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

STAT 319: PROBABILITY & STATISTICS FOR ENGINEERS & SCIENTISTS

Final Exam, Fall Semester (042)
Time: 0730 - 1030 am, Monday 13th June, 2005

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Serial #   Surname: ID#   Section #

You are allowed to use electronic calculators and other reasonable accessories that help write the exam. Try to define events, formulate problem and solve.

1. Do **not** keep your **mobile** with you during the exam, turn off and leave it aside.

2. **Write** your name, ID number, Section, and serial number (optional) on the cover page.

3. **Check** that the exam paper has _10_ questions and 10 pages.

4. You can **only** ask **questions** if you feel there is any mistake in the exam needing

    announcement for correction.

5. Keep your answers to **at least 4** decimal places.

Q	Full Marks	Marks Obtained	Strengths/ Weakness
1	5		
2	2		
3	2		
4	2		
5	8		
6	16		
7	13		
8	10		
9	12		
10	7		
Total	77		

1. [5 pts] Each month the American Automobile Association (AAA) publishes in the newspaper the gasoline prices (per gallon) in the US. On Feb 17th, AAA called a random sample of 25 stations to determine the price of unleaded gasoline that day. The resulting data are shown below:

1.07	1.31	1.18	1.01	1.23
1.09	1.29	1.10	1.16	1.08
0.96	1.66	1.21	1.09	1.02
1.04	1.01	1.03	1.09	1.11
1.11	1.17	1.04	1.09	1.05

   a. [3 pts] What proportion of the prices of gasoline in the sample is more than $1.15 per gallon?

   b. [2 pts] A local radio station has reported that 30% of the gas stations are charging $1.15 a gallon or more for gasoline. Is this report consistent with the data collected?

2. [2 pts]The weights (in ounces) of a metal ball bearings for car engines are tabulated below.

Weights	Frequency (f)	F	F/n	
35 to 40	3			
40 to 45	12			
45 to 50	7			
50 to 55	5			
55 to 60	3			

where F is the Cumulative Frequency. Complete the table, figure out the 90th percentile of the weight of the ball bearings and explain it in the context.

3. [2 pts] Explain why $w/\sqrt{n}$ is a better measure of variation of sample values in a sample compared to w , the sample range.

4. [2 pts] According to a report 7.85% of graduates from an electronic engineering department do not work in their specialty area. What is the mean number of graduates which do not work in their area out of current random selection of 545 graduates?

5. [8 pts] Armstrong Windows makes windows for use in home and commercial buildings. The standards for glass thickness call for the glass to average 0.375 with a standard deviation of 0.500 inches.

   a. [4 pts] Suppose a random sample of 49 windows from Armstrong yields a mean of 0.392 inches and windows from Armstrong meets the glass thickness standards. What is the probability of having a sample mean greater than 0.392?

   b. [4 pts] A production engineer at Armstrong wanted to see if he can afford to change the sample size to 36 without sacrificing information for Quality Control efforts. Help him find the probability of the event you found in (a) with this new sample size.

6. [16 pts] The makers of a new chemical fertilizer claim that **hay yields will average 0.40 tons** more per acre if its fertilizer is used instead of the leading brand. The Agricultural Testing Service at Oregon State University (OSU) wanted to **test** this claim. A random sample of acre-sized plots was sampled and the new fertilizer was applied to 14 of the sample and the leading brand was used on 16. The following sample data (in tons per acre) were observed.

	Current leading brand	New Product
Mean	4.3	5.2
Standard Deviation	0.8	0.7
Sample size	16	14

a. [10 pts] At 5% level of significance, what conclusion should be made with respect to the claim made by the makers of the new fertilizers? A Solution structure is provided.

Solution:

Population Info in popular symbols [1 pt]:

Sample Info in popular symbols [1 pt]:

Objective (hypothese) [2 Marks]:

Method (Test statistics / Formula No with Rejection Region) [2 Marks]:

Sample Evidence [3 Marks]:

Conclusion [1 pt]:

b. [2pts] Which method would you use to test this claim if the sample sizes were the same?

c. [2pts] Which method would you use to test this claim if the population variances were equal?

d. [2pts] Which method would you use to test this claim if both sample sizes were large (greater than 30)?

7. [13 pts] The *Lazer* Company produces for *Boeing* Corporation an airplane part that must have an **average diameter** of 6 inches and a **standard deviation** of 0.10 inch. *Lazer* has developed a process that will meet the specifications with respect to the standard deviation, but is still trying to meet the specifications for the mean. A test run on a random sample of parts was conducted to determine whether this latest process produced parts meeting the requirement of the 6-inch average diameter. The random sample of 200 parts produced a mean diameter of 6.03 inches.

By calculating an appropriate confidence interval with confidence coefficient 0.95, advise *Lazer* on the appropriate conclusion regarding the process they developed.

Solution:

Population Info in popular symbols [2 pt]:

Sample Info in popular symbols [1 pt]:

Objective [2 Marks]:

Method (Write Formula No.) [2 Marks]

Sample Evidence [4 Marks]:

Interpretation [2 pt]:

8. [10 pts] One of the major US producers of household products recently surveyed 64 adults in order to estimate the proportion of adults who prefer mint-flavored toothpaste to plain toothpaste to aid in its production planning efforts. The results of the survey are given below:

Flavor	Frequency
Mint	40
Plain	24
Total	64

   a) [7pts] Use this sample data to construct a 95% confidence interval for the true proportion of adults preferring mint-flavored toothpaste.

Solution: Population Info in popular symbols [1 pt]:

Sample Info in popular symbols [1 pt]:

Objective (Confidence Interval) [1 Marks]:

Sample Evidence [3 Marks]:

Interpretation [1 pt]:

c. [2pts] The Company wants to use a similar 99% confidence interval to aid in developing specifications for mint-flavored toothpaste production and the company's production engineer seeks to limit the error to at most 0.10. Help him find the minimum sample size he has to use for continuous quality control of this toothpaste.

9. [12 pts] The electric power consumed each month by a chemical plant depends on the ambient temperature.

Electric power	235	300	260	270
Temperature	25	40	45	50

Given: $s_{xx} = \sum x^2 - \left(\sum x\right)^2 / n = 6750 - (160)^2 / n = 350$

a. [3 pts] Predict the power consumption when temperature is 40.

b. [1 pt] Check if the line of best fit passes through $(\bar{x}, \bar{y})$.

c. [8 points] Test the hypothesis that the higher the temperature, the more is the power consumption.

Solution:

Population Info in popular symbols [1 pt]:

Objective (Hypotheses) [2 Marks]:

Method (Test Statistics/ Write Formula No. with Rejection Region) [2 pt]:

Sample Evidence [2 Marks]:

Conclusion [1 pt]:

10. [7 pts] The State Department of transportation has conducted a study of 27 randomly selected vehicles in which the speed of each vehicle and the age of the driver were measured. The data were collected from a stretch of highway that produces an unusually high accident rate. A regression model was developed with vehicle speed being predicted, using age as the independent variable. Given the following: $\hat{y} = 56.78 + 0.124x$; $s_{yy} = 203.0752$; $s_{xy} = 24.8$; $SSR = 3.0752$; $\bar{y}$=60

a. [2pts] For this regression model, state in words the following?
     i.   The variable y is _____.
    ii.   The predictor variable x is _____

b. [2 pts] Estimate the true variance $\left(\sigma^2\right)$ of the dependent variable.

c. [3 pts] Estimate the coefficient of determination