Code: 01

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS, DHAHRAN, SAUDI ARABIA

DEPARTMENT OF MATHEMATICS & STATISTICS

STAT 319: Probability & Statistics for Engineers & Scientists
Term 212, Major Exam I, Wednesday March 2, 2022, 6.30 PM – 8.10 PM

Name: _____ID #: _____

Instructions:

1. Formula sheet is attached at the end of 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. The answers are rounded. 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 11 unique pages of exam paper (including this title page.)

1. A machine has four components, A, B, C, and D, set up in such a manner that all four parts must work for the machine to work properly. Assume the probability of one part working does not depend on the functionality of any of the other parts. Also assume that the probabilities of the individual parts working are $P(A) = P(B) = 0.94$, $P(C) = 0.92$, and $P(D) = 0.93$. Find the probability that the machine works properly.
   (a) 0.244
   (b) 0.8043
   (c) 0.8129
   (d) 0.756
   (e) 0.8556

2. A shipment of chemicals arrives in 15 totes. Three of the totes are selected at random without replacement for an inspection of purity. If two of the totes do not conform to purity requirements, what is the probability that at least one of the nonconforming totes is selected in the sample?

   (a) 0.37142857
   (b) 0.34285714
   (c) 0.02857143
   (d) 0.62857143
   (e) 0.45213468

3. It is suspected that some of the totes containing chemicals purchased from a supplier exceed the moisture content target. Samples from 30 totes are to be tested for moisture content. Assume that the totes are independent. Determine the proportion of totes from the supplier that must exceed the moisture content target so that the probability is 0.90 that at least 1 tote in the sample of 30 fails the test.

(a) 0.2057
(b) 0.9261
(c) 0.01045
(d) 0.0739
(e) 0.8421

4. Which of the following statements is always true?
   (a) The complement of an event A, denoted by A', is the set of all outcomes in the sample space that are not contained in A.
   (b) The union of two events A and B, denoted by $A \cup B$, is the event consisting of all outcomes that are in both events.
   (c) The intersection of two events A and B, denoted by $A \cap B$, is the event consisting of all outcomes that are either in A or in B.
   (d) All of the choices.
   (e) None of the above

5. The probability that a lab specimen contains high levels of contamination is 0.10. Three samples are checked, and the samples are independent. What is the probability that none contain high levels of contamination?
   (a) 0.001
   (b) 0.5
   (c) 0.729
   (d) 0
   (e) 0.208

6. A large firm has 70% of its service calls made by a contractor, and 6 percent of these calls result in customer complaints. The other 30 percent of the service calls are made by their own employees, and these calls have a 3 percent complaint rate. Find the probability that the complaint was from a customer serviced by contractor.

   (a) 0.8235
   (b) 0.1765
   (c) 0.9426
   (d) 0.0574
   (e) 0.4613

7. An internet search engine looks for a certain keyword in a sequence of independent web sites. It is believed that 30% of the sites contain this keyword. Out of the first 10 websites, compute the probability that at least two of the websites contain the keyword.

(a) 0.0282
(b) 0.1211
(c) 0.8507
(d) 0.1493
(e) 0.4213

8. Let X be a random variable with *pmf*:

x	-1	0	1	2
$P(X = x)$	α	0.1	0.3	$0.6 - \alpha$

Given that $\sigma_X^2 = 1.29$, find the possible values of α.

(a) 0.1 and 0.511
(b) 0.3 and 0.721
(c) 0.2 and 0.467
(d) 0.1 and 0.856
(e) 0.2 and 0.856

9. Continuous inspection of electrolytic tin plate yields on average 0.2 imperfections per minute. Find the probability of at most one imperfection in 0.25 hours.
(a) 0.170

(b) 0.340
(c) 0.199
(d) 0.111
(e) 0.431

10. A very large batch of components has arrived at a distributor. The actual proportion of defectives is 0.05. If the engineer responsible starts inspecting components one after another, what is the probability that the first defective component in the sample occurs in the 5th trial?

(a) 0.0386
(b) 0.9593
(c) 0.9571
(d) 0.0407
(e) 0.05

11. The probability distribution function for X = the number of major defects on a randomly selected gas stove of a certain type is

x	0	1	2	3	4

$f(x)$	.10	.20	.40	.25	.05

The standard deviation of the number of defects on a randomly selected gas stove is equal to

(a) 1.0475
(b) 1.95
(c) 1.0235
(d) 1.0973
(e) 1.4750

12. Ten steel specimens were tested for their yield strength.

23	35	36	36	37	38	38	38	39	44

The 40th percentile equal to

(a) 36.5
(b) 36.4
(c) 36.6
(d) 36.3
(e) 36

13. A civil engineer monitors water quality by measuring the number of suspended solids (parts per million) in a sample of river water. The observed data of 31 days is presented below in a stem and leaf plot:

STEM	LEAVES	FREQUENCY
1	3 6 9	3
2	1 2 4 6 7 8 9	7
3	0 1 2 3 4 5 6 7 8 9	10
4	1 2 3 4 5 6 7 9	8
5	2 5 8	3

Given that $\sum_{i=1}^{31} x_i = 1092$ & $\sum_{i=1}^{31} x_i^2 = 42376$, the proportion of sample values lie within one standard deviation of the mean is equal to

(a) 67.7%

(b) 100%

(c) 70.9%

(d) 64.5%

(e) 95.5%

14. (Johnson, R. A., 2000, 22). Consider the following 20 humidity readings rounded to the nearest percent:

$$29 \ 44 \ 12 \ 53 \ 21 \ 34 \ 39 \ 25 \ 48 \ 23$$
$$17 \ 24 \ 27 \ 32 \ 34 \ 15 \ 42 \ 21 \ 28 \ 37$$

Calculate the coefficient of variation given that $\Sigma x = 605 \ and \ \Sigma x^2 = 20663$

(a) 40.71%

(b) 51.25

(c) 2.71%

(d) 30.25

(e) 36.86%

Data were collected on the percent of people not covered by health insurance. Summary statistics and a histogram for these data are shown below.

Min	Q1	Median	Q3	Max	Mean	SD
7.9	10.8	13.4	16.7	25.8	13.9	3.6

Histogram of % not covered
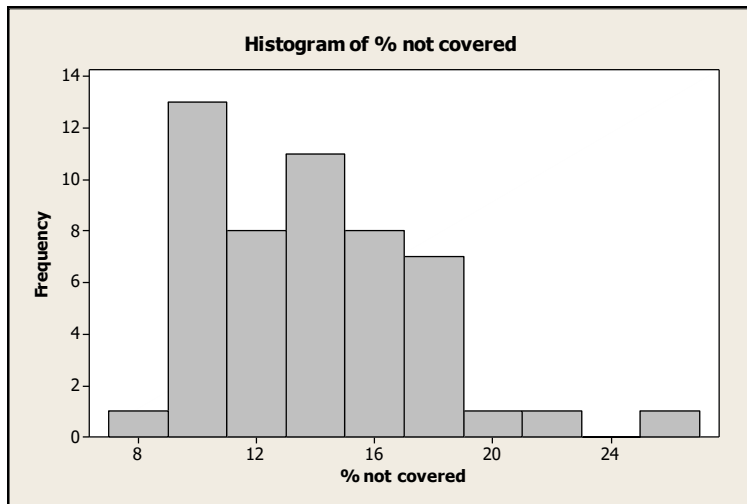
15. What is the most appropriate measure to describe the center of these data?

a) Range
b) Mean
c) IQR
d) Median
e) Mode

16. The IQR for these data is

a) 3.3 %
b) 5.5 %
c) 5.9 %
d) 17.9 %
e) 11.9%

17. The random variable X has probability density function

$$\begin{cases} a\sqrt{x}, & for\ 0 < x < 4 \\ 0, & Otherwise \end{cases}$$

Find $P(X > 1)$

(a) 0.055
(b) 0.875
(c) 0.245
(d) 0.923
(e) 0.584

18. The probability density function of the time X (in minutes) that a flight from Dammam to Jeddah arrives earlier or later than its scheduled arrival is given by

$$f(x) = \begin{cases} c(36 - x^2) & -6 \leq x \leq 6 \\ 0 & elsewhere \end{cases}$$

Where the negative values of x indicate flight arriving early, while positive values of x indicate flight arriving late. Find the probability that one of these flights will arrive between 1 and 3 minutes earlier than the scheduled arrival.

(a) 0.780093
(b) 0.003472
(c) 1
(d) 0.219907
(e) 0.45321

19. Suppose X has a continuous uniform distribution over the interval [-2, 2] . Determine the value for x such that $P(-x < X < x) = 0.80$.
(a) 0
(b) 1.5
(c) 1.8
(d) 0.25
(e) 1.6

20. The probability density function of a random variable X is given by:

$$f(x) = \begin{cases} kx^2 , & -1 < x < 1 \\ 0 , & otherwise \end{cases}$$

Then the value of k is

(a) $\frac{2}{3}$

(b) $\frac{3}{2}$

(c) $\frac{3}{4}$

(d) $\frac{4}{3}$

(e) $\frac{1}{2}$