NORTHERN ILLINOIS UNIVERSITY

PHYSICS DEPARTMENT

Physics 374 – Junior Physics Lab Spring 2021

Problem Set #7

Problem Set Due: Thurs., April 15, 2021
Read Bevington: Chapters 8 (Least Squares Fit to an Arbitrary Function)

1. Derive Eqs. 8.12 & 8.13. They give you the parameters of a fit as well as their uncertainties.

You can use the hint given on page 165 (Exercises 8.1 and 8.2).

Or you can just write down a general form of a parabola:

$$\chi_1^2 = b(a_1 - a_{min})^2 + \chi_{min}^2 \quad \text{(plus 2 more equations for the other 2 points)}$$

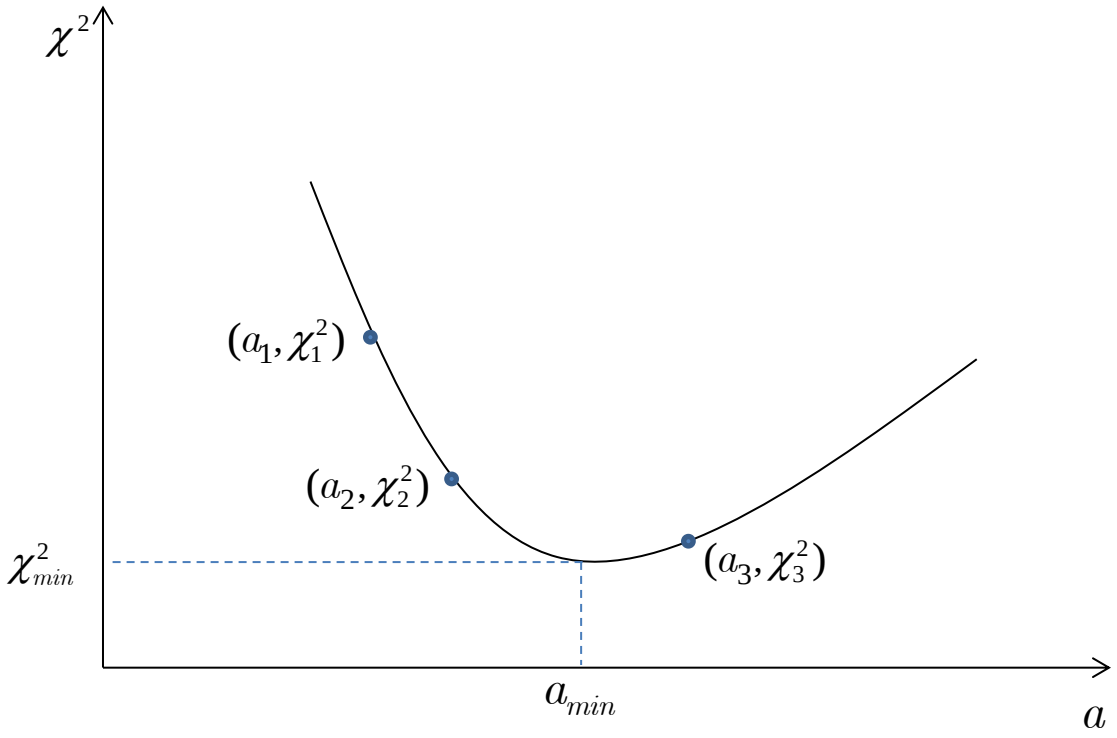
Where b is an arbitrary constant, and a_{min} and χ_{min}^2 are the values of the parabola at the minimum. Then you have 3 equations and 3 unknowns which gives you all the information to derive the equations below:

8.12:
$$a_{min} = a_3 - \Delta a \left(\frac{\chi_3^2 - \chi_2^2}{\chi_1^2 - 2\chi_2^2 + \chi_3^2} + \frac{1}{2} \right)$$

8.13:
$$\sigma_a = \Delta a \sqrt{\frac{2}{\chi_1^2 - 2\chi_2^2 + \chi_3^2}}$$

You may assume all the intervals are the same: $\Delta a_j \equiv \Delta a$ (to make life easier—and it is what the Fortran program GRIDSEAR does). See plot below:

2. Why are the σ_a values (or uncertainties) for the Grid-Search method so different than those for the Marquardt method? (Examine Tables 8.2 and 8.5—and recall that these differences occur even when *chiCut* is made small).


χ^2
(a_1, χ_1^2)
(a_2, χ_2^2)
(a_3, χ_3^2)
χ^2_{min}
a_{min}
a