Engin 103	Topics:
March 10, 2011	<u>CW5</u>
	Introduction to LabVIEW
back to e-syllabus	<u>CW6</u>
	Circuit Analysis with LabVIEW I
	Circuit Analysis with LabVIEW II
	Project 1 Progress Reports
	Logbook questions
Engineering 103	3 –UMass Boston
CI	N 5
(In-Class	s-Work 5)

1.- Import the data (metal distance and ultrasonic response) from http://www.itl.nist.gov/div898/handbook/pmd/section6/pmd631.htm into Excel (it helps to save them into a text file and then use 'Data/Get External Data/Import text file' with the 'fixed width' option). Produce a non-linear fit of the ultrasonic response Y' as a function of the metal distance X, with model Y'=exp(-b1*X)/(b2+b3*X). When importing data, note that in that website, the ultrasonic response (Y) appears in the first column, and the metal distance (X) in the second column. Plot the data and best fit on a same plot. Then copy the plot into a Word file. Also provide b1, b2, b3, and the final 'standard' deviation coefficient.

2.- Answer the following questions about data modeling

a) Using more coefficients in a model for a given data set will lead to a lower parameter s. True or false and why?

b) In studying a phenomenon, when doing data modeling, would scientists use more or less coefficients in their models, why? What would engineers do?

c) Does the way you build your physical system affect the quality of the mathematical model you can construct? Yes or no and why?

In each team, students working together at a computer numbered between 1 and 10 will submit file cw5_XX_a.xlsx, students working at a computer numbered between 11 and 20 will submit file cw5_XX_b.xlsx, to the *files* folder in the server. Replace XX by 01 if team 1, etc. Include your name within the files.

*Remember that this is an individual work (turn it in, as instructed, with your name and date). Home-works and class-works count 20% toward the course grade. Classworks are done in class.

Your Excel graph should look like:



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Image: Control Image: Control Image: Contro	K CVX5-1 CVX5-2 Street Screet Hone Isset Page Board Cutoms Extreet Hone A CUX5-2 Cutoms Extreet SM - Isset Figure Board CW5 0.625 0.75 0.875 1.125 1.75 2.255 1.75 2.255 2.75 3.75 3.25 3.755 2.25 5.75 0.55 0.625 0.75 0.625 0.75 0.625 0.75 0.625 0.75 0.625 0.875 0.875 1	Control Control Permuta Control Permuta Ear Ear <thear< th=""> <thear< t<="" td=""><td>View Zerm 100% Zerm 200% Zerm 200% Zerm 100% Zerm 100% Zerm</td><td>CVV J Q data = Microsoft</td><td>E (Y'-Y)^2 8555.444571 6141.952253 4087.05465 4183.201461 3239.437918 1863.878963 963.2835424 555.4303307 960.1823614 555.4303307 960.1823614 555.4303307 960.1823614 59.65238054 54.01015854 64.39305728 8135.254598 5863.058063 5087.979779 4016.72951 2896.168344</td><td>Parameter s =AVERAGE(E</td><td>3:E216)</td></thear<></thear<>	View Zerm 100% Zerm 200% Zerm 200% Zerm 100% Zerm	CVV J Q data = Microsoft	E (Y'-Y)^2 8555.444571 6141.952253 4087.05465 4183.201461 3239.437918 1863.878963 963.2835424 555.4303307 960.1823614 555.4303307 960.1823614 555.4303307 960.1823614 59.65238054 54.01015854 64.39305728 8135.254598 5863.058063 5087.979779 4016.72951 2896.168344	Parameter s =AVERAGE(E	3:E216)
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1 CW5		Name	Date	This type of chart	compares pairs of				
2 X (Met	al Distance)	Y (Ultrasonic Response)) Guess	values. es b1,b2,b3	Y'=exp(-	o1*X)/(b2+b3*X)	(Y'-Y)^2	Parameter s	
3	0.5	92.9		charted are not in when they represe	X-axis order or ent separate	0.404353773	8555.444571	. 146	51.921615
4	0.625	78.7		measurements.		0.329391648	6141.952253		
5	0.75	64.2		1		0.269923744	4087.05465	i	
6	0.875	64.9				0.22232641	4183.201461		
7	1	57.1				0.183939721	3239.437918	1	
8	1.25	43.3				0.127335465	1863.878963		
9	1.75	31.1				0.063190525	963.2835424		
10	2.25	23.6				0.03243053	060 193361/		
12	2.25	23 775				0.032430531	563 709605		
13	2.25	17,7375				0.01704743	314.0144393		
14	3.25	13.8				0.00912334	190.188279)	
15	3.75	11.5875				0.004951104	134.1554389)	
16	4.25	9.4125				0.002716997	88.54401616	;	
17	4.75	7.725				0.001504643	59.65238054	L	
18	5.25	7.35				0.000839603	54.01015854	l.	
19	5.75	8.025				0.000471523	64.39305728		
20	0.5	90.6				0.404353773	8135.254598	:	
21	0.625	76.9				0.329391648	5863.058063	•	
22	0.75	71.6				0.269923744	5087.979779)	
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Data Modeling and Science vs. Engineering

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



When only the leading term was used, the quadratic model showed the lowest s parameter. This means our data behave more in line with a quadratic term rather than a cubic or a linear term. In deed, based on Newton's Laws and the Universal Law of Gravitation, the period of an ideal pendulum (mass of string is negligible, bob is not so large, and friction is ignored) is given by

$$T = 2\pi \sqrt{\frac{L}{g}}$$
 or $L = \frac{gT^2}{4\pi^2}$

where T is the period, L is the length, and g is the acceleration of gravity.

From the value of the coefficient A, you can derive the constant acceleration of gravity g. In fact a method to measure this constant at different latitudes and longitudes is to measure the periods of a pendulum of different lengths, then extract g from the coefficient of the quadratic term.

-While doing data modeling, can we distinguish between an engineer and a scientist approach?

Engineers tend to make a more precise model of a system (getting lower s parameter) by including additional terms. Scientists tend to idealize a system in quest of a universal model that is simpler, but also less accurate when applied to a real system. Precision and universality satisfy a complementary relation similar to that of the uncertainty principle in quantum mechanics.

Data Modeling and System Design



A good design will affect the quality of X,Y data, which will affect the quality of a mathematical model. In the two systems above, which one will allow better data, and so model, and why?

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Introduction to LabVIEW

-LabVIEW: background for HW1 questions 4 and 5. How to locate different functions within the Front Panel (user interface: inputs and outputs quantities) and within the Block Diagram (programmer interface: operations, analysis).

-Things belonging to the Front Panel will be found under **Controls palette**, abbreviation is C, which can be brought up by 'right-clicking' (click on the mouse's right button) on the Front Panel.

-Things belonging to the Block Diagram will be found under **Functions palette**, abbreviation is F, which can be brought up by 'right-clicking' on the Block Diagram.

-Things to operate VI (Virtual Instruments) will be found under **Tools palette**, abbreviation is T, which can be brought up by clicking on Window, then select 'Show Tools Palette'

For example, where to locate 'Array'?. We start by guessing whether this is an input/output or

an operation, it is more of a numeric input utility, so right-click on the Front Panel to bring up the Controls palette (C), then select sub-palette All Controls, then select sub-palette Array and Cluster, to find Array in the first button. So the complete location for Array reads C/All Controls/Array and Cluster.

For example where to locate 'Reciprocal'?. This is more of an operation (getting the reciprocal of x is doing 1/x). So right-click on the Block Diagram to bring up the Functions palette (F), then select All Functions, then Numeric, and find Reciprocal under button 1/x. So the location for Reciprocal is F/All Functions/Numeric

-As a background to changing values on a Numeric Control, we make a simple addition VI. We will need two inputs (Numeric Controls) and one output (Numeric Indicator) in the Front Panel, where the user will input the numbers she/he would like to add, where she/he will read the result, respectively. We should label the inputs as n1 and n2, and the output as n1+n2. This is necessary to identify identical elements on the Block Diagram, and as part of the user interface. **Label** can be entered by typing into the blank box that is shown when an element is placed in the Front Panel. The blank box can be brought up by right-click on the element and select '**Show Label**'. To edit labels, select the Text tool, under Tools Palette, then click on the label.

To tell LabVIEW how to produce the output from these inputs, the programmer goes to the Block Diagram to place the addition operation (F/All Functions/Numeric), then wire the inputs n1 and n2 into the left terminals of the addition by selecting the **wiring tool** (under T), click to start, click to end, double-click to finish a wiring. Note that since the addition is commutative, n1 and n2 can be individually connected to either the left upper terminal or the left lower terminal of the addition operator. Should we have a division, the upper terminal is divided by the lower terminal, or the left terminals are different. In a subtraction, the upper terminal is subtracted by the lower one.

If we need to remove any piece of wire, use the **Select tool** (arrow under T) to select that piece, then hit 'backspace' on the keyboard.

Then it comes to put in values into the Numeric Controls to test our addition VI: using the **Operate Value tool** (finger, under T) and click on the left handles to increase or decrease by an integer unit. To run the VI, click on the **Run button** (right arrow in the upper left corner), the results should show as expected. If we would like to scan through different inputs and outputs without having to hit the Run button every time we change the inputs, then use **Run Continuously** (found to the right of the Run button). Under this mode, the VI should be stopped before any modification can be made.







Example: a VI that solves a simple electrical circuit with one battery and one resistance:

Developing a Virtual Instrument consists of the following steps:

1) Define the problem you want to solve, specify what will be the inputs and the outputs. The inputs are the battery voltage V (in Volts) and the resistance of the light bulb R in (in Ohms). The output is the current flowing in the circuit I (in Amps)

2) Determine the equations or operations needed to produce the outputs from the inputs We need an equation that gives I in terms of V and R. It is Ohm's law: I=V/R

3) Implement the controls and indicators and graphs in the Control Panel and the operations in the Block Diagram

Control panel: enter a numeric control for V, another one for R; a numeric indicator (without handle on the left side) for the current I

Block Diagram: enter the "divide" operation, then wire V and R to this operator, and the output to I

4) Fix any error and implement modifications as needed

If there is a broken wire, that needs to be fixed If there is no error, the arrow on the upper left corner ("Run") is not broken

5) Test the final results against expected theoretical values. Enter V=9V; R=2 Ohm, I should read 4.5 A In circuits with more than one resistor, if the output does not agree with our calculation, the Block Diagram needs to be revised.

Insert a text box by clicking on "A" (Edit Text) in the tool palette Insert a circuit diagram made in Paint by selecting (using the dotted rectangle in Paint left menu), then Edit/Copy; then in the Front Panel of LabVIEW, Edit/Paste

Front Panel: enter two numeric controls, label them as V and R; enter one numeric indicator, label it as I

Block Diagram: enter the "Divide" operator from Arith/Compare/Numeric Group V and R together with the "Divide" on the left side of the Block Diagram, and the I on the right.

Check if the "Run" button is continuous

Enter values in the Numeric Controls V and R boxes and check the result at the numeric indicator I box after clicking on the "Run" button.





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		use to test the predictability?	d) What instrument will you	4 –members always
1			use to measure X and Y	communicate how they are

(rulers, stop watch, etc.) e) What will be the range for X? (Note the range needs to allow for at least 10 doing on their part 3 – members sometimes communicate how they are doing on their part 2- some member does not reply emails or phone calls 1 – members show no interest in participating distinctive values for X) Cection 1 **2** Section 1 a) b) **3** Section 1 **4** Section 1 b) a) 5 Section 1 **6** Section 1 **7** Section 1 Section 1 Section 1 10 Section 1

S	ection 2 ((2:00PM)			
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