##### World Population

#### (Least Squares Linear Regression Fit)

**Due Time:** 23.59, 13 Nov 2016 **Earnings:** 9% of your final grade

***NOTE: The code in this assignment must be your own work. It must not be code taken from another student or written for you by someone else, even if you give a reference to the person you got it from (attribution); if it is not entirely your own work it will be treated as plagiarism and given a fail mark, or less.***

#### Algorithm

The application will ask the user to select a file source of data to read. In this assignment the file is named “WorldPopulation.txt”. The data in the file is listed below:

|  |  |
| --- | --- |
| Year t (in thousands of years AD)  0.001  1.000  1.500  1.650  1.750  1.800  1.850  1.900  1.927  1.950  1.955  1.960  1.965  1.970  1.975  1.980  1.985  1.990  1.995  2.000  2.005  2.008  2.009 | Population N (in billions)  0.200  0.310  0.450  0.500  0.791  0.978  1.262  1.650  2.000  2.519  2.756  2.982  3.335  3.692  4.068  4.435  4.831  5.263  5.674  6.070  6.454  6.707  6.800 |

It is found that the data approximately fits the function (N is population, t is time in years)



written in code as N = N0\*exp(b\*exp(t\*t)).

This is a double exponential showing that the population increased very quickly between 1 AD to 2009 AD. N0 and b are constants to be determined from the least-squares fit. Using the standard linear regression and a suitable transformation of variables, the data can be fit to the double exponential shown above. Here’s how it’s done:

1. Take the natural log of each side:
2. Ln(N) = Ln() = Ln(*N*0) + Ln() = Ln(*N*0) + Ln(e) = Ln(*N*0) +
3. Define Y = Ln(N), X = and C = Ln(*N*0)
4. The equation now becomes Y = bX + C and can be fit by least squares linear regression to get *b* and C
5. From C get N0, so you now have b and N0 and you’re finished.

The user is invited to do an interpolation/extrapolation of the data to find the World population at any time inside or outside the data range. There is example output of the running application at the end. Yours must be the same. Read the Marking Sheet to see how you can lose marks.

Note the following

* Your code should be able to deal with a file of arbitrary length
* When the program exits, all dynamically allocated memory must be released.

**What to Submit :** Use Blackboard to submit this assignment as a zipped file containing the source code file(s) (ass2.cpp) done as C or C++. The name of the zipped folder **must** contain your name as a prefix so that I can identify it, for example using my name the file would be tyleraAss2CST8233.zip. It is also vital that you include the Cover Information as specified in the Submission Standard as a file header in your source files so the files can be identified as yours. Use comment lines in the files to include the header.

Before you submit the code, check that it builds and executes in Visual Studio 2013 as you expect - if it doesn’t build for me, for whatever reason, you get a deduction of at least 60%. There is a late penalty of 25% per day. Do not send me the file as an email attachment – it will get 0.

#### Example Output

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**Exponential fit by Linear Regression**

**1. Read Data from File**

**2. Quit**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**Select an option: 1**

**please enter the name of the file to open:WorldPopulation.txt**

**FILE OPENED FOR READING**

**There are 23 records.**

**File read into memory**

**EXPONENTIAL FUNCTION**

**Fit data to double exponential: N = N0\*exp(b\*(exp(t\*t))**

**DOUBLE EXPONENTIAL: y = 0.214\*exp(0.0592exp(t\*t))**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**Eponential Interpolation/Extrapolation**

**1. Interpolation/Extrapolation of World Population**

**2. Quit Interpolation/Extrapolation**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**Select an option: 1**

**Interpolation/Extrapolation of World Population**

**Please enter the year(e.g. 2100) : 1910**

**World Population at 1910 = 2.0784 billion**

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**Eponential Interpolation/Extrapolation**

**1. Interpolation/Extrapolation of World Population**

**2. Quit Interpolation/Extrapolation**

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**Select an option: 1**

**Interpolation/Extrapolation of World Population**

**Please enter the year(e.g. 2100) : 2300**

**World Population at 2300 = 26907.3 billion**

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**Eponential Interpolation/Extrapolation**

**1. Interpolation/Extrapolation of World Population**

**2. Quit Interpolation/Extrapolation**

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**Select an option:**