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 AHELP for CIAO 3.4

# levenberg-marquardt

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## Synopsis

The Levenberg-Marquardt optimization method.

## Syntax

```
levenberg-marquardt [iters] [eps] [smp1x] [smp1xep] [smp1xit]
```

## Description

An abbreviated equivalent is LEV-MAR.

The LEVENBERG-MARQUARDT method is a single-shot method which attempts to find the local fit-statistic minimum nearest to the starting point. Its principal advantage is that it uses information about the first and second derivatives of the fit-statistic as a function of the thawed parameter values to guess the location of the fit-statistic minimum. Thus this method works well (and fast) if the statistic surface is well-behaved. Its principal disadvantages are that it will not work as well with pathological statistic surfaces, and there is no guarantee it will find the global fit-statistic minimum.

The code for this method is derived from the implementation in Bevington (1992).

The eps parameter controls when the optimization will cease; for LEVENBERG-MARQUARDT, this will occur when

$$| S_i - S_{(i-1)} | < \text{eps} ,$$

where  $S_{(i-1)}$  and  $S_i$  are the observed statistic values for the  $(i-1)$ th and  $i$ th iteration, respectively.

The smp1x parameter controls whether the LEVENBERG-MARQUARDT fit is refined with a SIMPLEX fit. SIMPLEX refinement can be useful for complicated fitting problems where straight LEVENBERG-MARQUARDT does not provide a quick solution. Switchover from LEVENBERG-MARQUARDT to SIMPLEX occurs when  $\Delta(S)$ , the change in statistic value from one iteration to the next, is less than LEVENBERG-MARQUARDT.smp1xep, for LEVENBERG-MARQUARDT.smp1xit iterations in a row. For example, the default is for switchover to occur when  $\Delta \chi^2 < 1$  for 3 iterations in a row.

## Parameters

| name                      | type    | def   | min    | max   |
|---------------------------|---------|-------|--------|-------|
| <u>iters</u>              | integer | 2000  | 1      | 10000 |
| <u>eps</u>                | real    | 1.e-3 | 1.e-9  | 1     |
| <u>smp<sub>l</sub>x</u>   | real    | 1     | 0      | 1     |
| <u>smp<sub>l</sub>xep</u> | real    | 1     | 0.0001 | 1000  |
| <u>smp<sub>l</sub>xit</u> | real    | 3     | 1      | 20    |

## Detailed Parameter Descriptions

**Parameter=iters** (integer default=2000 min=1 max=10000)

*Maximum number of iterations.*

**Parameter=eps** (real default=1.e-3 min=1.e-9 max=1)

*Criterion to stop fit.*

**Parameter=smp<sub>l</sub>x** (real default=1 min=0 max=1)

*Refine fit with simplex (0=no)*

**Parameter=smp<sub>l</sub>xep** (real default=1 min=0.0001 max=1000)

*Switch-to-simplex eps factor*

**Parameter=smp<sub>l</sub>xit** (real default=3 min=1 max=20)

*Switch-to-simplex iters factor*

## Bugs

See the [Sherpa bug pages](#) online for an up-to-date listing of known bugs.

## See Also

*sherpa*

[get\\_method](#), [expr](#), [grid](#), [grid-powell](#), [method](#), [monte-lm](#), [monte-powell](#), [montecarlo](#), [powell](#), [sigma-rejection](#), [simplex](#), [simul-ann-1](#), [simul-ann-2](#), [simul-pow-1](#), [simul-pow-2](#), [usermethod](#)

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<http://cxc.harvard.edu/ciao3.4/levenberg-marquardt.html>  
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