

3. Click the radio button labeled “Auto-set bins: $3.49 \cdot \text{Sdev} \cdot N^{1/3}$ ”.

The information text at the bottom of the Destination Bins box tells you that the histogram will have 48 bins.

This is a method by Sturges for selecting a “good” number of bins for a histogram. See the **Histogram** operation on page V-349 for a reference.

4. Click the Bin-Centered X Values checkbox to check it.

By default, the Histogram operation sets the X scaling of the output wave such that the X values are at the left edge of each bin, and the right edge is given by the next X value. This makes a nice bar plot.

In the next section you will do a curve fit to the histogram. For curve fitting you need X values that represent the center of each bin.

5. Click the Create Square Root(N) Wave checkbox to check it.

Counting data, such as a histogram, usually has Poisson-distributed values. The estimated mean of the Poisson distribution is simply the number of counts (N) and the estimated standard deviation is the square root of N.

The curve fit will be biased if this is not taken into account. You will use this extra wave for weighting when you do the curve fit.

6. Click the Do It button.

Note that the histogram output as shown in Graph0 has a Gaussian shape, as you would expect since the histogram input was noise with a Gaussian distribution.

7. Choose Data→Data Browser.

The Data Browser shows you the waves and variables in your experiment. You should see three waves now: fakeY, fakeY_Hist, and W_SqrtN. FakeY_Hist contains the output of the Histogram operation and W_SqrtN is the wave created by the Histogram operation to receive the square root of N data.

8. Close the Data Browser.

9. Click Graph0 and then double-click the trace to invoke the Modify Trace Appearance dialog.

10. Select Markers from the Mode menu, then select the open circle marker.

11. Click the Error Bars checkbox.

The Error Bars dialog appears.

12. Select “+/- wave” from the Y Error Bars menu.

13. Pop up the Y+ menu and select W_SqrtN.

Note that the Y- menu is set to Same as Y+. You could now select another wave from the Y- menu if you needed asymmetric error bars.

14. Click OK, then Do It.

Saving Your Work - Tour 3B

1. Choose the File→Save Experiment As menu item.

2. Navigate to your “Guided Tours” folder.

This is the folder that you created under **Saving Your Work - Tour 1A** on page I-21.

3. Type “Tour 3B.pxp” in the name box and click Save.

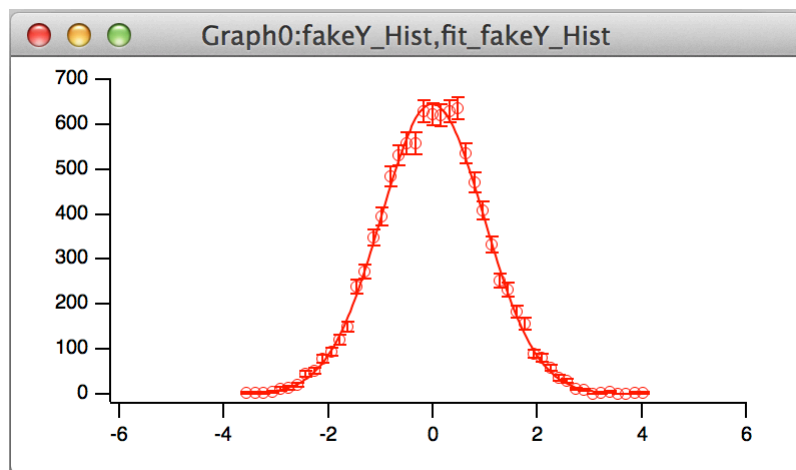
Curve Fit of Histogram Data

The previous section produces all the pieces required to fit a Gaussian to the histogram data, with proper weighting to account for the variance of Poisson-distributed data.

1. Click the graph to make sure it is the target window.

2. In the Analysis→Quick Fit menu make sure the Weight from Error Bar Wave item is checked. If it is not, select it to check it.
3. Choose Analysis→Quick Fit→gauss.

The graph now looks like this:



As shown in the history area, the fit results are:

```
Coefficient values ± one standard deviation
y0      = -0.35284 ± 0.513
A       = 644.85 ± 7.99
x0      = -0.0014111 ± 0.00997
width   = 1.406 ± 0.0118
```

The original data was made with a standard deviation of 1. Why is the width 1.406? The way Igor defines its gauss fit function, width is $\sigma \cdot 2^{1/2}$.

4. Execute this command in the command line:

```
Print 1.406/sqrt(2)
```

The result, 0.994192, is pretty close to 1.0.

It is often useful to plot the residuals from a fit to check for various kinds of problems. For that you need to use the Curve Fitting dialog.

5. Choose Analysis→Curve Fitting.
6. Click the Function and Data tab and choose gauss from the Function menu.
7. Choose fakeY_Hist (not fakeY) from the Y Data menu.
8. Leave the X Data pop-up menu set to “_calculated_”.
9. Click the Data Options tab. If there is text in the Start or End Range boxes, click the Clear button in the Range section.
10. Choose W_SqrtN from the Weighting pop-up menu.
11. Just under the Weighting pop-up menu there are two radio buttons. Click the top one which is labeled “Standard Dev”.
12. Click the Output Options tab and choose “_auto_” from the Destination pop-up menu.
13. Set the Residual pop-up menu to “_auto trace_”.
14. Uncheck the X Range Full Width of Graph checkbox.

Residuals will be calculated automatically and added to the curve fit in our graph.

This is appropriate only when we are fitting to a subset of the source wave.