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## Description

`summarize` calculates and displays a variety of univariate summary statistics. If no *varlist* is specified, summary statistics are calculated for all the variables in the dataset.

## Quick start

Basic summary statistics for continuous variable `v1`

```
summarize v1
```

Same as above, and include `v2` and `v3`

```
summarize v1-v3
```

Same as above, and provide additional detail about the distribution

```
summarize v1-v3, detail
```

Summary statistics reported separately for each level of `catvar`

```
by catvar: summarize v1
```

With frequency weight `wvar`

```
summarize v1 [fweight=wvar]
```

## Menu

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

# Syntax

```
summarize [ varlist ] [ if' ] [ in ] [ weight ] [ , options ]
```

options	Description
Main	
detail	display additional statistics
meanonly	suppress the display; calculate only the mean; programmer's option
format	use variable's display format
separator(#)	draw separator line after every # variables; default is separator(5)
display_options	control spacing, line width, and base and empty cells

varlist may contain factor variables; see [\[U\] 11.4.3 Factor variables](#).

varlist may contain time-series operators; see [\[U\] 11.4.4 Time-series varlists](#).

by, collect, rolling, and statsby are allowed; see [\[U\] 11.1.10 Prefix commands](#).

aweight, fweight, and iweight are allowed. However, iweight may not be used with the detail option; see [\[U\] 11.1.6 weight](#).

# Options

Main
detail produces additional statistics, including skewness, kurtosis, the four smallest and four largest values, and various percentiles.
meanonly, which is allowed only when detail is not specified, suppresses the display of results and calculation of the variance. Ado-file writers will find this useful for fast calls.
format requests that the summary statistics be displayed using the display formats associated with the variables rather than the default g display format; see <a href="#">[U] 12.5 Formats: Controlling how data are displayed</a> .
separator(#) specifies how often to insert separation lines into the output. The default is separator(5), meaning that a line is drawn after every five variables. separator(10) would draw a line after every 10 variables. separator(0) suppresses the separation line.
display_options: vsquish, noemptycells, baselevels, allbaselevels, novlabel, fvwrap(#), and fvwrapon(style); see <a href="#">[R] Estimation options</a> .

# Remarks and examples

summarize can produce two different sets of summary statistics. Without the detail option, the number of nonmissing observations, the mean and standard deviation, and the minimum and maximum values are presented. With detail, the same information is presented along with the variance, skewness, and kurtosis; the four smallest and four largest values; and the 1st, 5th, 10th, 25th, 50th (median), 75th, 90th, 95th, and 99th percentiles.

Also see [\[R\] ci](#) for calculating the standard error and confidence intervals of the mean.

### ► Example 1: summarize with the separator() option

We have data containing information on various automobiles, among which is the variable `mpg`, the mileage rating. We can obtain a quick summary of the `mpg` variable by typing

```
. use https://www.stata-press.com/data/r19/auto2
(1978 automobile data)
```

```
. summarize mpg
```

Variable	Obs	Mean	Std. dev.	Min	Max
mpg	74	21.2973	5.785503	12	41

We see that we have 74 observations. The mean of `mpg` is 21.3 miles per gallon, and the standard deviation is 5.79. The minimum is 12, and the maximum is 41.

If we had not specified the variable (or variables) we wanted to summarize, we would have obtained summary statistics on all the variables in the dataset:

```
. summarize, separator(4)
```

Variable	Obs	Mean	Std. dev.	Min	Max
make	0				
price	74	6165.257	2949.496	3291	15906
mpg	74	21.2973	5.785503	12	41
rep78	69	3.405797	.9899323	1	5
headroom	74	2.993243	.8459948	1.5	5
trunk	74	13.75676	4.277404	5	23
weight	74	3019.459	777.1936	1760	4840
length	74	187.9324	22.26634	142	233
turn	74	39.64865	4.399354	31	51
displacement	74	197.2973	91.83722	79	425
gear_ratio	74	3.014865	.4562871	2.19	3.89
foreign	74	.2972973	.4601885	0	1

There are only 69 observations on `rep78`, so some of the observations are missing. There are no observations on `make` because it is a string variable.

The idea of the mean is quite old ([Plackett 1958](#)), but its extension to a scheme of moment-based measures was not done until the end of the 19th century. Between 1893 and 1905, Pearson discussed and named the standard deviation, skewness, and kurtosis, but he was not the first to use any of these. [Thiele \(1889\)](#), in contrast, had earlier firmly grasped the notion that the  $m_r$  provide a systematic basis for discussing distributions. However, even earlier anticipations can also be found. For example, Euler in 1778 used  $m_2$  and  $m_3$  in passing in a treatment of estimation ([Hald 1998, 87](#)), but seemingly did not build on that.

Similarly, the idea of the median is quite old. The history of the interquartile range is tangled up with that of the probable error, a long-popular measure. Extending this in various ways to a more general approach based on quantiles (to use a later term) occurred to several people in the nineteenth century. [Galton \(1875\)](#) is a nice example, particularly because he seems so close to the key idea of the quantiles as a function, which took another century to reemerge strongly.

Thorvald Nicolai Thiele (1838–1910) was a Danish scientist who worked in astronomy, mathematics, actuarial science, and statistics. He made many pioneering contributions to statistics, several of which were overlooked until recently. Thiele advocated graphical analysis of residuals checking for trends, symmetry of distributions, and changes of sign, and he even warned against overinterpreting such graphs.

## ► Example 2: summarize with the detail option

The `detail` option provides all the information of a normal `summarize` and more. The format of the output also differs, as shown here:

```
. summarize mpg, detail
```

Mileage (mpg)				
Percentiles		Smallest		
1%	12	12		
5%	14	12		
10%	14	14	Obs	74
25%	18	14	Sum of wgt.	74
50%	20	Largest	Mean	21.2973
75%	25		Std. dev.	5.785503
90%	29		Variance	33.47205
95%	34		Skewness	.9487176
99%	41	41	Kurtosis	3.975005

As in the [previous example](#), we see that the mean of mpg is 21.3 miles per gallon and that the standard deviation is 5.79. We also see the various percentiles. The median of mpg (the 50th percentile) is 20 miles per gallon. The 25th percentile is 18, and the 75th percentile is 25.

When we performed `summarize`, we learned that the minimum and maximum were 12 and 41, respectively. We now see that the four smallest values in our dataset are 12, 12, 14, and 14. The four largest values are 34, 35, 35, and 41. The skewness of the distribution is 0.95, and the kurtosis is 3.98. (A normal distribution would have a skewness of 0 and a kurtosis of 3.)

*Skewness* is a measure of the lack of symmetry of a distribution. If the distribution is symmetric, the coefficient of skewness is 0. If the coefficient is negative, the median is usually greater than the mean and the distribution is said to be skewed left. If the coefficient is positive, the median is usually less than the mean and the distribution is said to be skewed right. *Kurtosis* (from the Greek *kyrtosis*, meaning curvature) is a measure of peakedness of a distribution. The smaller the coefficient of kurtosis, the flatter the distribution. The normal distribution has a coefficient of kurtosis of 3 and provides a convenient benchmark.



## □ Technical note

The convention of calculating the median of an even number of values by averaging the central two order statistics is of long standing. (That is, given 8 values, average the 4th and 5th smallest values, or given 42, average the 21st and 22nd smallest.) [Stigler \(1977\)](#) filled a much-needed gap in the literature by naming such paired central order statistics as “comedians”, although it remains unclear how far he was joking.



## ▷ Example 3: summarize with the by prefix

`summarize` can usefully be combined with the `by varlist:` prefix. In our dataset, we have a variable, `foreign`, that distinguishes foreign and domestic cars. We can obtain summaries of `mpg` and `weight` within each subgroup by typing

```
. by foreign: summarize mpg weight
```

```
-> foreign = Domestic
```

Variable	Obs	Mean	Std. dev.	Min	Max
mpg	52	19.82692	4.743297	12	34
weight	52	3317.115	695.3637	1800	4840

```
-> foreign = Foreign
```

Variable	Obs	Mean	Std. dev.	Min	Max
mpg	22	24.77273	6.611187	14	41
weight	22	2315.909	433.0035	1760	3420

Domestic cars in our dataset average 19.8 miles per gallon, whereas foreign cars average 24.8.

Because `by varlist:` can be combined with `summarize`, it can also be combined with `summarize, detail`:

```
. by foreign: summarize mpg, detail
```

```
-> foreign = Domestic
```

Mileage (mpg)				
Percentiles	Smallest			
1%	12	12		
5%	14	12		
10%	14	14	Obs	52
25%	16.5	14	Sum of wgt.	52
50%	19		Mean	19.82692
		Largest	Std. dev.	4.743297
75%	22	28		
90%	26	29	Variance	22.49887
95%	29	30	Skewness	.7712432
99%	34	34	Kurtosis	3.441459

```
-> foreign = Foreign
```

Mileage (mpg)				
Percentiles	Smallest			
1%	14	14		
5%	17	17		
10%	17	17	Obs	22
25%	21	18	Sum of wgt.	22
50%	24.5		Mean	24.77273
		Largest	Std. dev.	6.611187
75%	28	31		
90%	35	35	Variance	43.70779
95%	35	35	Skewness	.657329
99%	41	41	Kurtosis	3.10734

## □ Technical note

`summarize` respects display formats if we specify the `format` option. When we type `summarize price weight`, we obtain

```
. summarize price weight
```

Variable	Obs	Mean	Std. dev.	Min	Max
price	74	6165.257	2949.496	3291	15906
weight	74	3019.459	777.1936	1760	4840

The display is accurate but is not as aesthetically pleasing as we may wish, particularly if we plan to use the output directly in published work. By placing formats on the variables, we can control how the table appears:

```
. format price weight %9.2fc
. summarize price weight, format
```

Variable	Obs	Mean	Std. dev.	Min	Max
price	74	6,165.26	2,949.50	3,291.00	15,906.00
weight	74	3,019.46	777.19	1,760.00	4,840.00

□

If you specify a weight (see [\[U\] 11.1.6 weight](#)), each observation is multiplied by the value of the weighting expression before the summary statistics are calculated so that the weighting expression is interpreted as the discrete density of each observation.

## ▷ Example 4: summarize with factor variables

You can also use `summarize` to obtain summary statistics for factor variables. For example, if you type

```
. summarize i.rep78
```

Variable	Obs	Mean	Std. dev.	Min	Max
rep78					
Poor	69	.0289855	.1689948	0	1
Fair	69	.115942	.3225009	0	1
Average	69	.4347826	.4993602	0	1
Good	69	.2608696	.4423259	0	1
Excellent	69	.1594203	.3687494	0	1

you obtain the sample proportions for the five levels of the `rep78` variable. For example, 11.6% of the 69 cars with nonmissing values of `rep78` have a fair repair record.

We could have used `tabulate oneway rep78` to obtain the sample proportions along with the cumulative proportions. Alternatively, we could have used `proportions rep78` to obtain the sample proportions along with the standard errors of the proportions instead of the standard deviations of the proportions.

◀

### ► Example 5: summarize with weights

We have 1980 census data on each of the 50 states. Included in our variables is `medage`, the median age of the population of each state. If we type `summarize medage`, we obtain unweighted statistics:

```
. use https://www.stata-press.com/data/r19/census, clear
(1980 Census data by state)
```

```
. summarize medage
```

Variable	Obs	Mean	Std. dev.	Min	Max
medage	50	29.54	1.693445	24.2	34.7

Also among our variables is `pop`, the population in each state. Typing `summarize medage [w=pop]` produces population-weighted statistics:

```
. summarize medage [w=pop]
(analytic weights assumed)
```

Variable	Obs	Weight	Mean	Std. Dev.	Min	Max
medage	50	225907472	30.11047	1.66933	24.2	34.7

The number listed under `Weight` is the sum of the weighting variable, `pop`, indicating that there are roughly 226 million people in the United States. The `pop`-weighted mean of `medage` is 30.11 (compared with 29.54 for the unweighted statistic), and the weighted standard deviation is 1.67 (compared with 1.69).



### ► Example 6: summarize with weights and the detail option

We can obtain detailed summaries of weighted data as well. When we do this, *all* the statistics are weighted, including the percentiles.

```
. summarize medage [w=pop], detail
(analytic weights assumed)
```

Median age					
Percentiles			Smallest		
1%	27.1		24.2		
5%	27.7		26.1		
10%	28.2		27.1	Obs	50
25%	29.2		27.4	Sum of wgt.	225907472
50%	29.9			Mean	30.11047
				Std. dev.	1.66933
			Largest		
75%	30.9		32		
90%	32.1		32.1	Variance	2.786661
95%	32.2		32.2	Skewness	.5281972
99%	34.7		34.7	Kurtosis	4.494223





## □ Technical note

If you are writing a program and need to access the mean of a variable, the `meanonly` option provides for fast calls. For example, suppose that your program reads as follows:

```
program mean
    summarize '1', meanonly
    display " mean = " r(mean)
end
```

The result of executing this is

```
. use https://www.stata-press.com/data/r19/auto2
(1978 automobile data)

. mean price
    mean = 6165.2568
```



## Video example

[Descriptive statistics in Stata](#)

## Stored results

`summarize` stores the following in `r()`:

### Scalars

<code>r(N)</code>	number of observations	<code>r(p50)</code>	50th percentile (detail only)
<code>r(mean)</code>	mean	<code>r(p75)</code>	75th percentile (detail only)
<code>r(skewness)</code>	skewness (detail only)	<code>r(p90)</code>	90th percentile (detail only)
<code>r(min)</code>	minimum	<code>r(p95)</code>	95th percentile (detail only)
<code>r(max)</code>	maximum	<code>r(p99)</code>	99th percentile (detail only)
<code>r(sum_w)</code>	sum of the weights	<code>r(Var)</code>	variance
<code>r(p1)</code>	1st percentile (detail only)	<code>r(kurtosis)</code>	kurtosis (detail only)
<code>r(p5)</code>	5th percentile (detail only)	<code>r(sum)</code>	sum of variable
<code>r(p10)</code>	10th percentile (detail only)	<code>r(sd)</code>	standard deviation
<code>r(p25)</code>	25th percentile (detail only)		

## Methods and formulas

Let  $x$  denote the variable on which we want to calculate summary statistics, and let  $x_i, i = 1, \dots, n$ , denote an individual observation on  $x$ . Let  $v_i$  be the weight, and if no weight is specified, define  $v_i = 1$  for all  $i$ .

Define the total number of observations as  $N = n$  if  $v_i$  is an `aweight` and as

$$N = \sum_{i=1}^n v_i$$

otherwise.

Additionally, define the normalized weight as

$$w_i = \frac{nv_i}{\sum_{i=1}^n v_i}$$

if  $v_i$  is an `aweight` and as  $w_i = v_i$  otherwise.

The *mean*,  $\bar{x}$ , is defined as

$$\bar{x} = \frac{1}{N} \sum_{i=1}^n w_i x_i$$

The *variance*,  $s^2$ , is defined as

$$s^2 = \frac{1}{N-1} \sum_{i=1}^n w_i (x_i - \bar{x})^2$$

The *standard deviation*,  $s$ , is defined as  $\sqrt{s^2}$ .

Define  $m_r$  as the  $r$ th moment about the mean  $\bar{x}$ :

$$m_r = \frac{1}{N} \sum_{i=1}^n w_i (x_i - \bar{x})^r$$

The *coefficient of skewness* is then defined as  $m_3 m_2^{-3/2}$ . The *coefficient of kurtosis* is defined as  $m_4 m_2^{-2}$ .

Let  $x_{(i)}$  refer to the  $x$  in ascending order, and let  $w_{(i)}$  refer to the corresponding weights of  $x_{(i)}$ . The four smallest values are  $x_{(1)}$ ,  $x_{(2)}$ ,  $x_{(3)}$ , and  $x_{(4)}$ . The four largest values are  $x_{(n)}$ ,  $x_{(n-1)}$ ,  $x_{(n-2)}$ , and  $x_{(n-3)}$ .

To obtain the  $p$ th *percentile*, which we will denote as  $x_{[p]}$ , let  $P = Np/100$ . Let

$$W_{(i)} = \sum_{j=1}^i w_{(j)}$$

Find the first index  $i$  such that  $W_{(i)} > P$ . The  $p$ th percentile is then

$$x_{[p]} = \begin{cases} \frac{x_{(i-1)} + x_{(i)}}{2} & \text{if } W_{(i-1)} = P \\ x_{(i)} & \text{otherwise} \end{cases}$$

## References

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## Also see

- [R] [ameans](#) — Arithmetic, geometric, and harmonic means
- [R] [centile](#) — Report centile and confidence interval
- [R] [ci](#) — Confidence intervals for means, proportions, and variances
- [R] [mean](#) — Estimate means
- [R] [proportion](#) — Estimate proportions
- [R] [ratio](#) — Estimate ratios
- [R] [table](#) — Table of frequencies, summaries, and command results
- [R] [tabstat](#) — Compact table of summary statistics
- [R] [tabulate, summarize\(\)](#) — One- and two-way tables of summary statistics
- [R] [total](#) — Estimate totals
- [D] [codebook](#) — Describe data contents
- [D] [describe](#) — Describe data in memory or in a file
- [D] [inspect](#) — Display simple summary of data's attributes
- [ST] [stsum](#) — Summarize survival-time data
- [SVY] [svy estimation](#) — Estimation commands for survey data
- [XT] [xtsum](#) — Summarize xt data

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