Physics with Mathematica Fall 2019 Exercise #10 6 Nov 2019

Generate and fit two overlapping Gaussians

Use the RandomVariate function to generate a set of numbers that follow the sum of two Gaussian (aka Normal) distributions. Choose different peak positions and widths of the two Gaussians so that they overlap significantly, and generate a total of something like ten thousand numbers.

Make a histogram of these numbers to see that your distribution has two bumps that overlap significantly. It will be helpful if you define a parameter for the bin width of the histogram, because it will be useful later. A handy way to define the bin width would be something like one-tenth of the smaller of the two Gaussian width parameters.

Now extract the data values for the histogram using HistogramList. (It will be helpful to use the same bin width parameter you used for your displayed histogram.) Note that this function returns a list of bin edges and frequency values, and that there is one more element in the bin edge list than there are frequencies. Turn these two lists into a two-dimensional data array for fitting and plotting.

Use FindFit to fit this data to a function that is the sum of two Gaussians, and find the six parameters for the best fit. As a reminder, the form for a Gaussian normalized to unity is

$$g(x;\mu,\sigma) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left[-\frac{(x-\mu)^2}{2\sigma^2}\right]$$

Compare your six fitted parameters to the numbers you used to generate the distribution. (A generated distribution can be thought of as dN/dx where dx is the bin width.)

Finally, make a plot that superimposes the histogram values with the fitted curve. Try to code this in such a way that the horizontal and vertical limits on the plot are determined in a way you can control, and which neatly cover the range of values.

Send the grader an email with your notebook as an attachment.