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## lambda

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purpose:: “Lambda” refers to a series of MATLAB programs that allow one to use quoted strings describing a calculation to be passed to other programs. These lambda arguments are used internally in a number of Resampling Stats functions such as `CONFINTERVALS` and `JAB` and are available for use by people who want to write their own high-level functions. Here, we describe the syntax for using lambdas in Resampling Stats.

In ordinary use, we specify the argument to a function by enclosing the names of the variables containing the argument in parentheses, or by enclosing a MATLAB expression in parentheses. For example, to compute percentiles of a variable called `data`, we specify two arguments:

```
>> percentile( data, .90 )
or
>> percentile( data, [.05 .95])
or
>> percentile( weed(data, ismissing(data) ), [.05 .95])
```

In programs like `CONFINTERVALS` or `JAB`, we need to specify a computation to be carried out on the resampled data. One way to do this is to give the name of a function that carries out the desired computation. Often, however, we also need to specify additional parameters (such as the `[.05 .95]` in the example above).

The lambda syntax allows you to pass such functions along with their parameters. This is done by placing the command to be executed in quotation marks. In addition, we need to mark the place where the program will insert the resampled data in the argument list. For example, if we wanted to compute the 60% confidence interval of the 75% percentile of some data, we could use the `CONFINTERVALS` program in this way

```
>> confintervals( data, 'percentile( #, .75 )', .60)
```

Note that the place of the argument that contains the data is being marked by a `#` sign. The way `CONFINTERVALS` works is to resample the original data many times, and pass along each of the resampled data sets to the procedure specified in the quoted string.

You can use the `#` more than once. For example, to compute confidence intervals of the ratio of the standard deviation to the inter-

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quartile range

```
>> confintervals( data, 'std(#) / iqr(#)', .60)
```

If other variables are contained in the quoted command string, you must use the `lambda` function. For example, that you are computing the confidence interval on a percentile, but the desired percentile level is held in a variable, `myperc`. Then the syntax would be:

```
>> confintervals(data,lambda('percentile(#,myperc)'), .6)
```

(The role of `lambda` here is to tell MATLAB where to find the value of `myperc`.)

In some cases, your quoted command string may itself need to contain a quoted string. (See, e.g., JAB.) MATLAB requires that the inner string be double-quoted (using the single-quote symbol twice), for example `'This is an outer string containing 'an inner quote'' that is double quoted'`

**example.:** As a somewhat esoteric example, suppose we want to make a table of the sampling distribution of some statistic on a fixed distribution. We want to know the 90% confidence interval of the sampling distribution for different sample sizes. We'll illustrate using the sample mean as a statistic, and a normal distribution.

```
dist = normal(0,1);
res = starttally;
for sampsize = [25 100 400]; % three different sample sizes
    tmp = confintervals( 0, lambda('mean(sample(sampsize,dist))'), .68)';
    tally tmp' res;
end
res
```

The unusual aspect of this use of `confintervals` is that the “data” are not used in the calculation. Indeed, the 0 in the position of the data argument is just a placeholder, and the `#` symbol doesn't appear anywhere in the quoted command string. Instead, the statistic is to take a sample of the given distribution, and compute the mean of the sample. `lambda` is used because the quoted string contains variable names (`sampsize` and `dist`).

The results of the above computation are

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Sample Size	Computed Lower	Computed Upper	Theoretical Lower	Theoretical Upper
25	-.212	0.189	-.2	.2
100	-.101	.099	-.1	.1
400	0.045	.053	-.05	.05

see also:: JAB, CONFINTERVALS

If writing programs that use `lambda`, you should read the on-line documentation for `RUNLAMBDA`, and note how `runlambda` is used in `JAB` and `CONFINTERVALS`.

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