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

STAT 214: Statistical Methods for Actuaries

Semester 211, Final Exam, Wednesday December 29, 2021, 8:00 AM
Allowed time 130 minutes

Name: _____ID #: _____S. #:____

Please mark the correct answer to each of the questions by completely darkening the circle of your choice with a dark pen or pencil.

MULTIPLE CHOICE:	A	B	C	D	E
Q.No.1: -	O	O	O	O	O
Q.No.2: -	O	O	O	O	O
Q.No.3: -	O	O	O	O	O
Q.No.4: -	O	O	O	O	O
Q.No.5: -	O	O	O	O	O
Q.No.6: -	O	O	O	O	O
Q.No.7: -	O	O	O	O	O
Q.No.8: -	O	O	O	O	O
Q.No.9: -	O	O	O	O	O
Q.No.10: -	O	O	O	O	O
Q.No.11: -	O	O	O	O	O
Q.No.12: -	O	O	O	O	O
Q.No.13: -	O	O	O	O	O
Q.No.14: -	O	O	O	O	O
Q.No.15: -	O	O	O	O	O

MULTIPLE CHOICE:	A	B	C	D	E
Q.No.16: -	O	O	O	O	O
Q.No.17: -	O	O	O	O	O
Q.No.18: -	O	O	O	O	O
Q.No.19: -	O	O	O	O	O
Q.No.20: -	O	O	O	O	O
Q.No.21: -	O	O	O	O	O
Q.No.22: -	O	O	O	O	O
Q.No.23: -	O	O	O	O	O
Q.No.24: -	O	O	O	O	O
Q.No.25: -	O	O	O	O	O

Instructions:

1. Formula sheet and tables are provided with this exam. You are not allowed to bring with you, formula sheet or any other printed/written paper.

2. Mobiles are not allowed in exam. If you have your mobile with you, turn it off and keep it under your seat so that it is visible to proctor. Your mobile(s) should not be in your pocket during the exam.

3. If the exact answer is not there in any of the 5 choices, then pick the one that you think is closest to correct answer.

4. Make sure you have 25 questions in the exam paper.

1. A fast food restaurant that sells burritos is concerned about the variability in the amount of filling that different employees place in the burritos. To achieve product consistency it needs this variability (σ^2) to be no more than 1.7 ounces. A sample of n = 18 burritos showed a sample variance of 2.89 ounces. Using a 0.05 level of significance, what can you conclude?

a. The standards are being met since (test statistic) < (critical value).
b. The standards are not being met since (test statistic) > (critical value).
c. The standards are being met since (test statistic) > (critical value).
d. The standards are not being met since (test statistic) < (critical value).
e. The standards are not being met since (test statistic) = (critical value).

2. To test the following hypotheses at the 0.05 level of significance, using a sample size of n = 15. H_0: $\sigma^2 = 0.05$ H_1: $\sigma^2 \neq 0.05$. What is the upper tail critical value?

a. 23.685
b. 24.996
c. 27.488
d. 26.119
e. 25.137

3. It is believed that the SAT scores for students entering two state universities may have different standard deviations. Specifically, it is believed that the standard deviation at University A is greater than the standard deviation at University B. To test this using an alpha = 0.05 level, a sample of 16 student SAT scores from University A was selected and a sample of 8 SAT scores from University B was selected. The following sample results were observed:

University A: sample mean = 1104, s = 134
University B: sample mean = 1254, s = 108

Based on this information, the test statistic and critical value respectively are?

a. 1.2407 and 2.71
b. 0.6496 and 3.51
c. 1.5394 and 3.51
d. 1.5394 and 2.71
e. 1.1359 and 3.51

4. A car insurance company performed a study to determine whether an association exists between age of driver and the frequency of car accidents. They obtained the following sample data.

		Under 25	**25 – 45**	**Over 45**
Number of accidents in past three years	0 or 1	84	93	96
	More than 1	16	7	4

At 5% level of significant, to determine whether an association exists between age of driver and the frequency of car accidents the test statistic and critical value respectively are:

a. χ^2_{stat} = 8.6843, and $\chi^2_{critical\,value}$ = 5.991
b. χ^2_{stat} = 9.5238, and $\chi^2_{critical\,value}$ = 5.991
c. χ^2_{stat} = 10.7329, and $\chi^2_{critical\,value}$ = 7.3778
d. χ^2_{stat} = 7.8835, and $\chi^2_{critical\,value}$ = 5.991
e. χ^2_{stat} = 12.5617, and $\chi^2_{critical\,value}$ = 3.8415

5. A survey for the difference of proportions among different age groups to build a new community center in a housing society was conducted, 200 people of each age group were randomly selected and the results are given in the following Minitab printout.
   If needed test at 5% level of significance which age groups have different opinion.

   Note: Expected frequencies are printed below observed frequencies
   Chi-Square contributions are printed below expected frequencies

Table 1 **Age groups**

	Group1 < 35	Group 2 35-54	Group 3 > 54
Opinion			
Favor	48	56	24
Expected	42.67	42.67	42.67
Chi-square		4.164	8.168
Do not Favor	152	144	176
Expected	157.33	157.33	157.33
Chi-square	0.181		2.215

In the above **Table 1** first fill in the missing values of Chi-square. Now use the Marascuilo procedure if needed to test which age groups have different opinion for new community center? Use 1% level of significance.

a. Groups 1 & 3 and 2 & 3
b. Groups 1 & 2 and 1 & 3
c. Groups 1 & 2 and 2 & 3
d. All three groups
e. Marascuilo procedure is not needed

6. A recent study of 15 shoppers showed that the correlation between the time spent in the store and the dollars spent was 0.235. Using a significance level equal to 0.05, which of the following is the test statistic for testing whether the true population correlation is equal to zero?

a. t = 0.245
b. t = 1.76
c. t = 2.1604
d. t = 0.872
e. t = 0.439

Table 2: Use the following regression results of **Table 2** to answer the questions below.

Table 2.

Regression Statistics	
Multiple R	0.8851
R Square	0.7835
Adjusted R Square	0.7474
Standard Error	5.4006
Observations	8

ANOVA

	df	*SS*	*MS*	*F*
Regression	1	633.242	633.242	21.711
Residual	6	175.000	29.167	
Total	7	808.242		

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	5.93118	4.17721	1.41989	0.20545
Total Bill	-2.71551	0.58279	-4.65952	0.00347

7. Using the above regression results of **Table 2** which of the following is true?

a. x explains about 88.5 percent of the variation in y.
b. y explains about 88.5 percent of the variation in x.
c. y explains about 78.4 percent of the variation in x.
d. x explains about 74.7 percent of the variation in y.
e. x explains about 78.4 percent of the variation in y.

8. Using the above regression results of **Table 2** in conducting a hypothesis test of the slope using a 0.05 level of significance, which of the following is correct?

a. The slope differs significantly from 0 because p-value = 0.205 is greater than 0.05
b. The slope does not differ significantly from 0 because p-value = 0.205 is greater than 0.05
c. The slope differs significantly from 0 because p-value = 0.003 is less than 0.05
d. The slope does not differ significantly from 0 because p-value = 0.003 is less than 0.05
e. None of the above is correct

9. The following regression output is available. Notice that some of the values are missing.

Regression Statistics			
Multiple R	0.754525991		
Adjusted R Square	0.507782253		
Standard Error			
ANOVA			
	df	*SS*	*MS*
Regression	1		
Residual	7	27.3727758	3.910397
Total	8	63.55555556	
	Coefficients	*Standard Error*	
Intercept	4.822953737	2.20457789	
X	0.053825623	0.017694916	

Given this information, what is the standard error of the estimate for the regression model?

a. About 1.977
b. About 27.373
c. About 2.204
d. About 3.910
e. About 0.018

10. A recent study by a major financial investment company was interested in determining whether the annual percentage change in stock price for companies is linearly related to the annual percent change in profits for the company. The following data was determined for 7 randomly selected companies:

% Change Stock Price (X):	8.4, 9.5, 13.6, -3.2, 7, 18.4, -2.1
% Change in profit (Y):	4.2, 5.6, 11.2, 4.5, 12.2, 12, -13.4

Based upon this sample information, which of the following is the regression equation?

a. $\hat{Y} = - 0.693 + 0.7975x$
b. $\hat{Y} = 0.693 - 0.7975x$
c. $\hat{Y} = 1.19 - 3.00x$
d. $\hat{Y} = 1.19 + 3.00x$
e. $\hat{Y} = 0.7975 - 0.693x$

Table 3. The editors of a national automotive magazine recently studied 30 different automobiles sold in the United States with the intent of seeing whether they could develop a multiple regression model to explain the variation in highway miles per gallon. A number of different independent variables were collected. The following regression output (with some values missing) was recently presented to the editors by the magazine's analysts:

Table 3

Regression Statistics						
Multiple R	0.906876					
R Square						
Adjusted R Square						
Standard Error						
Observations	30					
ANOVA						
	df	*SS*	*MS*	*F*		
Regression						
Residual		89.88341785				
Total		506.1666667				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	41.77425	5.612843566				
Curb Weight	-0.00608	0.00145286				
cylinders	0.959134	0.887531206				
Horse Power	0.052399	0.023938405				
Torque	-0.01747	0.024737052				
0 to 60 mph	0.492998	0.486960357				
Price as Tested	-0.00015	4.31238E-05				
Displacement	-2.11223	0.88675014				

11. Based on the above output of **Table 3** and your understanding of multiple regression analysis, what is the adjusted R-square value for this model?

a. 0.82
b. 0.90
c. 0.48
d. 0.63
e. 0.77

12. Based on the above output of **Table 3** and your understanding of multiple regression analysis, how many degrees of freedom are associated with the Residual in the ANOVA table?

a. 19
b. 22
c. 7
d. 29
e. 11

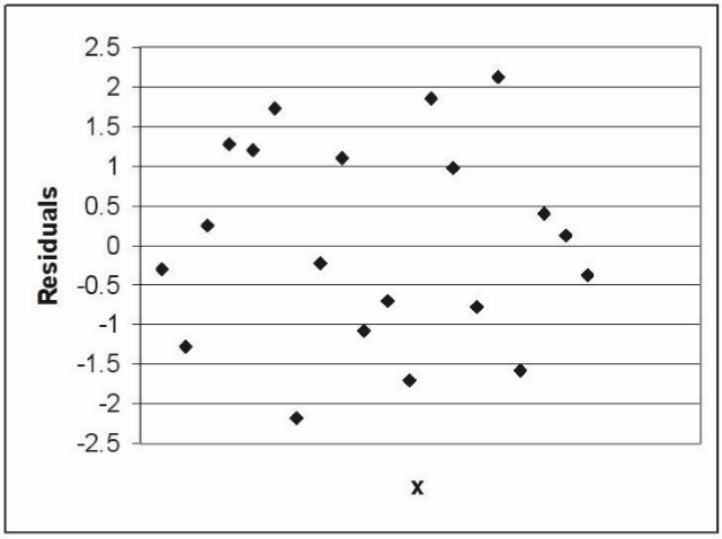
13. Based on the above output of **Table 3** and your understanding of multiple regression analysis, what is the critical value for testing the significance of the overall regression model at a 0.05 level of statistical significance?

a. F = 5.92
b. F = 3.80
c. F = 2.46
d. F = 4.57
e. F = 3.44

14. Based on the above output of **Table 3** and your understanding of multiple regression analysis, which of the independent variables is not considered statistically significant if the test is conducted at the 0.05 level of statistical significance?

a. All the variables in the model are statistically significant.
b. None of the variables in the model is statistically significant.
c. Torque and price as tested
d. Cylinders, torque, and 0 to 60
e. Horse power and displacement

15. The following residual plot shows:



a. linearity and nonconstant variance.
b. nonlinearity and constant variance.
c. linearity and constant variance.
d. nonlinearity and nonconstant variance.
e. none of the above

16. A company has a monthly time series that regularly shows sales being higher in the summer months. This is an example of which component?

a. Trend
b. Cyclical
c. Random
d. Seasonal and Random
e. Seasonal

17. The Boxer Company has been in business since 1998. The following sales data are recorded by quarter for the years 2010-2012.

Quarter	Winter 2010	Spring 2010	Summer 2010	Fall 2010	Winter 2011	Spring 2011	Summer 2011	Fall 2011	Winter 2012	Spring 2012	Summer 2012	Fall 2012
Sales	50	70	100	60	60	70	120	80	70	90	140	100

The managers at the company wish to determine the seasonal indexes for each quarter during the year. The first step in the process is to remove the seasonal and random components. To do this, they will begin by computing a four period moving average. What is the 5^{th} value of four-period moving average?

a. 82.5
b. 78.5
c. 85.0
d. 70
e. 80.5

18. The Zocor Company is interested in forecasting period 13 sales for a product. It has 12 months of historical data. The following shows the data and the forecasted values for periods 1-12 using a single exponential smoothing model with a smoothing constant value equal to 0.20.

Month	1	2	3	4	5	6	7	8	9	10	11	12
Sales	20	40	30	20	50	30	50	10	60	50	30	50
Forecast for Period t	20.0	20.0	24.0	25.2	24.2	29.3	29.5	33.6	28.9	35.1	38.1	36.5

Which of the following would be the forecast for period 13?

a. 40.3
b. 39.2
c. 34.7
d. 36.5
e. 35.1

Table 4. The office manager of Arapaho Valley Pediatrics Clinic examined prices of six items the clinic uses as part of its operation. Shown below are the items, their prices, and the quantities for the years 2010 and 2011.

Table 4

	2010		2011	
Item	**Price**	**Quantity**	**Price**	**Quantity**
Syringes (dozen)	6.70	150	6.95	135
Cotton swabs (box)	1.35	60	1.45	65
Patient record forms (pad)	5.10	8	6.25	12
Children's Tylenol (bottle)	4.50	25	4.95	30
Computer paper (box)	11.95	6	13.20	8
Thermometers	7.90	4	9.00	2
Totals	37.50		41.80	

19. Using **Table 4** data compute the Laspeyres Price Index for 2011 using 2010 as the base year.

    a. 106.1
    b. 1418.45
    c. 105.6
    d. 111.5
    e. 1379.60

20. Using **Table 4** data compute the Paasche Price Index for 2011 using 2010 as the base year.

    a. 111.5
    b. 105.6
    c. 110.8
    d. 103.5
    e. 106.1

21. Three events occur with probabilities P(E1) = 0.35, P(E2) = 0.15, P(E3) = 0.40, P(E1\B) = 0.25, P(B) = 0.30. Compute P(E1 or B).

    a. 0.575
    b. 0.075
    c. 0.021
    d. 0.475
    e. 0.525

22. The number of customers who enter a bank is thought to be Poisson distributed with a mean equal to 10 per hour. What are the chances that no customers will arrive in a 15-minute period?

    a. 0.9179
    b. 0.0067
    c. 0.0821
    d. 0.0250
    e. 0.0454

23. Assuming that the change in daily closing prices for stocks on the New York Stock Exchange is a random variable that is normally distributed with a mean of $0.35 and a standard deviation of $0.33. Based on this information, what is the probability that a randomly selected stock will close up $0.75 or more?

    a. 0.3869
    b. 0.1131
    c. 0.6131
    d. 0.7100
    e. 0.8869

24. In developing an interval estimate for a population mean, the interval estimate was 62.84 to 69.46. The population standard deviation was assumed to be 6.50, and a sample of 100 observations was used. What is the mean of the sample?

    a. 13.24
    b. 56.34
    c. 62.96
    d. 72.77
    e. 66.15

25. Suppose that the test statistic is $Z = 2.45$. Find the *p*-value if we assume that the alternative hypothesis was a two-tailed test ($H_1 : \mu_A - \mu_J \neq 0$).

    a. 0.0071
    b. 0.4929
    c. 0.9858
    d. 0.0142
    e. 0.9929