Subject: Minimization of deviations from multiple curve fits.
Posted by aaron_forster on Mon, 26 May 2003 21:59:42 GMT
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Hello Group,

I am utilizing IDL to analyze data obtained from adhesion tests. For those interested, the tests are used to determine the work of adhesion and system modulus. I measure contact area, load, and displacement during the test. I currently use Craig Markwardt's MPFIT program to fit two different non-linear equations to the experimental data. The first equation (EQ1) expresses contact area as a function of load, with the work of adhesion, system modulus, and indenter radius as fitting parameters. The second equation (EQ2) expresses displacement as a function of load and contact area, with the system modulus and indenter radius as fitting parameters. It has been suggested by others (Chin P. et al., J. Adhesion, 1997, 64 p. 145-160) that I can increase the precision by analyzing the fit deviations from each curve fit together. In other words, I need to minimize the function:

omega^2=sum {[EQ1_fit - EQ1i] + [EQ2_fit - EQ2i]^2}

where sum is the sum from i=1 to N of my data (EQ1, EQ2) and my fit (EQ1_fit, EQ2_fit)

I hope the above equation is clear to everyone. Anyway, my understanding of the regression programs I have seen in IDL is that they will fit an equation and measure success of fit by minimizing chi-sqr. My question is how do I both minimize chi-sqr for each equation AND minimize omega^2, such that the fitting parameters I obtain at the end of the day will provide satisfactory fits for EQ1 and EQ2. I hope this post is clearly written, but I am an IDL newbie and I may have left relevant information out. If you would like to hear more, please email me at aaron_forster@yahoo.com with questions. Thank you in advance for all of your help. I greatly appreciate it.

Sincerely,
Aaron Forster

Subject: Re: Minimization of deviations from multiple curve fits.
Posted by Craig Markwardt on Tue, 27 May 2003 22:10:45 GMT
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aaron_forster@yahoo.com (Aaron Forster) writes:

> first equation (EQ1) expresses contact area as a function of load,
> with the work of adhesion, system modulus, and indenter radius as

> fitting parameters. The second equation (EQ2) expresses displacement
> as a function of load and contact area, with the system modulus and
> indenter radius as fitting parameters. It has been suggested by
> others (Chin P. et al., J. Adhesion, 1997, 64 p. 145-160) that I can
> increase the precision by analyzing the fit deviations from each curve
> fit together. In other words, I need to minimize the function:

Any least squares fitter can do this, including MPFIT. You are asking
for a joint fit of two data sets.

> omega^2=sum {[EQ1_fit - EQ1i] + [EQ2_fit - EQ2i]^2}

I don't really understand this formula, since (a) the first term is
not squared, and (b) what exactly is the summation over? Your
description indicates that equations 1 and 2 have different sets of
independent variables.

All MPFIT really needs is an array of residuals, and you can make that
array in any consistent manner that you choose. So, one way to
achieve what you are seeking is to compute the residuals of each
equation separately, and then join them together using IDL [res1,res2]
notation.

> My question is how do I both minimize chi-sqr for each
> equation AND minimize omega^2,

I don't think this is possible. You are asking, "what is the shortest
route from Baltimore to Philadelphia to New York, which is *also* the
shortest route from Baltimore to New York." Both constraints can't be
met.

If you are performing a joint fit, you must be willing to accept a
slightly worse fit in one data set or the other, for the sake of an
overall improvement of the aggregate. If, however, that means that
one set of data is totally ignored, then you have to reconsider your
model, or your weighting strategy.

Happy fitting,
Craig

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Astrophysics, IDL, Finance, Derivatives | Remove "net" for better response
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