KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DEPARTMENT OF MATHEMATICAL SCIENCES
DHAHRAN, SAUDI ARABIA

STAT 212: BUSINESS STATISTICS II

Major Exam **I**
Sunday March 18, 2007
6:00 pm – 7:15 pm

Please **circle** your instructor's name:

Instructor's name	Section number
Rahimov I.	1 5
Anabosi R.	2 3 4
Al Sawi E.	6

Name: SOLUTION KEY ID#: **Serial:**

Question No	Full Points	Points Obtained
1	10	
2	10	
3	12	
4	8	
5	10	
6	10	
Total	**60**	

Q1. (*10 pts*) Answer the following questions by indicating it as **T**rue or **F**alse.

1. When the decision maker has control over the null and alternative hypotheses, the alternative hypotheses should be the "research" hypothesis. (**T**)

2. A conclusion to "not reject" the null hypothesis is the same as the decision to "accept" the null hypothesis. (**F**)

3. If all other factors are held constant, an increase in sample size will result in decreased chance of committing a Type I statistical error. (**F**)

4. Of the two types of statistical errors, the one that decision makers have most control of is the Type I error. (**T**)

5. If a hypothesis test leads to incorrectly rejecting the null hypothesis, a Type II statistical error has been made. (**F**)

Q2. (*10 pts*) Answer the following questions by choosing the right answer.

1. Which of the following would be an appropriate null hypothesis?

a. The mean of a population is equal to 55.
b. The mean of a sample is equal to 55.
c. The mean of a population is greater than 55.
d. Only (a) and (c) are true.

2. If the *p* value is less than α in a two-tailed test,

a. The null hypothesis should not be rejected.
b. The null hypothesis should be rejected.
c. A one-tailed test should be used.
d. More information is needed to reach a conclusion about the null hypothesis.

3. In a two-tailed hypothesis test for a population mean, an increase in the sample size will:

a. Have no affect on whether the null hypothesis is true or false.
b. Have no affect on the significance level for the test.
c. Result in a sampling distribution that has less variability.
d. All of the above are true.

4. The reason for using the t-distribution in a hypothesis test about the population mean is:

a. The population standard deviation is unknown and the sample size is fairly small.
b. It results in a lower probability of a Type I error occurring.
c. It provides a smaller critical value than the standard normal distribution for a given sample size.
d. None of the above would be a reason for using the t-distribution.

5. When testing a two-tailed hypothesis using a significance level of 0.05, a sample size equal to n = 16, and with the population standard deviation unknown, which of the following is true?

a. The null hypothesis can be rejected if the sample mean gets too large or too small compared with the hypothesized mean.
b. The alpha probability must be split in half and a rejection region must be formed on both sides of the sampling distribution.
c. The test statistic will be a t-value.
d. All of the above are true.

Q3. (*12 pts*) A company makes a device that can be fitted to automobile engines to improve the mileage. The company claims that if the device is installed, owners will observe a mean increase of more than 3.0 mpg. Assuming that the population standard deviation of increase is known to be 0.75 mpg, and a sample of size 64 cars is selected with an $\bar{x} = 3.25$ mpg.

a. Based on these data for which significance levels you would reject company's claim?

b. Do you have strong evidence to reject the company's claim using a significance level of 0.07?

The hypotheses are: **H_0:** $\mu \le 3.0$ **H_A:** $\mu > 3.0$ claim
The test statistic: $$Z_0 = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}} = \frac{3.25 - 3.0}{\frac{0.75}{\sqrt{64}}} = 2.67$$
The p-value: $$P(Z > Z_0) = P(Z > 2.67) = 0.5 - P(0 < Z < 2.67)$$ **= 0.5 – 0.4962 = 0.0038**
Answer: a) **The company's claim would be rejected for any significance level < 0.0038** b) **No, because p-value = 0.0038 < 0.07 = α.**

Q4. (*8 pts*) The following table shows the number of traffic citations given for speeding by two officers, Officer 1 and Officer 2, of the Dammam-Jubail Highway Patrol for the last six months.

	Month					
	September	**October**	**November**	**December**	**January**	**February**
Officer 1	30	22	25	19	26	29
Officer 2	26	19	20	15	19	21

At the 2% significance level, is there a significant difference in the average number of citations given by the two officers?

The hypotheses are: **H_0:** $p \le 0.04$ claim **H_A:** $p > 0.04$

Test Statistic:

Test statistic = $Z_0 = \dfrac{p - p_0}{\sqrt{\dfrac{p_0(1-p_0)}{n}}} = \dfrac{0.06 - 0.04}{\sqrt{\dfrac{0.04(1-0.04)}{100}}}$ **= 1.02**

Critical value(s): **Critical value =** $z_\alpha = z_{0.05} = 1.645$

The decision rule: **If Z_0 (test statistic) > z_α (critical value), reject H_0.**

The decision: **Since 1.02 $\not>$ 1.645, we do not reject H_0.**

The conclusion: **The proportion of defects in the shipment does NOT exceed 0.04.**

Q5. (*10 pts*) A department story study supplied the following data on customer ages from independent samples taken at two store locations.

	Inner-City Store	Suburban Store
Sample size	36	49
Sample mean	40	35
Sample standard deviation	9	10

If you allow 5% of type one error, do these data support the claim that the mean ages of the populations of customers at the two stores are different?

The hypotheses are: **H_0:** $\mu_1 - \mu_2 = 0$ **H_A:** $\mu_1 - \mu_2 \neq 0$ claim
The test statistic: $$Z_0 = \frac{\bar{X}_1 - \bar{X}_2 - 0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{(40-35)-0}{\sqrt{\frac{9^2}{36} + \frac{10^2}{49}}} = 2.41$$
Critical value(s): $\pm z_{\frac{\alpha}{2}} = \pm z_{\frac{0.05}{2}} = \pm z_{0.025} = \pm 1.96$
Decision rule: **Reject** H_0 **if** $Z_0 < -z_{\frac{\alpha}{2}}$ **or if** $Z_0 > z_{\frac{\alpha}{2}}$.   **Reject** H_0 **if** $\lvert Z_0 \rvert > z_{\frac{\alpha}{2}}$.
Decision: **Since 2.41 > 1.96, Reject** H_0.
Conclusion: **Customers at the two stores are different in terms of mean ages.**

Q6. (*10 pts*) Company claims that its light bulbs are better than those of company B. A study showed that a sample of 20 bulbs from company A had mean lifetime of 647 hours with a standard deviation of 27 hours, while a sample of 20 bulbs from company B had mean lifetime of 638 hours with a standard deviation of 31 hours.

a. Does this support the claim at the 0.05 level of significance?

b. What assumptions you need to answer this question?

The hypotheses are: $H_0: \mu_A - \mu_B \le 0$ $H_A: \mu_A - \mu_B > 0$ claim
The test statistic: $T_0 = \dfrac{\bar{X}_A - \bar{X}_B - 0}{s_p\sqrt{\dfrac{1}{n_A}+\dfrac{1}{n_B}}} = \dfrac{(647-638)-0}{29.069\sqrt{\dfrac{1}{20}+\dfrac{1}{20}}} = 0.979$ $s_p = \sqrt{\dfrac{(n_A-1)s_A^2+(n_B-1)s_B^2}{n_A+n_B-2}} = \sqrt{\dfrac{(20-1)27^2+(20-1)31^2}{38}} = 29.069$
Critical value(s): ***df* = 38,** $t_{0.05,38}$ **= 1.684,**
Decision rule : **Reject** H_0 **if** $T_0 > t_{\alpha,df}$
Decision and Conclusion: **Since** $T_0 = 0.979 \ngtr 1.684 = t_{0.05,38}$, **Do NOT reject** H_0.   **That is, bulbs of company A are NOT better of those of company B**
Assumptions: **a) Samples are INDEPENDENT.**   **b) Assume the two populations are NORMAL.**   **c) Population variances are EQUAL.**