

**Arkansas Council of Teachers of Mathematics
2013 Regional Exam
Statistics**

For questions 1 through 25, mark your answer choice on the answer sheet provided. After completing items 1 through 25, answer each of the tiebreaker items in sequential order (do #1 first, followed by #2, and then #3 last). Be sure that your name is printed on each of the tiebreaker pages.

1. A variable that is related to either the response variable or the predictor variable or both, but which is excluded from the analysis is a
 - a. discrete variable
 - b. lurking variable
 - c. qualitative variable
 - d. random variable
 - e. None of the above

2. A student scores 74 on a science test and 282 on a mathematics test. The science test has a mean of 80 and a standard deviation of 5. The mathematics test has a mean of 300 and a standard deviation of 12. If the data for both tests are normally distributed, on which test did the student score better relative to the other students in each class?
 - a. The student scored the same on both tests.
 - b. The student scored better on the science test.
 - c. The student scored better on the mathematics test.
 - d. None of the above

3. The percentage of measurements that are above the 39th percentile is
 - a. 71%
 - b. 39%
 - c. Cannot be determined
 - d. 61%
 - e. None of the above

4. For the data set given below the sample variance will be computed. How many degrees of freedom are there?

6 9 6 1 5 11 5 9 8

 - a. 9
 - b. 1
 - c. 10
 - d. 8
 - e. None of the above

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5. Which type of bias occurs because we do not obtain complete information about a population?
- a. Nonresponse bias
 - b. Sampling bias
 - c. No bias
 - d. Response bias
 - e. None of the above

6. Consider the discrete probability distribution given in the Table below when answering the following question.

x	3	4	7	9
P(x)	0.18	?	0.22	0.29

Find the probability that x exceeds 4.

- a. 0.51
 - b. 0.49
 - c. 0.31
 - d. 0.82
 - e. None of the above
7. A pharmaceutical testing company wants to test a new cholesterol drug. The average cholesterol of the target population is 200 mg and they have a standard deviation of 25 mg. The company wished to test a sample of people who fall between 1.5 and 3 z-scores above the mean. Into what range must a candidate's cholesterol level be in order for the candidate to be included in the study?
- a. 162.5 – 275
 - b. 237.5 – 275
 - c. 225 – 237.5
 - d. 125 – 162.5
 - e. None of the above
8. The total area below the standard normal curve that lies below -2.33 or above 2.33 is
- a. 0.789
 - b. 0.020
 - c. 0.981
 - d. 0.061
 - e. None of the above

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9. A local bank needs information concerning the savings account balances of its customers. A random sample of 15 accounts was checked. The mean balance was \$686.75 with a standard deviation of \$256.20. Find a 98% confidence interval for the true mean. Assume that the account balances are normally distributed.
- (\$513.14, \$860.36)
 - (\$238.23, \$326.41)
 - (\$487.31, \$563.80)
 - (\$326.21, \$437.90)
 - None of the above
10. Two brands of refrigerators, denoted A and B, are each guaranteed for 1 year. In a random sample of 50 refrigerators of brand A, 12 were observed to fail before the guarantee period ended. An independent random sample of 60 brand B refrigerators also revealed 12 failures during the guarantee period. The 98% confidence interval to estimate $P_A - P_B$, the difference between the population proportions of failures during the guarantee period is
- (-0.1451, 0.2251)
 - (0.1451, 0.2251)
 - (-0.2251, 0.1451)
 - (-0.2251, -0.1451)
 - None of the above.
11. The critical t -value that corresponds to 95% confidence intervals and sample size $n=16$ is
- 2.131
 - 2.947
 - 1.753
 - 2.602
 - None of the above.
12. In a college student poll, it is of interest to estimate the proportion p of students in favor of changing from a quarter-system to a semester-system. How many students should be polled so that we can estimate p to within 0.09 using a 99% confidence interval?
- 182
 - 114
 - 261
 - 205
 - None of the above

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13. The following table presents the average price in dollars for a dozen eggs and a gallon of milk for each month from March through December 2008.

Dozen Eggs	2.07	1.93	1.92	2.01	1.85	1.98	1.86	1.84	1.83	1.85
Gallon of Milk	3.80	3.76	3.77	3.96	3.89	3.77	3.66	3.73	3.68	3.58

The correlation coefficient between the price of eggs (x) and the price of milk (y) is

- 0.354
 - 0.534
 - 0.978
 - 0.568
 - None of the above
14. The probability that an individual has 20-20 vision is 0.12. In a class of 10 students, what is the mean and standard deviation of the number with 20-20 vision in the class?
- 10; 1.095
 - 10; 1.028
 - 1.2; 1.028
 - 1.2; 1.095
 - None of the above
15. A sample of five took the SAT. Their scores are listed below. Later on, they read a book on test preparation and retook the SAT. Their new scores are listed below.

Student	1	2	3	4	5
Scores before reading book	720	860	850	880	860
Scores after reading book	740	860	840	920	890

An hypothesis test was conducted to test the claim that the mean reading score increased after read the book at 0.05 level of significance. The value of the test statistics of the hypothesis test was found to be

- 0.0798
- 1.725
- 0.05
- 0.0173
- None of the above.

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16. A statistic is said to be biased if it
- has exactly the same value as the parameter
 - systematically underestimates or overestimates the parameter
 - is determined from a trimmed sample
 - leads to an erroneous conclusion about the sample
 - None of the above
17. For the following P-values, state whether the null hypothesis H_0 will be rejected at the 0.10 level: $P = 0.12, 0.07, 0.05,$ and $0.2.$
- Yes, Yes, No, and No.
 - No, No, Yes, and Yes.
 - Yes, No, No, and Yes.
 - No, Yes, Yes, and No.
 - None of the above.
18. A group of 79 students were asked how far they commute to work from home each time they go to work from home. The results are given in the Table below. Determine the first quartile.

Miles traveled	Frequency
1	1
2	2
3	12
4	18
5	7
6	10
7	10
8	11
9	5
10	3

- 4 miles
 - 5 miles
 - 6 miles
 - 3 miles
 - None of the above
19. Furnace repair bills are normally distributed with a mean of 270 dollars and a standard deviation of 20 dollars. If 64 of these repair bills are randomly selected, find the probability that they have a mean cost between 270 dollars and 272 dollars.
- 0.7881
 - 0.5517
 - 0.2881
 - 0.2119
 - None of the above

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20. Given the following least squares prediction equation, $\hat{y} = -173 + 74x$, we estimate y to _____ by _____ with each 1-unit increase in x .
- decrease; 74
 - decrease; 173
 - increase; 173
 - increase; 74
 - None of the above
21. If the graph of a distribution of data shows that the graph is skewed to the left then the
- Mean > Median
 - Mean = Median
 - Mean is approximately equal to Median
 - Mean < Median
 - None of the above
22. Which measure of central tendency may not exist for all numeric data sets?
- Mean
 - Median
 - Mode
 - Variance
 - None of the above
23. The complement of 4 heads in the toss of 4 coins is
- All tails
 - Exactly one tail
 - Three heads
 - At least one tail
 - None of the above
24. A recruiting firm reported that 78% of U.S. companies use social networks such as Facebook and LinkedIn to recruit job candidates. An economist thinks that the percentage is higher at technology companies. She samples 70 technology companies and finds that 55 of them use social networks. The P-value of the hypothesis test to test her claim at 0.05 level of significance is
- .0045
 - .4541
 - .7857
 - .1154
 - None of the above

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25. The city council of a small town needs to determine if the town's residents will support the building of a new library. The council decides to conduct a survey of a sample of the town's residents. Which one of the following procedures would be most appropriate for obtaining a sample of the town's residents?
- a. Survey every 13th person who enters the old library on a given day.
 - b. Survey a random sample of librarians who live in the town.
 - c. Survey 500 individuals who are randomly selected from a list of all people living in the state in which the town is located.
 - d. Survey a random sample of persons within each neighborhood of the town.
 - e. None of the above.

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Tie Breaker #1

A study was conducted by Joseph Jacobson and Diane Wille to determine the effect of early child care on infant-mother attachment patterns. In the study, 93 infants were classified as either “secure” or “anxious” using the Ainsworth strange-situation paradigm. In addition, the infants were classified according to the average number of hours per week that they spend in child care. The data appear in the accompanying table.

Attachment Pattern	Hours in Child Care		
	Low (0 - 3 hours)	Moderate (4 - 19 hours)	High (20 - 54 hours)
Secure	24	35	5
Anxious	11	10	8

Do the data indicate a dependence between attachment patterns and the number of hours spent in child care? Conduct an hypothesis test to answer this question at 0.05 level of significance. Write down the hypotheses, test statistics, P-values, decision, and conclusion.

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Tie Breaker #2

The following data represent SAT Mathematics scores for 2006

SAT Math Score	Number
200 – 249	13,159
250 – 299	23,083
300 – 349	59,672
350 – 399	124,616
400 – 449	202,883
450 – 499	243,565
500 – 549	247,435
550 – 599	213,880
600 – 649	156,057
650 – 699	120,933
700 – 749	54,108
750 – 800	35,136

1. Find the mean, median, and variance of the SAT Math scores.
2. According to the Empirical Rule, 95% of these students will have SAT Mathematics scores between what two values?

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Tiebreaker #3.

A company orders supplies from 10 distributors and wishes to place 7 orders. Assume that the company places the orders in a manner that allows every distributor an equal chance of obtaining any one order and there is no restriction on the number of orders that can be placed with any distributor. What is the probability that

- a. distributor 1 gets exactly 5 orders?
- b. all of the orders go to different distributors?

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Statistics Key

1. b.
2. b.
3. d.
4. d.
5. b.
6. a.
7. b.
8. b.
9. a.
10. a.
11. a.
12. d.
13. b.
14. c.
15. b.
16. b.
17. d.
18. a.
19. c.
20. d.
21. d.
22. c.
23. d.
24. b.
25. d.

Tie Breaker Key

I. Tie Breaker Number 2

H_0 : the attachment patterns are independent of the number of hours.

H_1 : the attachment patterns are dependent of the number of hours.

χ^2 - Test:

$$\chi^2 = 7.267; p = 0.0264$$

$p < \alpha$; reject H_0

There is sufficient evidence to support that the attachments patterns are dependent on the number of hours.

II. Tie Breaker Number 1

Answers

1. Mean = 518.646; Median = 524.5; Variance = 13107.593

2. $(\bar{x} - 2s, \bar{x} + 2s)$ will have 95% of the score
(518.646 - 2(114.488), 518.646 + 2(114.488))

Either are acceptable: $(289.669, 747.623)$ or $(289.67, 747.622)$

III. Tie Breaker Number 3

$$\text{a. } C_r^n = \frac{n!}{r!(n-r)!}$$

$$\frac{C_5^7(9)^{7-5}}{10^7} = 1.701 \times 10^{-4}$$

$$\text{b. } \frac{10*9*8*7*6*5*4}{10^7} = 0.06048$$