# *Practice for Exam 2*
# STAT 350 – Fall 2008
# Exam 2

Your Name: _____ Your Seat: _____

Section Time (circle): 10:30 12:30 1:30

Note:

- You are responsible for upholding the Honor Code of Purdue University. This includes protecting your work from other students.
- Show your work on all questions. Unsupported work will not receive full credit. Credit will not be given for dumb luck. Showing work includes defining any random variable or event you use in the solution. Showing work also includes identifying any named distribution you are using the solution and the values of all relevant parameters.
- Decimal answers should be exact or to at least four significant digits.
- Unless otherwise stated, assume the significance level for any hypothesis test is 0.05.
- Standard Normal ($Z$) and values/probabilities must be taken from the tables provided. Probabilities, $p$-values, critical values, etc., for $\chi^2$, $t$, and $F$ distributions must also be taken from the tables provided.
- You are allowed the following aids: a one-page (8.5×11 inch) cheat sheet, a scientific calculator, and pencils.
- Turn off and put away your cell phone before the exam begins!

| Question | Points Possible | Points Missed |
|---|---|---|
| 1 | 27 | |
| 2 | 8 | |
| 3 | 21 | |
| 4 | 28 | |
| 5 | 6 | |
| 6 | 10 | |
| Total | 100 | |

1. ETS (the company that administers the SAT) will endorse a SAT preparation course only if there is substantial evidence that the course will increase a student's score by at least 30 points. Contracted by ETS, you wish to evaluate a new SAT prep course, so you find 20 volunteer high school juniors. You randomly select 10 of the volunteers to take prep course, which you pay for (the rest of the volunteers get no preparation). You also pay for all 20 volunteers to take the SAT. You obtain the following summary data:
   $\bar{x}_c = 1343$, $\bar{x}_n = 1278$, $s_c = 68$, $s_n = 72$
   The subscript "*c*" denotes those taking the SAT preparation Course and the subscript "*n*" denotes the group those Not taking the prep course. Assume that the populations do have the same underlying variance (that is, $\sigma_c^2 = \sigma_n^2$).

   a. (5 points) Let $\mu_c$ denote the true mean SAT score of the population of students who would take this SAT prep course and let $\mu_n$ denote the true mean SAT score of the population of students who do not take this prep course. If the null hypothesis is $H_0 : \mu_c - \mu_n = 30$, state the appropriate alternative hypothesis for this test in terms of $\mu_c$ and $\mu_n$.

   b. (3 points) How many degrees of freedom are there for the test statistic? *df* = _____

   c. (5 points) Find the critical value for this test ($\alpha = 0.05$), and sketch the rejection region.

   d. (6 points) Find the value of the appropriate test statistic.

   e. (4 points) Find the *p*-value of this test.

   f. (4 points) Based on your analysis, should ETS endorse this SAT prep course? Just answer "yes" or "no".

2. (8 points; 2 points each) Multiple Choice. For each part, circle the single *most* appropriate answer from the options provided.

   a. Assume that you are tested $H_0$: $\mu = 5$ versus $H_a$: $\mu > 5$ at $\alpha = 0.05$ and you rejected the null hypothesis. If you had used the same data to instead test $H_0$: $\mu = 5$ versus $H_a$: $\mu \neq 5$ at $\alpha = 0.05$, would you have also rejected the null hypothesis?

      (i) definitely yes

      (ii) definitely no

      (iii) maybe

   b. Assume that you are tested $H_0$: $\mu = 5$ versus $H_a$: $\mu > 5$ at $\alpha = 0.05$ and you rejected the null hypothesis. If you had used the same data to instead test $H_0$: $\mu = 5$ versus $H_a$: $\mu > 5$ at $\alpha = 0.10$, would you have also rejected the null hypothesis?

      (i) definitely yes

      (ii) definitely no

      (iii) maybe

   c. Assume that you are tested $H_0$: $\mu = 5$ versus $H_a$: $\mu > 5$ at $\alpha = 0.05$ and you rejected the null hypothesis. If you had used the same data to instead test $H_0$: $\mu = 5$ versus $H_a$: $\mu > 5$ at $\alpha = 0.01$, would you have also rejected the null hypothesis?

      (i) definitely yes

      (ii) definitely no

      (iii) maybe

   d. Assume that you are testing $H_0$: $\mu = 5$ versus $H_a$: $\mu \neq 5$ at $\alpha = 0.05$ and you rejected the null hypothesis. Assume also that you found that $\bar{x}$ was greater than 5. If you had used the same data to instead test $H_0$: $\mu = 5$ versus $H_a$: $\mu > 5$ at $\alpha = 0.05$, would you have also rejected the null hypothesis?

      (i) definitely yes

      (ii) definitely no

      (iii) maybe

3. Lesser Snow Geese come in two color variants, white and blue. The color is controlled by a single gene with the blue being dominant to the white. So the offspring of two white parents will all be white. Scientist studying imprinting in birds wanted to know if the color of a birds parents affected the birds' mate-choice (these geese mate for life). That is, do birds raised by white parents have a preference for white mates over blue mates (or maybe opposites attract and they might have a preference for blue mates). To control for the effects of the gosling (baby goose) color, color of siblings, and non-color genetic effects, the researchers took 40 eggs from the nests where both parents were white and gave one egg each to be raised by "foster" parents that were either both white (20 eggs) or both blue (20 eggs). The next year when the study goslings had reached sexual maturity, they recorded the color of each bird's mate. The data is summarized in the table below.

| | | mate color | |
|---|---|---|---|
| | | white | blue |
| parent color | white | 15 | 5 |
| | blue | 8 | 12 |

a. (8 points) Give a table of the expected values (counts).

| | | mate color | |
|---|---|---|---|
| | | white | blue |
| parent color | white | | |
| | blue | | |

b. (5 points) What is the value of the test statistic (chi-square) for this data?

c. (4 points) What is the *p*-value for this test? Give as accurately as possible.

d. (4 points) Based on your analysis above, what is your conclusion? Does the color of a bird's parents affect the bird's mate-choice? Just answer "yes" or "no"?

4. Tomato yield weight was compared in plants given one of three different formulations of fertilizers. Eleven plants were used for *each* fertilizer treatment. The results are summarized in the table below.

| | $\bar{x}_i$ | $s_i$ |
|---|---|---|
| A | 97.9 | 14.9 |
| B | 109.7 | 17.3 |
| C | 86.3 | 21.6 |

a. (20 points) Conduct an analysis of variance, summarizing your results in the ANOVA table outlined below (space to show relevant work is given below the table).

| Source | *df* | Sums of Squares | Mean Squares | *F* |
|---|---|---|---|---|
| Fertilizer | | | | |
| Error | | | | |
| Total | | | | |

b. (4 points) Give the critical value for this test ($\alpha = 0.05$).

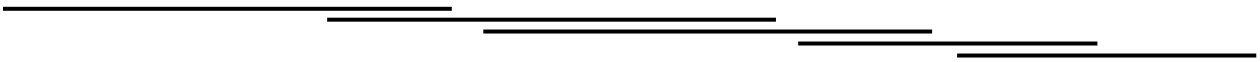
c. (4 points) Based on your analysis above, you would conclude (circle your choice):

(i) There is NO statistically significant difference in the mean tomato yield weight among these three fertilizers

(ii) There IS a statistically significant difference in the mean tomato yield weight for at least one of these fertilizers.

5. (6 points; 2 points each) Children were given a number of different vegetables and asked to rate them on a scale of 1 to 10 on taste (10 is best tasting, 1 is the worst). Using ANOVA, the researchers found that the preferences (ratings) for these vegetables were not all the same, so they conducted a Tukey Multiple Comparison ($\alpha = 0.05$) to determine which vegetables children had significantly different preferences for. The results of the Tukey Multiple Comparison procedure are summarized below.

| lima beans | beets | spinach | brussel sprouts | asparagus | broccoli | tomatoes | carrots |
|---|---|---|---|---|---|---|---|
| 1.23 | 1.35 | 2.46 | 3.74 | 4.13 | 5.12 | 6.91 | 8.34 |



   a. Children's preference for brussel sprouts was significantly different from their preference for broccoli (circle). Yes No

   b. Children's preference for brussel sprouts was significantly different from their preference for beets (circle) Yes No

   c. Children's preference for asparagus was significantly different from their preference for broccoli (circle) Yes No

6. (10 points) You hear a news clip reporting that a recent study found that students with parents who smoke do worse in school. You decide to examine the original paper. You see that they randomly selected a large number of students in a range of grade levels and obtained their grades and contacted each student's parents to determine whether at least one of the parents smoked. At each grade level they had a large number of students with parents that smoked and parents that did not smoke. At each grade examined, the average difference between children of smokers and children of non-smokers was at least half a grade ($\geq 0.5$ grade points) and the *p*-values were all less than 0.01.

   The newscaster that covered this study concluded her story stating, "This should serve as one more reason for parents to quit smoking – your children will do better in school if you do."

   Based on the information provided, do you agree with the newscaster's conclusion? Be sure to support your answer using clear and complete sentences.