KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DEPARTMENT OF MATHEMATICS AND STATISTICS
Term 162

STAT 319 Statistics for Engineers and Scientists

Thursday May 25 2017

Please circle your instructor's name:

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Name: _____ ID #:_____

Important Note:

- Show all your work including formulas, intermediate steps and final answer

Question No	Full Marks	Marks Obtained
1	3	
2	4	
3	7	
4	14	
5	18	
Multiple Choice	20	
Total	66	

1) At a computer manufacturing company, the actual size of a particular type of computer chips is normally distributed with a mean of 1 centimeter and a standard deviation of 0.1 centimeter. A random sample of 16 computer chips is taken. Above what value do 2% of the sample means fall? (3 marks)

2) In order to ensure efficient usage of a server, it is necessary to estimate the mean number of concurrent users. According to records, the mean and standard deviation of number of concurrent users at 25 randomly selected times is 37.7 and 9.2, respectively.

   a) Construct a 90% confidence interval for the mean number of concurrent users. (3 marks)

   b) Interpret the interval. (1 mark)

3) Test of $H_0: \mu = 100 \; vs \; H_1: \mu \neq 100$

Variable	N	Mean	Standard Deviation	SE of the Mean	95% CI	T	P value
X	16	98.33	4.61				

   a) Fill in the missing information. You may use bounds on the *P*-value. (4 marks)

   b) What is your conclusion if $\alpha = 0.05$? (1 mark)

   c) What is your conclusion if the hypothesis is $H_0: \mu = 100 \; vs \; H_1: \mu > 100$? Explain. (2 marks)

4) In reference to the data below, the independent variable x is SO_2 deposition rate ($mg/m^2/day$) and the dependent variable y is steel weight loss (g/m^2).

x	14	18	40	43	45	112
y	280	350	470	500	560	1200

with summary statistics: $\sum x = 272,\ \sum y = 3360,\ \sum x^2 = 18538,\ \sum y^2 = 2425400,\ \sum xy = 210120$

a) Find the equation of the estimated regression line between deposition rate and steel weight loss. (3 marks)

b) What is the expected change in the steel weight loss if the deposition rate is increased by 2 $mg/m^2/day$? (1 mark)

c) Test, at 5% level of significance, the hypothesis that the higher the deposition rate, the more is the steel weight loss. (6 marks)

i) Hypothesis

ii) Test Statistic

iii) Observed Test Statistic

iv) Decision

v) Conclusion

d) Compute the correlation coefficient and explains what it means. (2 marks)

e) Estimate, with 95% confidence, the expected steel weight loss if the deposition rate is 50. (2 marks)

5) The pull strength of a wire bond is an important characteristic. A computer output of fitting a multiple linear regression model on the pull strength (y), die height (x_1), post height (x_2), loop height (x_3), wire length (x_4), bond width on the die (x_5), and bond width on the post (x_6).

Predictor	Coef	SE Coef	T	P
Constant	3.137	8.110	8.110	0.706
x_1	0.6444	0.5889	1.09	0.295
x_2	-0.0104	0.2667	-0.04	0.970
x_3	0.5046	0.1423	3.55	0.004
x_4	-0.1197	0.0562	-2.13	0.055
x_5	-2.462	2.598	-0.95	0.362
x_6	1.504	1.519	0.99	0.342

S = $R^2 =$

Analysis of Variance

Source	DF	SS	MS	F
Regression				
Residual		9.5924		
Total	18	33.2211		

a) Fill in the blanks in the above output. (8 marks)

b) Write the fitted regression equation. (1 mark)

c) Estimate σ^2 (1 mark)

d) Write the hypothesis of the significance of the regression model, and test it. Use $\alpha = 0.05$. (4 marks)

e) Which one of the regression coefficients is significant, and why? Use $\alpha = 0.1$. (2 marks)

f) What is the amount of variation that explained by the model? (1 mark)

g) What is the amount of variation that explained by the model taking into account number of independent variables in the model and the sample size? (1 mark)

Multiple Choice Questions (2 marks each)

Consider the following partial output from a multiple regression problem,

$$(X'X) = \begin{pmatrix} 7 & 51 & 32 \\ 51 & 471 & 235 \\ 32 & 235 & 163.84 \end{pmatrix}, \quad SS_E = 27.58, \text{ and}$$

$$(X'X)^{-1} = \begin{pmatrix} 1.7996 & -0.06854 & -0.25316 \\ -0.06854 & 0.01008 & -0.00107 \\ -0.25316 & -0.00107 & 0.05708 \end{pmatrix}$$

Use the above to answer the following three problems

1) The number of independent (regressor) variables equals to:
   a) 1
   b) 2
   c) 3
   d) 7
   e) 9

2) The estimate of the variance of the error is
   a) 2.758
   b) 3.060
   c) 3.940
   d) 9.193

3) For testing $\beta_1 = 0$, if the estimated value is 1.4974. If R= reject and A = accept, then using α = 0.05 the test statistic and your decision are
   a) (5.681, A)
   b) (5.681, R)
   c) (10.717, R)
   d) (14.640, A)
   e) (14.640, R)

4) Two types of errors associated with hypothesis testing are Type I and Type II. Type II error is committed when

   a) We accept a null hypothesis when it is true
   b) We accept a null hypothesis when it is not true
   c) We reject the null hypothesis when the alternative hypothesis is true
   d) We reject a null hypothesis when it is true

5) The average life time of traditional tube lights of a certain company is 10 years. An engineer claims that a new type of tube lights (based on solar energy) will have a greater lifetime. A random sample of 30 of the new tube lights has an average life time growth of 11 years and a standard deviation of 2 years. The appropriate null and alternate hypotheses to test the engineer's claim are

   a) $H_0: \mu = 10 \; vs \; H_1: \mu < 10$
   b) $H_0: \mu = 10 \; vs \; H_1: \mu > 10$
   c) $H_0: \mu = 10 \; vs \; H_1: \mu > 11$
   d) $H_0: \mu = 11 \; vs \; H_1: \mu > 11$

6) If we wish to increase the precision of a confidence interval, we would
   a) Increase the population standard deviation.
   b) Increase the sample size.
   c) Decrease the sample size.
   d) Decrease the level of confidence.

7) To conduct a research project on whether college students purchase textbooks, the number of students to sample needs to be calculated. To estimate the population proportion, we decide to use a 95% level of confidence. The desired margin of error is 0.10. There is no prior estimate of the population proportion. What sample size should be used?
   a) 5
   b) 10
   c) 25
   d) 68
   e) 97

8) At a computer manufacturing company, the actual size of a particular type of computer chips is normally distributed with a mean of 1 centimeter and a standard deviation of 0.1 centimeter. A random sample of 12 computer chips is taken. What is the standard error for the sample mean?
   a) 0.008
   b) 0.029
   c) 0.083
   d) 0.288

9) The probability that a new airport will get an award for its design is 0.16, the probability that it will get an award for the efficient use of materials is 0.24, and the probability that it will get both awards is 0.11. What is the probability that it will get at least one award?
   a) 0.29
   b) 0.37
   c) 0.40
   d) 0.51

10) If the average number of textbooks in professors' offices is 16, the standard deviation is 5, and the average age of the professors is 43, with a standard deviation of 8, which of the following statements is true?
   a) Number of Textbooks is relatively more variable
   b) Professors Age is relatively more variable
   c) Both professors age and number of textbooks are equally variable.
   d) Cannot compare variability of professors age and number of textbooks

11) If the grades distribution of the students at KFUPM is thought to be bell-shaped with a mean equal to 43 and a standard deviation equal to 7, then the percentage of the grades that will be between 29 and 50 is
   a) 81.5%
   b) 95.5%
   c) 68.5%
   d) 99.5%

12) Let X be a random variable with the following probability function:

x	-1	0	1	2
$f(x)$	1/4	1/8	1/8	1/2

$P(X \leq 1 | 0 < X \leq 2)$ is
   a) 0
   b) 1/5
   c) 1/2
   d) 2/3

13) Each of the 200 questions in a test has a right and wrong answer. A passing grade is defined as a score greater than 110 correctly answered questions. Supposing that the answers are entered at random, an approximate probability of passing is
   a) 0.07982
   b) 0.0901
   c) 90/200
   d) 110/200
   e) None of the above