Plotting and fitting in Matlab

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Most of you probably have encountered that Excel isn't the most friendly tool for plotting measurement data in a scientific accurate way and doing a proper linear fit (although it is certainly possible). This documents describes how to do it in Matlab, which is a useful skill to have during your studies. Matlab is installed in on the computers at the RUG campus and can also be accessed through uwp from home at http://uwp.rug.nl/.

Code

All necessary code is found in the listing below. You can type the commands after the >> signs in the command window.

You first define the x, y and y-errors in three vector variables. These have to be comma separated. Next, you plot an errorbar (see http://www.mathworks.com/help/matlab/ref/errorbar.html for an extensive explanation of this function) graph, which is essentially a scatterplot with vertical error bars. This function pops up a figure window. How to handle it is explained in the last section of this document. Next, you determine if you want to modify the range of the axis (could add some aesthetic improvements).

Listing 1: Fitting in Matlab

```matlab
% x values separated by comma's
x = [1, 2, 3, 4];
% y values separated by comma's
y = [0.9, 2.1, 2.9, 4.2]

% errors in y
e = [0.1, 0.2, 0.15, 0.2]

% make an errorbar plot
% where '.k' denotes "black points"
errorbar(x, y, e, '.k')

% set the axis to the value you want
% in this case, x = 0 -> 5 and y = 0 -> 5
% axis([x1 x2 y1 y2])
axis([0 5 0 5])

% do a linear fit and get the
% parameter estimations and
% standard errors.
fitlm(x, y)
```

The output of the linear fit function `fitlm` (see http://www.mathworks.com/help/stats/fitlm.html), for this data, is:

```
Linear regression model:
    y ~ 1 + x1

Estimated Coefficients:
                 Estimate         SE         tStat        pValue

    (Intercept)    -0.15       0.17958      -0.83527      0.49145
    x1              1.07       0.065574      16.317       0.0037348


Number of observations: 4, Error degrees of freedom: 2
Root Mean Squared Error: 0.147
R-squared: 0.993,   Adjusted R-Squared 0.989
F-statistic vs. constant model: 266, p-value = 0.00373
```

From this, all that is necessary is to see that the intercept is -0.15 ± 0.18 and the linear parameter is 1.07 ± 0.066.

Adding a linear fit to the plot

You can add a linear fit by clicking `Tools -> Basic Fitting` in the figure window, and selecting linear fit, as shown in the figure below. Via `Insert` you can add axis labels and a title to your graph. After you are happy with your plot, you can save it by `File -> Save As`.