CHAPTER 13 FORM A

Name_____ Course Number:_____ Section Number:_____

Directions: Answer the questions and solve the problems in the spaces provided, or attach paper. Circle the correct choice in each response set. Where appropriate, use computer assistance.

Provide an appropriate response.

1) List the advantages and disadvantages of nonparametric tests.

2) Describe the sign test. What types of hypotheses is it used to test? What is the underlying concept?

3) Describe the Wilcoxon rank–sum test. What type of hypotheses is it used to test? What assumptions are made for this test? What is the underlying concept?

4) Which of the following tests could detect some nonlinear relationships between two variables?

A) Wilcoxon signed–ranks test B) rank correlation test

C) Wilcoxon rank–sum test D) sign test

5) Which of the following nonparametric tests reaches a conclusion equivalent to the Mann–Whitney U test?

A) Wilcoxon rank–sum test B) sign test

C) Kruskal–Wallis test D) Wilcoxon signed–ranks test

Use the sign test to test the indicated claim.

6) A standard aptitude test is given to several randomly selected programmers, and the scores are given below for the mathematics and verbal portions of the test. Use the sign test to test the claim that programmers do better on the mathematics portion of the test. Use a 0.05 level of significance.

Mathematics	347	440	327	456	427	349	377	398	425
Verbal	285	378	243	371	340	271	294	322	385

7) A researcher wishes to study whether a particular diet is effective in helping people to lose weight. 82 randomly selected adults were weighed before starting the diet and again after following the diet for one month. 49 people lost weight, 31 gained weight, and 2 observed no change in their weight. At the 0.01 significance level, test the claim that the diet is effective.

Use the Wilcoxon signed–ranks test to test the claim that the matched pairs have differences that come from a population with a median equal to zero.

8) 11 runners are timed at the 100–meter dash and are timed again one month later after following a new training program. The times (in seconds) are shown in the table. Use Wilcoxon's signed–ranks test and a significance level of 0.05 to test the claim that the training has no effect on the times.

Before	12.1	12.4	11.7	11.5	11.0	11.8	12.3	10.8	12.6	12.7	10.7
After	11.9	12.4	11.8	11.4	11.2	11.5	12.0	10.9	12.0	12.2	11.1

Use the Wilcoxon rank–sum test to test the claim that the two independent samples come from populations with equal medians.

9) SAT scores for students selected randomly from two different schools are shown below. Use a significance level of 0.05 to test the claim that the scores for the two schools are from populations with the same median.

School A			School B		
550	480	670	460	580	620
400	700	520	380	680	570
540	740	560	660	500	480
360	560	650		600	550

Solve the problem.

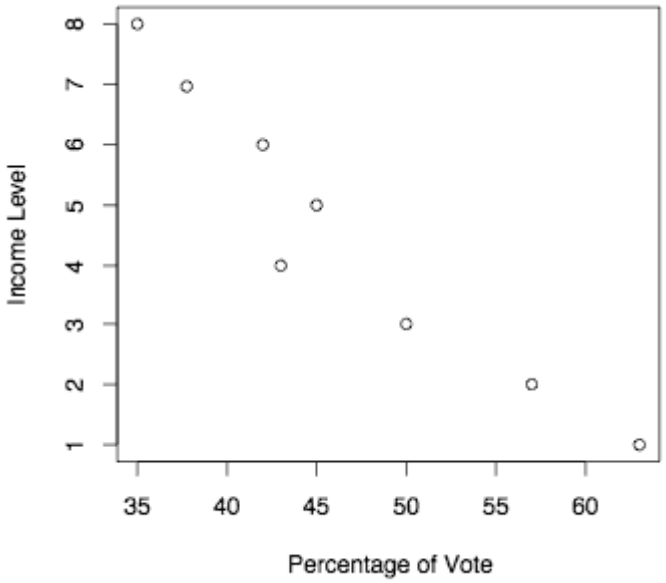
10) How does the Wilcoxon rank–sum test compare to the corresponding t–test in terms of efficiency, ease of calculations and assumptions required? Are there any kinds of data for which the Wilcoxon rank–sum test can be used but the t–test cannot be used?

Use a Kruskal–Wallis test to test the claim that the samples come from populations with equal medians.

11) A fire–science specialist tests three different brands of flares for their burning times (in minutes) and the results are given below for the sample data. At the 0.05 significance level, test the claim that the three different brands have the same median burn time.

Brand X	16.4	17.6	18.3	17.0	17.1	17.3	17.8
Brand Y	17.9	18.0	17.8	18.4	17.6	19.0	19.1
Brand Z		17.3	16.4	16.5	16.0	15.8	16.3	17.1

The following scatterplot shows the percentage of the vote a candidate received in the 2004 senatorial elections according to the voter's income level based on an exit poll of voters conducted by CNN. The income levels 1–8 correspond to the following income classes: 1=Under $15,000; 2=$15–30,000; 3=$30–50,000; 4=$50–75,000; 5=$75–100,000; 6=$100–150,000; 7=$150–200,000; 8=$200,000 or more.



12) Use the election scatterplot to the find the critical values corresponding to a 0.01 significance level used to test the null hypothesis of $\varrho_S = 0$.

A) 0.881 B) −0.881

C) −0.738 and 0.738 D) −0.881 and 0.881

Find the critical value. Assume that the test is two–tailed and that n denotes the number of pairs of data.

13) n =7, $\alpha = 0.05$

A) −0.786 B) ±0.786 C) 0.786 D) ±0.714

Use the rank correlation coefficient to test for a correlation between the two variables.

14) Given that the rank correlation coefficient, r_S, for 35 pairs of data is 0.321, test the claim of correlation between the two variables. Use a significance level of 0.01.

15) Ten trucks were ranked according to their comfort levels and their prices.

Make	Comfort	Price
A	1	6
B	6	2
C	2	3
D	8	1
E	4	4
F	7	8
G	9	10
H	10	9
I	3	5
J	5	7

Find the rank correlation coefficient and test the claim of correlation between comfort and price. Use a significance level of 0.05.

16) The scores of twelve students on the midterm exam and the final exam were as follows.

Student	Midterm	Final
Navarro	93	91
Reaves	89	85
Hurlburt	71	73
Knuth	65	77
Lengyel	62	67
Mcmeekan	74	79
Bolker	77	65
Ammatto	87	83
Pothakos	82	89
Sullivan	81	71
Wahl	91	81
Zurfluh	83	94

Find the rank correlation coefficient and test the claim of correlation between midterm score and final exam score. Use a significance level of 0.05.

Use the runs test to determine whether the given sequence is random. Use a significance level of 0.05.

17) The outcomes (odd number or even number) of a roulette wheel are shown below. Test for randomness of odd (O) and even (E) numbers.

O E O E O E O E E O E E
E E O E O O E O E E O E

18) Use a 0.05 level of significance to test the claim that the sequence of computer–generated numbers is random. Test for randomness above and below the mean.
8 7 5 7 3 9 1 8 0 4 3 8 4 6 2 3 9 7 5

19) A pollster interviews voters and claims that her selection process is random. Listed below is the sequence of voters identified according to gender. At the 0.05 level of significance, test her claim that the sequence is random according to the criterion of gender.
M, M, M, M, M, M, M, M, M, M, M, M, F, F, F, F,
M, M, M, M, M, M, M, M, M, M, F, F, F, F, F, F

Solve the problem.

20) When performing a rank correlation test, one alternative to using the *Critical Values of Spearman's Rank Correlation Coefficient* table to find critical values is to compute them using this approximation:

$$r_S = \pm\sqrt{\frac{t^2}{t^2 + n - 2}}$$

where t is the t–score from the *t Distribution* table corresponding to n – 2 degrees of freedom. Use this approximation to find critical values of r_S for the case where n = 40 and $\alpha = 0.10$.

A) ±0.264 B) ±0.304 C) ±0.312 D) ±0.202

1) Advantages: 1) Nonparametric methods can be applied to a wide variety of situations because they do not have the rigid requirements of their parametric counterparts. In particular, nonparametric tests do not require normally distributed populations. 2) Nonparametric tests can often be applied to nonnumerical data. 3) Nonparametric methods usually involve simpler computations than the corresponding parametric methods.
   Disadvantages: 1) Nonparametric methods tend to waste information because exact numerical data are often reduced to a qualitative form. 2) Nonparametric tests are not as efficient as parametric tests so we generally need stronger evidence (such as a larger sample or a greater difference) before we reject a null hypothesis.
2) The sign test compares the signs (negative or positive) of the differences for data sets, ignoring any ties resulting in a difference of zero. The sign test can be used to test claims involving two dependent samples, claims involving nominal data, and claims about the median of a single population. The underlying concept is that if two sets of data have equal medians, the number of positive signs should be approximately equal to the number of negative signs.
3) This test is used to test claims about equal medians of two independent populations. The assumptions include: two independent samples; testing the null hypothesis that the two independent samples come from the same distribution; and more than 10 scores in each of the samples. The underlying principle is that if two samples are drawn from identical populations and the individual scores are all ranked as one combined collection of values, then the high and low ranks should fall evenly between the two samples. For example, if low ranks are found predominantly in one sample with the high ranks in the other, then we suspect that the two samples are from populations with different medians.
4) B
5) A
6) H_0: The math scores are equal to or less than the verbal scores.
   H_1: The math scores are greater than the verbal scores.
   Test statistic: x = 0. Critical value: x = 1.
   Reject the null hypothesis. There is sufficient evidence to support the claim that the math scores are greater than the verbal scores.
7) H_0: The diet is not effective. H_1: The diet is effective.
   Convert x = 31 to the test statistic z = −1.90. Critical value: z = −2.33.
   Fail to reject the null hypothesis. There is not sufficient evidence to support the claim that the diet is effective.
8) H_0: Training has no effect on running times. H_1: Training has an effect on running times. Test statistic T = 16.5. Critical value: T = 8.
   Fail to reject the null hypothesis that the population of differences has a median of zero.
9) H_0: SAT scores for the two schools are from populations with the same median. H_1: SAT scores for the two schools are from populations with different medians. $\mu_R = 144$, $\sigma_R = 16.2481$, $R_1 = 145$, $R_2 = 131$, z = 0.06.
   Test statistic: z = 0.06. Critical values z = ±1.96.
   Fail to reject the null hypothesis that the populations have the same median.
10) The Wilcoxon rank−sum test does not require the assumption of normality while the t−test does. The calculations for the Wilcoxon rank−sum test are easier and it is only slightly less efficient than the t−test. The Wilcoxon rank−sum test can be used for ordinal data while the t−test cannot be used for ordinal data.

11) H_0: The three samples come from populations with equal median burn time.
H_1: The three samples come from populations with median burn times which are not equal.
Test statistic: H = 13.2597. Critical value: $\chi^2 = 5.991$.
Reject the null hypothesis of equal medians. There is sufficient evidence to warrant rejection of the claim that the three samples come from populations with equal median burn time.
12) D
13) B
14) $r_s = 0.321$. Critical values: $r_s = \pm 0.442$.
Fail to reject the null hypothesis $\rho_s = 0$. There does not appear to be a correlation between the two variables.
15) $r_s = 0.382$. Critical values: $r_s = \pm 0.648$.
Fail to reject the null hypothesis $\rho_s = 0$. There does not appear to be a correlation between comfort and price.
16) $r_s = 0.706$. Critical values: $r_s = \pm 0.587$.
Reject the null hypothesis $\rho_s = 0$. There appears to be a correlation between midterm score and final exam score.
17) $n_1 = 10$, $n_2 = 14$, G = 18, 5% cutoff values: 7, 18.
Reject the null hypothesis of randomness.
18) $n_1 = 9$, $n_2 = 10$, G = 14.
Test statistic: G = 14. Critical values: 5, 16.
Fail to reject the null hypothesis of randomness.
19) $n_1 = 22$, $n_2 = 10$, G = 4, $\mu_G = 14.75$, $\sigma_G = 2.38$.
Test statistic: z = –4.52. Critical values: z = ±1.96.
Reject the null hypothesis of randomness. The sequence does not appear to be random.
20) A