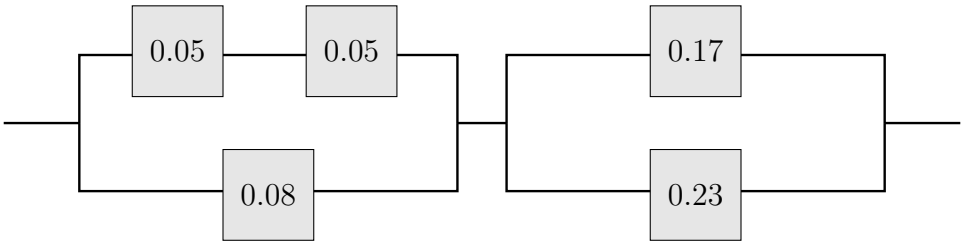
King Fahd University of Petroleum and Minerals
Department of Mathematics
Stat 201
Final Exam
251
21 December 2025
Net Time Allowed: 120

USE THIS AS A TEMPLATE

Write your questions, once you are satisfied upload this file.

1. (Suggested Problem 2-180) The following circuit operates if and only if there is a path of functional devices from left to right. Assume devices fail independently and that the probability of failure of each device is as shown. What is the probability that the circuit operates?



Note: Each gray box is a device. It fails with the probability written in the box and all devices fail independently. The circuit works only if you can go from left to right along the wires through working devices without passing a failed device.

(a) 0.9534
(b) 0.9970
(c) 0.5306
(d) 0.5953
(e) 0.6341

2. (Suggested Problem 3-133) Suppose that the number of customers who enter a bank in an hour is a Poisson random variable, and suppose that $P(X = 0) = 0.0655$. Determine the variance of X.

(a) 2.7257
(b) 1.6510
(c) 0.0655
(d) 1.1838
(e) 7.4295

3. (Exercise 4-35) The thickness of a conductive coating in micrometers has a density function of $400x^{-2}$ for 80 μm $< x <$ 100 μm. If the coating costs \$ 0.40 per micrometer of thickness on each part, what is the average cost of the coating per part?

   (a) \$ 35.7
   (b) \$ 40.0
   (c) \$ 32.0
   (d) \$ 89.3
   (e) \$ 44.6

4. (Exercise 6-24) A dataset on the percentage of cotton in material used to manufacture men's shirts is available. A stem-and-leaf display for these data is shown below.

```
30 | 6 8
31 | 2 9 9
32 | 6 8
33 | 1 2 3 3 4 4 7 8
34 | 2 3 4 7 8 8
35 | 0 0 3 5 6
36 | 6 7 7 8

Stem Unit = 1.0, Leaf Unit = 0.1
```

   What is the median percentage of cotton?

   (a) 34.0
   (b) 33.8
   (c) 34.2
   (d) 3.40
   (e) 33.5

5. (Exercise 7-5) A synthetic fiber used in manufacturing carpet has tensile strength that is normally distributed with mean 74.0 psi and standard deviation 4.0 psi. Find the probability that a random sample of $n = 9$ fiber specimens will have sample mean tensile strength that exceeds 75.0 psi given that the sample mean tensile strength is less than 76.0 psi.

   (a) 0.17126
   (b) 0.22663
   (c) 0.77337
   (d) 0.93319
   (e) 0.13414

6. (Exercise 8-53) The fraction of defective integrated circuits produced in a photolithography process is being studied. A random sample of 400 circuits is tested, revealing 54 defectives. Calculate a 99.52% two-sided CI on the fraction of defective circuits produced by this particular tool. What is the upper limit of this confidence interval?

   (a) 0.18318
   (b) 0.16849
   (c) 0.08682
   (d) 0.13582
   (e) 0.17925

7. (Exercise 9-15) A consumer products company is formulating a new shampoo and is interested in foam height (in millimeters). Foam height is approximately normally distributed and has a standard deviation of 12 millimeters. The company wishes to test $H_0: \mu = 180$ millimeters versus $H_1: \mu > 180$ millimeters, using the results of $n = 25$ samples. Using the critical region $\bar{x} > 186$, what is the probability of type II error if the true mean foam height is 183.5 millimeters?

   (a) 0.85083
   (b) 0.14917
   (c) 0.58317
   (d) 0.99379
   (e) 0.00621

8. (Exercise 9-42) A melting point test of $n = 20$ samples of a binder used in manufacturing a rocket propellant resulted in $\bar{x} = 148.9\,^{\circ}\text{F}$. Assume that the melting point is normally distributed with $\sigma = 2.0\,^{\circ}\text{F}$. Test $H_0: \mu = 150$ versus $H_1: \mu \neq 150$ using $\alpha = 0.01$. The $p-$value is

   (a) 0.01389
   (b) 0.00695
   (c) 0.58232
   (d) 0.98611
   (e) 0.41768

9. (Exercise 9-61) The sodium content of nine 300-gram boxes of organic cornflakes was determined. The data (in milligrams) are as follows:

   130.41, 128.98, 131.43, 129.69, 128.08, 129.49, 128.43, 128.85, 129.15.

   The sums are $\sum x_i = 1164.51$ and $\sum x_i^2 = 150684.4059$.

   To test the claim that mean sodium content of this brand of cornflakes exceeds 130 milligrams, which one of the following statements is true?

   (a) $0.90 < p - \text{value} < 0.95$
   (b) $0.05 < p - \text{value} < 0.10$
   (c) $0.95 < p - \text{value} < 0.99$
   (d) $0.75 < p - \text{value} < 0.90$
   (e) $0.01 < p - \text{value} < 0.05$

10. (Exercise 9-81) A tire engineer for a tire manufacturer is investigating tire life for a new rubber component and has built 20 tires and tested them to end-of-life in a road test. The engineer wants to test the hypothesis that the standard deviation of tire life is less than 4000 km. At the 5% significance level, which of the following is the correct critical region for the Test Statistic (TS)?

    (a) We reject H_0 if TS < 10.117.
    (b) We reject H_0 if TS < 8.907
    (c) We reject H_0 if TS < 32.852.
    (d) We reject H_0 if TS < 1.729.
    (e) We reject H_0 if TS < 30.144.

11. (Suggested Problem 9-92) An article in *Fortune* (September 21, 1992) claimed that nearly one-half of all engineers continue academic studies beyond the B.S. degree, ultimately receiving either an M.S. or a Ph.D. degree. Data from an article in *Engineering Horizons* (Spring 1990) indicated that 229 of 500 new engineering graduates were planning graduate study.

    For testing the hypothesis that the data from *Engineering Horizons* is consistent with the claim reported by *Fortune*, which one of the following is true? (Use $\alpha = 0.05$.)

    (a) $z_0 \approx -1.88$ and we fail to reject H_0.

    (b) $z_0 \approx -1.88$ and we reject H_0.

    (c) $z_0 \approx -2.24$ and we reject H_0.

    (d) $z_0 \approx -1.64$ and we reject H_0.

    (e) $z_0 \approx 1.88$ and we fail to reject H_0.

12. (Example Page 311) Suppose a researcher tests a null hypothesis H_0 versus an alternative hypothesis H_1 and obtains a $p-$value of 0.03. Which one of the following statements gives a correct interpretation of this $p-$value?

    (a) If H_0 is true, the probability of observing a test statistic at least as extreme as the one obtained in this sample is 0.03.

    (b) The probability that the null hypothesis H_0 is true is 0.03.

    (c) The probability that the alternative hypothesis H_1 is true is 0.97.

    (d) The probability of making a type II error in this test is 0.03.

    (e) There is a 3% chance that the sample was chosen incorrectly.

13. **Note:** For this question, round your calculations to at least 5 decimal places.

(Exercise 11-9) An article in *Wear* (1992, Vol. 152, pp. 171–181) presents data on the fretting wear of mild steel and oil viscosity. Representative data follow with $x =$ oil viscosity and $y =$ wear volume (10^{-4} cubic millimeters).

y	240	181	193	155	172	110	113	75	94
x	1.6	9.4	15.5	20	22	35.5	43	40.5	33

$\sum y_i = 1333,\ \sum x_i = 220.5,\ \sum y_i^2 = 220549,\ \sum x_i^2 = 7053.67,\ \sum x_i y_i = 26864.4.$

Fit the simple linear regression model using least squares. For every one unit increase in oil viscosity,

(a) wear volume decrease, on average, by approximately 3.51×10^{-4} cubic millimeters.

(b) wear volume increases, on average, by approximately 3.51×10^{-4} cubic millimeters.

(c) wear volume decrease, on average, by approximately 234.07×10^{-4} cubic millimeters.

(d) wear volume increases, on average, by approximately 234.07×10^{-4} cubic millimeters.

(e) wear volume decrease, on average, by approximately 5794.1×10^{-4} cubic millimeters.

14. **Note:** For this question, round your calculations to at least 5 decimal places.

(Exercise 11-9) An article in *Wear* (1992, Vol. 152, pp. 171–181) presents data on the fretting wear of mild steel and oil viscosity. Representative data follow with $x =$ oil viscosity and $y =$ wear volume (10^{-4} cubic millimeters).

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x	1.6	9.4	15.5	20	22	35.5	43	40.5	33

$\sum y_i = 1333,\ \sum x_i = 220.5,\ \sum y_i^2 = 220549,\ \sum x_i^2 = 7053.67,\ \sum x_i y_i = 26864.4.$

Fit the simple linear regression model using least squares. An estimate of σ^2 is

(a) 398.28

(b) 19.96

(c) 234.07

(d) 2787.94

(e) – 3.51

15. **Note:** For this question, round your calculations to at least 5 decimal places.

(Exercise 11-47) An article in *Wear* (1992, Vol. 152, pp. 171–181) presents data on the fretting wear of mild steel and oil viscosity. Representative data follow with $x =$ oil viscosity and $y =$ wear volume (10^{-4} cubic millimeters).

y	240	181	193	155	172	110	113	75	94
x	1.6	9.4	15.5	20	22	35.5	43	40.5	33

$\sum y_i = 1333,\ \sum x_i = 220.5,\ \sum y_i^2 = 220549,\ \sum x_i^2 = 7053.67,\ \sum x_i y_i = 26864.4.$

Fit the simple linear regression model using least squares. Find a 99% interval estimate on the mean wear when oil viscosity is 36. The upper limit is

(a) 138.30

(b) 130.24

(c) 183.98

(d) 159.28

(e) 234.07

16. (Exercise 11-66) Suppose that data are obtained from 25 pairs of (x, y) and the sample correlation coefficient is 0.48. To test the presence of linear association between x and y at 5% level of significance, which one of the following is true?

(a) $0.01 < p - \text{value} < 0.02$

(b) Test Statistics $= 2.68$

(c) We reject H_0 if the value of test statistic is greater than 1.714.

(d) $0.005 < p - \text{value} < 0.01$

(e) We conclude that there is no significant linear association between x and y.

17. (Exercise 12-26) The electric power consumed each month by a chemical plant is thought to be related to the average ambient temperature (x_1), the number of days in the month (x_2), the average product purity (x_3), and the tons of product produced (x_4). The past year's historical data are available and the R outputs for fitted regression model are given below:

```
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
---
Residual standard error: 11.79 on 7 degrees of freedom
Multiple R-squared:  0.852,  Adjusted R-squared:  0.7675
F-statistic: ???? on 4 and 7 DF,  p-value: ????
```

At 10% level of significance, how many regressors are contributing significantly to the model?

(a) 1

(b) 2

(c) 0

(d) 3

(e) 4

18. (Exercise 12-44) The electric power consumed each month by a chemical plant is thought to be related to the average ambient temperature (x_1), the number of days in the month (x_2), the average product purity (x_3), and the tons of product produced (x_4). The past year's historical data are available and the R outputs for fitted regression model are given below:

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x4            -0.4811     0.5552  -0.867    0.415
---
Residual standard error: 11.79 on 7 degrees of freedom
Multiple R-squared:  0.852,  Adjusted R-squared:  0.7675
F-statistic: ???? on 4 and 7 DF,  p-value: ????
```

What is the estimated mean monthly electric power consumption for a month in which the average ambient temperature is 73, the number of days in the month is 29, the average product purity is 91, and the tons of product produced is 100?

(a) 328.05

(b) 451.18

(c) 424.27

(d) 150.20

(e) 123.13

19. (Exercise 12-26) The electric power consumed each month by a chemical plant is thought to be related to the average ambient temperature (x_1), the number of days in the month (x_2), the average product purity (x_3), and the tons of product produced (x_4). The past year's historical data are available and the R outputs for fitted regression model are given below:

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---
Residual standard error: 11.79 on 7 degrees of freedom
Multiple R-squared:  0.852,  Adjusted R-squared:  0.7675
F-statistic: ???? on 4 and 7 DF,  p-value: ????
```

For testing the significance of regression using $\alpha = 0.1$, the decision rule is to reject H_0 if

(a) $f_0 > 2.96$

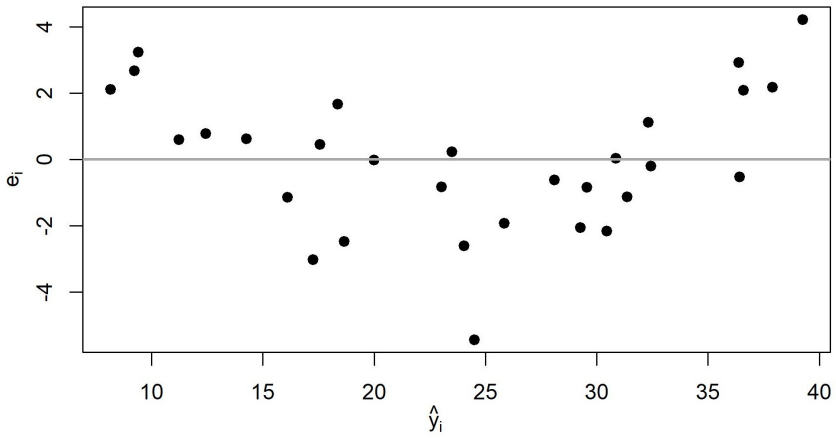
(b) $f_0 > 3.98$

(c) $f_0 < 2.96$

(d) $f_0 > 4.12$

(e) $f_0 < 6.09$

20. (Example 12-10, Page 490) Following figure shows a residuals versus fitted-values plot from a multiple linear regression model with response Y and three predictors x_1, x_2, and x_3.



Based on this plot, which of the following statements best describes the model assumptions?

(a) Linearity assumption is violated.

(b) Independence assumption is violated.

(c) Constant variance (homoscedasticity) assumption is violated.

(d) Normality assumption is violated.

(e) Normality and independence are both violated.