Engin 103 September 25, 2008 back to e-syllabus	Topics: Differences between Science and Engineering CW1 Logbook questions

Differences between Science and Engineering:

Copy this page and fill in your team response below. Then save as a web page: name "engsci.**html**" and upload to your *files* folder.

Indicate at least one difference between your engineering field (as assigned in Project 0) and a related science subject such as Physics (including mechanics, thermodynamics, electricity and magnetism, static, fluids), Chemistry, Biology, Computer Science. Please try to be specific. Since they are not the same thing, avoid words like "engineering science", or "engineering is a branch of physics". Since they have different missions, avoid comparisons such as one is generally better than the other, etc.

Team #	Difference between Engineering and Science	Rating
1		
2		
3	Chemists analyze, Chemical Engineers change the analysis to a creation	4
4	Civil engineers will solve physical problems and scientists will solve theoretical problems.	5
5	Science contains laws of Nature, Engineering is problem solving using those laws "contains" → "discovers"	4
6	Biology is the study of living things while EE is how electrical things work and the manufacturing of them. EE is more closely related to Physics; manufacturing is a different branch of engineering	3
7	Scientist are meant to discover while Engineer's goals are to built things out of already existing knowledge	5
8	Physics defines the world around us; IE's use those definitions to improve efficiency. "defines" →"studies" or "investigates", since Nature defines the law of Physics and not viceversa	4
9	Material science Engineers test a material and look to find the best technique then apply the tested materials to create a product. Science tests how things work and then build models to test their predictions. Engineers also build models and test their predictions, but on specific systems	4
10	Engineering – Design; Science – composition and behavior of physical world Engineering –Design **and Build**	4

Team #	Explain any connection between what you said above and any difference between the outcomes of a science/math homework and an engineering project	Rating
1		
2		
3		
4	In a science/math homework you are learning, and an engineering project is applying everything you know.	4
5	Science/math homework includes learning, the engineering project is using what you learned	4
6	Homework for any class is either right or wrong while an engineering project can be viewed as trial and error to help further your education in that field. This trial and error process is called the "engineering design cycle" to deliver the best project given a number of specifications, budget, and timeline.	5
7	Math and science are closely related to engineers because what we built relies on there discoveries.	2
8		
9	Material Science Engineering is very closely related to field of science.	2
10	Engineering project – knowledge and something tangible; math/science HW – knowledge	4

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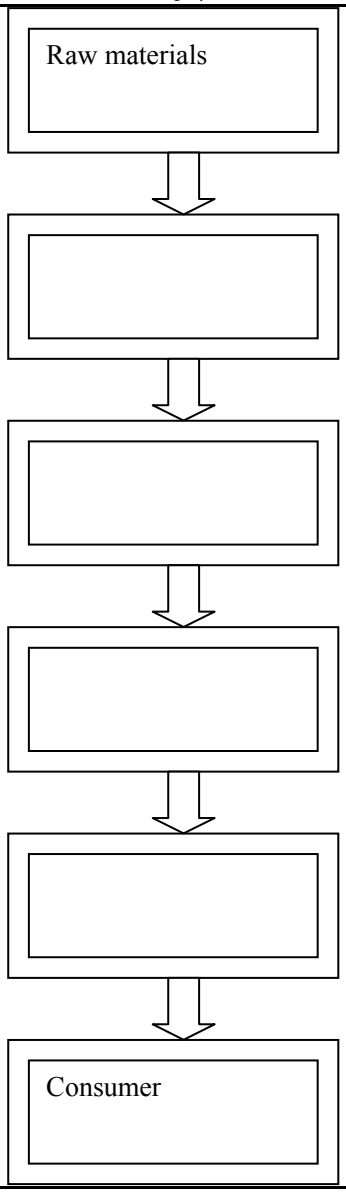
CW1 (This CW will be done on 9/30/08)

Engineering 103 -UMass Boston
CW 1
(Class Work #1)

Use boxes and arrows in MS Word to create a flow chart to show the supply chain of an automobile from the raw materials to the end consumer. The chain should include at least 6 steps: 1) Raw materials 2)_____ 3)_____ 4)_____ 5)_____ 6) Consumer. In each step, indicate what type of engineers from the table below would be involved. In a few words explain what they do specifically. Can you include all ten fields in the supply chain? Save the file as a webpage (see rules for naming the file below), and upload them to the *files* folder using ftp.



Engineering fields	Abbreviations
Aeronautical and Aerospace Engineering	AAE
Biomedical Engineering	BME
Chemical Engineering	ChE
Civil Engineering	CiE
Computer Engineering	CE
Electrical Engineering	EE
Geological/Geophysical Engineering	GGP
Industrial and Manufacturing Engineering	IME
Material Science Engineering	MSE
Mechanical Engineering	ME

In each team, students working together at a computer numbered between 1 and 10 will submit file cw1_XX_a.html and folder cw1_XX_a_files, students working at a computer numbered between 11 and 20 will submit file cw1_XX_b.html and folder cw1_XX_b_files, to the *files* folder in the server. Replace XX by 01 if team 1, etc. Include your name within the files.

Introduction to Project 1

Design and build a simple system, a system produces a measurable output Y for each measurable input X. Model the system by relating a sufficient number of (X,Y) pairs using Excel to obtain the best fit. Test system predictability by comparing actual output for a new input with the model prediction. Read complete project specifications in the course e-syllabus.

FAQ:

1) Should we bring the system into class or do we need to make a video?
   The system needs to be brought in for the presentations
2) Can the money limit exceed twenty dollars a little?
   No
3) What kind of design we are supposed to look at? Anything specific?
   -This is the main difference between a project and a homework, there is not a unique answer to a project. However the project specifies certain things that need to be satisfied.
   Are there any previous models from the previous class that we can take a look at?
   - A "rollercoaster track" was shown in class
4) What are we going to be measuring?
   -This is a good question, you will be doing two types of measurements in this project: a) Raw measurements of the inputs X's and outputs Y's for the system you built. (These raw measurements will be used to obtain a model or equation describing the system, you will create an Excel spreadsheet to do this); b) Once you have the equation/model in hand, you will use it to measure the predictability of your system by comparing a new measurement (done during the second day of presentation) with the prediction from your equation.
5) What type of materials are we limited to?
   -No, just the $20 limit
6) What kind of systems could we build?
   -See answer to 3)
7) Is there any size constraint to the system?
   -No, but it should not cause any damage to the lab, or pose a danger to the class
8) Can we use items we obtain for free or already own?
   -Yes
9) How do we get a model/equation for our system?
   -Work through CW3-5
10) Where can we find a device capable of measuring the frequency
   -Measure lengths, weights, times, not frequency
11) How to build a pendulum? Should the ball be metal or plastic
   -See answer to 3)
12) Do we need a PowerPoint presentation?
   -No, but if one is made, it can be uploaded as the team web page for Project 1

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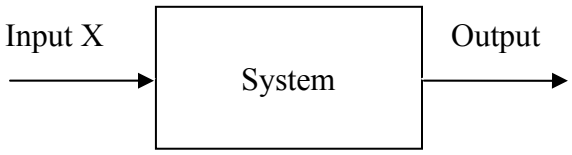
Systems

A system is a physical object that produces a measurable output (Y) for every measurable input (X).



Y'= f(X)

Examples of a system could be a catapult (X=initial height of a weight; Y=range for a clay ball), a pendulum (X=period; Y=length needed to produce that period), or a car on an inclined ramp (X=ramp angle; Y=distance traveled in 2s). When random factors affecting the system are controlled (task of the engineering design team), it can be described with an equation or model, that is, using this model it is possible to predict the output given an input.

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Data Modeling

Project 1 requires the use of data modeling with Excel (© Microsoft), this is learned by doing CW3-CW5, a polynomial or exponential curve-fitting or data modeling. **What is data modeling?** When an input X is applied to a system, an output Y is produced. A mathematical model of the system can be obtained by relating Y to X: e.g. Y'=f(X). We have used a Y' to indicate that it is not be possible in general to obtain an equation that relates all measured Y values to all measured X values but approximate Y' values to all measured X values.

To simplify the introduction, we discuss just simple polynomial models, e.g.

$Y'=aX^2+bX+c$
$Y'=\quad bX+c$
$Y'=dX^3+aX^2+bX+c$
$Y'=\exp(-b1*X)/(b2+b3*X)$

How to obtain a model? Perform CW3 by following 7 steps shown in class and repeated below. The process consists of using Solver (get it under Tools/Add-ins if needed) to minimize a "standard deviation" parameter s by allowing the polynomial coefficients to vary. After using Solver, the final values for a, b, c determine our quadratic model that describes the pendulum. In this CW3, to save time, we will be using only 4 pairs of data, however this is not sufficient to obtain a good model in practice: **For your Project 1, please use at least 10 pairs of data.**

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CW3

Open Excel and type your first and last name in cell A1, today's date in cell D1

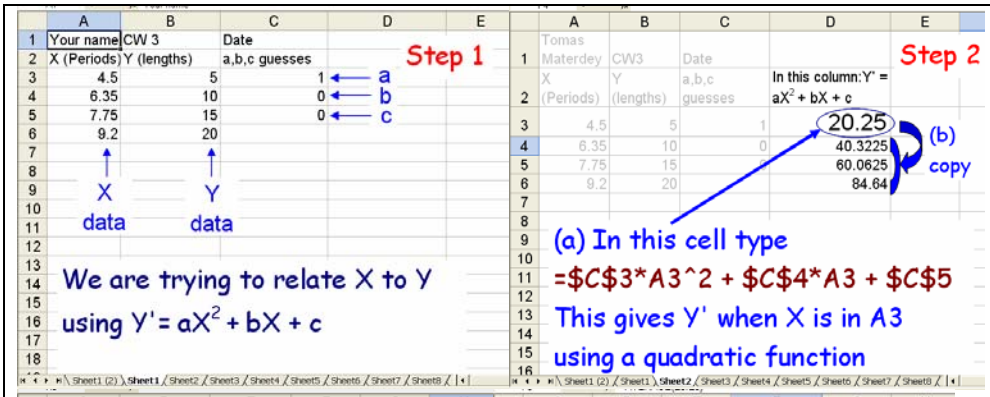
Quadratic curve fitting with Excel:

Use Excel Solver (under Tools) to produce coefficients a,b,c for your quadratic model ($y'=a*x^2+b*x+c$) by minimizing the 'standard deviation' s for the following set of data ($s \equiv \frac{\sum_{i=1}^{n}(y_i' - y_i)^2}{n}$, this is not a conventional standard deviation, and so it is not given by the 'stdev' function in Excel, but it is what we need to model our data; n is the number of data; y' indicates values predicted by our model; y indicates measured values given as data). Use '=' to start the formula for y' in cell D3; click on the corresponding cells to enter the coefficients and variables into the formula (if a is in cell C3, then click on C3, if the first x is in A3, then click on A3, etc.); remember to add a '$' before and after the letter of the cell containing the coefficients (since we don't want these to change for the second, third, and fourth x's); produce similar results for cells D4-D6 by 'copy D2 and paste' into those; produce the squared difference formula between y' and y using another '=' in E3; etc. Produce the average of E3-E6 by writing in E7 '=average(E3..E6)' and hit enter. Click on E7 and pull out 'Solver' under 'Tools'; select 'minimum' and in the 'by changing' box click and drag on the cells containing your guesses for the coefficients. Note that after running 'Solver', the 'standard deviation' or 'how far is our model from the data' is reduced to be a small number (0.1 or less, the smaller the better model you've built for those data). Watch the movies clip 'curve-fitting with Excel' as you follow these instructions.

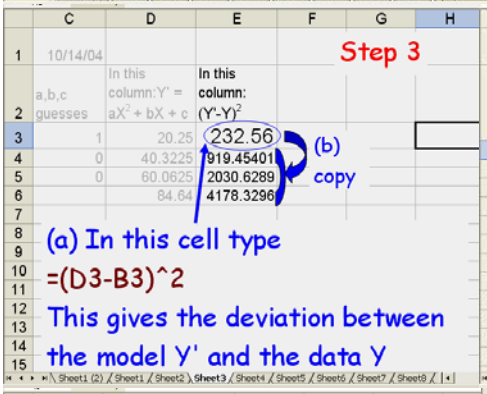
Periods x (s)	***Lengths y (m)***
4.5	**5**
6.35	**10**
7.75	**15**
9.2	**20**

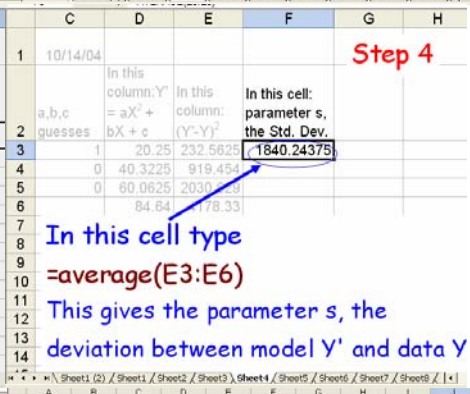
By alphabetical order of the last names, the first two students in each team will submit file cw3_XX_a.html and folder cw3_XX_a_files, the next two students will submit file cw3_XX_b.html and folder cw3_XX_a_files, to the *files* folder in the server. These files need to be uploaded to the server on the due date to receive credit.

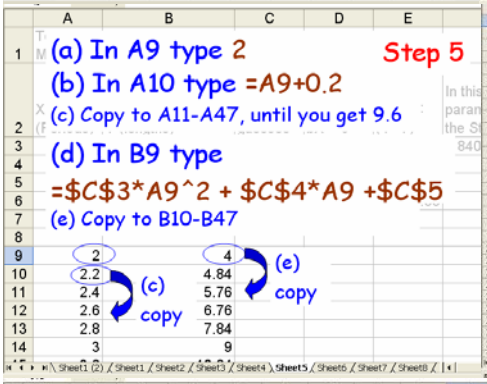
Follow these 7 steps to perform CW3:

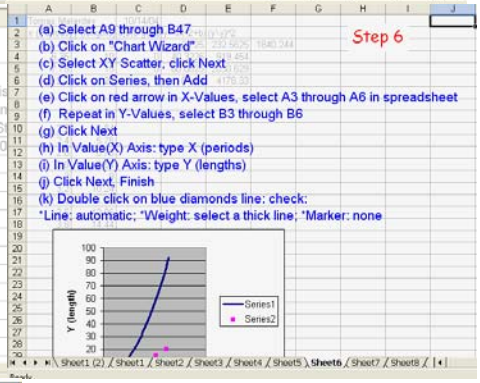

Step 1
Your name
CW 3
Date
X (Periods)
Y (lengths)
a,b,c guesses
4.5
6.35
7.75
9.2
5
10
15
20
1
0
0
a
b
c
X data
Y data
We are trying to relate X to Y
using Y'= aX² + bX + c

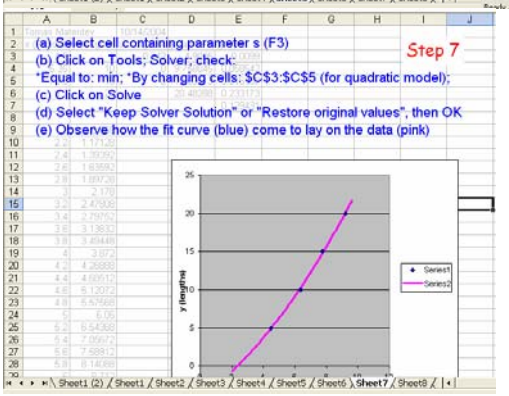
Step 2
Tomas Materdey
CW3
Date
X (Periods)
Y (lengths)
a,b,c guesses
In this column:Y' = aX² + bX + c
20.25
40.3225
60.0625
84.64
(b) copy
(a) In this cell type
=$C$3*A3^2 + $C$4*A3 + $C$5
This gives Y' when X is in A3
using a quadratic function


Step 3
10/14/04
a,b,c guesses
In this column:Y' = aX² + bX + c
In this column: (Y'-Y)²
20.25
40.3225
60.0625
84.64
232.56
919.45401
2030.6289
4178.3296
(b) copy
(a) In this cell type
=(D3-B3)^2
This gives the deviation between
the model Y' and the data Y


Step 4
10/14/04
a,b,c guesses
In this column:Y' = aX² + bX + c
In this column: (Y'-Y)²
In this cell: parameter s, the Std. Dev.
20.25
40.3225
60.0625
84.64
232.5625
919.454
2030.629
4178.33
1840.24375
In this cell type
=average(E3:E6)
This gives the parameter s, the
deviation between model Y' and data Y


Step 5
(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$3*A9^2 + $C$4*A9 +$C$5
(e) Copy to B10-B47
2
2.2
2.4
2.6
2.8
3
4
4.84
5.76
6.76
7.84
9
(c) copy
(e) copy


Step 6
(a) Select A9 through B47
(b) Click on "Chart Wizard"
(c) Select XY Scatter, click Next
(d) Click on Series, then Add
(e) Click on red arrow in X-Values, select A3 through A6 in spreadsheet
(f) Repeat in Y-Values, select B3 through B6
(g) Click Next
(h) In Value(X) Axis: type X (periods)
(i) In Value(Y) Axis: type Y (lengths)
(j) Click Next, Finish
(k) Double click on blue diamonds line; check:
*Line: automatic; *Weight: select a thick line; *Marker: none
Y (length)
Series1
Series2


Step 7
(a) Select cell containing parameter s (F3)
(b) Click on Tools; Solver; check:
*Equal to: min; *By changing cells: $C$3:$C$5 (for quadratic 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)
y (lengths)
Series1
Series2

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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:

9) Explain in your own words at least two main differences between science and engineering, for the field you worked with in Project 0.

10) Make a flow chart for the supply chain of a cell phone from raw materials to the end customer. It should include at least 6 steps. Map the ten engineering fields in the table for CW1 into each step, with a few words on what would those engineers be doing.

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