UCL DEPARTMENT OF PHYSICS AND ASTRONOMY
Gower Street Teaching Laboratories

Course PHAS1240: Mat 1

Using Matlab to plot graphs

Objectives:

To introduces some of the data analysis packages which are available on the computers in Laboratory 1

Relevant Lecture Courses:
PHAS1240 Data Analysis Lectures

Department: Physics and Astronomy Risk Assessment Form

WORK/PROJECT TITLE : Experimental skills and introduction to computers

LOCATION(S): First year teaching laboratory

DESCRIPTION OF WORK: Undergraduate experiment involving use of computers

PERSONS INVOLVED: Undergraduate students and academic staff

HAZARD IDENTIFICATION *(state the hazards involved in the work)*

Normal electrical hazards when using computers

RISK ASSESSMENT (make an assessment of the risks involved in the work and where possible state high, medium or low risk)

Low risk.

Use of office equipment and computers.

CONTROL MEASURES (*state the control measures that are in place to protect staff and others from the above risks. Put in place adequate control measures for any risks that have been identified as uncontrolled.)*

Students will be supervised and are instructed to only place the pendulum into gentle oscillation.

Departmental safety procedures will be followed.

DECLARATION

I, the undersigned have assessed the work, titled above, and declare that there is no significant risk / the risks will be controlled by the methods stated on this form *(delete as applicable)* and that the work will be carried out in accordance with Departmental codes of practice.

Name P Bartlett

Signed

Date 17/08/09

1. Introduction

In the laboratory, you should use your notebook in the correct manner. Make notes of anything that you think may be useful to you in the future, as well as recording any results which you obtain. Write down the answers to any questions in the script. The most important idea is to get maximum feedback from interaction with the demonstrators - your work may be marked, but the information you get from these people will help you to succeed.

2 Introduction to Laboratory 1 Computers

In this laboratory, the computers are only to be used as tools. Please do NOT try to adjust the initial screen layout in any way: this only annoys other users and wastes everyone's time.

You will mainly be using two programs on the laboratory PCs: Microsoft **Excel** which is a spreadsheet for data analysis and **MATLAB** for plotting graphs and determining best fit functions for the data values. You will learn about all of these as part of the programming course. The next few pages are intended to show you how to use **MATLAB** using data you have in an **Excel** table. If you have not used **Excel** before let **Dr. Bartlett** know so he can ensure you have the training you need. By learning how to use these programs, you will gain a useful (and necessary) insight into the use of computers.

2.1 MATLAB

MATLAB is a high-level language and interactive environment that enables you to perform computationally intensive tasks faster than with traditional programming languages such as C, C++, and Fortran. You will receive instruction on basic use of MATLAB in the Computer Based Skills element of PHAS1240. However, you will need to be able to fit data to a straight line graph early on in the experimental component of PHAS1240. Consequently a program (llsfitcol) has been installed on the laboratory computers so that you will be able to easily perform this function.

Remember to quote measured and calculated values to a realistic number of decimal places related to the known error. For clarity it is recommended that you label the columns of your spread sheet. These column heading will later be used by the MATLAB program, llsfitcol, to form the axis labels of a graph. Store this file under an appropriate name.

You can start MATLAB by double-clicking on the MATLAB icon or invoking the application from the Start menu of Windows. The main MATLAB window (called the MATLAB Desktop), will then pop-up and will be divided into the Current Directory, Command History and Command Window as follows:

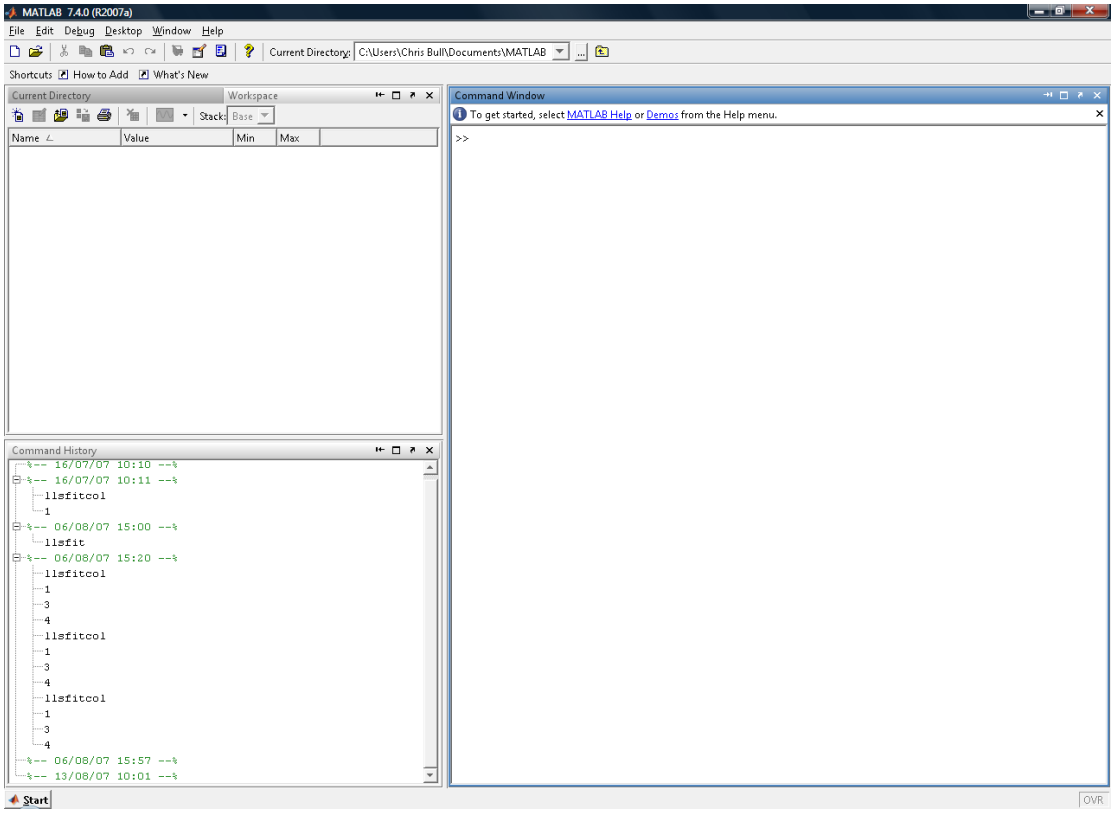

Figure 1 Main MATLAB window

To import your data into MATLAB click on the File drop down menu and select Import Data. Find the file you have stored using the browser. Press open

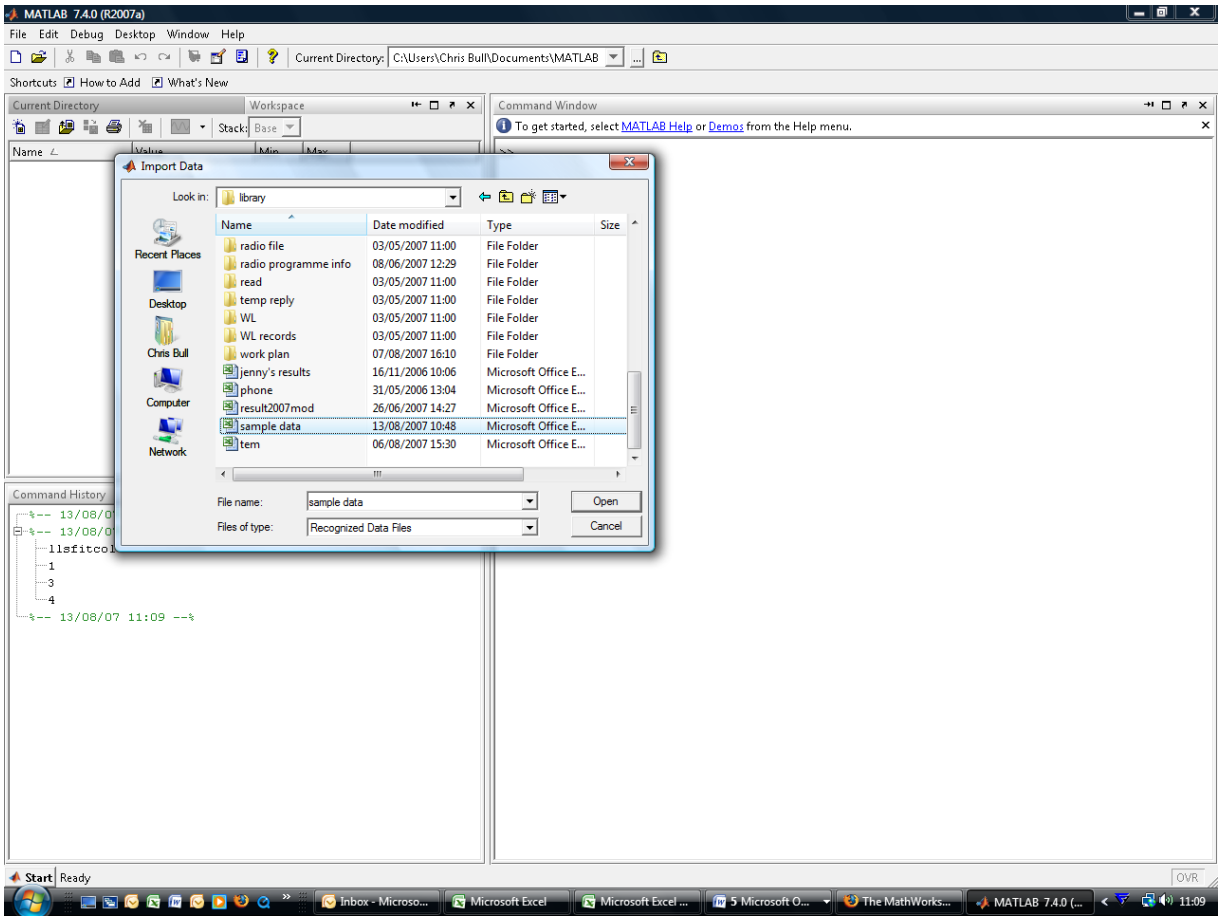

Figure 2 'Import Data' pop-up window

You will have to wait a short while then the following window will appear

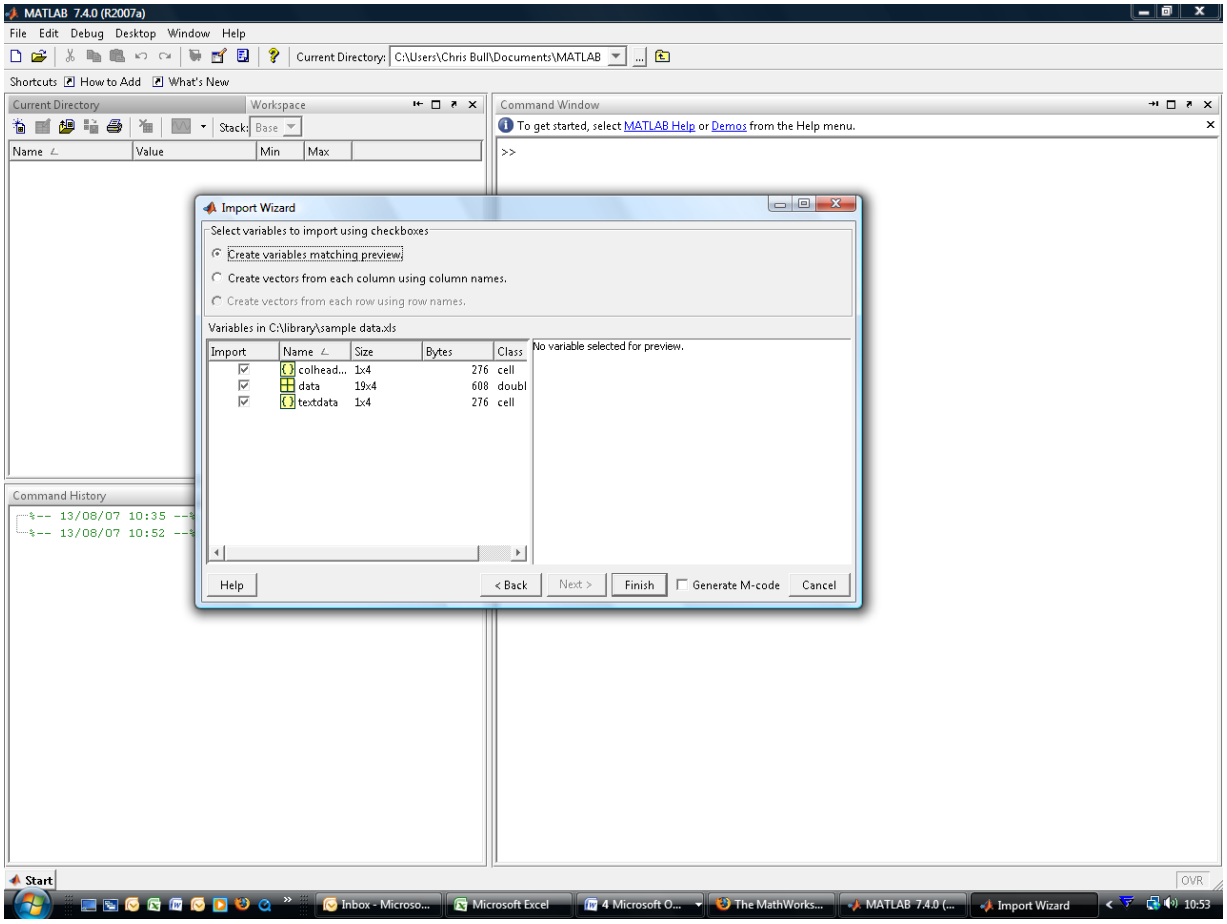

Figure 3'Import Data Wizard' pop-up window

This shows that you have an array colhead (and textdata) that contains the text labels you put at the column headings and a data array. Press Finish. The data will then be imported and you will see that you have these variables in your Current Directory.

Now look in the MATLAB command window. The "» " is called the *command prompt*, and there will be a blinking cursor right after it waiting for you to type something. The idea is that you type commands at the command prompt for MATLAB to execute. After the » prompt type llsfitcol. This will instruct MATLAB to run the program llsfitcol that has previously been entered into the MATLAB library.

The program will respond with "type in a which column x data is in ". If the data is in column 1 press 1 followed by return. The data you will require is that which you wish to be associated with the *x* axis, Continue to tell the program which columns the *y* and *error data* (error in *x*) are in. When you have told the program where the data can be found it will return the gradient and intercept of the best fit line together with the errors in these values. The program will also return a graph with the best fit line and error bars. The *x* and *y* axis will be labelled with the column headings you used in your Excel file.

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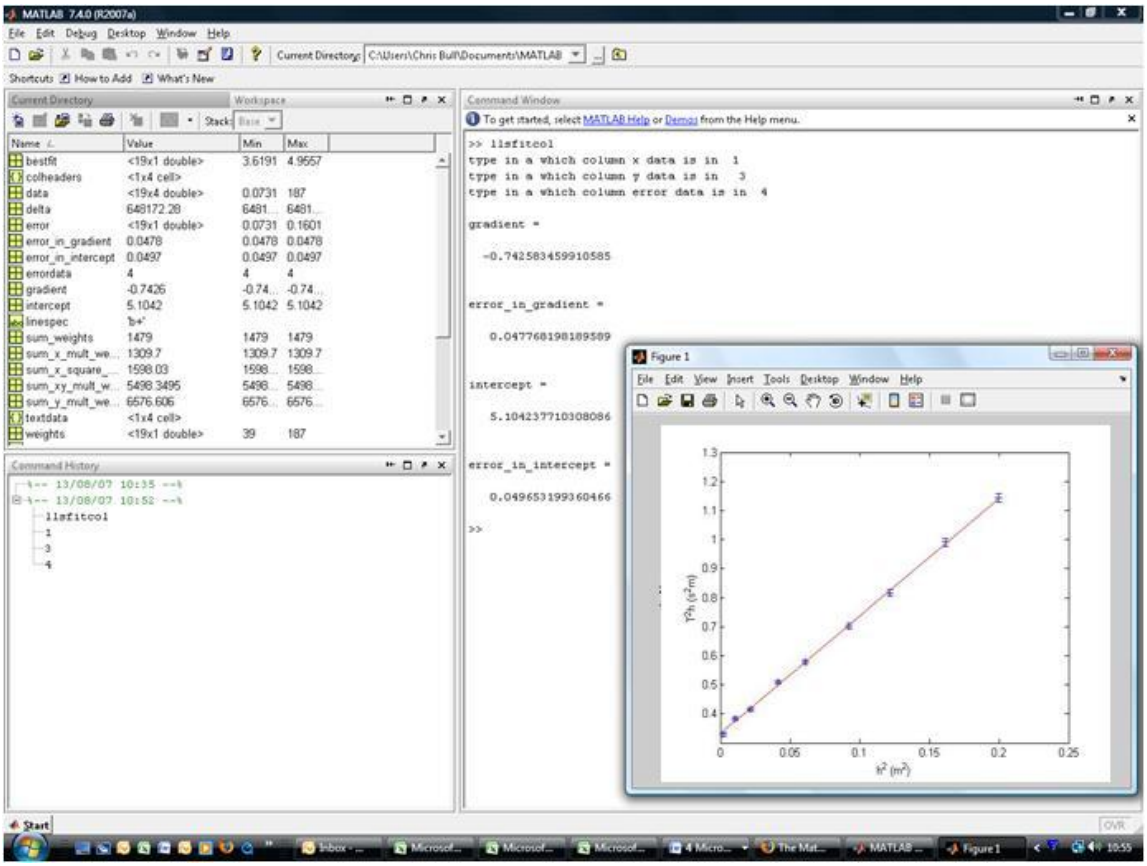

Figure 4 Plotted data with error bars (nb: Numerical values shown are not intended to represent those that will be obtained by the student for the intercept, gradient and error in gradient)

You will notice that the Current Directory now lists a long list of arrays. These variables were defined and calculated as part of the llsfitcol program.

In the experiments that follow this term you will be expected to determine the best line fit for your data set and use the value for the gradient (and or intercept) to derive an experimental determination of various constants. It is vital that you also consider the error in the fit and propagate these errors in your calculation. This will be covered in the Experimental Procedures and Data Analysis lectures and is also covered in the laboratory handbook.