TENNESSEE MATHEMATICS TEACHERS'ASSOCIATION

FIFTY-NINTH ANNUAL MATHEMATICS CONTEST

2015

Statistics

Prepared by:

Mathematics and Science Division
Nashville State Community College
Nashville, Cookeville, and Waverly, TN

Coordinated by: Stacy Brown

Reviewed by:

Mathematics Faculty
Carson-Newman University
Jefferson City, Tennessee

Scoring formula: 4 x (Number Right) – (Number Wrong) + 40

DIRECTIONS:

Do not open this booklet until you are told to do so.

This is a test of your competence in high school mathematics. For each problem, determine the <u>best</u> answer and indicate your choice by making a heavy black mark in the proper place on the separate answer sheet provided. You must use a pencil with a soft lead (No. 2 lead or softer).

This test has been constructed so that most of you are not expected to answer all of the questions. Do your best on the questions you feel you know how to work. You will be penalized for incorrect answers, so wild guesses are not advisable.

If you change your mind about an answer, be sure to erase <u>completely</u>. Do not mark more than one answer for any problem. Make no stray marks of any kind on the answer sheet. The answer sheets will not be returned to you; if you wish a record of your performance, mark your answers in this booklet also. You will keep the booklet after the test is completed.

When told to do so, open your test booklet and begin. You will have exactly eighty minutes to work

1. An inspector at a manufacturing warehouse must check the production of products for defects. He chooses to inspect every 50th item produced. What type of sampling scheme is utilized?
   a. Random sampling
   b. Cluster sampling
   c. Convenience sampling
   d. Systematic sampling
   e. Stratified sampling

2. The local movie theater administers a survey to all their customers. The responses to one of the questions are:

   will definitely not recommend, probably will not recommend, neutral,
   probably will recommend, will definitely recommend

   Which of the following best describes the data level and data type of the survey question?

   a. Categorical and Nominal
   b. Categorical and Ordinal
   c. Quantitative and Nominal
   d. Quantitative and Ratio
   e. Quantitative and Ordinal

3. The following frequency distribution table displays the white blood cell count of males.

   The number 9.95 is a _____.

White Blood Cell Count of Males	Frequency
3.0 – 4.9	8
5.0 – 6.9	15
7.0 – 8.9	11
9.0 – 10.9	5
11.0 – 12.9	1

   a. Class width
   b. Class boundary
   c. Lower class limit
   d. Upper class limit
   e. Class midpoint

4. Given the following probability distribution table, find the mean, μ.

X	0	1	2	3	4
P(x)	0.29	0.38	0.15	0.12	0.06

    a. 1.00
    b. 1.28
    c. 0.32
    d. 0.25
    e. 1.57

5. Which of the following is a true statement?
    a. An outlier has no effect on the mean.
    b. If the standard deviation of a sample is 0, then the values must all be the same.
    c. If a data value has negative z-score, then the data value is above the mean.
    d. Standard deviation can be a negative number.
    e. Every data set has a mode.

6. The five-number summary for the heights of students at Massey College is 63, 71, 74, 76, 77. From this we infer that the shape of the distribution of student heights at Massey College is

    a. Right-skewed
    b. Bell-shaped
    c. Symmetric
    d. Left-skewed
    e. Cannot tell from the information given

7. A campaign manager wants to survey individuals in Ashville before the upcoming election. Complete the table of all registered voters and then determine the probability that the campaign manager will question a male voter given that they are a Democrat?

	Democrat	Republican	Independent	Total
Male		20	12	65
Female	17	12		
Total	50		18	100

    a. 0.65
    b. 0.20
    c. 0.12
    d. 0.34
    e. 0.66

8. There are 15 red, 12 blue, 11 orange, and 8 yellow marbles in a bag, identical except for their color. A marble is selected, its color observed, and not replaced. A second marble is drawn. Find the probability that the second marble is red given that the first marble was not red.

    a. $\dfrac{14}{45}$

    b. $\dfrac{15}{46}$

    c. $\dfrac{1}{3}$

    d. $\dfrac{13}{46}$

    e. $\dfrac{217}{1035}$

9. How many ways can a 4 person subcommittee be picked from a 15 member committee?
    a. 1365 ways
    b. 6840 ways
    c. 15 ways
    d. 360 ways
    e. 60 ways

10. How many ways can the letters in the word Tennessee arranged? (Arrangements may not be actual words)
    a. 3780
    b. 1
    c. 1,209,600
    d. 7560
    e. 151,200

11. A new strand of pumpkin seeds have an 85% chance of germinating. If 12 seeds are planted, what is the probability that exactly 9 of them germinate?
    a. 0.8500
    b. 0.0001
    c. 0.2642
    d. 0.7500
    e. 0.1720

12. The grades on a certain exam are normally distributed with a mean of 100 and a standard deviation of 20. What is the probability that a given student scored between 90 and 110?
   a. 0.3830
   b. 0.6915
   c. 0.3085
   d. 0.5000
   e. 0.7257

13. A simple random sample of 25 students in the Tennessee area is selected and asked how much money they spend each semester on school supplies. The sample mean is $500 with a standard deviation of $40. Find the 95% confidence interval for the population mean amount of money spent on school supplies in Tennessee each semester. (Assume the money spent on school supplies follows a normal distribution.)
   a. ($479.40, $520.60)
   b. ($460.00, $540.00)
   c. ($484.84, $513.16)
   d. ($480.00, $520.00)
   e. ($484.32, $515.68)

14. A common opinion in the medical community is that the average body temperature of a healthy adult is less than 98.6° F. A researcher collects the following samples from 9 healthy adults

   98.6   97.5   98.8   98.1   97.6   99.4   97.0   98.7   98.2

   Assume that body temperatures are normally distributed. Conduct a hypothesis test with $\alpha = 0.05$ to determine which outcome would be most appropriate.

   a. We fail to reject the null hypothesis since $t_{critical} = -1.86$ is less than $t = -1.55$. As a result there is not enough evidence to support the claim that the sample comes from a population with a mean that is less than 98.6
   b. We fail to reject the null hypothesis since $t_{critical} = -1.86$ is less than $t = -1.55$. As a result there is enough evidence to support the claim that the sample comes from a population with a mean that is less than 98.6
   c. We cannot perform the hypothesis test because σ is unknown and the sample size is less than 30
   d. We fail to reject the null hypothesis since $t_{critical} = -1.86$ is greater than $t = -1.55$. As a result there is not enough evidence to support the claim that the sample comes from a population with a mean that is less than 98.6
   e. We fail to reject the null hypothesis since $t_{critical} = -1.86$ is greater than $t = -1.55$. As a result there is enough evidence to support the claim that the sample comes from a population with a mean that is less than 98.6

15. The Wechsler Adult Intelligence Scale measures IQ scores with a test designed so that the mean is 100 and the standard deviation is 15. Convert an IQ score of 120 to a z-score.
    a. 113.33
    b. 1.33
    c. 92.00
    d. -1.33
    e. 1.05

16. Find the area under the curve for a Z-score greater than 0.82 with mean 0 and standard deviation 1.
    a. 0.7939
    b. 0.2850
    c. 0.3925
    d. 0.8200
    e. 0.2061

17. A high school class election is approaching and we would like to estimate ahead of time what percentage of the students plan to vote for candidate A. In the past, we've had 18% of the students vote for candidate A. How many students should we have in the sample size if we want to estimate that percentage with a margin error of 2% and a 90% confidence level?
    a. n = 60
    b. n = 724
    c. n = 29
    d. n = 1225
    e. n = 999

18. A survey of 1050 people who file tax returns showed that 48% of them file with a tax professional. Use hypothesis testing to test the claim that among those who file a tax return less than one-half file them through a tax professional. Identify the null and alternative hypothesis.
    a. $H_o: \mu = 0.50 ; H_1: \mu < 0.50$
    b. $H_o: p < 0.50 ; H_1: p = 0.50$
    c. $H_o: \sigma = 0.48 ; H_1: \sigma < 0.48$
    d. $H_o: p = 0.50 ; H_1: p < 0.50$
    e. $H_o: \mu = 0.48 ; H_1: \mu < 0.48$

19. In a poll of 1015 randomly selected people, 376 said that they have guns in their homes. Use a 0.05 significance level to test the claim that more than 35% of the homes have guns in them.

   a. We fail to reject the null hypothesis since $z_{critical} = 1.645$ is greater than $z = 1.37$. As a result there is not sufficient evidence to support the claim that more than 35% of the homes have guns in them.

   b. We reject the null hypothesis since $z_{critical} = 1.645$ is greater than $z = 1.37$. As a result there is sufficient evidence to support the claim that more than 35% of the homes have guns in them.

   c. We reject the null hypothesis since $z_{critical} = 1.645$ is greater than $z = 1.37$. As a result there is not sufficient evidence to support the claim that more than 35% of the homes have guns in them.

   d. We fail to reject the null hypothesis since $z_{critical} = 1.645$ is greater than $z = 1.37$. As a result there is sufficient evidence to support the claim that more than 35% of the homes have guns in them.

   e. We cannot perform the hypothesis because we do not have enough information.

20. A new drug to improve high blood pressure was given to a group with the results below. Use a 0.01 significance level to test the claim that the treatment group has a greater mean than the placebo group.

   Treatment group: $n_1 = 22$, $\bar{x}_1 = 4.20$, $s_1 = 2.20$
   Placebo group: $n_2 = 22$, $\bar{x}_2 = 1.71$, $s_2 = 0.72$

   Which is the appropriate test to accomplish this task?

   a. T-test
   b. 1-Prop Z-test
   c. 2-Sample T-test
   d. Z test
   e. X^2 – test

21. A sample of ten college students were selected and the time they studied for a 10 question quiz and their quiz grade was recorded. Using a 0.05 significance level, is there a linear correlation between the time spent studying and the quiz grade?

Study time (hr)	.55	.45	.82	1.1	1.25	.88	1	.85	.77	.65
Quiz grade	8	8	6	5	7	9	6	7	7	9

    a. Reject the null hypothesis since $r_{critical}$ = 0.632 is greater than $|r|$ = 0.560. Therefore there is a linear correlation between time spent studying and quiz grade.

    b. Fail to reject the null hypothesis since $r_{critical}$ = 0.632 is less than $|r|$ = 0.560. Therefore there is not enough evidence to conclude there is a linear correlation between time spent studying and quiz grade.

    c. Reject the null hypothesis since $r_{critical}$ = 0.632 is less than $|r|$ = 0.560. Therefore there is a linear correlation between time spent studying and quiz grade.

    d. Fail to reject the null hypothesis since $r_{critical}$ = 0.632 is greater than $|r|$ = 0.560. Therefore there is not enough evidence to conclude there is a significant linear correlation between the time spent studying and quiz grade.

    e. There is no way to determine if there is a correlation between time spent studying and quiz grade with the information given.

22. An airline estimates that 94% of people booked on their flights actually show up to fly. If the airline books 45 people on a flight for which the maximum number of seats is 44, what is the probability that the number of people who show up will exceed the capacity of the plane?

    a. 0.177

    b. 0.006

    c. 0.062

    d. 0.254

    e. 0.066

23. If an airline books 45 people on a flight for which the maximum number of seats is 44 and the probability of people booked on the flight actually showing up decreases from 94% to 90%, which of the following would be a good financial decision for the airline?

    a. They should overbook more seats. A decrease from 94% to 90% means less people are actually showing up to fly, so the airline can overbook more seats to maximize profit and still keep their customers satisfied.

    b. They should overbook more seats. A decrease from 94% to 90% means more people are actually showing up to fly, so the airline can overbook more seats to maximize profit and still keep their customers satisfied.

    c. They should overbook fewer seats. A decrease from 94% to 90% means more people are actually showing up to fly, so the airline can overbook fewer seats to maximize profit and still keep their customers satisfied.

    d. They should overbook fewer seats. A decrease from 94% to 90% means less people are actually showing up to fly, so the airline can overbook fewer seats to maximize profit and still keep their customers satisfied.

    e. They should overbook the same amount of seats. A decrease from 94% to 90% does not change actually number of people showing up to fly, so the airline can continue with current procedures to maximize profit and still keep their customers satisfied.

24. A study of the amount of time it takes a mechanic to rebuild the transmission for a 2006 Ford Fusion shows that the mean is 8.4 hours and the standard deviation is 1.8 hours. If 40 mechanics are randomly selected, find the probability that their mean rebuild time exceeds 8.7 hours. Assume the time it takes to rebuild the transmission is normally distributed.

    a. 0.1285
    b. 0.1346
    c. 0.1459
    d. 0.1946
    e. 0.1667

25. A poll of 2400 randomly selected adults were asked if they shared a cell phone plan with someone else. The survey showed that 1800 of them share a cell phone plan. Calculate the margin of error that corresponds to a 95% confidence level.

    a. 0.017
    b. 0.035
    c. 0.009
    d. 0.015
    e. 0.023

26. Find the critical value for a left tailed t test with $\alpha = 0.01$ and $n = 18$.
    a. -2.878
    b. 2.552
    c. 2.898
    d. -2.567
    e. 2.567

27. Suppose we know the following about students at Massey College: if we select one student at random, P(Male | Art Major) = P(Art Major | Male) = 0.35, and P(Male) = .3.
    Find the probability of selecting a female art major.
    a. 0.105
    b. 0.195
    c. 0.28
    d. 0.35
    e. 0.7

28. Ages of students at Massey College are normally distributed with mean $\mu = 20$ years and standard deviation $\sigma = 1.8$ years. If five students are selected randomly (with replacement), find the probability to four decimal places that exactly three are older than 21.8 years
    a. 0.1587
    b. 0.283
    c. 0.9717
    d. 0.8413
    e. 0.0028

29. In how many ways can a club president, vice-president, and secretary be chosen from a group of twenty students?
    a. 20 ways
    b. 1140 ways
    c. 8000 ways
    d. 380 ways
    e. 6840 ways

30. If 52% of 1400 adults in a sample are men, what is the actual number of men in the sample?
    a. 728
    b. 27
    c. 52
    d. 730
    e. 1400

31. Find the number of ways you can select a 4 digit PIN if you can use the numbers 0 through 9 and cannot repeat numbers.
    a. 10000
    b. 40
    c. 5040
    d. 1
    e. 3024

32. An archer hits the bull's eye 83% of the time. If she shoots 15 arrows, what is the probability that she will hit the bull's eye exactly 13 times? (Assume each shot is independent of the others.)
    a. 0.269
    b. 0.482
    c. 0.003
    d. 0.125
    e. 0.061

33. The show *Jersey Shore* recently had a share of 60, meaning that among the TV sets in use, 60% were tuned to *Jersey Shore*. An independent advertiser wants to check this statistic. They begin with 15 households having TV sets and survey during this this time *Jersey Shore* is on. What is the standard deviation for this sample?
    a. 3
    b. 1.9
    c. 3.6
    d. 9
    e. 0

34. Using the traditional method for a right tailed test, the rejection (or critical) region is formed to the right of the_____.
    a. Test statistic
    b. P-value
    c. Critical value
    d. Significance level
    e. Hypothesis

35. One-hundred students were asked their favorite burrito place. Five said Qdoba, seventeen said Moe's, twelve said Nuvo Burrito, forty-six said Chipotle and twenty said Baja Burrito. Find the mode for this sample.
    a. Mode = 46 since that is the biggest number
    b. Mode = Chipotle since that is the most common response
    c. Mode = Nuvo since that is the response in the middle of the list
    d. Mode = 12 since that is the number that falls in the middle of the list
    e. Mode = 5 since that is the smallest number

36. Which of the following is a true statement?
    a. The standard deviation of a sample will be 0 if all of the values are less than the mean
    b. The more spread out (varied) the data values are the smaller the standard deviation will be
    c. The standard deviation of a sample will be 0 if all of the values are the same
    d. The standard deviation of a sample will be negative if all of the values are negative
    e. The standard deviation of a sample will always equal the range

37. Which of the following cannot be a probability?
    a. 0
    b. 1
    c. -1
    d. ½
    e. ¼

38. The weights (in lbs.) of nine beagles were recorded in the following table.

Stem	Leaf
1	0 0 1 3 4 7
2	4 8
3	0

Select the correct statement.

    a. Mode = 10; Median= 14
    b. Mode = 10; Median = 17
    c. Mode = None; Median = 15.5
    d. Mode = 14; Median= 10
    e. Mode = 17; Median = 24

39. Suppose two brands of light bulbs both (truthfully) claim that their average burning time is 1000 hours. If you wanted to compare the consistency of their length of life, what descriptive statistic could you use to give you that additional information?
    a. Mode
    b. Median
    c. Mean
    d. Range
    e. Standard Deviation

40. On the 2010 ACT test, the mean score for women taking the test was 20.9 with a standard deviation for the women's test being 4.7. The mean score for men taking the test in 2010 was 21.2 and the men's test had a standard deviation of 5.0. A woman, Cherise, and a man, John, both scored 23 on the test. Which of them scored better with respect to their gender?
    a. Cherise scored better with respect to gender because she had a lower z-score than John
    b. Cherise scored better with respect to gender because she had a higher z-score than John
    c. John scored better with respect to gender because he had a lower z-score than Cherise
    d. John scored better with respect to gender because he had a higher z-score than Cherise
    e. They performed the same with respect to gender.