Arkansas Council of Teachers of Mathematics

2014 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 tiebreakers.

1. A national random sample of 20 ACT scores from 2010 is listed below. Calculate the sample mean and standard deviation.

   29, 26, 13, 23, 23, 25, 17, 22, 17, 19, 12, 26, 30, 30, 18, 14, 12, 26, 17, 18

   A. 20.50, 5.79
   B. 20.50, 5.94
   C. 20.85, 5.79
   D. 20.85, 5.94

2. The data in question 1. appears to be reasonably symmetric.

   A. True
   B. False

3. The ACT is hypothesized to be normally distributed with a population mean of 18 and standard deviation of 6. Using the data in question 1., calculate the *p*-value testing the hypothesis that the population mean is 18.

   A. 0.0168
   B. 0.0225
   C. 0.0336
   D. 0.0451

4. Using the data in question 1., calculate the two-sided 95% confidence interval for the mean ACT score based on the *t*-distribution.

   A. $-\infty$ to 23.05
   B. $-\infty$ to 23.15
   C. 18.07 to 23.63
   D. 18.22 to 23.48

5. Using the data in question 1., calculate number of observations that are two or more sample standard deviations from the sample mean.

   A. 0
   B. 1
   C. 2
   D. 3

6. Colleges and universities commonly use ACT and SAT scores to help determine scholarship eligibility. Assuming that the ACT and SAT are reasonably normally distributed with a mean and standard deviation of 18 and 6 respectively for the ACT and 1000 and 140 respectively for the SAT, determine the SAT score that theoretically corresponds with an ACT cutoff of 33.

   A. 1200
   B. 1280
   C. 1350
   D. 1420

7. Provided that the ACT scores are reasonably normally distributed with a mean of 18 and standard deviation of 6, determine the proportion of students with a 33 or higher.

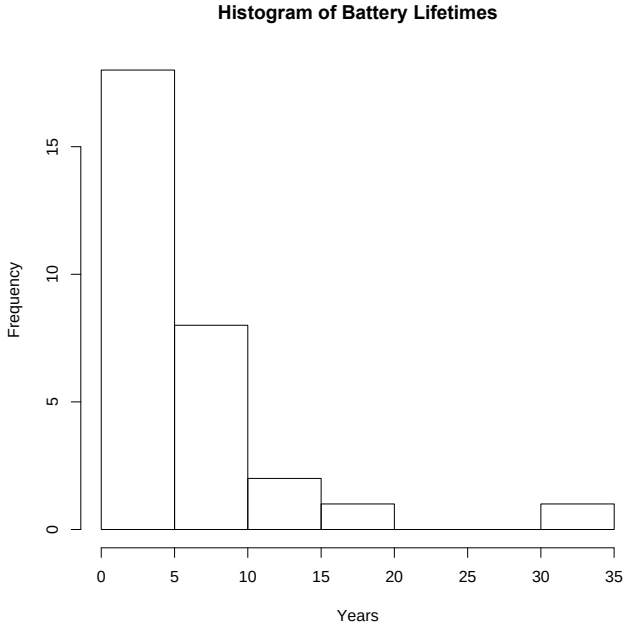
   A. 0.0062
   B. 0.0109
   C. 0.0124
   D. 0.0217

8. Causal inference is made possible by:

   A. randomly assigning treatments to subjects
   B. randomly selecting subjects
   C. double blinding
   D. matched pairs

9. When the null hypothesis is incorrectly rejected, this is known as:

   A. alpha
   B. type I error
   C. power
   D. beta



10. The histogram above was generated from a random sample of the lifetimes of 30 car batteries. Determine the relationship between the mean and median.

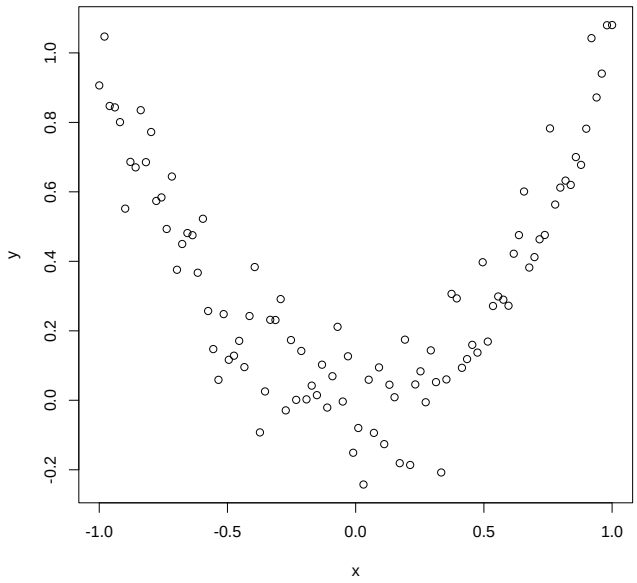
    A. mean = median
    B. mean ≈ median
    C. mean < median
    D. mean > median

11. When asked questions concerning personal hygiene, people commonly lie. This is an example of:

    A. sampling bias
    B. confounding
    C. non-response bias
    D. response bias

12. Select the order of sampling schemes from best to worst.

    A. simple random, stratified, convenience
    B. simple random, convenience, stratified
    C. stratified, simple random, convenience
    D. stratified, convenience, simple random



13. Using a simple linear model the data in the scatterplot above would have a correlation coefficient that is close to:

    A. –1.0
    B. +0.0
    C. +1.0
    D. +0.5

14. The following data gives the length of the right humerus (mm) in the top row and right tibia (mm) in the bottom row of 11 rats that were sent by NASA aboard Spacelab Life Sciences 2. Estimate the Pearson correlation coefficient.

24.80	24.59	24.59	24.29	23.81	24.87	25.90	26.11	26.63	26.31	26.84
36.05	35.57	35.57	34.58	34.20	34.73	37.38	37.96	37.46	37.75	38.50

    A. 0.894
    B. 0.905
    C. 0.951
    D. 0.975

15. Using the data in question 14., state the proportion of variation in the right tibia that can be explained by variation in the right humerus.

    A. 0.894
    B. 0.905
    C. 0.951
    D. 0.975

16. Using the data in question 14., estimate the slope and intercept assuming that the tibia and humerus are the response and explanatory variables, respectively.

    A. 0.651, 1.682
    B. 1.682, 0.651
    C. 1.114, 1.390
    D. 1.390, 1.114

17. Using the data in question 14., predict the length of the right tibia (mm) of a rat with a 25.25 mm right humerus.

    A. 18.12 mm
    B. 43.12 mm
    C. 29.52 mm
    D. 36.21 mm

18. Using the data in question 14., predict the length of the right humerus (mm) of a rat with a 37.50 mm right tibia.

    A. 26.09 mm
    B. 63.73 mm
    C. 43.17 mm
    D. 53.24 mm

19. Using the data in question 14., test the null hypothesis that the slope coefficient for the humerus is zero at the 0.05 level of significance.

    A. reject the null hypothesis that the slope coefficient is zero
    B. fail to reject the null hypothesis that the slope coefficient is zero
    C. accept the null hypothesis that the slope coefficient is zero

20. The following data is the weight of rats in grams on a diet of beef (first row), cereal (second row), or pork (third row). Conduct a one-way ANOVA at the 0.05 level of significance to test the null hypothesis that the mean weights of the rats are the same across the diets.

73	102	118	104	81	107	100	87	117	111
98	74	56	111	95	88	82	77	86	92
94	79	96	98	102	102	108	91	120	105

    A. reject the null hypothesis that the mean weights of the rats are the same across the diets
    B. fail to reject the null hypothesis that the mean weights of the rats are the same across diets
    C. accept the null hypothesis that the mean weights of the rats are the same across diets

21. Using the data in question 20., construct a two sample *t*-interval at the 95% level of confidence for the mean weight difference between rats eating cereal and rats eating pork. Do not assume that the data is homoscedastic.

    A. –26.02 g to –1.18 g
    B. –25.95 g to –1.26 g
    C. 1.18 g to 26.02 g
    D. 1.26 g to 25.95 g

22. Observational studies allow:

    A. population inference
    B. casual inference
    C. both types of inference
    D. neither type of inference

23. In 1923, Babe Ruth had 522 at bats with 205 hits. Assuming that the binomial distribution can be appropriately applied, find the expected number of hits in 529 at bats.

    A. 321
    B. 186
    C. 230
    D. 208

24. Assuming that the binomial distribution can be applied using Babe Ruth's batting average from 1923, find the standard deviation of the number of hits in 529 at bats.

    A. 11.23
    B. 11.16
    C. 11.15
    D. 11.07

25. In 1924, Babe Ruth actually had 200 hits in 529 at bats. Assuming that the binomial distribution can be appropriately applied using his batting average from 1923, find the probability that he would have had 200 or fewer hits in 529 at bats.

    A. 0.481
    B. 0.519
    C. 0.260
    D. 0.740

Name:_____

Tie-Breaker 1

List the mathematical assumptions of the binomial distribution.

Name:_____

Tie-Breaker 2

If one failed to apply a multiple comparisons correction for three tests conducted at the 0.05 level of significance, state the family-wise type I error rate.

Name:_____

Tie-Breaker 3

It is important for tests for diseases to be accurate in two respects. It needs to accurately identify people with the disease, but it also needs to accurately identify people without the disease. State the formal terms associated with these two types of accuracy.

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Key:

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

Tie-Breaker 1

a. Constant probability of success
b. Fixed number of trials
c. Independence of the trials
d. Two outcomes

Tie-Breaker 2

0.1465

Tie-Breaker 3

a. Sensitivity
b. Specificity