Key: acedb babca adbca bbdea babcb

MATH202

Spring 2007

Exam 1a

Name:____

Section:__________

Instructions:

1. Do not start until instructed to do so.

2. If you brought a cell phone by mistake, turn it off and place it under your seat. You may NOT use it as a calculator.

3. You may use a calculator (NOT a cell phone calculator), but nothing else.

4. Code your **UDelNet ID** in the **Last Name** space on your scansheet and fill in the bubbles.

5. Write your name in the white space below the name box on your scansheet.

6. DO NOT put any part of your Social Security Number on your scansheet.

7. Choose the **best** answer to each question.

8. Use $\alpha = .05$ unless otherwise specified.

1. A teacher finds that final grades for all courses in the department are distributed as: A, 25%; B, 25%; C, 40%; D, 5%; F, 5%. For a random sample of students in her course, the distribution of final grades is shown. Calculate the chi-square test statistic to determine if the grade distribution for this teacher's course differs from that for the department.

Grade	A	B	C	D	F
Number	36	42	60	14	8

   a. 5.25
   b. 4.82
   c. 6.87
   d. 3.41

2. Consider a completely randomized design with 15 treatments. If all possible pairwise comparisons of treatment means are to be made using a multiple comparisons procedure, how many comparisons would be made?
   a. 225
   b. 210
   c. 105
   d. 30
   e. 7.5

Questions 3 – 5: Safety in motels and hotels is a growing concern among travelers. Suppose a survey was conducted to compare U.S. travelers' perception of safety in various motel chains. Four different national chains were randomly chosen from the economy lodging sector. Six frequent business travelers are randomly selected and each was assigned to stay at each of the four motels in some random order on four of their business trips. Each traveler then rated each motel on a scale from 0 to 100 to indicate how safe he or she felt at the motel. A score of 0 indicates completely unsafe and a score of 100 indicates perfectly safe. The scores are shown below.

```
Traveler    Motel1    Motel2    Motel3    Motel4
1           50        35        65        60
2           30        30        50        50
3           55        30        60        55
4           70        70        70        70
5           65        60        80        75
6           45        25        45        50

Motel  N   Mean  StDev                       1         4  52.50  13.23
1      6  52.50  14.40                       2         4  40.00  11.55
2      6  41.67  18.62                       3         4  50.00  13.54
3      6  61.67  12.91                       4         4  70.00   0.00
4      6  60.00  10.49                       5         4  70.00   9.13
                                             6         4  41.25  11.09

Traveler  N   Mean  StDev
```

General Linear Model: Rating versus Motel, Traveler

```
Factor     Type   Levels  Values
Motel      fixed       4  1, 2, 3, 4
```

```
Traveler  fixed       6  1, 2, 3, 4, 5, 6


Analysis of Variance for Rating

Source    DF       SS       MS      F       P
Motel          1494.79                  0.000
Traveler       3555.21                  0.000
Error
Total          5648.96


S = 6.31906   R-Sq = 89.40%   R-Sq(adj) = 83.74%


Tukey 95.0% Simultaneous Confidence Intervals
Response Variable Rating
All Pairwise Comparisons among Levels of Motel
Motel = 1  subtracted from:

Motel   Lower  Center    Upper  ----+---------+---------+---------+--
2      -21.36  -10.83  -0.3080  (------*------)
3       -1.36    9.17  19.6920              (------*------)
4       -3.03    7.50  18.0254             (------*------)
                                ----+---------+---------+---------+--
                                  -15         0        15        30


Motel = 2  subtracted from:

Motel  Lower  Center  Upper  ----+---------+---------+---------+--
3      9.475   20.00  30.53                     (------*------)
4      7.808   18.33  28.86                    (------*------)
                             ----+---------+---------+---------+--
                               -15         0        15        30


Motel = 3  subtracted from:

Motel   Lower  Center  Upper  ----+---------+---------+---------+--
4      -12.19  -1.667  8.859        (------*------)
                              ----+---------+---------+---------+--
                                -15         0        15        30
```

3. Find the value of the F-statistic for the test for the block effect.
   a. 39.9
   b. 2.9
   c. 12.5
   d. 711.0
   e. 17.8

4. What is the null hypothesis for testing whether there is a traveler effect on safety scores?
   a. Ho: $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq \mu_6$
   b. Ho: $\mu_1 = \mu_2 = \mu_3 = \mu_4$
   c. Ho: there is no relationship between traveler and motel
   d. Ho: $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$
   e. Ho: traveler and motel do not interact with respect to mean safety score

5. Which of the following is correct?
   a. There is strong evidence of differences among motels with respect to mean safety score for all business travelers; we are confident that motel 3 has the highest mean safety, then 4, then 1, and motel 2 has the lowest mean safety.
   b. There is strong evidence of differences among motels with respect to mean safety score for all business travelers; we are confident that motels 1, 3, and 4 have higher mean safety scores than motel 2.
   c. There is strong evidence of differences among motels with respect to mean safety score for all business travelers; we are confident that motels 3 and 4 have higher mean safety scores than motel 1 and that motel 3 has a higher mean safety score than motel 4.
   d. There is strong evidence of differences among motels with respect to mean safety score for all business travelers; we are confident that motels 3 and 4 have lower mean safety scores than motel 2.
   e. There is almost no evidence of differences among motels with respect to mean safety score for all business travelers.

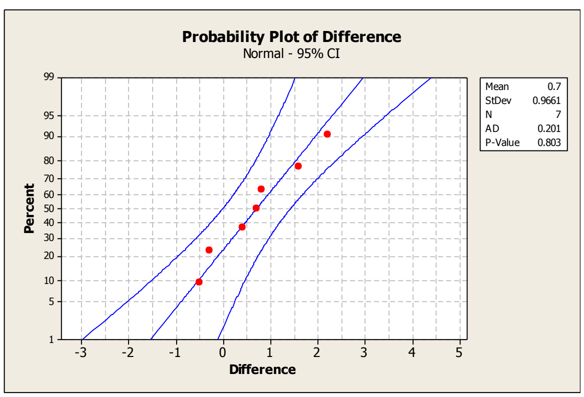
Questions 6 - 8: Suppose we are interested in learning about the effect of a newly developed gasoline detergent additive on automobile mileage. We specifically wish to determine if there is a difference between gasoline with the additive and gasoline without the additive. To gather information, seven cars have been randomly selected, and their gasoline mileages (mpg) have been determined. For each car this determination is made both when gasoline without the additive is used and when gasoline with the additive is used. Minitab output is attached.

Paired T-Test and CI: NoAdditive(mpg), Additive (mpg)

```
Paired T for NoAdditive(mpg) - Additive (mpg)

                  N      Mean     StDev  SE Mean
NoAdditive(mpg)  7   25.6000    4.4993   1.7006
Additive (mpg)   7   24.9000    5.0166   1.8961
Difference       7  0.700000  0.966092 0.365148


95% CI for mean difference: (-0.193486, 1.593486)
T-Test of mean difference = 0 (vs. not = 0): T-Value =______  P-Value = 0.104
```



6. Which of these conditions is/are necessary to perform the test?
   a. Populations have equal variances
   b. The population of differences is approximately normal.
   c. No assumption is needed since the samples are large enough.
   d. Population variances are known.
   e. a and b.

7. What are the test statistic and the critical value of the test?
   a. Test statistic = 1.92 and the critical value = 2.45.
   b. Test statistic = 0.7 and the critical value = 0.97.
   c. Test statistic = 2.45 and the critical value = 1.92.
   d. Test statistic = 0.72 and the critical value = 1.94
   e. Test statistic = 1.92 and the critical value = 2.37

8. What is your decision and conclusion?
   a. Since the observed level of significance (0.104) is greater than α = 0.05, reject the null hypothesis and conclude that there is evidence of a difference between the two gasolines.
   b. Since the observed level of significance (0.104) is greater than α = 0.05, do not reject the null hypothesis and conclude that there is not enough evidence of a difference between the two gasolines.
   c. Since the difference between the two sample means is only 0.7 and the sample size is only 7, reject the null hypothesis and conclude that there is a difference between the two gasolines.
   d. Since the difference between the two sample means is only 0.7 and the sample size is only 7, do not reject the null hypothesis and conclude that there is not enough evidence of a difference between the two gasolines.
   e. Since the sample size is so small, any inference made will be invalid.

Questions 9 – 11: *Quality Engineering* (vol. 2, 1990) published the results of an experiment that was conducted by a dog food manufacturer to improve a filling process in which ground meat is packed into cans. The process uses a rotary filling machine with six cylinders, each of which dispenses ground meat. The company wanted to study the effects of differences in batches of meat and differences in cylinders on the weight of the final product. Five batches of meat were used in the experiment. Three filled cans were randomly selected from each cylinder while each batch was being run. The cans were weighed and the differences between each can's weight and 12 oz. were recorded. Some results are shown below.

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*
Cylinder	55.78889		11.15778	5.942012	0.000158
Batch	62.44444		15.61111	8.313609	0.000021
Interaction	48.48889		2.424444	1.291124	0.220592
Within	112.6667		1.877778		
Total	279.3889				

9. What is the rejection region for the test for interaction?
   a. F > 1.39
   b. F > 1.65
   c. F > 1.75
   d. F > 1.95
   e. F > 1.94

10. What is the correct interpretation of interaction?
    a. The differences among the mean weights for the cylinders depend on the batch.
    b. There is a relationship between cylinder and batch.
    c. There are differences among the mean weights for the cylinders.
    d. There are differences among the mean weights for the batches.
    e. Both c and d.

11. If we find significant differences among the treatment means, which of the following is the correct sequence of analyses we should perform next? (e.g. "Test 1; test 2" means perform test 1, then perform test 2.)
    a. Test for interaction; test for cylinder; multiple comparisons among cylinder means; test for batch; multiple comparisons among batch means
    b. Test for interaction; test for cylinder; test for batch
    c. Test for interaction
    d. Test for cylinder; test for batch
    e. Test for cylinder; multiple comparisons among cylinder means; test for batch; multiple comparisons among batch means

12. The data in the table below resulted from an experiment with three treatments. The response variable is X.

Treatment 1	Treatment 2	Treatment 3
3.8	5.4	1.3
1.2	2.1	0.7
4.1	4.8	
5.5		
2.3		

Descriptive Statistics: X

Variable	Treatment	N	Mean	StDev
X	1	5	3.380	1.666
	2	3	4.10	1.76
	3	2	1.000	0.424

How is SST (sum of squares for treatment) computed?
    a. $(5-1)1.666 + (4-1)1.76 + (3-1)0.424$
    b. $(5-1)1.666^2 + (4-1)1.76^2 + (3-1)0.424^2$
    c. $5(3.38-2.827)^2 + 3(4.10-2.827)^2 + 2(1-2.827)^2$
    d. $5(3.38-3.12)^2 + 3(4.10-3.12)^2 + 2(1-3.12)^2$
    e. $(3.8-3.12)^2 + (1.2-3.12)^2 + ... + (0.7-3.12)^2$

13. Consider the following scenarios:

    <u>I</u>
    A researcher wishes to see whether there is any difference in the average weight gains of athletes following one of three special diets. Athletes are randomly assigned to three groups (A, B, C) and placed on the diet for six weeks. Their weight gains are then recorded. A data analysis determines that there is enough evidence that average weight gain for all athletes on diet B is higher than A and C.

    <u>II</u>
    In order to find out if there is a difference in failure rates between two emissions stations (A, B), cars are selected from each station and the results of the emissions test for each (pass or fail) is recorded. A data analysis determines that there is enough evidence that the failure rate for all cars at station A is higher than station B.

Determine the type of study used in each scenario.

a. Scenario I is an observational study and scenario II is a designed experiment.
b. Scenario I is a designed experiment and scenario II is an observational study.
c. Both scenarios are observational studies.
d. Both scenarios are designed experiments.

14. Mutual funds are classified as large-cap funds, medium-cap funds, or small-cap funds, depending on the market capitalization of the companies in the fund. Hawaii Pacific University researchers investigated whether the average performance of a mutual fund is related to capitalization size (*American Business Review*, Jan. 2002). Which of the following methods is appropriate to analyze the data from this study? Assume all relevant conditions would be satisfied.
    a. Independent, 2-sample t-test
    b. Paired t-test
    c. One-way ANOVA
    d. Two-way ANOVA
    e. Chi-squared test

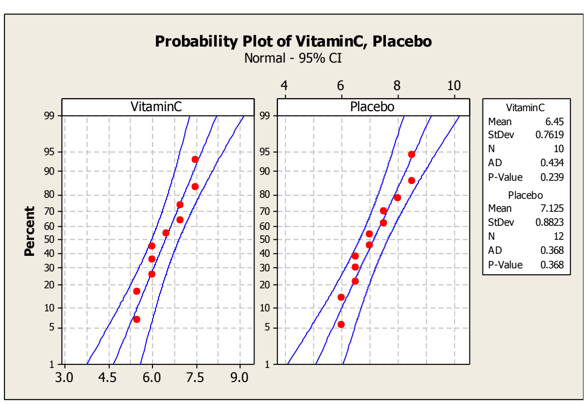
Questions 15- 18**:** Twenty-two volunteers at a cold research institute caught a cold after having been exposed to various cold viruses. A random selection of 10 volunteers were given tablets containing 1 gram of vitamin C. These tablets were taken 4 times daily. The control group consisting of the other 12 volunteers was given placebo tablets that looked and tasted exactly like the vitamin C ones. This was continued for each volunteer until a doctor, who did not know whether the volunteer was receiving vitamin C or the placebo, decided that the volunteer was no longer suffering from the cold. The length of time the cold lasted in days was then recorded. Do the data provide sufficient evidence that taking 4 grams of vitamin C daily reduces the time that a cold lasts? Use the attached Minitab output.

Two-Sample T-Test and CI: VitaminC, Placebo

```
Two-sample T for VitaminC vs. Placebo

           N   Mean  StDev  SE Mean
VitaminC  10  6.450  0.762     0.24
Placebo   12  7.125  0.882     0.25


Difference = mu (VitaminC) - mu (Placebo)
Estimate for difference:  -0.675000
95% upper bound for difference:  -0.061850
T-Test of difference = 0 (vs. ____): T-Value = -1.90  P-Value = 0.036  DF = 20
Both use Pooled StDev = 0.8303
```



15. Which one is a variable of interest?
    a. Length of time the cold lasts.
    b. The populations of vitamin C patients and the population of placebo patients.
    c. The mean time for vitamin C patients and the mean time for placebo patients.
    d. Various cold viruses.
    e. Length of time the doctors spent attending to each patient.

16. What is the purpose of randomly assigning some volunteers to get vitamin C and others to get placebo?
    a. We'll be able to generalize to all cold sufferers.
    b. We'll be able to conclude that it was the vitamin C that was responsible if we see differences in cold durations.
    c. We'll be able to use a paired samples analysis instead of an independent samples analysis.
    d. We'll be able to assume equal population variances.
    e. We'll be able to calculate more accurate results.

17. State the hypotheses of interest for the test.
    a. $H_o : \mu_c - \mu_p = 0 \qquad H_a : \mu_c - \mu_p \neq 0$
    b. $H_o : \mu_c - \mu_p = 0 \qquad H_a : \mu_c - \mu_p < 0$
    c. $H_0 : \overline{x_c} - \overline{x_p} = 0 \qquad H_a : \overline{x_c} - \overline{x_p} < 0$
    d. $H_o : \mu_c - \mu_p = 0 \qquad H_a : \mu_c - \mu_p > 0$
    e. $H_0 : \overline{x_c} - \overline{x_p} = 0 \qquad H_a : \overline{x_c} - \overline{x_p} > 0$

18. Interpret the p-value in the context of this problem.
    a. There is a 3.6% chance that there is no difference between vitamin C and placebo.
    b. There is a 3.6% chance that vitamin C shortens cold duration compared to placebo.
    c. There is a 3.6% chance that vitamin C lengthens cold duration compared to placebo.
    d. There is a 3.6% chance that the sample mean duration for vitamin C patients could be at least .675 days shorter than for placebo patients if there is no difference between vitamin C and placebo.
    e. There is a 3.6% chance that the sample mean duration for vitamin C patients could be at least .675 days shorter than for placebo patients if vitamin C is effective.

Questions 19 & 20: A manufacturer has devised a new method for producing computer chips. He feels that his new method will reduce the proportion of chips that have defects. To verify this, 320 chips were produced by the new method and 360 by the old. The result was that 76 of the former and 94 of the latter were defective. Is this significant enough evidence for the manufacturer to conclude that the new method will produce a smaller proportion of defective chips? Minitab output is attached.

Test and CI for Two Proportions

```
Sample   X    N  Sample p
1       76  320  0.237500
2       94  360  0.261111


Difference = p (1) - p (2)
Estimate for difference:  -0.0236111
95% upper bound for difference:  0.0309881
Test for difference = 0 (vs < 0):  Z = ___________  P-Value = 0.239
```

19. What are H_0 and H_a ?
    a. H_0: $\mu_1 - \mu_2 = 0$ H_a: $\mu_1 - \mu_2 \neq 0$
    b. H_0: $\hat{p}_1 - \hat{p}_2 = 0$ H_a: $\hat{p}_1 - \hat{p}_2 \neq 0$
    c. H_0: $p_1 - p_2 = 0$ H_a: $p_1 - p_2 \neq 0$
    d. H_0: $\hat{p}_1 - \hat{p}_2 = 0$ H_a: $\hat{p}_1 - \hat{p}_2 < 0$
    e. H_0: $p_1 - p_2 = 0$ H_a: $p_1 - p_2 < 0$

20. Calculate the test statistic.
    a. -0.71 b. -1.01 c. -0.21 d. 0.71 e. 1.01

21. Two methods have been proposed for producing transistors. If method 1 resulted in 20 unacceptable transistors out of 100 produced, and method 2 resulted in 12 unacceptable transistors out of 100 produced, can we conclude that the proportion of unacceptable transistors that will be produced by the two methods are different? Minitab output is attached.

Test and CI for Two Proportions

```
Sample   X    N  Sample p
1       20  100  0.200000
2       12  100  0.120000


Difference = p (1) - p (2)
Estimate for difference:  0.08
95% CI for difference:  (-0.0210095, 0.181009)
Test for difference = 0 (vs not = 0):  Z = 1.54  P-Value = ________
```

Find the p-value for the test.
    a. 0.0618 b. 0.1236 c. 0.3764 d. 0.7528 e. 0.8764

22. In a multinomial experiment, what are the possible outcomes called?
    a. classes, categories, or cells
    b. factors or blocks
    c. variables
    d. none of the preceding

Questions 23 – 25: The contingency table below shows the results of a random sample of 200 state representatives that was conducted to see whether their opinions on a bill are related to their party affiliation.

	Opinion		
Party	**Approve**	**Disapprove**	**No Opinion**
Republican	42	20	14
Democrat	50	24	18
Independent	10	16	6

Chi-Square Test: Approve, Disapprove, NoOpinion

```
       Approve  Disapprove  NoOpinion  Total
    1       42          20         14     76

    2       50          24         18     92

    3       10          16          6     32

Total      102          60         38    200

Chi-Sq = 8.030, DF = 4, P-Value = 0.090
```

23. If there is no relationship between party and opinion, find an estimate for the expected cell count of Democrats who disapprove.
    a. 17.48
    b. 27.60
    c. 22.8
    d. 46.92

24. Find the critical value that defines the rejection region.
    a. 15.5073
    b. 3.32511
    c. 9.48773
    d. 11.1433
    e. 0.710721

25. Is there enough evidence to indicate the state representatives' opinions on a bill are related to their party affiliation?
    a. Yes   b. No