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

STAT 319: Probability & Statistics for Engineers & Scientists
Semester 172
Final Exam

Please circle your instructor's name:

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Name: _____ID #:_____Section #:___

- This is a multiple-choice exam consisting of 24 questions, with 4 choices each.
- There is only one correct answer.
- If you mark more than one answer to any question, that answer will be considered wrong even if the correct answer is marked.
- Duration of the exam is 2 hours.

1) If a histogram is skewed with a long left tail, which of the following must be correct?
   a) The sample mean is smaller than the sample median.
   b) The sample mean is larger than the sample median.
   c) Some data points should be classified as outliers.
   d) No data points should be classified as outliers.

2) The following data represents a sample of 13 measurements of concentration of suspended material in water.

42.4	65.7	29.8	58.7	52.1	55.8	57.0	54.3	73.1	59.9	62.2	69.9	67.9

   The percentage of concentration exceeded by 20% of the measurements is

   a) 63.74
   b) 65.70
   c) 67.90
   d) 68.30

3) There is a 4% probability that the plane used for a commercial flight has technical problems, and this causes a delay in the flight. If there are no technical problems with the plane, then there is still a 33% probability that the flight is delayed due to all other reasons. What is the probability that the flight is delayed?
   a) 0.370
   b) 0.356
   c) 0.330
   d) 0.040

4) After production, an electrical circuit is given a quality score of A, B, C, or D. Over a certain period of time, 77% of the circuits were given a quality score A, 11% were given a quality score B, 7% were given a quality score C, and 5% were given a quality score D. Furthermore, it was found that 2% of the circuits given a quality score A eventually failed, and the failure rate was 10% for circuits given a quality score B, 14% for circuits given a quality score C, and 25% for circuits given a quality score D. If a circuit failed, what is the probability that it had received a quality score either C or D?
   a) 0.0223
   b) 0.0487
   c) 0.2407
   d) 0.4579

5) An archer hits a bull's-eye with a probability of 0.09, and the results of different attempts can be taken to be independent of each other. If the archer shoots a series of arrows, what is the probability that the *first* bull's-eye is scored with the fourth arrow?
   a) 0.0001
   b) 0.0007
   c) 0.0678
   d) 0.7536

6) A company receives 60% of its orders over the Internet. Within a collection of 10 independently placed orders, what is the probability that at least two orders are received over the Internet?
   a) 0.9983
   b) 0.0106
   c) 0.0017
   d) 0.0006

7) The time in days between breakdowns of a machine is exponentially distributed with λ = 0.2. If the machine has performed satisfactorily for six days, what is the probability that it lasts at least two more days before breaking down?
   a) 0.1123
   b) 0.3207
   c) 0.6703
   d) 0.9501

8) Specifications call for the thickness of aluminum sheets that are to be made into cans to be between 9 and 13 thousandth of an inch. Let X be the thickness of aluminum sheets. Assume the probability density of X is given by

$$f(x) = \begin{cases} \frac{x}{100}, & 5 < x < 15 \\ 0 & elsewhere \end{cases}$$

   The probability that a randomly selected sheet will **not** meet the specifications is
   a) 0.10
   b) 0.14
   c) 0.28
   d) 0.72

9) Suppose a certain mechanical component produced by a company has a width that is normally distributed with a mean 2600 and a standard deviation 0.6. What proportion of the components have a width outside the range 2599 to 2601?
   a) 0.8130
   b) 0.1970
   c) 0.0948
   d) 0.0052

10) The time that a technician requires to perform preventive maintenance on air conditioning unit is governed by the exponential distribution with mean time one of hour. Your company has a contract to maintain 70 of these units in an apartment building. What is the probability that the average maintenance time exceeds 75 minutes?
   a) 0.0000
   b) 0.0183
   c) 0.0813
   d) 0.286

The following are two $100(1-\alpha)\%$ confidence interval estimates of the mean of the cycles to failure of a mechanical device

$$3124.9 \leq \mu \leq 3215.7 \qquad \& \qquad 3079.5 \leq \mu \leq 3261.1$$

11) The value of the sample mean cycles to failure is equal to

   a) 90.10
   b) 181.6
   c) 3170.3
   d) We need more information

12) If the sample size used by the second confidence interval is n, then the sample size needed to get the first confidence interval is

   a) n
   b) $2n$
   c) $4n$
   d) Need to know α

13) A machine is producing metal pieces that are cylindrical in shape. A sample of pieces is taken and the diameters (in centimeters) are:

1.01 0.97 1.03 1.04 0.99 0.98 0.99 1.02 1.06

Assume the normality assumption is satisfied, then a 99% confidence interval for the mean diameter of pieces from this machine is given by:

a) Between 0.976 and 1.043
b) Between 0.986 and 1.033
c) Between 0.991 and 1.028
d) Between 1.009 and 1.010

14) In testing the null hypothesis $H_0: \mu = 10$ vs $H_1: \mu > 10$, using the rejection region RR = $\{\bar{x} > 12\}$. The probability of type II error is

a) $P(\bar{x} \leq 10 | \mu = 11)$
b) $P(\bar{x} > 10 | \mu = 11)$
c) $P(\bar{x} \leq 10 | \mu = 9)$
d) $P(\bar{x} > 10 | \mu = 9)$

15) An experimenter claims that the viscosity of a liquid detergent is supposed to average 800. A random sample of size 16 batches of detergent is collected and the average viscosity is 812, with a standard deviation of 25. The smallest level of significance at which the claim is rejected is:

a) Between 0.0274 and 0.050
b) Between 0.035 and 0.05
c) Between 0.05 and 0.100
d) Between 0.07 and 0.1

16) In an experiment to determine if two products are equally liked by consumers, a sample of 1000 randomly selected consumers found that 515 favored product A. To perform an appropriate test of hypothesis at 1% level of significance, the observed test statistic equals

a) 0.0513
b) 0.5000
c) 0.5150
d) 0.9487

A regression model was used to analyze the data from a study investigating the relationship between compressive strength (x) and intrinsic permeability (y) of various concrete mixes and cures. Summary quantities are:

$$\sum_{i=1}^{14} y_i = 572, \quad \sum_{i=1}^{14} x_i = 43, \quad S_{xx} = 25.348, \quad S_{yy} = 159.714, \quad S_{xy} = -59.057$$

Use the above information to answer the following four questions

17) If compressive strength increases by 2 units, then then permeability decreases by
   a) 2.3298
   b) 4.6597
   c) 29.0418
   d) 33.7014

18) Suppose that the observed value of permeability at $x = 3.7$ is $y = 46.1$, the corresponding residual is
   a) 6.707
   b) 39.392
   c) 42.414
   d) 48.013

19) An estimate of the variance of the error is
   a) 1.3578
   b) 1.8436
   c) 4.7035
   d) 22.123

20) A 99% confidence interval estimate for the slope of the regression line is
   a) $[-2.8104, -1.8492]$
   b) $[-3.0529, -1.6067]$
   c) $[-3.1536, -1.5060]$
   d) $[-3.3897, -1.2699]$

Information from 20 houses was used to develop a regression model to predict the cost of air conditioning, *y*, in SR, using the variables
x_1= daily minimum outside temperature in °F
x_2 = thickness of insulation in inches

Predictor	Coef	SE Coef	T
Constant	448.3	90.78	4.93
x_1	2.7	1.23	2.23
x_2	-15.9	10.06	-1.58

S = 40.91

Analysis of Variance

Source	DF	SS	MS	F
Regression				
Residual Error		28452.60		
Total		39395.62		

Use the above information to answer the following four questions

21) The estimated cost of air conditioning for temperature of 80°F and 0.30 inch insulation is
a) 1170.47
b) 659.53
c) 529.223
d) 187.3

22) The observed test statistic for testing the significance of the model is
a) -2.23
b) -1.58
c) 3.26
d) 4.93

23) The percentage of variation explained by the model is
a) 10.94%
b) 27.787%
c) 39.39%
d) 40.91%

24) A 95% confidence interval for the expected change in heating costs as a result of a 1°F change in the daily minimum outside temperature is
a) Between SR0.1520 and SR5.3721
b) Between SR5.2919 and SR37.174
c) Between SR204.78 and SR497.17
d) Between SR4.3860 and SR36.380