

## **Appendix 2. Homework for module 4 to review experimental design and data analysis.**

Instructions: To prepare for this assignment read pages 1-10 in the Data Analysis Primer. This assignment - due at the beginning of your week 4 lab - should be completed *without* help from classmates. *\*On this assignment only, we will base a greater percentage of your grade on demonstrated effort than on accuracy of answers.\**

### **Part I. Experimental Design**

Question 1 Isabel and Saul hypothesized that active adult dogs on a protein-plus-carbohydrate diet would gain more weight over 10 weeks than active adult dogs on a protein-only diet with the same calorie count.

a) In the paragraph below, underline the sections of their research summary that show weaknesses in the experimental design. Below, explain why you underlined each section.

Of 50 dogs that owners volunteered for the diet study, researchers randomly assigned 25 to the protein-plus-carb diet and 25 to the protein-only diet. Although subjects included different breeds, ages, and exercise regimes (with walking distances ranging from 0.1 to 10 km/day), all had approximately the same weight at the start of the study. Biologists instructed owners to continue their normal feeding and exercise regimes during the 10 weeks, except that food must be limited to the assigned treatment. Both diet treatments included the same number of calories. Biologists weighed and measured each dog at the end of week 10, as soon as each dog arrived at the laboratory. They used statistical tests to compare mean weight change, body mass index, and skin fat thickness between the protein-plus-carb group (sample size = 25) and the protein-only group (sample size = 25).

b) Suppose that the weight of each dog was recorded at both 8 and 10 weeks. Does this result in a doubling of the sample size? Explain why or why not.

Question 2 Maxim and Camillo hypothesized that when young adult humans drink 100 mL of soda, their heart rates rise within five minutes. Which of the following experiments (a or b) would you choose to test this hypothesis? \_\_\_\_\_  
Briefly explain your choice:

Experiment a) In a classroom where 100 college students have been sitting for 20 minutes, Sasha and Maria record all students' heart rates. Next, all students drink 100 mL of soda, and they record students' heart rates 4 minutes later. They will test whether the mean difference between individuals' heart rates before and after drinking soda is greater than zero.

Experiment b) In a classroom where 100 college students have been sitting for 20 minutes, Alex and Pat randomly assign 50 students to drink 100 mL of soda and the other 50 students to drink nothing. Four minutes later, they record the heart rates of all students. They will compare mean heart rates of the two groups.

## Part II. Data Analysis

Instructions: Use the enzyme reaction velocity data collected by all of the “Team C’s” in this year’s 304 lab sections (available on My WebSpace) to evaluate whether the average enzyme reaction velocities at 37°C and 55°C are significantly different from each other. Each row of data, collected by a pair of students, includes the mean of 5 replicates measured at 37 ° and the mean of 5 replicates measured at 55 °C.

1. Use your lab notebook paper to graph **by hand** the mean of each sample and indicate the variation around each mean. Label axes clearly.
2. a. Based on your graph, is there a significant difference between mean reaction velocities at 37 and 55 °C ? \_\_\_\_\_  
  
b. Evaluate your certainty in your part “a” answer (using this scale: 1= very sure of my answer, 2 = mostly certain, 3 = slightly unsure, 4= not at all sure of my answer), and explain your rationale in the space below:
3. Write the null hypothesis for this experiment.
4. Write an alternative hypothesis for this experiment.
5. What is a p-value?
6. a. What tends to increase a t-score? Hint: look at the t-statistic formula.  
  
b. What tends to decrease a t-score?
7. How do we use a t-score and p-value to make a conclusion about the experimental hypothesis?

8. Considering the following t-test results from a different set of enzyme reaction velocity data (and given that the data meet the three t-test assumptions), write a conclusion statement for this experiment:

t-Test: Two-Sample Assuming Equal Variances

	<i>Variable 1:</i> 37C	<i>Variable 2:</i> 55C
Mean	0.020042	0.02728
Variance	7.97E-06	3.332E-06
Observations	5	5
t-statistic:	-4.5624	
degrees of freedom:	8	
two-sided t-test p-value:	0.001844	