**Take-home Final for GEOL 2000 – due at 4:30pm on December 18, 2014 (220 pts)**

**I. Hand-calculating individual statistics**

A. (15 pts) Using a calculator – **not Excel** – calculate the statistics indicated below and put your answers in the second table. Include all your work on a separate sheet. I have added some columns in the first table to help you with your “hand” calculations.

|  |  |  |
| --- | --- | --- |
|  | ppm-mean ppm | sq ppm-mean ppm |
| 166 |  |  |
| 170 |  |  |
| 159 |  |  |
| 160 |  |  |
| 115 |  |  |
| 169 |  |  |
| 159 |  |  |
| 175 |  |  |
| 160 |  |  |
| 161 |  |  |
| 150 |  |  |
| 161 |  |  |
| 161 |  |  |
| 162 |  |  |

|  |  |
| --- | --- |
| **STATISTIC** | **CALCULATED VALUE** |
| Mean |  |
| Median |  |
| Mode |  |
| Variance |  |
| Standard deviation |  |
| Standard error |  |
| Degrees of freedom |  |
| t (95) |  |
| t(95) \* *se* |  |
| 95% confidence interval (give the  range from minimum to maximum) |  |

B. (10 pts) Plot a histogram of these data by hand using a bin range of 2 ppm. Is the distribution normal? How do you know?

**II. Estimating Error, Comparing Data Sets, and Determining Statistical Significance of Differences**

A. You have been emailed a spreadsheet containing data for the nutrient concentrations of stream waters from various types of streams in eastern NC (2000 FINAL RIVER data set for students.xls). Assume all the values are good to 3 decimal places and maintain this number of decimal places throughout your calculations. You will evaluate basic statistical parameters for these data sets to allow you to compare them and determine whether or not observed differences are statistically significant. Sometimes the means of two sample sets, for example, are different, but if the difference between them is less than the variation within each of the two sample sets then that difference in the means is not statistically significant and is basically meaningless.

1. Take a look at the data in the spreadsheet. The samples were analyzed for phosphate (*PO43-*), ammonium (NH4+ ), and nitrate + nitrite (NO3- + NO2-). They are organized into 4 sets of concentration values for samples collected in 2000 through 2002 from 4 different sample locations:

* Pamlico River near Washington, NC
* Greenville Urban Stream – Greens Mill Run
* Greenville Suburban Stream – Meeting House Branch
* Rural Pitt County Stream near Simpson, NC

B. Calculate Excel’s common statistical values for all 4 samples (20 pts)

* Click on the “data” tab on the top toolbar and a new set of options will pop up underneath
* In the “Analysis” box all the way to the right, click on the “Data Analysis” tab
* In the “Data Analysis” dialog box choose Descriptive Statistics and hit OK.
* In the upper part of the box that pops up – on the Input Range box click the Collapse Dialog button and highlight all of the concentration data in the third, fourth, and fifth columns, **including the nutrient name** at the top of the list.
* Click the “Labels in first row” box
* In the Output options section click the Output Range radio button and type in a range of values from upper left to lower right that encompasses 6 columns and 15 rows. You can also use the Collapse Dialog button.
* Click Summary statistics box
* Hit OK

C. The Resultant table of Descriptive Statistics will provide the initial information you need to complete this assignment.

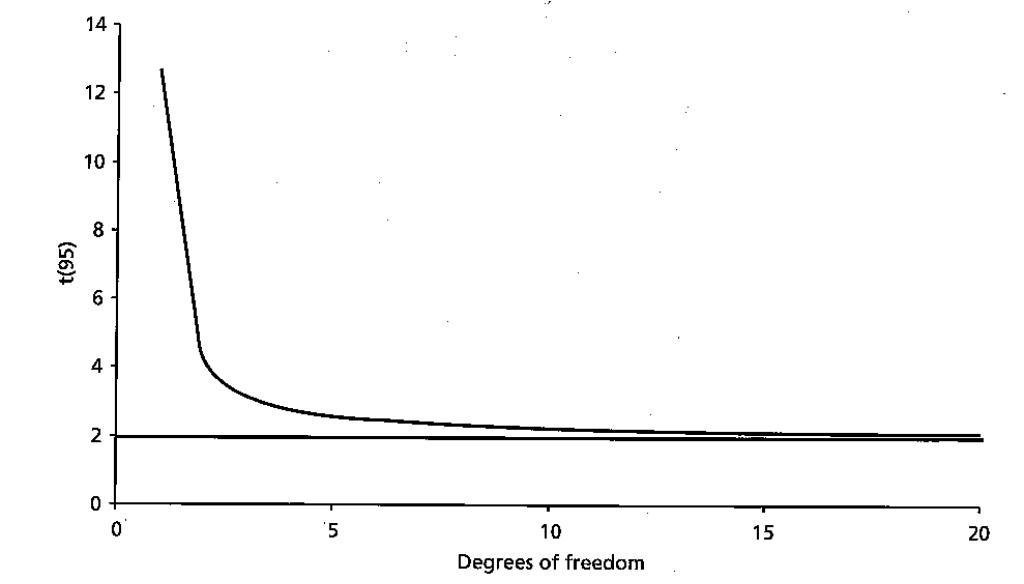
1. For **each of the three constituents** (*PO43-* , NH4+, and NO3- + NO2-) **at all four sites** calculate the characteristics indicated in the table below for each sample by generally following the procedure outlined in the powerpoint.

a. Determine degrees of freedom for N

b. Use graph to determine multiplier for *se*

c. Multiply *se* by this multiplier to determine 95% confidence interval

1) Record this confidence interval in your table as a range within which the true mean has a 95% chance of lying. That is, with the range showing the lower and upper bounds of the 95% confidence interval.



D. Summarize your results in the table below (39 pts)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sample Site | Nutrient | Deg. of Free-dom | Mean  (ppm) | Std Dev | Std Err | *se* multiplier | 95% Confiden. Interval (ppm) | RANGE |
| Pamlico R | NH4+ |  |  |  |  |  |  |  |
| Greens Mill | NH4+ |  |  |  |  |  |  |  |
| Meeting Hs | NH4+ |  |  |  |  |  |  |  |
| Pitt Co. | NH4+ |  |  |  |  |  |  |  |
| Pamlico R | NO3- + NO2- |  |  |  |  |  |  |  |
| Greens Mill | NO3- + NO2- |  |  |  |  |  |  |  |
| Meeting Hs | NO3- + NO2- |  |  |  |  |  |  |  |
| Pitt Co. | NO3- + NO2- |  |  |  |  |  |  |  |
| Pamlico R | *PO43-* |  |  |  |  |  |  |  |
| Greens Mill | *PO43-* |  |  |  |  |  |  |  |
| Meeting Hs | *PO43-* |  |  |  |  |  |  |  |
| Pitt Co. | *PO43-* |  |  |  |  |  |  |  |

E. (18 pts) In the three tables below – one for each of the three chemical constituents – type **Yes** if the difference in means for the chemical constituent is statistically significant for each pair of localities.

1. NH4+

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Pamlico R | Greens Mill | Meeting Hs | Pitt Co. |
| Pamlico R |  |  |  |  |
| Greens Mill |  |  |  |  |
| Meeting Hs |  |  |  |  |
| Pitt Co. |  |  |  |  |

2. NO3- + NO2-

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Pamlico R | Greens Mill | Meeting Hs | Pitt Co. |
| Pamlico R |  |  |  |  |
| Greens Mill |  |  |  |  |
| Meeting Hs |  |  |  |  |
| Pitt Co. |  |  |  |  |

3. *PO43-*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Pamlico R | Greens Mill | Meeting Hs | Pitt Co. |
| Pamlico R |  |  |  |  |
| Greens Mill |  |  |  |  |
| Meeting Hs |  |  |  |  |
| Pitt Co. |  |  |  |  |

**Data to complete the next exercises are found in a second spreadsheet emailed to you.**

**III. Using Column Graphs to Describe and Interpret Data**

A. (22 pts) The sheet entitled Vivos Totales (total live forams) shows the number of live forams found per 80 cm3 sediment sample at 13 different locations in the Bilbao Estuary and one location in El Abra Bay at the mouth of the estuary. The gray, green, white, and yellow rows indicate sediment samples collected between 1997 and 2006. [Gray = upper estuary, green = middle estuary, white = lower estuary, yellow = El Abra Bay (mouth of estuary)]

1. Construct a column graph showing the number of live foraminifera/80cm3 found in the **14 spring (May or April)**  **samples** within the Bilbao Estuary and El Abra Bay.

a. (16 pts) Clearly differentiate each of the **Spring (May or April)** data sets for each year (1998, 2000, 2003, and 2006) by using different colors to plot their columns.

b. (3 pts) Clearly identify each year’s data set in the legend.

c. (3 pts) Use a log scale for the y axis

B. (4 pts) Use the column graph to answer these questions:

1. In general did the number of live forams increase or decrease between Spring, 1998 and Spring, 2006?

2. In general does the number of live foraminifera increase or decrease as you move from the upper estuary toward the Bay?

**IV. Calculating Other Statistics and Creating Histograms**

A. Histograms

1. The sheet entitled Sr isotope histo contains data on the strontium isotopic signature (87/86 ratio) of fossils and limestone rocks - as well as other information - from various Cenozoic and Late Mesozoic Formations from the North Carolina Coastal Plain.

a. The 87/86 values are good to 5 or 6 decimal places, so **don’t round them off**.

2. (15 pts) Create **5 separate histograms** describing these data – one for each of the following units: Yorktown, Pungo River, Belgrade + River Bend, Castle Hayne, and Peedee.

a. Have your bin values increase from 0.7077 to 0.7092 by increments of 0.0001. Clearly and completely label your graph.

b. To help you visualize the change in 87/86 ratio through geologic time, stack these 5 histograms in your spreadsheet one on top of the other with the oldest on the bottom.

3.(5 pts) In a few sentences describe the change in 87/86 ratio through time for formations in the NC Coastal Plain.

B. This sheet (Student grades) contains exam grades for a group of GEOL 1500 students.

1. (10 pts) Construct a histogram with bin sizes of 5 from 45 to 95.

2. (6 pts) Then, using whichever method you prefer, determine the mean, mode, and median for this data set. Indicate which method you are using to determine these values. Summarize your data in a clearly labeled table and graph.

**V. Interpreting Graphs of Logarithmic Functions**

A. (7 pts) On the attached piece of 3 X 4 cycle log paper plot the following points. You will first have to decide on your scale and **mark it clearly along the axes**. Then, **label each plotted point** with the indicated number.

1. (13 , 0.025)

2. (575 , 0.000019)

3. (6.5 , 0.00009)

4. (42 , 0.082)

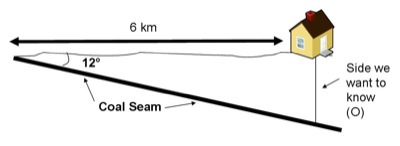
5. (200 , 0.002)

B. (4 pts) Use the graph of Activity Coefficient versus Ionic Strength to determine the Activity Coefficients of the following ions in the following solutions.

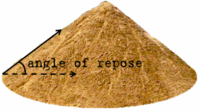
|  |  |  |
| --- | --- | --- |
| Ionic Strength | Ion | Activity Coefficient |
| 0.03 | Na+ |  |
| 0.03 | Fe2+ |  |
| 0.009 | PO4 3- |  |
| 0.0006 | Th4+ |  |

**VI. Trigonometry**

A. (6 pts) You note that a coal bed is tilted at 12 degrees and comes to the surface 6 kilometers from your property. How deep will you have to dig to get to the coal bed on your property?

[](http://serc.carleton.edu/images/mathyouneed/_1236146099.v2.jpg)

B. (6 pts) The angle of repose is the steepest angle at which dry, unconsolidated sediment is stable. You create a conical pile of sand that is as steep as you can make it. The pile is 11 cm high and has a radius of 16 cm. What is the angle of repose of this sand?

[](http://serc.carleton.edu/images/mathyouneed/angle_repose.gif)

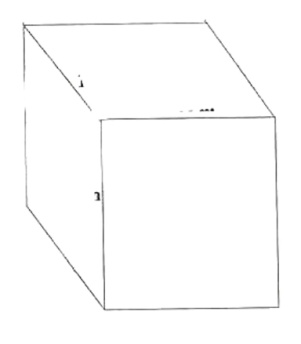
**VII. Review Problems SHOW ALL YOUR WORK**

A. (10 pts) Using a clearly labeled diagram (complete the one below) to calculate your conversion factors, convert 25 mi3 to cm3. You may **only use the conversion factors below**. **COMPLETE THE DIAGRAM FOR THAT CONVERSION FACTOR AND SHOW ALL OF YOUR WORK!!!!** (Keep **3** decimal places for your answer)

1 in = 2.54 cm

1 foot = 12 in

1 mile = 5280 feet

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B.(13 pts) Logarithms and Exponents --- Fill in answers to the following problems in the table.

Remember that “ ● “ represents the operation of multiplication. Show your work for partial credit. Remember that you may not be able to calculate an actual number for your answer. Just solve for “x” in that situation.

|  |  |  |
| --- | --- | --- |
| Point  Value | Problem | Answer |
| 1 | 10472 ÷ 104700= ? |  |
| 1 | log 10 X = 5 | **X = ?** |
| 3 | 5x  = 980 | **X = ?** |
| 3 | 6.746x = 532960 | **X = ?** |
| 2 | (yx)7 = ? |  |
| 3 | 77.89 = x2.7 | **X = ?** |

C. Solving algebraic equations for different variables.

1. (5 pts) Solve the following equation for “r”.

2 σ

h = -------------- cos α

r ρ g

2. (5 pts) Solve the following equation for “Ti”.

T(t) = Tm + (Ti – Tm) \* *e*(–*kt*)