Chem 220

Practice Problem Set Four

As a check of your method, the average of 1, 2, 3 is 2 and the standard deviation is 1. When calculating confidence limits, *show values used for t, s, and N and the ± value*.

1. Consider the data set:
   3.46, 3.47, 3.34, 3.67, 3.39, 3.54, 3.45, 3.38, 3.72, 3.56, 3.48, 3.47, and 3.42
   a. What are the mean and sample standard deviation?
   b. What are the 80%, 90%, and 99.9% confidence limits?

2. The pH of a solution was measured as:
   8.34, 8.37, 8.29, 8.39, 8.35, 8.42, 8.37, 8.29, 8.31, 8.32, 8.53, 8.39, 8.32, 8.36, 8.21, 8.32, 8.41, 8.36, 8.34, 8.32, 8.35, 8.29, 8.36, 8.34, and 8.30
   a. Later a different solution was measured to have a pH of 7.21. What is the 95% confidence interval on this single measurement if the method used was the same as above?
   b. A third solution was measured to have pH 3.12, 3.22, 3.18, 3.24. What are the 95% confidence limits for this pH measurement if the method used was the same as above?
   c. What are the 95% confidence limits for parts *a* and *b* if the original large number of data had not been taken?

3. A sample was analyzed for asbestos and was found to contain 0.8467, 0.8464, 0.8472, 0.8463, 0.8467, 0.8458, 0.8462, 0.8465, 0.8466, 0.8463, 0.8471, 0.8467, 0.8463, 0.8463, 0.8465, 0.8458, 0.8462, 0.8469, 0.8453, 0.8469, 0.8476, 0.8465, 0.8452, 0.8462 grams.
   If the amount must be known to the nearest 0.0001 grams, how many analyses using the same method must be performed to know the amount of asbestos in a different sample to the 80% confidence level? to the 95% confidence level?

4. Based on our class lab results (a) to what confidence level is the class average 5 mL pipet volume different from 5 mL? How many determinations are needed to know the volume delivered by a 5 mL pipet with 95% confidence to (b) ±0.02mL? (c) to ±0.002mL?

5. Use the comparison of averages t-test to compare the sets.
   I. 1.987, 1.983, 1.986, 1.980, 1.984
   II. 1.986, 1.990, 1.998, 1.987
   Report the *t* value. To what confidence level are the sets different?

6. What are the 95% confidence limits for each sample,

Sample	Pb Content, ppm
1	3.24, 2.84, 2.95
2	1.65, 1.58, 1.84, 1.98

   a. using only data from that set?
   b. making use of the fact that the data for both sets were determined by the same method?

Harris problems are similar and have answers in the back of the book.
4-6, 4-7, 4-10, 4-11, and 4-12

Chem 220

Practice Problem Set Four

As a check of your method, the average of 1, 2, 3 is 2 and the standard deviation is 1.
When calculating confidence limits, *show the values used for t, s, and N and the ± value.*

1. Consider the data set:
   3.46, 3.47, 3.34, 3.67, 3.39, 3.54, 3.45,
   3.38, 3.72, 3.56, 3.48, 3.47, and 3.42

   $\bar{x} = 3.488$, s = 0.110

   80% $3.488 \pm \frac{1.36(.110)}{\sqrt{13}} = 3.488 \pm .041$

   90% $3.488 \pm \frac{1.78(.110)}{\sqrt{13}} = 3.488 \pm .054$

   99.9% $3.488 \pm \frac{4.32(.110)}{\sqrt{13}} = 3.488 \pm .132$

   a. What are the mean and sample standard deviation?
   b. What are the 80%, 90%, and 99.9% confidence limits?

2. The pH of a solution was measured as:
   8.34, 8.37, 8.29, 8.39, 8.35, 8.42, 8.37, 8.29, 8.31, 8.32, 8.53, 8.39, 8.32,
   8.36, 8.21, 8.32, 8.41, 8.36, 8.34, 8.32, 8.35, 8.29, 8.36, 8.34, and 8.30

   s = 0.0589

   2a. $\pm \frac{1.96(.0589)}{\sqrt{1}} = \pm .115$

   s = 0.0529 $F = \frac{(0.0589)^2}{(0.0529)^2} = 1.24$

   The two *s* values are not significantly different

   2b. $3.19 \pm \frac{1.96(.0589)}{\sqrt{4}} = 3.19 \pm .058$

   2c-a. $7.21 \pm \infty$ (0 degrees of freedom)

   2c-b. $3.19 \pm \frac{3.18(.0529)}{\sqrt{4}} = 3.19 \pm .084$

   a. Later a different solution was measured to have a pH of 7.21.
      What is the 95% confidence interval on this single measurement
      if the method used was the same as above?
   b. A third solution was measured to have pH 3.12, 3.22, 3.18, 3.24.
      What are the 95% confidence limits for this pH measurement
      if the method used was the same as above?
   c. What are the 95% confidence limits for parts *a* and *b* if the
      original large number of data had not been taken?

3. A sample was analyzed for asbestos and was found to contain
   0.8467, 0.8464, 0.8472, 0.8463, 0.8467, 0.8458, 0.8462, 0.8465,
   0.8466, 0.8463, 0.8471, 0.8467, 0.8463, 0.8463, 0.8465, 0.8458,
   0.8462, 0.8469, 0.8453, 0.8469, 0.8476, 0.8465, 0.8452, 0.8462 grams.

   $s = 5.49 \times 10^{-4}$

   If the amount must be known to the nearest 0.0001 grams, how many analyses using the same method must be performed to know the amount of asbestos in a different sample to the 80% confidence level? to the 95% confidence level?

   80% $\left\{\frac{1.29(5.49 \times 10^{-4})}{.0001}\right\}^2 = 50;$ 95% $\left\{\frac{1.96(5.49 \times 10^{-4})}{.0001}\right\}^2 = 116$

4. Based on our class lab results (a) to what confidence level is the class average 5 mL pipet volume different from 5 mL? How many determinations are needed to know the volume delivered by a 5 mL pipet with 95% confidence to (b) ±0.02mL? (c) to ±0.002mL?

   $\bar{x} = 4.9821$
   s = 0.0268
   n = 116

   $t = \frac{5 - 4.9821}{.0268}\sqrt{116} = 7.19$

   Different to >98% confidence but not to 99% confidence

   $N = \left\{\frac{1.96(.0268)}{.02}\right\}^2 = 7$

   $N = \left\{\frac{1.96(.0268)}{.002}\right\}^2 = 690$

5. Use the comparison of averages t-test to compare the sets.

   I. 1.987, 1.983, 1.986, 1.980, 1.984 $\bar{x} = 1.984$, s = 0.00274, n =5

   II. 1.986, 1.990, 1.998, 1.987 $\bar{x} = 1.990$, s = 0.00544, n =4

   $F = \frac{(0.00544)^2}{(0.00279)^2} = 3.80$

   The two *s* values are not significantly different

   Report the *t* value. To what confidence level are the sets different?

   $$t = \frac{(1.984 - 1.990)\sqrt{\frac{5 \times 4}{5 + 4}}}{\sqrt{\frac{(5-1)(.00274)^2 + (4-1)(.00544)^2}{5 + 4 - 2}}} = 2.17$$

   The sets are different to the 90% (but not 95%) confidence level for 7 degrees of freedom.

6. What are the 95% confidence limits for each sample,

Sample	Pb Content, ppm	
1	3.24, 2.84, 2.95	s = .2066
2	1.65, 1.58, 1.84, 1.98	s = .1819

   $3.01 \pm \frac{4.30(.2066)}{\sqrt{3}} = 3.01 \pm .51$

   $1.76 \pm \frac{3.18(.1819)}{\sqrt{4}} = 1.76 \pm .29$

   a. using only data from that set?
   b. making use of the fact that the data for both sets were determined by the same method?

   $s_{pool} = \sqrt{\frac{2(.2066)^2 + 3(.1819)^2}{2 + 3}} = .1922$

   $3.01 \pm \frac{2.57(.1922)}{\sqrt{3}} = 3.01 \pm .29$

   $1.76 \pm \frac{2.57(.1922)}{\sqrt{4}} = 1.76 \pm .25$