Take-Home "Data Analysis" lab supplement.

This lab is due W, October 29. You can work with other students, but each of you must hand in your own answer sheet.
To get credit, you must write your answers in the blanks.

1. Precision vs Accuracy, and Significant Figures

To answer the questions in this section, read pages 42-46 of Kotz/Treichel.

three data-sets: A: 55.2, 54.9, 55.1, 54.8, 55.0 B: 42.5, 41.7, 41.8, 42.4, 41.6 C: 51, 50, 48, 49, 52
If the true mass is 50.0, which data set (A, B or C) is least accurate? ___ most accurate? ___ least precise? ___ most precise? ___

Explain, by quoting the first two words and last two words of a sentence (hint: it contains 33 words) on page 43 of K/T, what happened in DataSet A: _____ . { This sentence explains the concept of *systematic error*. }

To answer the question below, read the italicized sentence on page 43 of Kotz/Treichel.
Which data set produces a more precise result, Data-Set A { (50.0)(24.73 + 25.22) } or Data-Set B { (50)(24.730 + 25.220) } ___

To the correct precision, calculate the answer for: 12.54 x .369 = _____ , 12.54 + 3.868 + 127.929 = _____
When dividing "125.4 / .241" the precision-limiting number is _____ . For "125.4 – .241" the precision-limiter is _____ .

State the number of significant figures in: 0.0023 ____ , 2.0023 ____ , 0.00230 ____ , 2300.0 ____ , 2300. ____ , 2300 ____

2. Calculating Standard Deviations

For DataSet #1 below, I have calculated σ by using the formula on page C1 at the back of your lab-book. Please fill in the blanks for the DataSet #2, following my example for DS #1 (including a calculation-precision to the .01 place), in order to find σ for DS #2.
{ note: N is the number of "N – 1" (on bottom of the fraction) is "5 – 1 = 4".

DS #1	$x_i - x_{ave}$	$(x_i - x_{ave})^2$	
1.00	–3.80	14.44	
2.00	–2.80	7.84	
5.00	+0.20	.04	
7.00	+2.20	4.84	
9.00	+4.20	17.64	finding σ
$x_{average}$ = 4.80		$\sum (x_i - x_{ave})^2$ = 44.80	$(44.80/4)^{1/2}$ = 3.35

DS #2	$x_i - x_{ave}$	$(x_i - x_{ave})^2$	
2.00			
3.00			
4.00			
6.00			
7.00			finding σ
$x_{average}$ =		$\sum (x_i - x_{ave})^2$ =	$\sigma = (\ /\ )^{1/2}$ =

You can also calculate another type of σ by using "N" instead of "N – 1" for the fraction. Convince yourself that, for DS #1, this σ is 2.99.

For DS #1 (1 2 5 7 9), σ = 3.347. For DS #3 (4 8 20 28 36), σ = 13.387. For DS #4 (2 3 6 8 10), σ = 3.347.
Using these principles (that **multiplying** each data point --> multiplying σ, and that **adding to** each data point --> no change in σ), predict Standard Deviations: for DS #5 (10 20 50 70 90), σ = _____ ; for DS #6 (15 25 55 75 95), σ = _____ .

Using your calculator, show me that you can calculate σ for DS #2, and make sure I "check your name" on my grading sheet.

3. Using the "slope method" for calculating density.

For the following data set, calculate density in two different ways: a) by calculating the density for each mass-density pair (to get 5 densities) and then finding the average of these 5 densities, d = _____ ; b) by using the "slope method", d = _____ .
Data Set: (1.00 mL, 6.00 g) , (2.00 mL, 10.00 g) , (3.00 mL, 14.00 g) , (4.00 mL, 18.00 g) , (5.00 mL, 22.00 g)

Which of these densities do you think is most accurate? Explain what probably happened in this experiment: _____

_____

4. Data Analysis

Using our class-data for the "Diluting Solutions" lab, fill in the following table with the **number of data-points** for each concentration

and the **average absorption**. Use all of the data, as given; for example, use ".0972" for A, and ".17" for P. Record $A_{average}$ values to the .001 place, just as I have done when calculating the values for $d_{average}$. I've filled in two numbers; you can use these as a "check".

molarity	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50
# of points	4									
$A_{average}$	.096									
$d_{average}$	.981	1.052	1.019	1.026	1.110	1.012	1.041	1.029	1.096	?

modified from page 30 of lab-book, Part III: What is the "best value" for the average density of the .25 M solution? Describe the reason(s) you think this value is the best value. (It is not acceptable to state that the concentration is the best value because that is the value you calculated from the data you collected. What makes a value acceptable?) Also, describe which data set you chose to report. (You could choose to report another group's results if you demonstrate that your data is unacceptable.) ... Were any data points disregarded in your analysis? If any points were disregarded, explain (in the "because" space below) why they were disregarded.

The best value is probably _________ because

When for the .25 M solution, one data-point is an "outlier" that it might be wise to discard. Give two examples of students (list their name or number) whose data might be considered as a potential "outlier" when calculating an average. _____ and _____

Which of the nine values for $A_{average}$ do you think would be most "out of line" if you plotted a straight-line graph through the points for A_{avg}? ______ { hint: To answer this, you don't need to make a graph; instead, do a rough "visual logic" type of guess. }

5. Using "pseudo-graphs" to retroductively invent a numerical relationship.

For each data set below, do the data transformation I've suggested (and have illustrated for one y-value). Then find the "differences": the Δy that occurs for each change of 1 in x. Do you see why this difference would correspond to the Δy/Δx slope in this part of a graph?

Also, retroductively invent a theory (a mathematical equation, y = ___) to "explain" the relationships between y and x in each data set.

x	y	difference

	difference

y =

x	y	difference

	difference

y =

x	y	difference

	difference

y =

x	y	difference

	difference

y =

x	y	difference

	difference

y =

x	y	difference

	difference

y =

x	y	difference

	difference

y =

x	y	difference

	difference

y =