrap`, `jackknife`); see [R] [vce\\_option](#).

`vce(analytic)`, the default, uses the analytically derived variance estimator associated with the sample mean.

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#### Reporting

`level(#)`; see [R] [estimation options](#).

`noheader` prevents the table header from being displayed. This option implies `nolegend`.

`nolegend` prevents the table legend identifying the subpopulations from being displayed.

*display\_options*: `cformat(%fmt)` and `noLstretch`; see [R] [estimation options](#).

The following option is available with `mean` but is not shown in the dialog box:

`coeflegend`; see [R] [estimation options](#).

## Remarks and examples

## ▷ Example 1

Using the fuel data from [example 3](#) of [\[R\] ttest](#), we estimate the average mileage of the cars without the fuel treatment (mpg1) and those with the fuel treatment (mpg2).

```
. use http://www.stata-press.com/data/r15/fuel
. mean mpg1 mpg2
Mean estimation           Number of obs   =           12
```

	Mean	Std. Err.	[95% Conf. Interval]	
mpg1	21	.7881701	19.26525	22.73475
mpg2	22.75	.9384465	20.68449	24.81551

Using these results, we can test the equality of the mileage between the two groups of cars.

```
. test mpg1 = mpg2
( 1) mpg1 - mpg2 = 0
      F( 1, 11) = 5.04
      Prob > F = 0.0463
```

◀

## ▷ Example 2

In example 1, the joint observations of mpg1 and mpg2 were used to estimate a covariance between their means.

```
. matrix list e(V)
symmetric e(V) [2,2]
      mpg1      mpg2
mpg1 .62121212
mpg2 .4469697 .88068182
```

If the data were organized this way out of convenience but the two variables represent independent samples of cars (coincidentally of the same sample size), we should reshape the data and use the `over()` option to ensure that the covariance between the means is zero.

```
. use http://www.stata-press.com/data/r15/fuel
. stack mpg1 mpg2, into(mpg) clear
. mean mpg, over(_stack)
Mean estimation           Number of obs   =           24
      1: _stack = 1
      2: _stack = 2
```

Over	Mean	Std. Err.	[95% Conf. Interval]	
mpg	1	21	.7881701	19.36955 22.63045
	2	22.75	.9384465	20.80868 24.69132

```

. matrix list e(V)
symmetric e(V)[2,2]
      mpg:      mpg:
      1         2
mpg:1  .62121212
mpg:2   0      .88068182

```

Now we can test the equality of the mileage between the two independent groups of cars.

```

. test [mpg]1 = [mpg]2
( 1) [mpg]1 - [mpg]2 = 0
      F( 1, 23) = 2.04
      Prob > F = 0.1667

```

◀

### ▶ Example 3: standardized means

Suppose that we collected the blood pressure data from [example 2](#) of [R] `dstdize`, and we wish to obtain standardized high blood pressure rates for each city in 1990 and 1992, using, as the standard, the age, sex, and race distribution of the four cities and two years combined. Our rate is really the mean of a variable that indicates whether a sampled individual has high blood pressure. First, we generate the strata and weight variables from our standard distribution, and then use `mean` to compute the rates.

```

. use http://www.stata-press.com/data/r15/hbp, clear
. egen strata = group(age race sex) if inlist(year, 1990, 1992)
(675 missing values generated)
. by strata, sort: gen stdw = _N
. mean hbp, over(city year) stdize(strata) stdweight(stdw)
Mean estimation
N. of std strata =      24      Number of obs   =      455
      Over: city year
      _subpop_1: 1 1990
      _subpop_2: 1 1992
      _subpop_3: 2 1990
      _subpop_4: 2 1992
      _subpop_5: 3 1990
      _subpop_6: 3 1992
      _subpop_7: 5 1990
      _subpop_8: 5 1992

```

Over	Mean	Std. Err.	[95% Conf. Interval]	
hbp				
_subpop_1	.058642	.0296273	.0004182	.1168657
_subpop_2	.0117647	.0113187	-.0104789	.0340083
_subpop_3	.0488722	.0238958	.0019121	.0958322
_subpop_4	.014574	.007342	.0001455	.0290025
_subpop_5	.1011211	.0268566	.0483425	.1538998
_subpop_6	.0810577	.0227021	.0364435	.1256719
_subpop_7	.0277778	.0155121	-.0027066	.0582622
_subpop_8	.0548926	0	.	.

The standard error of the high blood pressure rate estimate is missing for city 5 in 1992 because there was only one individual with high blood pressure; that individual was the only person observed in the stratum of white males 30–35 years old.

By default, mean rescales the standard weights within the `over()` groups. In the following, we use the `nostdrescale` option to prevent this, thus reproducing the results in [R] [dstdize](#).

```
. mean hbp, over(city year) nolegend stdize(strata) stdweight(stdw)
> nostdrescale
```

Mean estimation

N. of std strata = 24                      Number of obs = 455

Over	Mean	Std. Err.	[95% Conf. Interval]	
hbp				
_subpop_1	.0073302	.0037034	.0000523	.0146082
_subpop_2	.0015432	.0014847	-.0013745	.004461
_subpop_3	.0078814	.0038536	.0003084	.0154544
_subpop_4	.0025077	.0012633	.000025	.0049904
_subpop_5	.0155271	.0041238	.007423	.0236312
_subpop_6	.0081308	.0022772	.0036556	.012606
_subpop_7	.0039223	.0021904	-.0003822	.0082268
_subpop_8	.0088735	0	.	.

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## Video example

[Descriptive statistics in Stata](#)

## Stored results

`mean` stores the following in `e()`:

### Scalars

<code>e(N)</code>	number of observations
<code>e(N_over)</code>	number of subpopulations
<code>e(N_stdize)</code>	number of standard strata
<code>e(N_clust)</code>	number of clusters
<code>e(k_eq)</code>	number of equations in <code>e(b)</code>
<code>e(df_r)</code>	sample degrees of freedom
<code>e(rank)</code>	rank of <code>e(V)</code>

### Macros

<code>e(cmd)</code>	<code>mean</code>
<code>e(cmdline)</code>	command as typed
<code>e(varlist)</code>	<i>varlist</i>
<code>e(stdize)</code>	<i>varname</i> from <code>stdize()</code>
<code>e(stdweight)</code>	<i>varname</i> from <code>stdweight()</code>
<code>e(wtype)</code>	weight type
<code>e(wexp)</code>	weight expression
<code>e(title)</code>	title in estimation output
<code>e(cluster)</code>	name of cluster variable
<code>e(over)</code>	<i>varlist</i> from <code>over()</code>
<code>e(over_labels)</code>	labels from <code>over()</code> variables
<code>e(over_namelist)</code>	names from <code>e(over_labels)</code>
<code>e(vce)</code>	<i>vcetype</i> specified in <code>vce()</code>
<code>e(vcetype)</code>	title used to label Std. Err.
<code>e(properties)</code>	<code>b V</code>
<code>e(estat_cmd)</code>	program used to implement <code>estat</code>
<code>e(marginsnotok)</code>	predictions disallowed by <code>margins</code>

Matrices	
<code>e(b)</code>	vector of mean estimates
<code>e(V)</code>	(co)variance estimates
<code>e(_N)</code>	vector of numbers of nonmissing observations
<code>e(_N_stdsum)</code>	number of nonmissing observations within the standard strata
<code>e(_p_stdize)</code>	standardizing proportions
<code>e(error)</code>	error code corresponding to <code>e(b)</code>
Functions	
<code>e(sample)</code>	marks estimation sample

## Methods and formulas

Methods and formulas are presented under the following headings:

*The mean estimator*  
*Survey data*  
*The survey mean estimator*  
*The standardized mean estimator*  
*The poststratified mean estimator*  
*The standardized poststratified mean estimator*  
*Subpopulation estimation*

## The mean estimator

Let  $y$  be the variable on which we want to calculate the mean and  $y_j$  an individual observation on  $y$ , where  $j = 1, \dots, n$  and  $n$  is the sample size. Let  $w_j$  be the weight, and if no weight is specified, define  $w_j = 1$  for all  $j$ . For `aweights`, the  $w_j$  are normalized to sum to  $n$ . See *The survey mean estimator* for `pweighted` data.

Let  $W$  be the sum of the weights

$$W = \sum_{j=1}^n w_j$$

The mean is defined as

$$\bar{y} = \frac{1}{W} \sum_{j=1}^n w_j y_j$$

The default variance estimator for the mean is

$$\widehat{V}(\bar{y}) = \frac{1}{W(W-1)} \sum_{j=1}^n w_j (y_j - \bar{y})^2$$

The standard error of the mean is the square root of the variance.

If  $x$ ,  $x_j$ , and  $\bar{x}$  are similarly defined for another variable (observed jointly with  $y$ ), the covariance estimator between  $\bar{x}$  and  $\bar{y}$  is

$$\widehat{\text{Cov}}(\bar{x}, \bar{y}) = \frac{1}{W(W-1)} \sum_{j=1}^n w_j (x_j - \bar{x})(y_j - \bar{y})$$

## Survey data

See [SVY] **variance estimation**, [SVY] **direct standardization**, and [SVY] **poststratification** for discussions that provide background information for the following formulas. The following formulas are derived from the fact that the mean is a special case of the ratio estimator where the denominator variable is one,  $x_j = 1$ ; see [R] **ratio**.

## The survey mean estimator

Let  $Y_j$  be a survey item for the  $j$ th individual in the population, where  $j = 1, \dots, M$  and  $M$  is the size of the population. The associated population mean for the item of interest is  $\bar{Y} = Y/M$  where

$$Y = \sum_{j=1}^M Y_j$$

Let  $y_j$  be the survey item for the  $j$ th sampled individual from the population, where  $j = 1, \dots, m$  and  $m$  is the number of observations in the sample.

The estimator for the mean is  $\bar{y} = \hat{Y}/\hat{M}$ , where

$$\hat{Y} = \sum_{j=1}^m w_j y_j \quad \text{and} \quad \hat{M} = \sum_{j=1}^m w_j$$

and  $w_j$  is a sampling weight. The score variable for the mean estimator is

$$z_j(\bar{y}) = \frac{y_j - \bar{y}}{\hat{M}} = \frac{\hat{M}y_j - \hat{Y}}{\hat{M}^2}$$

## The standardized mean estimator

Let  $D_g$  denote the set of sampled observations that belong to the  $g$ th standard stratum and define  $I_{D_g}(j)$  to indicate if the  $j$ th observation is a member of the  $g$ th standard stratum; where  $g = 1, \dots, L_D$  and  $L_D$  is the number of standard strata. Also, let  $\pi_g$  denote the fraction of the population that belongs to the  $g$ th standard stratum, thus  $\pi_1 + \dots + \pi_{L_D} = 1$ .  $\pi_g$  is derived from the `stdweight()` option.

The estimator for the standardized mean is

$$\bar{y}^D = \sum_{g=1}^{L_D} \pi_g \frac{\hat{Y}_g}{\hat{M}_g}$$

where

$$\hat{Y}_g = \sum_{j=1}^m I_{D_g}(j) w_j y_j \quad \text{and} \quad \hat{M}_g = \sum_{j=1}^m I_{D_g}(j) w_j$$

The score variable for the standardized mean is

$$z_j(\bar{y}^D) = \sum_{g=1}^{L_D} \pi_g I_{D_g}(j) \frac{\hat{M}_g y_j - \hat{Y}_g}{\hat{M}_g^2}$$



## The poststratified mean estimator

Let  $P_k$  denote the set of sampled observations that belong to poststratum  $k$  and define  $I_{P_k}(j)$  to indicate if the  $j$ th observation is a member of poststratum  $k$ ; where  $k = 1, \dots, L_P$  and  $L_P$  is the number of poststrata. Also let  $M_k$  denote the population size for poststratum  $k$ .  $P_k$  and  $M_k$  are identified by specifying the `poststrata()` and `postweight()` options on `svyset`; see [\[SVY\] svyset](#).

The estimator for the poststratified mean is

$$\bar{y}^P = \frac{\hat{Y}^P}{\widehat{M}^P} = \frac{\hat{Y}^P}{M}$$

where

$$\hat{Y}^P = \sum_{k=1}^{L_P} \frac{M_k}{\widehat{M}_k} \hat{Y}_k = \sum_{k=1}^{L_P} \frac{M_k}{\widehat{M}_k} \sum_{j=1}^m I_{P_k}(j) w_j y_j$$

and

$$\widehat{M}^P = \sum_{k=1}^{L_P} \frac{M_k}{\widehat{M}_k} \widehat{M}_k = \sum_{k=1}^{L_P} M_k = M$$

The score variable for the poststratified mean is

$$z_j(\bar{y}^P) = \frac{z_j(\hat{Y}^P)}{M} = \frac{1}{M} \sum_{k=1}^{L_P} I_{P_k}(j) \frac{M_k}{\widehat{M}_k} \left( y_j - \frac{\hat{Y}_k}{\widehat{M}_k} \right)$$

## The standardized poststratified mean estimator

The estimator for the standardized poststratified mean is

$$\bar{y}^{DP} = \sum_{g=1}^{L_D} \pi_g \frac{\hat{Y}_g^P}{\widehat{M}_g^P}$$

where

$$\hat{Y}_g^P = \sum_{k=1}^{L_P} \frac{M_k}{\widehat{M}_k} \hat{Y}_{g,k} = \sum_{k=1}^{L_P} \frac{M_k}{\widehat{M}_k} \sum_{j=1}^m I_{D_g}(j) I_{P_k}(j) w_j y_j$$

and

$$\widehat{M}_g^P = \sum_{k=1}^{L_P} \frac{M_k}{\widehat{M}_k} \widehat{M}_{g,k} = \sum_{k=1}^{L_P} \frac{M_k}{\widehat{M}_k} \sum_{j=1}^m I_{D_g}(j) I_{P_k}(j) w_j$$

The score variable for the standardized poststratified mean is

$$z_j(\bar{y}^{DP}) = \sum_{g=1}^{L_D} \pi_g \frac{\widehat{M}_g^P z_j(\hat{Y}_g^P) - \hat{Y}_g^P z_j(\widehat{M}_g^P)}{(\widehat{M}_g^P)^2}$$

where

$$z_j(\hat{Y}_g^P) = \sum_{k=1}^{L_P} I_{P_k}(j) \frac{M_k}{\widehat{M}_k} \left\{ I_{D_g}(j) y_j - \frac{\hat{Y}_{g,k}}{\widehat{M}_k} \right\}$$

and

$$z_j(\widehat{M}_g^P) = \sum_{k=1}^{L_P} I_{P_k}(j) \frac{M_k}{\widehat{M}_k} \left\{ I_{D_g}(j) - \frac{\widehat{M}_{g,k}}{\widehat{M}_k} \right\}$$

## Subpopulation estimation

Let  $S$  denote the set of sampled observations that belong to the subpopulation of interest, and define  $I_S(j)$  to indicate if the  $j$ th observation falls within the subpopulation.

The estimator for the subpopulation mean is  $\bar{y}^S = \widehat{Y}^S / \widehat{M}^S$ , where

$$\widehat{Y}^S = \sum_{j=1}^m I_S(j) w_j y_j \quad \text{and} \quad \widehat{M}^S = \sum_{j=1}^m I_S(j) w_j$$

Its score variable is

$$z_j(\bar{y}^S) = I_S(j) \frac{y_j - \bar{y}^S}{\widehat{M}^S} = I_S(j) \frac{\widehat{M}^S y_j - \widehat{Y}^S}{(\widehat{M}^S)^2}$$

The estimator for the standardized subpopulation mean is

$$\bar{y}^{DS} = \sum_{g=1}^{L_D} \pi_g \frac{\widehat{Y}_g^S}{\widehat{M}_g^S}$$

where

$$\widehat{Y}_g^S = \sum_{j=1}^m I_{D_g}(j) I_S(j) w_j y_j \quad \text{and} \quad \widehat{M}_g^S = \sum_{j=1}^m I_{D_g}(j) I_S(j) w_j$$

Its score variable is

$$z_j(\bar{y}^{DS}) = \sum_{g=1}^{L_D} \pi_g I_{D_g}(j) I_S(j) \frac{\widehat{M}_g^S y_j - \widehat{Y}_g^S}{(\widehat{M}_g^S)^2}$$

The estimator for the poststratified subpopulation mean is

$$\bar{y}^{PS} = \frac{\widehat{Y}^{PS}}{\widehat{M}^{PS}}$$

where

$$\widehat{Y}^{PS} = \sum_{k=1}^{L_P} \frac{M_k}{\widehat{M}_k} \widehat{Y}_k^S = \sum_{k=1}^{L_P} \frac{M_k}{\widehat{M}_k} \sum_{j=1}^m I_{P_k}(j) I_S(j) w_j y_j$$

and

$$\widehat{M}^{PS} = \sum_{k=1}^{L_P} \frac{M_k}{\widehat{M}_k} \widehat{M}_k^S = \sum_{k=1}^{L_P} \frac{M_k}{\widehat{M}_k} \sum_{j=1}^m I_{P_k}(j) I_S(j) w_j$$

Its score variable is

$$z_j(\bar{y}^{PS}) = \frac{\widehat{M}^{PS} z_j(\widehat{Y}^{PS}) - \widehat{Y}^{PS} z_j(\widehat{M}^{PS})}{(\widehat{M}^{PS})^2}$$

where

$$z_j(\widehat{Y}^{PS}) = \sum_{k=1}^{L_P} I_{P_k}(j) \frac{M_k}{\widehat{M}_k} \left\{ I_S(j) y_j - \frac{\widehat{Y}_k^S}{\widehat{M}_k} \right\}$$

and

$$z_j(\widehat{M}^{PS}) = \sum_{k=1}^{L_P} I_{P_k}(j) \frac{M_k}{\widehat{M}_k} \left\{ I_S(j) - \frac{\widehat{M}_k^S}{\widehat{M}_k} \right\}$$

The estimator for the standardized poststratified subpopulation mean is

$$\bar{y}^{DPS} = \sum_{g=1}^{L_D} \pi_g \frac{\widehat{Y}_g^{PS}}{\widehat{M}_g^{PS}}$$

where

$$\widehat{Y}_g^{PS} = \sum_{k=1}^{L_p} \frac{M_k}{\widehat{M}_k} \widehat{Y}_{g,k}^S = \sum_{k=1}^{L_p} \frac{M_k}{\widehat{M}_k} \sum_{j=1}^m I_{D_g}(j) I_{P_k}(j) I_S(j) w_j y_j$$

and

$$\widehat{M}_g^{PS} = \sum_{k=1}^{L_p} \frac{M_k}{\widehat{M}_k} \widehat{M}_{g,k}^S = \sum_{k=1}^{L_p} \frac{M_k}{\widehat{M}_k} \sum_{j=1}^m I_{D_g}(j) I_{P_k}(j) I_S(j) w_j$$

Its score variable is

$$z_j(\bar{y}^{DPS}) = \sum_{g=1}^{L_D} \pi_g \frac{\widehat{M}_g^{PS} z_j(\widehat{Y}_g^{PS}) - \widehat{Y}_g^{PS} z_j(\widehat{M}_g^{PS})}{(\widehat{M}_g^{PS})^2}$$

where

$$z_j(\widehat{Y}_g^{PS}) = \sum_{k=1}^{L_P} I_{P_k}(j) \frac{M_k}{\widehat{M}_k} \left\{ I_{D_g}(j) I_S(j) y_j - \frac{\widehat{Y}_{g,k}^S}{\widehat{M}_k} \right\}$$

and

$$z_j(\widehat{M}_g^{PS}) = \sum_{k=1}^{L_P} I_{P_k}(j) \frac{M_k}{\widehat{M}_k} \left\{ I_{D_g}(j) I_S(j) - \frac{\widehat{M}_{g,k}^S}{\widehat{M}_k} \right\}$$

## References

- Bakker, A. 2003. The early history of average values and implications for education. *Journal of Statistics Education* 11(1). <http://www.amstat.org/publications/jse/v11n1/bakker.html>.
- Cochran, W. G. 1977. *Sampling Techniques*. 3rd ed. New York: Wiley.
- Stuart, A., and J. K. Ord. 1994. *Kendall's Advanced Theory of Statistics: Distribution Theory, Vol I*. 6th ed. London: Arnold.

## Also see

- [R] **mean postestimation** — Postestimation tools for mean
- [R] **ameans** — Arithmetic, geometric, and harmonic means
- [R] **proportion** — Estimate proportions
- [R] **ratio** — Estimate ratios
- [R] **summarize** — Summary statistics
- [R] **total** — Estimate totals
- [MI] **estimation** — Estimation commands for use with mi estimate
- [SVY] **direct standardization** — Direct standardization of means, proportions, and ratios
- [SVY] **poststratification** — Poststratification for survey data
- [SVY] **subpopulation estimation** — Subpopulation estimation for survey data
- [SVY] **svy estimation** — Estimation commands for survey data
- [SVY] **variance estimation** — Variance estimation for survey data
- [U] **20 Estimation and postestimation commands**