KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DEPARTMENT OF MATHEMATICS & STATISTICS
DHAHRAN, SAUDI ARABIA

STAT 212: BUSINESS STATISTICS I I

Semester 063

First Exam *SOLUTIONS*

Saturday July 24, 2007

7:00 - 8:15PM

Please **circle** your:

Instructor's name	**& section number**	
Mohammad F. Saleh	Sec 1: (9:20 – 10:20)	Sec 2 : (10:30 – 11:30)
Marwan M. Almomani	Sec 3 : (10:30 – 11:30)	

Name: Student ID#: Serial #:

Directions:

1) You must **show all work** to obtain full credit for questions on this exam.
2) DO NOT round your answers at each step. Round answers only if necessary at **your final step to 4 decimal places**.

Question No	Full Marks	Marks Obtained
Part One	6	
Part Two	6	
Q1	12	
Q2	10	
Q3	13	
Q4	9	
Q5	11	
Q6	13	
Total	80	

Part One (6 pts, 1 for each)

Indicate which of the following TRUE or FALSE

T 1. Whenever possible, in establishing the null and alternative hypotheses, the research hypothesis should be made the alternative hypothesis. True

T 2. If a decision maker wishes to reduce the chance of making a Type II error, one option is to increase the sample size. True

F 3. After performing a one tail test and reject H_0, you realize you should have done a two tailed test, at the same significance level. You will also reject H_0 for the test. False

T 4. Testing the differences between tow means with dependent samples becomes a one sample test once you compute the differences of the paired observations. True

T 5. The p – value is the largest significance at level which you wouldn't reject the null hypothesis. True

F 6. In a null hypothesis test involving two population variances, if the null hypothesis states that the two variances are strictly equal, then the test statistic is a chi-square statistic. False

Part Two (6 pts 1 for each)

Circle the correct answer:

1. In a one tail test using z distribution as the test statistic and the 0.01 significance level, the critical value either

$Z_\alpha = Z_{.01} = 2.33$

   a. – 1.96 or + 1.96
   b. – 1.645 or + 1.645
   c. – 2.575 or + 2.575
   d. .0 or 1
   e. None of these is correct.

2. A type II error is committed if we:

   a. Reject a true null hypothesis.
   b. Don't reject a true alternative hypothesis.
   c. Reject a true alternative hypothesis.
   d. Don't reject both null and alternative hypotheses at the same time.
   e. None of these is correct.

3. The F distribution:

   a. Cannot be negative.
   b. Cannot be positive.
   c. Is the same as the t distribution.
   d. Is the same as the z distribution.
   e. None of these is correct.

4. As the sample size increases, the t distribution approaches will be:

   a. The standard normal distribution.
   b. The chi distribution.
   c. The F distribution.
   d. Zero.
   e. None of these is correct.

5. Airline A and Airline B boast successful baggage routing rates of 95 and 98 percent, respectively. From this information we can determine.

   a. Airline A has better baggage service.
   b. Airline B has better baggage service
   c. The baggage services are equally accurate.
   d. Nothing, we need more information to decide.
   e. None of these is correct.

6. For which of the following is a two sample test not appropriate?

   a. Seeing whether the proportions of childless couples with children who buy sports cars different.
   b. Seeing whether the mean tea consumption is higher in KSA than in UAE.
   c. Testing whether there are more men than women in Al – Dammam.
   d. Deciding whether average attendance at major league football games is the same in Al - Riyadh and Al – Dammam.
   e. None of these is correct.

(c) $\Rightarrow$ It can be tested using:

$H_0: P_{men} \le .5$ vs $H_A: P_{men} > .5$

which is a one-sample test for single proportion.

Part Three

Question One (2+3+1+1+2+1+1+1 = 12 pts):

From old records, it is believed that the average speeds of the cars at Al – Khobar Street is 99 km per hour. A random sample of 25 cars was selected and the speed for each car registered. The sample gave an average of 107.92 km per hour and a standard deviation of 14.474 km per hour. Do the data support the old records? Use the 2% significance level.

a. The test hypotheses are:

H_0: $\mu = 99$ vs. H_A: $\mu \neq 99$ ② points

b. The assumptions are:

1. Small sample size
2. σ is unknown
3. population is normal

③ points

c. The critical values are:

$t_{\alpha/2, n-1} = t_{.01, 24} = 2.4922$ ① point

d. The decision rule using the test statistic approach is:

Reject H_0 if $|t_c| > t_{\alpha/2, n-1}$ ① point

e. The test statistic is:

$$t_c = \frac{\bar{X} - \mu_0}{S/\sqrt{n}} = \frac{107.92 - 99}{14.474/\sqrt{25}} = \frac{8.92}{2.8948} = 3.0814$$ ② poin

f. The decision is:

Since $|t_c| = |3.0814| > t_{\alpha/2, n-1} = 2.4922$

Reject H_0 ① point

g. Your conclusion is:

The sample information do NOT support the old records which is believed that the average speed is 99 Km/hr. ① poin

h. Based on your decision, what type of error you might have committed?

Type I error (Because H_0 was rejected) ① point.

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Question Two (2+2+1+1+2+1+1 = 10 pts):

A PC company uses two suppliers for rechargeable batteries for their notebook computers. Two factors are important quality features of the batteries: mean use time and variation. It is desirable that the mean use time be high and the variability be low. Recently, the PC maker conducted a test on batteries from the two suppliers. In the test, 9 randomly selected batteries from Supplier 1 were tested and 12 randomly selected batteries from Supplier 2 were tested. The following results were observed:

Supplier 1	Supplier 2
$n_1 = 9$	$n_2 = 12$
$\bar{x}_1 = 67.25$ min.	$\bar{x}_2 = 72.40$ min.
$s_1 = 11.2$ min.	$s_2 = 9.9$ min.

Based on these sample results, can the PC maker conclude that a difference exists between the two batteries with respect to the population standard deviations? Test using a 0.10 level of significance.

a. The test hypotheses are:
H₀: $\sigma_1^2 - \sigma_2^2 = 0$ vs. H_A: $\sigma_1^2 - \sigma_2^2 \neq 0$ } (2-pts)

b. The assumptions are
1. The two populations are normally distributed
2. Samples Variances are independent. } (2-pts)

c. The critical value(s) is(are):
$F_{\alpha/2, n_1-1, n_2-1} = F_{.05, 8, 11} = 2.948$ } (1-pt)

d. The decision rule is:
Reject Ho if $F_c > F_{\alpha/2, n_1-1, n_2-1}$ } (1-pt)

e. The test statistic is:
$$F_c = \frac{S_1^2}{S_2^2} = \frac{(11.2)^2}{(9.9)^2} = \frac{125.4}{98.01} = 1.2799$$ } (2-pts)

f. The decision is:
Since $F_c = 1.2799 \not> F_{\alpha/2, n_1-1, n_2-1} = 2.948$
∴ Do NOT reject Ho } 1 pt

g. The conclusion is:
Based on Samples information, there is NO difference between the two population standard deviations. } 1 pt

Question Three (2+1+1+5+1+1+2 = 13pts):

In the previous question (question 2). Can the PC maker conclude that a difference exists between the two batteries with respect to the population mean use time? Test using a 0.05 level of significance. Assuming that both samples selected randomly from normal populations

a. The test hypotheses are:
H_0: $\mu_1 - \mu_2 = 0$ vs. H_A: $\mu_1 - \mu_2 \neq 0$ } ② pts

b. The critical value(s) is (are):
$t_{\alpha/2, n_1+n_2-2} = t_{.025, 19} = 2.0930$ } ① pt

c. The decision rule using the test statistic approach is:
Reject Ho if $|t_c| > t_{\alpha/2, n_1+n_2-2}$ } ① pt

d. The test statistic is:

$$S_p = \sqrt{\frac{(n_1-1)S_1^2+(n_2-1)S_2^2}{n_1+n_2-2}} = \sqrt{\frac{(8)(11.2)^2+(11)(9.9)^2}{9+12-2}} = 10.4671$$ } ② pts

$$t_c = \frac{(\bar{x}_1-\bar{x}_2)-d_0}{S_p\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}} = \frac{67.25-72.40-0}{10.4671\sqrt{\frac{1}{9}+\frac{1}{12}}} = -1.1158$$ } ③ pts

e. The decision is:
Since $|t_c| = |-1.1158| \not> t_{\alpha/2, n_1+n_2-2} = 2.0930$
∴ Do NOT reject Ho } ① pt

f. The conclusion is:
Based on the samples information, there is NO difference between the two populations mean use time. } ① pt

g. What is other assumption required to perform the test in part (a)? is it satisfied? Explain.

I. The other assumption is: σ_1^2, σ_2^2 are unknown, but equal. } ① pt

II. Yes, because Ho: $\sigma_1^2 - \sigma_2^2 = 0$ was not rejected in the previous question. } ① pt

Question Four (2+1+1+1+2+1+1 = 9 pts):

An automatic filling machine is used to fill bottles with liquid detergent. A random sample of 20 bottles results in a sample variance of fill volume of 0.0153 (fluid ounces)^2. If the variance of fill volume exceeds 0.01 (fluid ounces)^2, an unacceptable proportion of bottles will be underfilled or overfilled. Is there evidence in the sample data to suggest that the manufacturer has a problem with underfilled or overfilled bottles? Use 0.05 level of significant, and assume that fill volume has a normal distribution.

a. The test hypotheses are:

H_0: $\sigma^2 \le 0.01$ vs. H_A: $\sigma^2 > 0.01$ } 2 pts

b. The assumption is:

The population is normally distributed. } 1 pt

c. The critical value is:

$\chi^2_{\alpha, n-1} = \chi^2_{0.05, 19} = 30.1435$ } 1 pt

d. The decision rule using test statistic approach is:

Reject H_0 if $\chi^2_c > \chi^2_{\alpha, n-1}$. } 1 pt

e. The test statistic is:

$$\chi^2_c = \frac{(n-1)S^2}{\sigma_0^2} = \frac{(19)(0.0153)}{0.01} = 29.07$$ } 2 pts

f. The decision is:

Since $\chi^2_c = 29.07 \not> \chi^2_{\alpha, n-1} = 30.1435$

Do NOT reject H_0 } 1 pt

g. The conclusion is:

Based on the sample information, the manufacturer has NO problem with underfilled or overfilled bottles } 1 pt

Question Five (2+1+3+3+1+1 = 11 pts):

A manager believed that at most 18 percent of the company's employees work overtime every week. If the observed proportion this week is 23 percent in a sample of 250 of the 2,500 employees, can you accept his belief as reasonable or must you conclude that other values is more appropriate?? Use 0.025 level of significant

a. The test hypotheses are:
H_0: $p \le 0.18$ vs. H_A: $p > 0.18$ } ② pts

$n = 250$, $\bar{p} = 0.23$

b. The assumptions are:
1. $n p_0 \ge 5 \Rightarrow (250)(.18) = 45 \ge 5$
2. $n(1-p_0) \ge 5 \Rightarrow (250)(1-.18) = 205 \ge 5$
} ① pt

c. The test statistic is:

$$Z_c = \frac{\bar{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} = \frac{0.23 - 0.18}{\sqrt{\frac{(.18)(1-.18)}{250}}} = 2.06$$ } ③ pts

d. The p-value is:

$$\begin{aligned} \text{P-value} &= p(Z > Z_c) \\ &= p(Z > 2.06) \\ &= 0.5 - p(0 < Z < 2.06) \\ &= 0.5 - 0.4803 = 0.0197 \end{aligned}$$ } ③ pts

e. The decision is:

Reject Ho if the P-value $< \alpha$
$0.0197 < 0.025$
∴ Reject Ho.
} ① pt

f. Your conclusion is:

Based on the sample information, there is NO evidence to conclude that at most 18% of the company's employees work overtime every week. } ① pt

Question Six (2+2+1+1+5+1+1 = 13 pts):

A random sample of 500 adult residents of Al- Dammam city found that 385 were in favor of increasing the highway speed limit to 75 mph, while another sample of 400 adult residents of Al - Riyadh city found that 267 were in favor of the increased speed limit. Do these data indicate that there is a difference in the support for increasing the speed limit between the residents of the two counties? Use $\alpha = 0.05$.

Let Sample 1 = Al-Dammam
Sample 2 = Al-Riyadth.

$\bar{P}_1 = \frac{x_1}{n_1} = \frac{385}{500} = 0.77$ (3) pts

$\bar{P}_2 = \frac{x_2}{n_2} = \frac{267}{400} = 0.6675$

$\bar{P} = \frac{x_1 + x_2}{n_1 + n_2} = \frac{385+267}{500+400} = 0.7244$

a. The test hypotheses are:

H_0: $P_1 - P_2 = 0$ vs. H_A: $P_1 - P_2 \neq 0$ (2) pts

b. The assumptions are:

1. $n_1 \bar{P}_1 = 500(.77) = 385 \geq 5$, $n_1(1-\bar{P}_1) = 500(.23) = 115 \geq 5$ ✓
2. $n_2 \bar{P}_2 = 400(.6675) = 267 \geq 5$, $n_2(1-\bar{P}_2) = 400(.3325) = 133 \geq 5$ ✓

(2) pts

c. The critical values are:

$Z_{\alpha/2} = Z_{.025} = 1.96$ (1) pt

d. The decision rule using test statistic approach is:

Reject H_0 if $|Z_c| > Z_{\alpha/2} = 1.96$ (1) pt

e. The test statistic is:

$$Z_c = \frac{\bar{P}_1 - \bar{P}_2 - 0}{\sqrt{\bar{P}(1-\bar{P})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} = \frac{0.77 - 0.6675 - 0}{\sqrt{(.7244)(1-.7244)\left(\frac{1}{500} + \frac{1}{400}\right)}}$$

$$= \frac{0.1025}{0.02997333\bar{6}} = 3.42$$

(2) pts

f. The decision is:

since $|Z_c| = |3.42| > Z_{\alpha/2} = 1.96$

$\therefore$ Reject H_0. (1) pt

g. The conclusion is:

Based on samples information, there is a difference in the support for increasing the speed limit between the residents of the two counties. (1) pt