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AHELP for CIAO 3.4

projection

Context: sherpa

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Synopsis

Estimates confidence intervals for selected thawed parameters.

Syntax

```
sherpa> PROJECTION [<dataset range> | ALLSETS] [ <arg_1> , ... ]

where <dataset range> = #, or more generally #:#,#:#,..., such that #
specifies a dataset number, and #:# represents an inclusive range of
datasets; one may specify multiple inclusive ranges by separating them
with commas. The default is to estimate limits using data from all
appropriate datasets.
```

Description

The command−line arguments <arg_n> may be:

PROJECTION Command Arguments

Argument	Description
<sherpa_modelname>.{<paramname> | <#>}	A specified model component parameter (e.g., GAUSS.pos).
<modelname>.{<paramname> | <#>}	A specified model component parameter (e.g., g.pos).

The user may configure PROJECTION via the Sherpa state object structure proj. The current values of the fields of this structure may be displayed using the command print(sherpa.proj), or using the more verbose Sherpa/S−Lang module function list_proj().

The structure fields are:

proj Structure Fields

Field	Description
fast	If 1, use a fast optimization algorithm (LEVENBERG−MARQUARDT or SIMPLEX) regardless of the current METHOD. If 0, use the current METHOD.
sigma	Specifies the number of sigma (i.e., the change in statistic).

Field values may be set using directly, e.g.,

```
sherpa> sherpa.proj.sigma = 2.6
```

NOTE: strict checking of value inputs is not done, i.e., the user can errantly change arrays to scalars, etc. To restore the default settings of the structure at any time, use the Sherpa/S−Lang module function restore_proj().

Confidence interval bounds are determined for each selected parameter in turn. A given parameter's value is varied along a grid of values while the values of all the other nominally thawed parameters are allowed to float to new best−fit values (compare to UNCERTAINTY, where the values of all the other nominally thawed parameters remain fixed to their best−fit values). This method of estimating confidence interval bounds gives truly accurate results only in special cases (see caveats below).

Because PROJECTION estimates confidence intervals for each parameter independently, the relationship between sigma and the change in statistic value delta_S can be particularly simple: sigma = the square root of delta_S for statistics sampled from the chi−square distribution and for the Cash statistic, and is approximately equal to the square root of (2 * delta_S) for fits based on the general log−likelihood (log(L)).

Confidence Intervals for the projection command

Confidence	sigma	delta_chi−square	delta_log(L)
68.3%	1.0	1.00	0.50
90.0%	1.6	2.71	1.36
95.5%	2.0	4.00	2.00
99.0%	2.6	6.63	3.32
99.7%	3.0	9.00	4.50

Caveats

An estimated confidence interval is accurate if and only if:

- the chi−square or log(L) surface in parameter space is approximately shaped like a multi−dimensional paraboloid, and
- the best−fit point is sufficiently far from parameter space boundaries.

One may determine if these conditions hold, for example, by plotting the fit statistic as a function of each parameter's values (the curve should approximate a parabola) and by examining contour plots of the fit statistics made by varying the values of two parameters at a time (the contours should be elliptical, and parameter space boundaries should be no closer than approximately 3−sigma from the best−fit point). The INTERVAL−PROJECTION and REGION−PROJECTION commands can be used for these checks.

If either of these conditions does not hold, then the output from PROJECTION may be meaningless except to give an idea of the scale of the confidence intervals. To accurately determine the confidence intervals, one would have to reparameterize the model, or use Monte Carlo simulations or Bayesian methods.

The user may retrieve the upper− and lower−bound estimates using the Sherpa/S−Lang module function get_proj.

Example 1

List the current and default values of the proj structure, and restore the default values:

```
sherpa> sherpa.proj.sigma = 5
sherpa> list_proj()
Parameter   Current         Default                           Description
```

```
----------------------------------------------------------------------
fast             1              1    Switch to LM/simplex: 0(n)/1(y)
sigma            5              1                    Number of sigma
sherpa> restore_proj()
sherpa> list_proj()
Parameter   Current         Default                      Description
----------------------------------------------------------------------
fast             1              1    Switch to LM/simplex: 0(n)/1(y)
sigma            1              1                    Number of sigma
```

Example 2

Search parameter space to find a range of parameter values, within a confidence in terval of 68.3%, for all thawed parameters:

```
sherpa> READ DATA example1.dat
sherpa> PARAMPROMPT OFF
Model parameter prompting is off
sherpa> SOURCE = poly[p]
sherpa> THAW p.c1 p.c2 p.c3
sherpa> METHOD SIMPLEX
sherpa> FIT
...
sherpa> PROJECTION
Projection: optimization reset to LM.
Projection complete for parameter: p.c0
Projection complete for parameter: p.c1
Projection complete for parameter: p.c2
Projection complete for parameter: p.c3

Computed for projection.sigma = 1
        --------------------------------------------------------
        Parameter Name      Best−Fit Lower Bound     Upper Bound
        --------------------------------------------------------
             p.c0          −0.302766  −8.34233        +7.87706
             p.c1           0.598026  −8.7713         +9.42289
             p.c2           0.792121  −2.72725        +2.53915
             p.c3           0.018429  −0.205409       +0.2213
```

CHANGES IN CIAO 3.2

Prior to CIAO 3.2 the PROJECTION command could not be used until the dataset had been fit. This was done to ensure that the parameter values were at their best−fit location, but caused problems when fitting multiple datasets or loading previously−saved analysis sessions. This restriction has now been removed. Please note that the results of PROJECTION will not be valid unless the parameters are at their best−fit values.

Bugs

See the Sherpa bug pages online for an up−to−date listing of known bugs.

See Also

sherpa

berrors, bsyserrors, compute_errors, compute_statistic, covariance, errors, ftest, get_paramest, get_paramestint, get_paramestlim, get_paramestreg, goodness, interval−projection, interval−uncertainty, list_paramest, mlr, region−projection, region−uncertainty, restore_paramest, run_paramest, run_paramestint, run_paramestlim, run_paramestreg, set_errors, set_syserrors, staterrors, syserrors, uncertainty

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