**BIO 3B Statistics Quiz** Name:_____
FALL 2010

1. To determine the amount of sugar in a typical serving of breakfast cereal, a diligent Saddleback college biology student selected sample labels from all 60 different types of cereal from the shelves of a local grocery store. The student noticed that the side panel labels of some of the cereals showed sugar content based on one-cup servings, while others showed sugar content based on three-quarter-cup servings. Many of the labels that showed three-quarter-cup servings were ones that appealed to younger children and the student wondered whether there might be some differences in the sugar content of the cereals that showed different-size servings on their labels. To investigate the question, the data were separated into two groups. One group consisted of 29 cereals that showed one-cup serving sizes; the other group consisted of 31 cereals that showed three-quarter-cup serving sizes. The sugar content, in grams per serving, for each of the cereals grouped by serving size is shown in Figure 1.

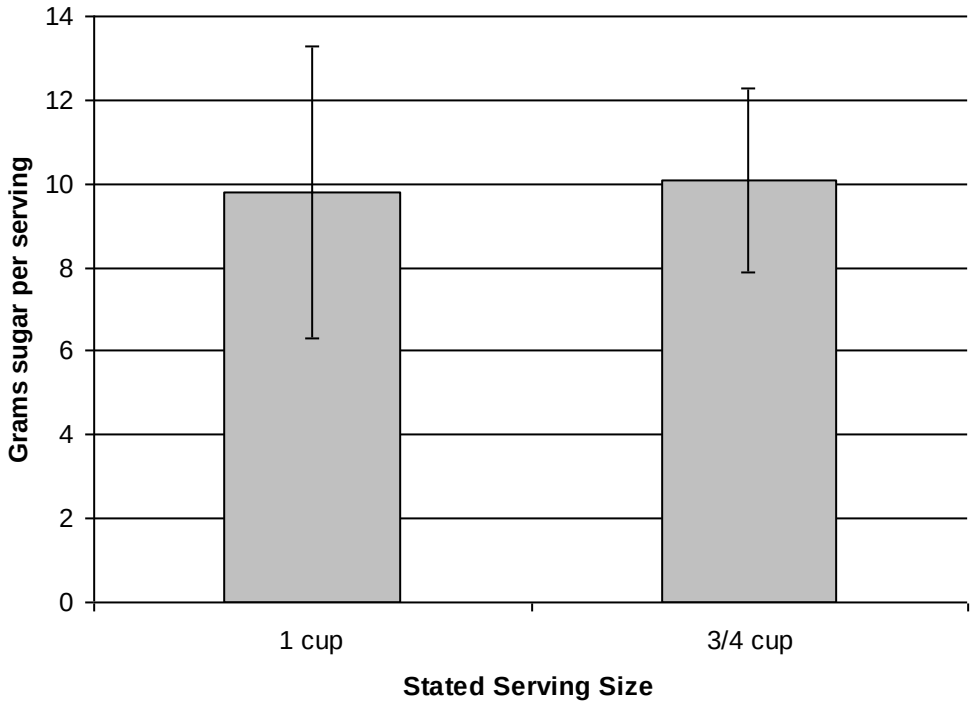



**Figure 1.** Mean sugar content per serving of 60 breakfast cereals. Left bar indicates the mean sugar content per recommended serving size for 29 cereals that stated a serving was 1 cup. Right bar indicates the mean sugar content per recommended serving size for 31 cereals that stated a serving was ¾ cup. Error bars indicate 95% confidence intervals.

(a) In one sentence compare the distributions of sugar content per serving for the two serving sizes of cereals as shown in Figure One.

After analyzing Figure One, the student decided that instead of a comparison of sugar content per recommended serving, it might be more appropriate to compare sugar content for equal-size servings. To compare the amount of sugar in serving sizes of one cup each, the amount of sugar in each of the cereals showing ¾ cup servings on their labels was multiplied by 4/3. Figure Two shows sugar content (in grams) per cup for cereals of both recommended serving sizes.

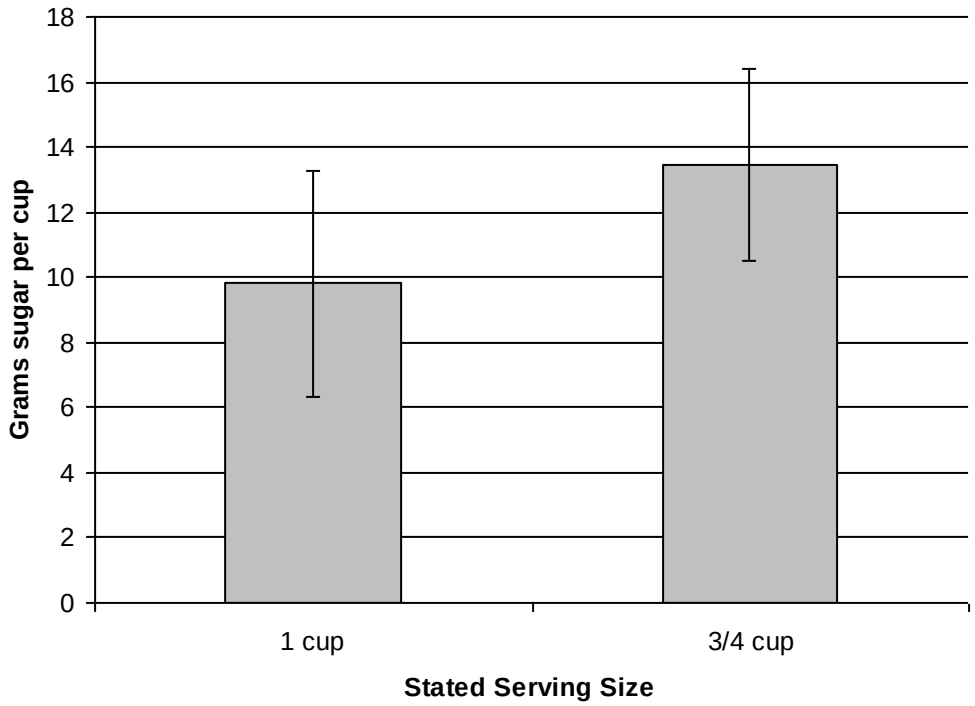



**Figure 2.** Mean sugar content per cup of 60 breakfast cereals. Left bar indicates the mean sugar content per cup for 29 cereals that stated a serving was 1 cup. Right bar indicates the mean sugar content per cup for 31 cereals that stated a serving was ¾ cup. Error bars indicate 95% confidence intervals.

(b) What new information about sugar content does Figure Two provide?

(c) Using Figure Two, please write out in proper format the mean and standard deviation of the sugar content of the one cup serving cereal. (You will need to estimate.)

(d) Based on Figure Two, how does the mean amount of sugar per cup to compare for the different recommended serving sizes? Are there significant differences?

(d) If you had access to the entire data set (all 60 measurements), what test could you use to determine if a significant statistical difference exists between the means shown in Figure Two?

This test should be (circle one of each pair):

paired or unpaired

one-tailed or two tailed

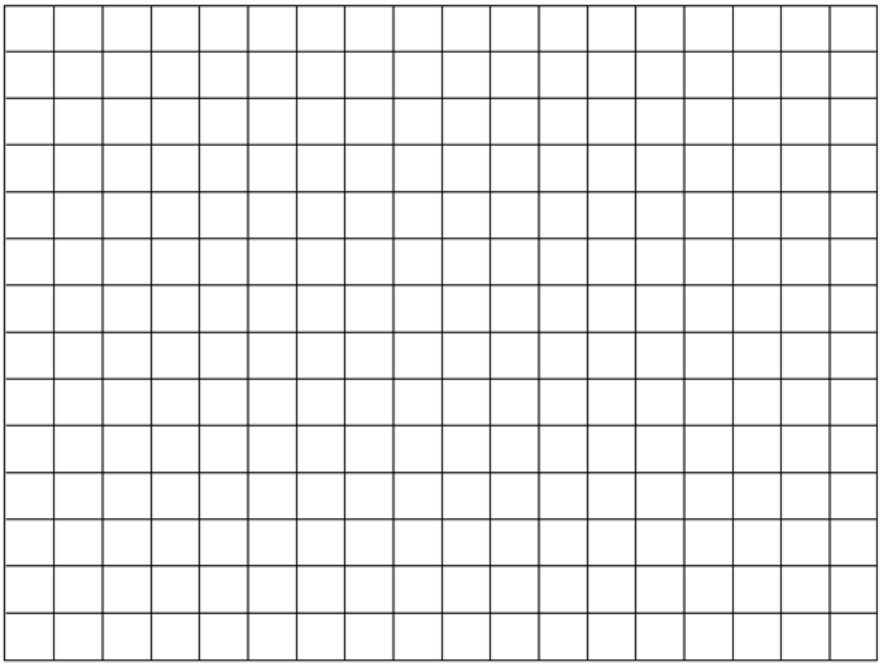
2. An experiment was conducted to study the effect of temperature on the reliability of an electronic device used in an undersea communications system. The experiment was done in a laboratory where tanks of seawater were maintained at 10 °C, 30 °C, 50 °C, or 70 °C. After the electronic devices were submerged in the tanks for 5,000 hours, each device was inspected to determine if it was still working. The Table One provides information on the number of devices tested at each temperature and the number of working devices at the end of the 5,000-hour test.

**Table 1.** Temperature of test runs, number of devices tested at each temperature and number of devices operating after 5000 hours at each temperature.

| Temperature °C | 10 | 30 | 50 | 70 |
|---|---|---|---|---|
| No. working at end of test | 29 | 42 | 21 | 12 |
| Total No. tested | 30 | 50 | 30 | 20 |

(a) Using the information Table One, construct a scatter plot that would be useful for showing the effect of water temperature on the ability of the devices to work for at least 5,000 hours.

Draw your graph on the grid on the next page!



(b) Comment on any trend or pattern that is revealed by the scatter plot you constructed.

(c) Fit a line (*by eye is ok*) to the data plotted in (b).

If you were to use Excel, what statistical tool would you use to fit this line?

Based upon your line, estimate the number of instruments that will survive to 5000 hours at 40 °C.

3. A study was conducted to determine where moose are found in a region following a major fire. A map of the study area was partitioned into the following four habitat types.

(1) Inside the burned area, not near the edge of the burned area,
(2) Inside the burned area, near the edge,
(3) Outside the burned area, near the edge, and
(4) Outside the burned area, not near the edge.

The Figure Three shows these four habitat types. The total area (hectares, ha) in each of the habitat types was determined for the study area. Using an aerial survey, moose locations were observed and classified into one of the four habitat types. The results are given in Table Two.

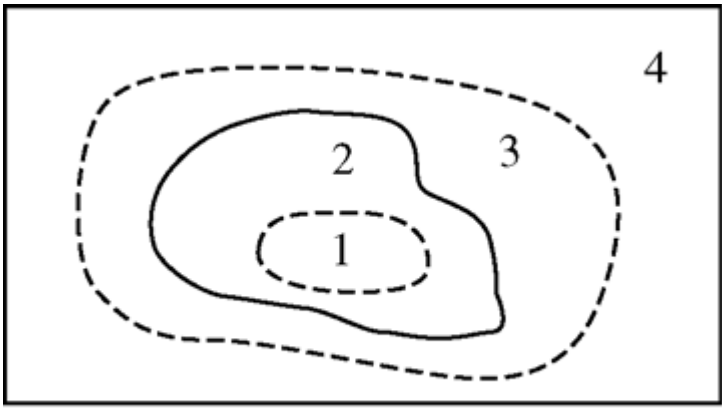



**Figure 3.** Map of study area shown four habitats as indicated in text.

**Table 2.** Habitat type, area of each habitat in hectares and number of moose seen in each habitat.

| Habitat Type | Area (ha) | No. of Moose Observed |
|---|---|---|
| **1** | 3400 | 25 |
| **2** | 1010 | 22 |
| **3** | 1040 | 30 |
| **4** | 4550 | 40 |
| **Total** | 10000 | 117 |

(a) The researchers conducting the study expect the number of moose observed in a habitat type to be proportional to the amount of acreage of that type of habitat. Are the data consistent with this expectation?

(b) What statistical test could you use to test this hypothesis? Even though you do not have to do the test, set up the appropriate table for the test.

(c) Without doing the test, relative to the proportion of total acreage, which habitat types did the moose seem to prefer (refer to your table)? Propose a reasonable hypothesis to support your choice.

4. A clever group of Saddleback College Biology 3A students measured the resting metabolism of Madagascan giant cockroaches at three ambient temperatures. The data are shown in Table Three.

**Table 3.** Resting metabolic rate (ml $O_2$/gm/h) in ten Madagascan cockroaches (*Gromphadorhina portentosa)* at three ambient temperatures

| Animal No. | 10 | 20 | 30 |
|---|---|---|---|
| **1** | 0.21 | 0.55 | 0.90 |
| **2** | 0.22 | 0.55 | 0.90 |
| **3** | 0.25 | 0.58 | 0.70 |
| **4** | 0.25 | 0.65 | 0.80 |
| **5** | 0.25 | 0.49 | 0.80 |
| **6** | 0.26 | 0.55 | 0.70 |
| **7** | 0.27 | 0.56 | 0.60 |
| **8** | 0.23 | 0.59 | 0.60 |
| **9** | 0.23 | 0.61 | 0.70 |
| **10** | 0.25 | 0.60 | 0.80 |

(a) Please complete the following table of basic descriptive statistics. For each of the temperatures please compute the indicated statistic.

| | Mean | Median | Mode | Max | Min |
|---|---|---|---|---|---|
| **10** | **0.242** | | | | |
| **20** | **0.573** | | | | |
| **30** | **0.750** | | | | |

(b) Now our clever 3A students are sure that there are statistical differences between the mean metabolic rates at each temperature. So they complete paired, one tailed t-tests between each of the rows of data in Table Three. Here are the results of the statistical tests:

| Group | p value |
|---|---|
| **10 to 20** | 0.00000000184 |
| **20 to 30** | 0.000000144 |
| **10 to 30** | 0.000707 |

Based on all the information given in this question, what can you conclude regarding the metabolism of these animals at the stated temperatures? Please write an appropriate single summary sentence.