Second Integral Project of Numerical Methods

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It is a fresh cool May's morning and final projects are being delivered at ITESM CCM. You and your team mates have work hard to prepare an experiment over the past months, in order to collect the results just in time for being presented and get 100 on the score.

Figure 1 Your Teammate (One Dollar Hernández)

Suddenly, your teammate in charge of running the tests (Figure 1) sends you an email with the results ready to be analyzed, but he tells you some bad news. The testing bench was broken after the last test and it is not possible to run any more experiments... "It´s a relief that I could collect the data before it failed".

Checking the results, you find out that your teammate did not correctly scaled the signal and as a matter of fact, he used Excel to write down the data as they were appearing. According to his own words: "I've already worked too much writing down the data, it is up to you to do what is left".

Out of fear and feeling a chill down in your spine, you decide to open the Excel file to find out there are three main flaws: The signal is saturated due to bad scaling, the time periods of each sample are not the same and it is possible that some samples are missing (you cannot tell).

For the project you have to find some data about the experiment:

1. The time when the 2 crests to the left and 2 to the right of 0.5 that appear and their magnitude
2. The time when the 2 valleys (basins) to the left and 2 to the right of 0.5 that appear and their magnitude
3. The first 4 inflexion points
4. The total time when the signal is above 0.5
5. The total time when the signal is below -0.8
6. Extra: search for the time when the signal amplitude is below 0.1
7. The time when the valleys (basins) appear and what is their magnitude when the amplitude is bigger than 0.5

Accordingly to your deep knowledge on the subject, you know that the experiment would have delivered a signal of the form (1) and that its amplitude was never bigger than 6.

$$f(x) = \frac{A}{2\pi} e^{-Bt^2} sin(Ct) \qquad (1)$$

Objective: Save the project and save your final work from the incompetence of your teammate. Find at least the 5 first point stated earlier.

Method: Suggest and implement a solution to the proposed problem and delivered a SINGLE CODE for solving it completely (in MATLAB and per team), as well as a report to explain your answers.

Evaluation: The report must contain: Title / Author / Summary / Introduction / Methods / Results / Discussion and Conclusions / Attachments (here's the code) / References. The proposed solution is evaluated, the results obtained and how they were obtained (according to the document "Understanding the publishing process"). All items are weighted according to the document "Report Checklist". There are several parts for this project, each one will be evaluated separately in the methodology and should have a concrete introduction for the whole project and individual introductions if needed.

- The delivery is considered in two parts: MATLAB implementation with an individual report for the teacher. Although the code will not be evaluated it will be taken into consideration to validate your answers. If it is found out that the answers do not correspond to your answers the report will be considered invalid and it will be consider a DA on the assignment.
- The code and the report must be send to the blackboard link available. No physical documents are accepted.

Tips: Consider the accuracy of their results, whenever you need a value between two known points, /Use encapsulated numerical methods in functions / Make use of secondary functions to sort your final program / Be clear in your report and program, doing otherwise is the easiest way to lose points and offer solutions incomplete/ Add comments to your code, and adequately report.

Expected results: As it always happens, one of your classmates of numerical methods managed to obtain the exact results, and by using their characteristic Academic Dishonesty he sends them to you by mail, but he did not send you the code?.

Crests

0.300	0.634
0.373	0.864
0.570	1.000
0.670	0.727

Trough

0.330	-0.742
0.430	-1.000
0.630	-0.863
0.700	-0.635

Inflexion Points

0.012	0.003
0.025	-0.013
0.038	0.019
0.053	-0.018

Total Times

0.140
0.046

Magnitude time margin

0.694

Remember to use any numerical method as long as you solve the problem. It is required to use a combination of some of them: interpolation, regression, root finding, derivation,...

- The answers to the questions raised in the project do not validate your solution, the grade will be given accordingly to the methodology used and the results obtained, not whether or not answered these questions.
- You are not allowed to use MATLAB functions to solve predefined methods seen in class (or Similar). Using a method that is not owned by the students will be cause for DA.

There is no single way to solve it, however, the results achieved must be accurate according to the chosen method, consider the importance of numerical methods is actually used or even modify them to get very close to the actual result. Note that this does not imply that the programming can be done without relying on conventional methods using excessive ifs and fors for example. If a new method is proposed for either of the solutions it must presented with sufficient evidence that the method can be used to solve other problems as well as their mathematical basis.

The difficulty of solving the problem is (like most of the time) in the approach to their solution and the data flow and not on the complexity of numerical methods or programming.

Final Recommendations

- Be sure to write your name and student number.
- Delivers after the due date are not accepted.
- As a reference, you can use the code available in: http://www.cs.cornell.edu/Courses/cs321/2003fa/Matlab%20Coding%20Style.pdf