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CW4 (Part b i)

b) Download this data set, repeat the table above for this new data set: (i) In Sheet#2 using all terms in each polynomial model. Insert spreadsheet snapshots, polynomial coefficients, and parameter s into **Table 2** in your MS Word file (ii) In Sheet #3 using only the highest order term in each polynomial model. Insert spreadsheet snapshots, polynomial coefficients, and parameter s into **Table 3** in your MS Word file. Can you conclude what is the dominant relationship (linear, quadratic, or cubic) between the periods and the lengths of a pendulum?

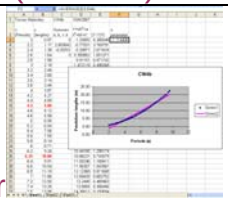
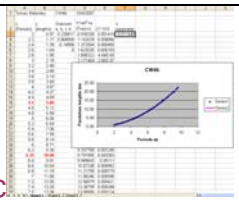
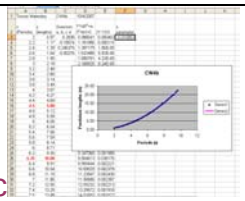
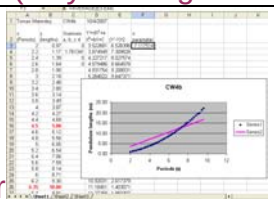
Model (all terms)	Coefficients	S parameter
Linear 	A= B= C= D=	
Quadratic 	A= B= C= D=	
Cubic 	A= B= C= D=	

Table 2: All terms in polynomials models using new data set

Model (only leading terms)	Coefficients	S parameter
Linear 	A= B= C= D=	

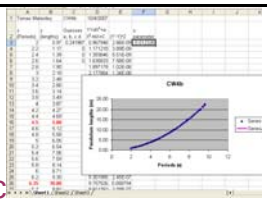
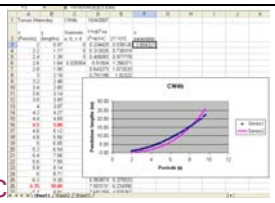
Quadratic 	A= B= C= D=	
Cubic 	A= B= C= D=	

Table 3: Only highest order term in polynomial models using new data set

In each team, students working together at a computer numbered between 1 and 10 will submit file cw4_XX_a.html and folder cw4_XX_a_files, students working at a computer numbered between 11 and 20 will submit file cw4_XX_b.html and folder cw4_XX_b_files, to the *files* folder in the server. Replace XX by 01 if team 1, etc.

Include your names within the files.

Q&A

1) I have copied Sheet#1 to Sheet #2, cleared contents in cells A9-B47 and pasted in the new data set in columns A and B. Do I need to change anything in column C and cell D3?

No, we are going to try the same cubic, quadratic and linear models on the new data set. So the formula will be the same in D3 and there should still be guess values in C3 through C6, although some of them will be zero depending on the particular model we will be using.

2) Do I need to change anything in column D?

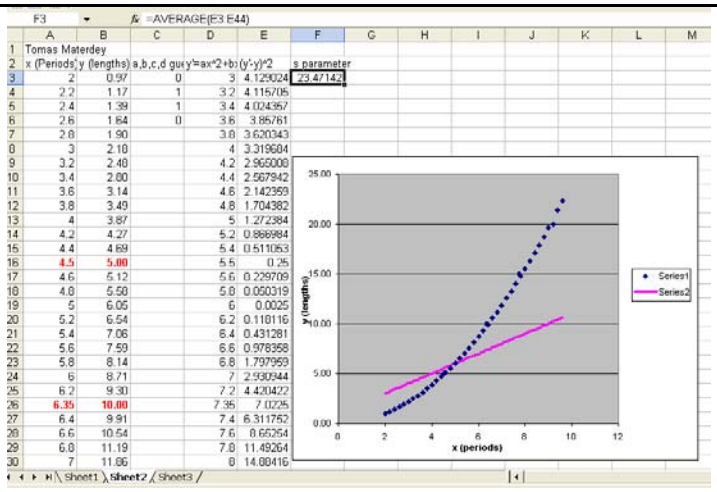
Yes, since in Sheet#1 you worked with only 4 pairs of data. Now we have 42 pairs of data, so copy cell D6 to D7-D44.

3) Any change in column E?

Yes, same as with column D: copy cell E6 to E7-E44.

4) When I click on F3, the "s parameter", the formula was "=average(E3:E6)", do I need to change anything here?

Yes, since we now have 42 pairs of data, we need to average over 42 deviations between Y' (model) and Y (data): change the formula to "=average(E3:E44)". Notice that these cell numbers refer to the instructor's example, that is, when the first row of numbers is row #3.

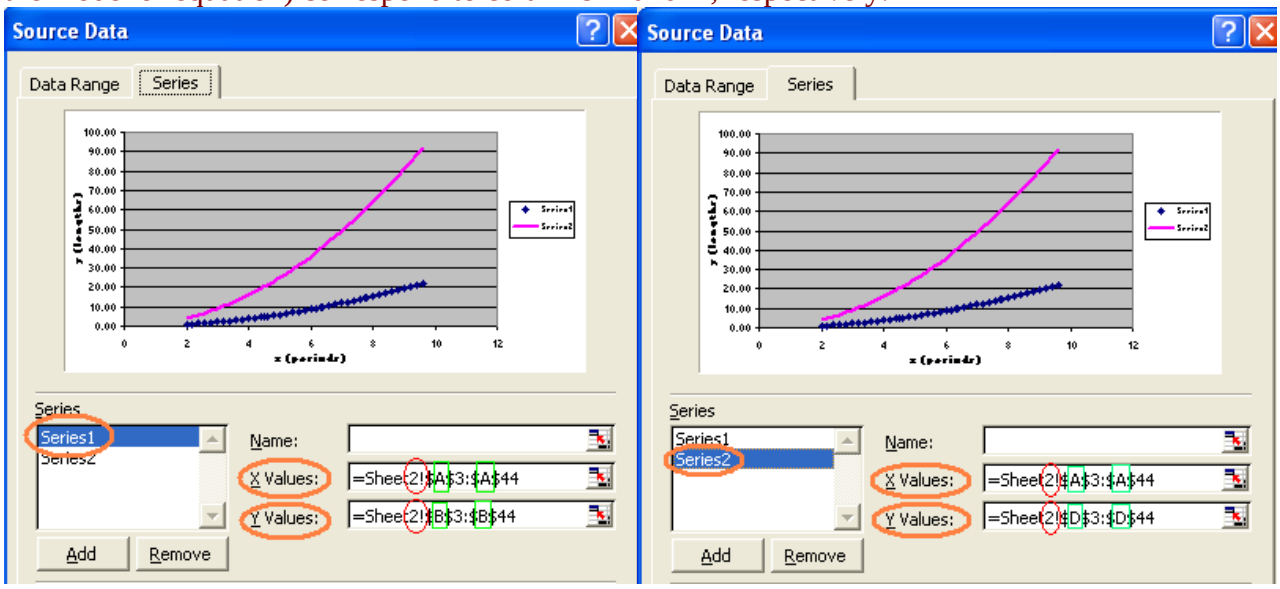


5) Am I now ready to copy the polynomial coefficients and the s parameter to the table?

Not yet. Any time you make a change to the data or the model, you need to repeat the s parameter minimization using Solver to obtain a new model.

6) Why my graph does not change after I use Solver?

Since we copied Sheet#1 to Sheet#2, the series in the graph are still referred to Sheet#1. In Sheet#2, right click inside the graph, select "Source Data", click on "Series", then make sure you have the right Series1 and Series2 as shown in the figures below. Notice the X and Y values for Series1 (data) correspond to columns A and B, respectively, and those for Series2 (calculated from the model or equation) correspond to columns A and D, respectively.

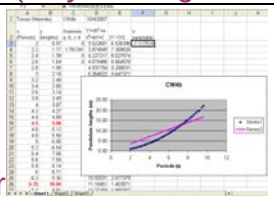
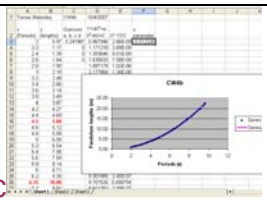
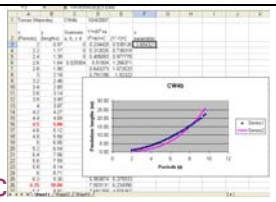


7) How do I get the different models without changing the formula in cell D3?

If you already have a cubic formula in D3-D44, you can get the cubic, quadratic, and linear models by allowing Solver to change $C$3:$C$6, $C$3:$C$5, $C$4:$C$5, respectively. Notice that at the same time, in Sheet#2 to obtain the quadratic model, cell C6 (carrying the cubic coefficient D) should contain a 0, and for the linear model both cells C3 (carrying the quadratic coefficient A) and C6 (carrying the cubic coefficient D) should contain a 0.

CW4 (Part b ii)

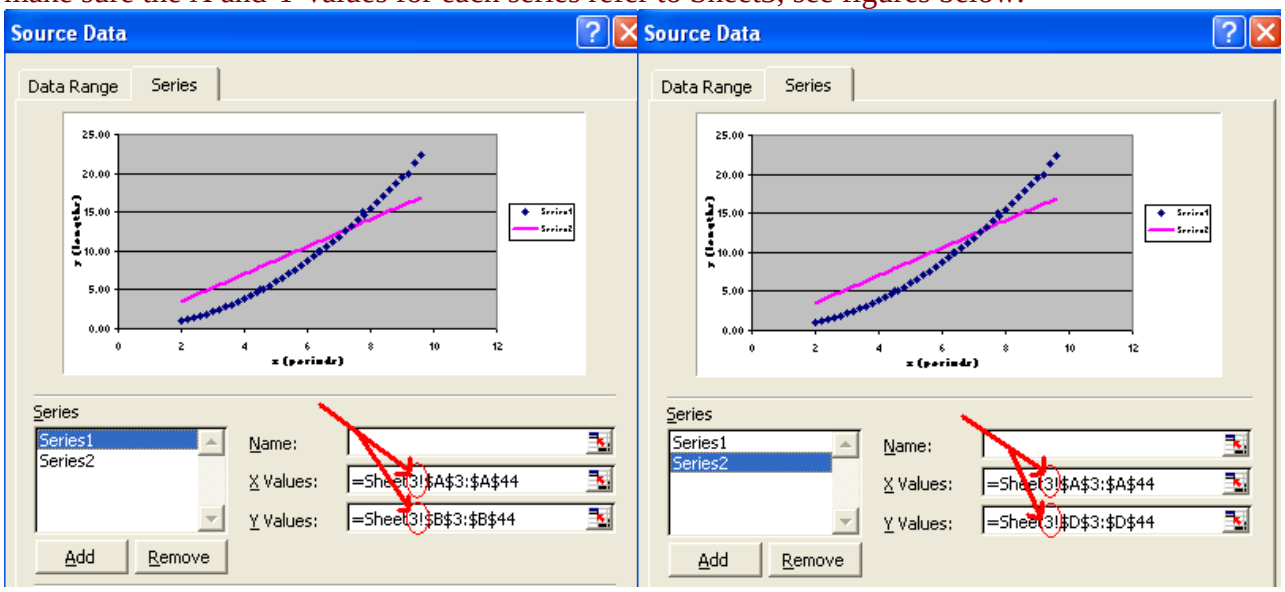
b) (ii) In Sheet #3 using only the highest order term in each model

Model (only leading terms)	Coefficients	S parameter
Linear 	A= B= C= D=	
Quadratic 	A= B= C= D=	
Cubic 	A= B= C= D=	

Q&A

1) After copying Sheet#2 to Sheet#3, do I need to check the two series in the graph?

Yes, nn Sheet#3, right click inside the graph, select "Source Data" click on "Series", and make sure the X and Y values for each series refer to Sheet3, see figures below.



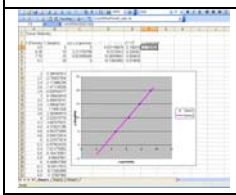
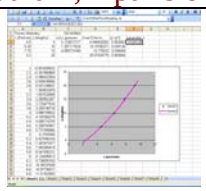
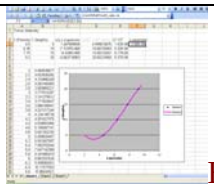
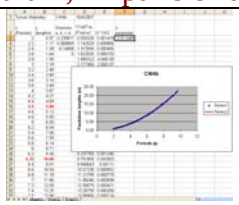
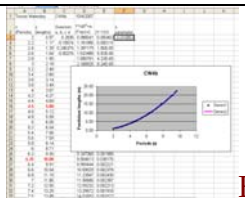
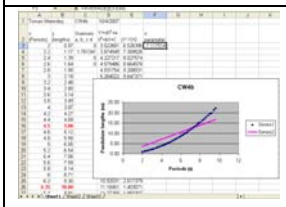
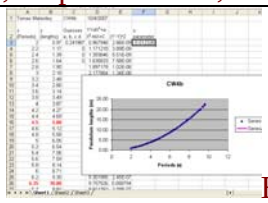
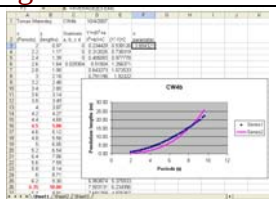
2) How do I get the different models with only the leading terms without changing the formula in cell D3?

If you already have a cubic formula in D3-D44, you can get the cubic, quadratic, and linear models using only the leading terms by allowing Solver to change $C$6, $C$3, or $C$4,

respectively. Notice that at the same time, in Sheet#3, to obtain the cubic model cells C3 through C5 should contain a zero, for the quadratic model, cell C4 through C6 should contain a 0, and for the linear model, cells C3, C5, and C6 should contain a 0.

3) So what is the best model if we use only the leading term?

The summary of CW4 results is shown in the table below.

Linear	Quadratic	Cubic
Pendulum, 4 pairs of data, used all terms		
		 Best
Pendulum, 42 pairs of data, used all terms		
		 Best s=0.010853
Pendulum, 42 pairs of data, used only leading terms		
	 Best s=0.012326	

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LOGBOOK: example of a logbook page

-Use a quadrille notebook; number all pages; date all entries
-Write your notes for all activities, thoughts, problems and solutions, and learning conclusions related to Engin 103. You should write down progress, outcomes, and conclusions on projects and teamwork; conclusions from class work (including LabVIEW) and homework.
-In addition you should answer in the logbook all questions listed in these notes in blue, as shown below:

19) Insert copies of the Tables 1, 2, 3 into your logbook.
(a) Did you expect to get the same coefficients A, B, C, D and the s parameter for these two sets of data? Notice that the initial four pairs of data are contained in the longer data set. Explain why Tables 1 and 2 contain different results.
(b) After looking at Tables 2 and 3 can you conclude that for any set of data, the higher the order of the polynomial model (e.g. in this case, the cubic model), the better the model (as reflected in the final s parameter achieved)? Explain why.
(c) Looking at Tables 2 and 3, which one would be preferred by a scientist, which by an engineer? How would you characterize each table in one word?

20) Write a quadric (fourth order) polynomial in a similar format as we wrote the cubic polynomial in the previous class note. Explain in your own words what are the changes you will need to do to in the Excel spreadsheet you made for a cubic model to produce a quadric model.
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