



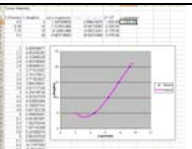
Engin 103  
October 5, 2010

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## CW4

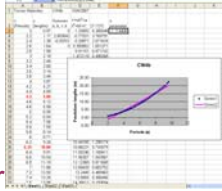

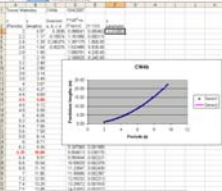
- (a) Save CW3 into a new file, then in Sheet #1 modify it to produce a linear and a cubic model for the same data set, insert snapshots of these worksheets into **Table 1** in a MS Word file. Make a table like the one below for the “s” values for the linear, quadratic, and cubic models, along with the coefficients obtained for each model. Indicate which is the best model (linear, quadratic, or cubic) for our set of data, and explain why.

Model	Coefficients	S parameter
Linear 	A= B= C= D=	
Quadratic 	A= B= C= D=	
Cubic 	A= B= C= D=	
<b>Table 1: All terms in polynomial models using same data set as in CW3</b>		

- (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?

(c)

Model (all terms)	Coefficients	S parameter
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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.xlsx (containing the spreadsheets) and cw4\_XX\_a.docx (containing the Tables), students working at a computer numbered between 11 and 20 will submit file cw4\_XX\_b.xlsx (containing the spreadsheets) and cw4\_XX\_b.docx (containing the Tables), to the *files* folder in the server. Replace **XX** by 01 if team 1, etc. **Include your**

## names within the files.

### Q&A

#### 1) What is the purpose of CW4?

The purpose is to modify the Excel Spreadsheet we created for CW3 to obtain a cubic and linear model for the same data set. After assembling a table with the parameters and coefficients for the three models, we will be able to select the best model for a given data set. This is something you need to do for part II of Project 1.

#### 2) How many coefficients are there in these different models?

Cubic polynomial:

$$Y' = f(X) = D \cdot X^3 + A \cdot X^2 + B \cdot X + C \quad (\text{has 4 coefficients: D, A, B, C})$$

Quadratic polynomial:

$$Y' = f(X) = A \cdot X^2 + B \cdot X + C \quad (\text{has 3 coefficients: A, B, C or 4 being D=0})$$

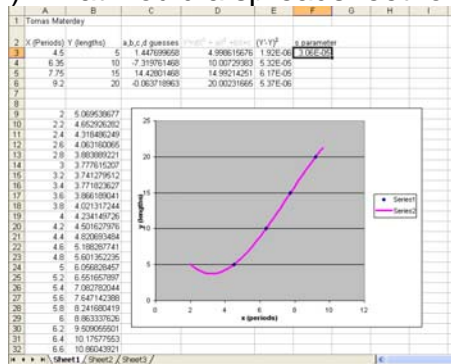
Linear polynomial:

$$Y' = f(X) = B \cdot X + C \quad (\text{has 2 coefficients: B, C or 4 being D=A=0})$$

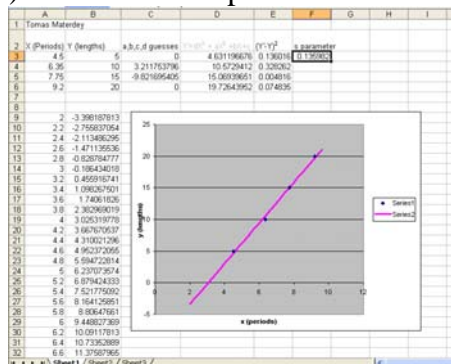
#### 3) How can I get a snapshot of the worksheet?

Copy a snapshot of the Excel screen by doing ALT+PRINT SCREEN, then PASTE into a WORD file

#### 4) What would a spreadsheet for a cubic model look like?



#### 5) What would a spreadsheet for a linear model look like?



#### 6) What changes should I make to the CW3 spreadsheet to produce a cubic model?

Here are the changes (in green) to make to the spreadsheet for CW3 to obtain a cubic model in CW4a)

	A	B	C	D	E
1	Your name		10/19/2004		
2	X (Periods)	Y (lengths)	a,b,c, d guesses		
3	4.5	5	1	← a	
4	6.35	10	0	← b	
5	7.75	15	0	← c	
6	9.2	20	0	← extra cubic parameter 'd'	
7					
8					
9	X	Y			
10	data	data			
11					
12					
13					

We are trying to relate X to Y  
using  $Y' = dX^3 + aX^2 + bX + c$

	A	B	C	D	E	F
2	X (Periods)	Y (lengths)	a,b,c,d guesses	In this column: Y' = $dX^3 + aX^2 + bX + c$		
3	4.5	5	1	20.25		
4	6.35	10	0	40.3225		
5	7.75	15	0	60.0625		
6	9.2	20	0	84.64		
7						
8						
9						

(a) In this cell type

$=\$C\$6*A3^3 + \$C\$3*A3^2 + \$C\$4*A3 + \$C\$5$

This gives Y' when X is in A3 using a cubic polynomial

	A	B	C	D	E	F
1						
2						
3						
4						
5						
6						
7						
8						
9	2	4				
10	2.2	4.84				
11	2.4	5.76				
12	2.6	6.76				
13	2.8	7.84				
14	3	9				

(a) In A9 type 2

(b) In A10 type  $=A9+0.2$

(c) Copy to A11-A47, until you get 9.6

(d) In B9 type  $=\$C\$6*A9^3$

$+\$C\$3*A9^2 + \$C\$4*A9 + \$C\$5$

(e) Copy to B10-B47

Step 5

In this cell:  
parameter s,  
the Std. Dev.

	A	B	C	D	E	F	G	H	I	J
1	Tomas Materdey		10/14/2004							
2						parameter				
3						s here				
4										
5										
6										
7										
8										
9		2	5.07054							
10		2.2	4.653826							
11		2.4	4.319292							
12		2.6	4.063981							
13		2.8	3.884531							
14		3	3.778186							
15		3.2	3.741786							
16		3.4	3.772271							
17		3.6	3.866584							
18		3.8	4.021665							
19		4	4.234456							
20		4.2	4.501897							
21		4.4	4.82093							
22		4.6	5.188496							
23		4.8	5.601536							
24		5	6.056991							
25		5.2	6.551802							
26		5.4	7.08291							

(a) Select cell containing parameter s (F3)  
 (b) Click on Tools; Solver; check: (Y-Y)<sup>2</sup>  
 \*Equal to: min; \*By changing cells: \$C\$3:\$C\$6 (for cubic model);  
 (c) Click on Solve  
 (d) Select "Keep Solver Solution" or "Restore original values", then OK  
 (e) Observe how the fit curve (blue) come to lay on the data (pink)

Step 7

6) How to get a QUADRATIC model using the spreadsheet made for a CUBIC model?

7) How to get a LINEAR model using the spreadsheet made for a CUBIC model?

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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:

17) Explain in your own words what did you do in each of the seven steps to do data modeling with Excel in CW3. Write  $Y=f(X)$ , being f the quadratic polynomial obtained after using Solver with values for the coefficients a,b,c substituted in. Also write down the final s parameter achieved with these coefficients. Attach a copy of your spreadsheet for CW3.

18) You have the spreadsheet to make a quadratic model for certain data set, such as the one used in CW3.

(a) Explain what changes you would do on the spreadsheet to make a linear model for the same data set. Use the most economical way that would not require changing

the equations in cells D3 and B9 and copying them into the cells below.  
(b) Explain what changes you would do on the spreadsheet to make a cubic model for the same data set.

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