Arkansas Council of Teachers of Mathematics
Statistics Regional Exam Spring 2009

Select the best answer for each of the following questions and mark it on the answer sheet provided. Be sure to read all the answer choices before making your selection. When you are finished with the multiple-choice questions, please attempt the tiebreaker questions.

1. A data distribution is "skewed to the left" if
    a) the mean is to the left of the median   b) the median is to the left of the mean
    c) the median is to the left of zero   d) none of a) – c) is correct

2. A possible cause of a "skewed to the left" distribution would be
    a) one or more extremely small values (outliers)
    b) one or more extremely large values (outliers)
    c) a bimodal distribution
    d) none of a) – c) is true.

3. A sample is taken from a population of size 10,000 by numbering the individuals in the population from 1 – 10,000 then picking #17, #117, #217, #317, … , #9,917. This method of sampling is called
    a) a stratified random sample
    b) a clustered random sample
    c) a convenience sample
    d) a sequential (systematic) random sample

4. A sample of n=400 is to be taken from a population that is 60% female and 40% male. If the statistician randomly picks exactly 240 from the female members and exactly 160 from the male members then the sampling method is called
    a) a stratified random sample
    b) a clustered random sample
    c) a convenience sample
    d) a sequential (systematic) random sample.

5. A large bowl contains ten ping pong balls. Six are red and four are white. Event A is defined to be "randomly drawing two white balls in two draws from the bowl". Which of the following statements is true?
    a) P(A) is the same whether the sampling is done with replacement or without replacement.
    b) P(A) is greater for sampling with replacement than for sampling without replacement.
    c) P(A) is greater for sampling without replacement than for sampling with replacement.

6. The five number summary for a particular set of sample data is: $x_{min} = 18$, $Q_1 = 40$, $Q_2 = 55$, $Q_3 = 70$, and $x_{max} = 102$. Which of the following statements is true.
    a) The distribution is a symmetrical, uniform distribution.
    b) The distribution is a right skewed distribution.
    c) The distribution is a symmetrical distribution but it is not a uniform distribution.
    d) none of a) – c) is true.

7. Referring to the five number summary given in #6 the inter-quartile range (IQR) is
   a) 84   b) 32   c) 62   d) none of a) – c) is correct.

8. Suppose that two balanced dice, a red die and a green die, are rolled. Let Y denote the value of G - R where G represents the number on the green die and R represents the number on the red die. What are the possible values of the random variable Y?

   a) -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5   b) 0, 1, 2, 3, 4, 5, 6
   c) -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6   d) 0, 1, 2, 3, 4, 5
   e) none of a) – d) is correct

9. The random variable X is the number of houses sold by a realtor in a single month at the Sendsom's Real Estate office. Its probability distribution is given in the table. Which is the mean of the random variable X?

X	P(X = x)
0	0.24
1	0.01
2	0.12
3	0.16
4	0.01
5	0.14
6	0.11
7	0.21

   a) 3.50   b) 3.60   c) 3.40   d) 3.35   e) none of a) – d) is correct.

10. Which of the following is **not** true about the binomial distribution?

   a) The random variable X is continuous.
   b) The probability of success is constant from trial to trial.
   c) Each outcome is independent of the other.
   d) The probability of success plus the probability of failure is one.
   e) None of the above.

11. According to a college survey, 22% of all students work full time. Find the mean for the random variable X, the number of students who work full time in samples of size 16.

   a) 3.52   b) 4.00   c) 0.22   d) 2.75   e) 4.26

12. According to a college survey, 22% of all students work full time. Find the standard deviation for the random variable X, the number of students who work full time in samples of size 16.

   a) 1.66   b) 3.52   c) 1.88   d) 2.75   e) 1.98

13. In one city, the probability that a person will pass his or her driving test on the first attempt is 0.68. Eleven people are selected at random from among those taking their driving test for the first time. What is the probability that among these 11 people, the number passing the test is between 2 and 4 inclusive?

a) 0.0345   b) 0.0251   c) 0.0299   d) 0.0308   e) 0.616

14. In one region, the September energy consumption levels for single-family homes are found to be normally distributed with a mean of 1050 kWh and a standard deviation of 218 kWh. If 50 different homes are randomly selected, find the probability that their mean energy consumption level for September is greater than 1075 kWh.

a) 0.2910   b) 0.2090   c) 0.4562   d) 0.0438   e) 0.4180

15. A population distribution has mean 50 and standard deviation 20. For a random sample of size 100, the sampling distribution of the sample mean has

a) mean 50 and standard error 2.
b) mean 50 and standard error 0.20.
c) mean 50/100 and standard error 20/100.
d) mean 50/10 and standard error 20/10.
e) mean and standard error that are unknown unless we know the exact shape of the population distribution.

16. Just how accurate are the weather forecasts we hear every day? The table below compares the daily forecast with a city's actual weather for a year.

	Actual Rain	Actual No Rain
Forecast Rain	33	55
Forecast No Rain	3	274

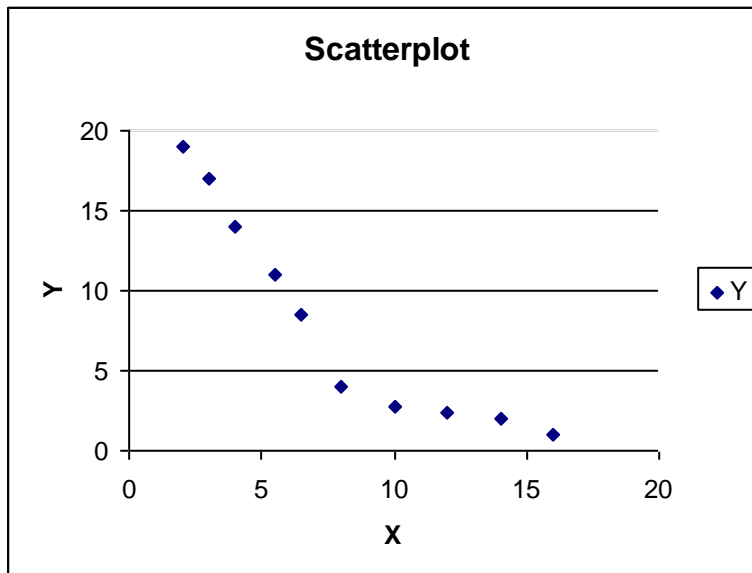Given that rain was forecast, what proportion of the time did it actually rain?

a) 0.08   b) 0.62   c) 0.92   d) 0.38   e) 0.17

17. The relationship between the number of games won by a minor league baseball team and the average attendance at their home games is analyzed. A regression to predict the average attendance from the number of games won has an r = 0.73. Interpret this statistic.

    a) Positive, fairly strong linear relationship. 73% of the variation in average attendance is explained by the number of games won.
    b) Positive, weak linear relationship. 7.29% of the variation in average attendance is explained by the number of games won.
    c) Positive, fairly strong linear relationship. 53.29% of the variation in average attendance is explained by the number of games won.
    d) Negative, fairly strong linear relationship. 53.29% of the variation in average attendance is explained by the number of games won.
    e) No association

18. Pick the best description of the scatterplot shown below.

    a) Moderately strong association, negative association
    b) Negative association, linear association
    c) Linear association
    d) Little or no association
    e) Linear association, moderately strong association

19. In a survey of 500 residents, 300 were opposed to the use of the photo-cop for issuing traffic tickets. It is found that the point estimate for the mean is 60% with a standard error of 0.022. Construct the 95% confidence interval for the population proportion.

    a) (300, 500)
    b) (0.564, 0.636)
    c) (0.578, 0.622)
    d) (0.557, 0.643)
    e) None of the above.

20. In monitoring lead in the air after an explosion at a battery factory, it is found that the amounts of lead (in ug/m3) in a 6 day period had a mean of 1.54 and a standard error of 1.91. Construct the 95% confidence interval for the population mean.

    a) (-2.2, 5.28)
    b) (-0.37, 3.45)
    c) (-4.11, 7.19)
    d) (-1.60, 4.68)
    e) None of the above.

21. The incomes of trainees at a local mill are normally distributed with a mean of $1,100 and a standard deviation $150. What percentage of trainees earns less than $900 a month?

    a) 9.18%   b) 40.82%   c) 90.82%   d) 35.31%   e) 18.36%

22. Assume that the weights of quarters are normally distributed with a mean of 5.67 g and a standard deviation 0.070 g. A vending machine will only accept coins weighing between 5.48 g and 5.82 g. What percentage of legal quarters will be rejected?

    a) 1.62%   b) 0.0196%   c) 1.94%   d) 2.48%   e) 3.92%

Name _____

In the event of a tie, the following questions will be graded in order. *Please work them consecutively and show all your work.*

Tie Breaker # 1

Residents of a particular city worry that a waste dump next to the city's water supply may elevate the chance of cancer for its residents. Of the past 80 deaths of residents, 50 were due to cancer. Investigate whether this number is unusually high or if it could it be explained by random variation, if actually the probability of a death being due to cancer was 0.22 in this town. Explain your reasoning, stating all assumptions.

Tie Breaker #2

The table below shows part of a MINITAB printout for the relationship between y = Internet use and x = female economic activity (female employment as a percent of male employment).

Internet use and female economic activity

Predictor	Coef	SE Coef	T	P
Constant	-24.479	9.258	-2.64	0.012
Fem-economic	0.7145	0.1405	5.09	0.000

R-Sq = 41.2%

a. Find the predicted Internet use for a country with (i) x = 50, (ii) x = 60. Describe the effect of a 10-unit increase in x on the percent using the Internet, and show how you could use the slope to get this information.
b. Report r^2, and interpret its value.
c. What sign does the correlation have? Why? Find it.

Tie Breaker #3

A department supervisor is considering purchasing one of two comparable photocopy machines, *A* or *B*. Machine *A* costs $10,000 and machine *B* costs $10,500. This department replaces photocopy machines every three years. The repair contract for machine *A* costs $50 per month and covers an unlimited number of repairs. The repair contract for machine *B* costs $200 per repair. Based on past performance, the distribution of the number of repairs needed over any one-year period for machine *B* is shown below.

Number of Repairs	0	1	2	3
Probability	.45	.25	.18	.12

You are asked to give a recommendation based on overall cost as to which machine, *A* or *B*, along with its repair contract, should be purchased. What would your recommendation be? Give a statistical justification to support your recommendation.

ANSWERS TO ACTM REGIONAL STATISTICS EXAM

1. A
2. A
3. D
4. A
5. B
6. C
7. D
8. A
9. B
10. A
11. A
12. A
13. D
14. B
15. A
16. D
17. C
18. A
19. D
20. E
21. A
22. C

TB #1: Can't be considered a chance variation since if deaths are considered to be independent of each other P(50 or more of 80 | p=.22) is virtually zero.

TB #2: (a) (i) 11.246, (ii) 18.391 Since slope is 0.7145 and slope is change in y per unit change in x then when x changes 10 units y will change 10 * 0.7145

(b) $r^2 = .412$ and means that 41.2% of the change in y is due to (explained by) change in x

(c) Sign of the coefficient of correlation is positive because the slope is positive. r = .642

TB # 3: I'd recommend B because repair cost for A is $600 per year whether or not any repairs are needed. Expected repair cost for B run 200 x expected number of repairs = 200 x .97 = 194. Hence the $500 additional initial cost for B should be offset by the $918 expected reduction in repair cost over the life of the machine.

OR

A actually costs $11,800 over the three years which is $1,300 more than B's actual cost. You could buy B and have it repaired 6 times over the three years and still save $100. In any year there is only a probability of 0.12 of having to repair more than twice.