King Fahd University of Petroleum and Minerals
Department of Mathematics

Stat 319
Final Exam
233
August 15, 2024

EXAM COVER

Number of versions: 4
Number of questions: 20

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Net Time Allowed: 120 Minutes

MASTER VERSION

1. A synthetic fiber used in manufacturing carpet has tensile strength that is normally distributed with mean 75.5 psi and standard deviation 3.5 psi. Find the probability that a random sample of 6 fiber specimens will have a total tensile strength that exceeds 454.5 psi.

   (a) 0.43251 (correct)

   (b) 0.47210

   (c) 0.56749

   (d) 0.52790

   (e) 0

2. A sample preparation for a chemical measurement is completed correctly by 25% of the lab technicians, completed with a minor error by 70%, and completed with a major error by 5%. What is the probability that it is completed with either a minor or a major error?

   (a) 0.75 (correct)

   (b) 0.70

   (c) 0.05

   (d) 0.1875

   (e) 0.2125

3. The mean pull-off force of a connector depends on cure time, which of the following is a correctly hypotheses used to demonstrate that the pull-off force is 25 newtons?

(a) $H_0 : \mu = 25$ *vs.* $H_1 : \mu \neq 25$ (correct)

(b) $H_0 : \mu \neq 25$ *vs.* $H_1 : \mu = 25$

(c) $H_0 : \bar{x} = 25$ *vs.* $H_1 : \bar{x} \neq 25$

(d) $H_0 : \hat{p} = 25$ *vs.* $H_1 : \hat{p} \neq 25$

(e) $H_0 : p = 25$ *vs.* $H_1 : p = 0.25$

4. The heat evolved in calories per gram of a cement mixture is approximately normally distributed. The mean is thought to be 100 and the standard deviation is 2. You wish to test $H_0 : \mu = 100$ *vs.* $H_1 : \mu \neq 100$ with a sample of size 9 specimens. Find the observed level of significance if the observed statistic is 102

(a) 0.00270 (correct)

(b) 0.00135

(c) 0.99865

(d) 0.49933

(e) 0.05000

5. A hypothesis will be used to test that a population mean equals 10 against the alternative that the population mean is greater than 10 with known variance. At 0.1 significance level, what is the critical value for the test statistic Z_0?

   (a) 1.28 (correct)

   (b) -1.28

   (c) -2.33

   (d) 2.33

   (e) 1.64

6. Air crew escape systems are powered by a solid propellant. The burning rate of this propellant is an important product characteristic. Specifications require that the mean burning rate must be 50 centimeters per second. We know that the burning rate is normally distributed with standard deviation of 2 centimeters per second. The experimenter decides to specify a significance level of 0.05 and selects a random sample of size 25 and obtains a sample average burning rate of 51.3 centimeters per second. Which of the following is true?

   (a) Since the test statistics is 3.25 which is more than the critical value which is 1.96, we conclude that the mean burning rate differs from 50 centimeters per second. (correct)

   (b) Since the test statistics is 3.25 which is more than the critical value which is 1.96, we conclude that the mean burning rate is 50 centimeters per second.

   (c) Since the test statistics is 51.3 which is more than the critical value which is 1.96, we conclude that the mean burning rate differs from 50 centimeters per second.

   (d) Since the test statistics is 51.3 which is more than the critical value which is 1.96, we conclude that the mean burning rate is 50 centimeters per second.

   (e) We cannot tell, we need more information.

7. A random sample of 200 circuits generated 13 defectives. To test that the percentage of defectives is different from 5%, the *p*-value of the test is

(a) 0.33204 (correct)

(b) 0.83398

(c) 1.66796

(d) 0.16602

(e) 0.41699

8. Consider the computer output below

One-Sample T

Test *mu* = 34 *vs* not = 34

Variable	N	Mean	StDev	SE Mean	95% CI	T	P
x	16	35.3	1.78				

A 95% confidence interval on the true mean is given by

(a) Between 34.35 and 36.25 (correct)

(b) Between 34.51 and 34.52

(c) Between 34.43 and 36.17

(d) Between 34.57 and 36.03

(e) Between 33.84 and 36.76

9. Consider the computer output below
One-Sample T
Test *mu* = 34 *vs* not = 34

Variable	N	Mean	StDev	SE Mean	95% CI	T	P
x	16	35.3	1.78				

If you wish to test the claim that the mean is more than 34,
the smallest level of significance such that you will reject H_0, is equal to

(a) Between 0.005 and 0.01 (correct)
(b) Between 0.01 and 0.02
(c) Between 0.025 and 0.05
(d) Between 0.0025 and 0.005
(e) 0.02743

Regression methods were used to analyze the data from a study investigating the relationship between roadway surface temperature (x) and pavement deflection (y). Summary quantities were
$\sum_{i=1}^{n=20} x_i = 1478,\ \sum_{i=1}^{n=20} x_i^2 = 143215.8, \sum_{i=1}^{n=20} y_i = 12.75, \sum_{i=1}^{n=20} y_i^2 = 8.86,$
$\sum_{i=1}^{n=20} x_i\, y_i = 1083.67,\ MSE = 0.00796$

Using the given information, solve the next five questions

10. What change in mean pavement deflection would be expected for a 1 $^\circ F$ change in surface temperature?

(a) 0.00416 (correct)
(b) 0.70449
(c) 0.32999
(d) 141.445
(e) 0.73188

11. The mean pavement deflection when the surface temperature is $90\,^{\circ}F$ equals to

    (a) 0.70448 (correct)
    (b) 0.00416
    (c) 0.32999
    (d) 141.445
    (e) 0.73188

12. To test $H_0 : \beta_1 = 0$ *vs.* $H_1 : \beta_1 \neq 0$ at 1% level of significance, the test statistic equals to

    (a) Approximately 8.597 (correct)
    (b) Approximately 0
    (c) Approximately 0.1432
    (d) Approximately 6.599
    (e) Approximately 1.96

13. The percentage of the variation in the pavement deflection that can be explained by the variation from roadway surface temperature is

    (a) 80.4% (correct)
    (b) 89.7%
    (c) 33.3%
    (d) 85%
    (e) 15%

14. The length of a 99% prediction interval on pavement deflection when the temperature is $90^{\circ}F$ is

    (a) About 0.5281 (correct)
    (b) About 0.2557
    (c) About 0.3855
    (d) About 0.1928
    (e) About 0.1233

The electric power consumed each month by a chemical plant is thought to be related to the average ambient temperature (x_1 in °F), the number of days in the month (x_2), the average product purity (x_3 in %), and the tons of product produced (x_4).

We wish to fit the model $Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \epsilon$.

Data are collected and the results of the regression model and the NOVA table are shown in the following table

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -123.1312   157.2561  -0.783    0.459
x1             0.7573     0.2791   2.713    0.030
x2             7.5188     4.0101   1.875    0.103
x3             2.4831     1.8094   1.372    0.212
x4            -0.4811     0.5552  -0.867    0.415

Analysis of Variance Table

Source Df     SS    MS       F         P
Reg          5600  1400             0.005
Error              138.86
Total  11    6572
```

Using the given information, solve the next six questions

15. The predicted power consumption for a month in which x_1 = 75 °*F,* x_2 = 24 days, x_3 = 90%, and x_4 = 98 tons, is

    (a) 290.4487 (correct)

    (b) 384.7443

    (c) 631.0067

    (d) 536.7111

    (e) 413.5799

16. To test the overall significance of the model, the test statistic is

    (a) 10.01 (correct)

    (b) 12.34

    (c) 0.005

    (d) 0.905

    (e) 5.10

17. The proportion of total variability that is explained by this model taken the sample size and the number of variables into account, is

    (a) 76.76% (correct)
    (b) 85.21%
    (c) 91.54%
    (d) 92.23%
    (e) 74.11%

18. Using the *t*-test to assess the contribution of each regressor to the model, at 0.05 level of significance, the critical value equals to

    (a) 2.365 (correct)
    (b) 2.306
    (c) 2.776
    (d) 2.201
    (e) 2.228

19. Using the *t*-test to assess the contribution of each regressor to the model, at 0.05 level of significance, we conclude that

    (a) Only one of the regressors makes a significant contribution to the model (correct)
    (b) All of regressors make a significant contribution to the model
    (c) Two of the regressors make a significant contribution to the model
    (d) None of the regressors makes a significant contribution to the model
    (e) Three of the regressors make a significant contribution to the model

20. The upper end boundary of the 95% confidence interval for the increase in the electric power consumed for $1^{\circ}F$ increase in the ambient temperature, holding the other regressors constant is

    (a) 1.4173 (correct)
    (b) 1.4009
    (c) 1.5321
    (d) 1.3716
    (e) 1.3791