Review for Test 4

STA - 3123

I. The annual percentage turnover rates for five U.S. and five Japanese plants are shown in the table.

U.S. Plants	Japanese Plants
7.11%	3.52%
6.06%	2.02%
8.00%	4.91%
6.87%	3.22%
4.77%	1.92%

What nonparametric comparison is appropriate for the data?

a. Wilcoxon Rank Sum Test
b. Wilcoxon Signed Rank Test
c. The Kruskal–Wallis H Test
d. Friedman F_r–Test

Which parametric procedure could be used to analyze this data (assuming all the necessary assumptions were met)?

a. Independent samples comparison of μ_1 and μ_2.
b. Matched Pairs comparison of μ_1 and μ_2.
c. Randomized Block Analysis of Variance design.
d. All three parametric procedures could be used.

Find the rejection region when testing a two-tailed Wilcoxon rank sum test using $\alpha = .05$.

a. $T \leq 19$ or $T \geq 41$
b. $T \leq 18$ or $T \geq 37$
c. $T \leq 12$ or $T \geq 28$
d. $18 \leq T \geq 37$

II. In 1982 there were 612,593 lawyers in USA. About 70% of these lawyers were in private practice; about 15% worked in government; and about 9% worked for businesses. Because of mushrooming government regulation, the number of corporate lawyers has been growing at a rapid pace. The data are the average salaries for lawyers with 8 years experience for 10 U.S. cities.

City	*Corporate Lawyers*	*Lawyers with Law Firms*
Atlanta	$45,500	$45,500
Chicago	43,000	48,000
Cincinnati	43,500	45,000
Dallas/Ft. Worth	49,500	46,500
Los Angeles	47,000	60,000
Milwaukee	37,500	50,000
Minneapolis/St. Paul	47,500	43,500
New York	43,500	54,000
Pittsburgh	42,000	44,000
San Francisco	47,500	59,500

What nonparametric procedure you will use to compare the salaries?

a. Wilcoxon Rank Sum Test
b. Wilcoxon Signed Rank Test (WSR Test)
c. Kruskal-Wallis H Test
d. The Friedman F_r-Test

Calculate the WSR Test statistic for a two-tailed test.

a. $T_+ = 7$ b. $T_- = 38$ c. $T = 80.5$ d. $T = 129.5$

Find the RR when testing if the distribution of corporate lawyer salaries is shifted to the left of the PD of lawyers with law firm salaries. Use $\alpha = .05$.

a. $T_+ \leq 60$ b. $T_- \leq 60$ c. $T_+ \leq 8$ d. $T_- \leq 11$

III. Use a Wilcoxon Signed Rank test.

H_a: The scores in Population A tend to be higher than Population B scores.
n = 10

There are no ties. The value in sample B was subtracted from the value in sample A.

Test Statistic: _____

$\alpha = .05$ RR: _____

IV. A researcher wants to determine whether the cost per patient per day is higher in Florida hospital than in Georgia hospitals. 8 hospitals from Georgia and 10 from Florida were randomly chosen for her study. **No data is given. Set up the test. Use a test with $\alpha = .05$**

H_a:

H_o:

Test Statistic: _____

$\alpha = .05$ RR: _____

V. For each experiment identify the nonparametric test to be used.

1) A major domestic airline initiated a campaign to improve baggage handling. The home office randomly selected 5 of its flights to Los Angeles, 5 of its flights to Atlanta, 6 of its flights to Chicago and 6 of its flights to Boston. The baggage manger at each airport was asked to report the time required (in minutes) to deliver baggage from the airplane to the baggage claim area. Do the data provide sufficient evidence to indicate that the distributions of the time required differ for at least two of the 4 airports?

2) A local bank claims that the waiting time for its customers to be served is the lowest in the area. A competitor's bank checks the waiting times at both banks using 10 randomly choosen customers from the local bank and 9 from its own bank. Do the data provide sufficient evidence to support the local bank's claim?

VI. Use a Wilcoxon Rank Sum Test.

H_a: The scores in Population A tend to be higher than Population B scores. $n_A = 8$ and $n_B = 6$

Test Statistic: ___ $\alpha = .05$ RR: _____

VII. The data collected from a paired data experiment is given. **Compute T_+ and T_-. Show all your work.**

A:	**1.7**	**3.2**	**4.9**	**2.4**	**4.2**	**2.8**
B:	**4.1**	**2.9**	**4.9**	**5.2**	**4.2**	**1.9**

VIII. Do the data provide enough evidence to indicate that the scores in Population A tend to be higher than the scores in Population B? Use $\alpha = .01$. **Use a Wilcoxon rank sum test. Complete the hypothesis test. The data are given below.**

A:	**17**	**14**	**13**	**12**	**19**	**21**	**23**	**15**
B:	**12**	**10**	**14**	**9**	**8**	**16**		

H_a:

Test Statistic: _____

$\alpha = .05$ **RR:** _____

IX. A researcher wants to know whether the ability to solve a geometric puzzle improves between the ages of 4 and 6. She tests this by measuring how long it takes seven 4 years old children and eight 6 years old children to solve the puzzle. Use $\alpha = 0.05$

4-year-olds	Ranks	6-year-olds	Ranks
9	7	4	2
14	12	10	8
5	3	7	5
11	9	15	13
13	11	12	10
17	15	8	6
6	4	18	16
16	14	3	1
	Sum = 75		Sum = 61

X. A wildlife conservation group wants to test the effectiveness of a new ad campaign designed to promote more favorable attitudes toward conservation. Ten subjects are given a test that measures their attitude. Those subjects were then shown the ad, and given the test again. Use $\alpha = 0.01$

Subject	Before	After	D	Absolute value	Ranks
1	40	44	4	4	4
2	33	40	7	7	5.5
3	36	49	13	13	9
4	34	36	2	2	2
5	40	39	-1	1	1
6	31	40	9	9	8
7	30	27	-3	3	3
8	36	43	7	7	5.5
9	29	29	0	Ignore	
10	20	28	8	8	7

$T_- = 4$ $T_+ = 41$

1. Calculate difference score, D, for each subject
2. Rank the difference scores from smallest to largest, based on their absolute values
4. Separate the positive ranks from the negative ranks, using the sign of the difference scores
5. Sum the positive ranks, then sum the negative ranks
6. Compare these sums to what you would expect under the null hypothesis.

XI. Does a golfer's height influence the distance he or she can drive a ball? A researcher tests this by having short, medium, or tall novice golfers hit a ball as far as they can. The researcher measures the distance hit, in meters. Use $\alpha = 0.01$

Short	Rank	Med	Rank	Tall	Rank
10	1	24	3	68	14
27	5.5	27	5.5	71	15
26	4	35	7	57	10
39	8	44	9	60	12
22	2	58	11	62	13
	Sum = 22.5		Sum = 35.5		Sum = 64

XII. Does background music affect the performance of factory workers? We takea group of eight workers, and measure each worker's productivity (in terms of the number of items manufactured per hour). We have three conditions: silence, "easy-listening" music and marching-band music. We take five workers, and measure each worker's productivity three times (once while working under each type of background music). Note that, to avoid practice and fatigue effects, the order of presentation of each of these conditions should be varied. Use $\alpha = 0.05$

	No Music (raw score)	No Music (ranked score)	Easy listening (raw score)	Easy listening (ranked score)	Marching band (raw score)	Marching band (ranked score)
Worker 1	4		5		6	
Worker 2	2		7		7	
Worker 3	6		6		8	
Worker 4	3		7		5	
Worker 5	3		8		9	

The Wilcoxon Sign Rank Test:

Does background music affect the performance of factory workers? We take a group of eight workers, and measure each worker's productivity (in terms of the number of items manufactured per hour) twice –once while the worker is listening to background music, and once while the same worker is working in silence.

Here are the workers' scores:

Worker	No music	Music	Difference	Rank
1	15	10	5	4.5
2	12	14	-2	2.5
3	11	11	0	ignore
4	16	11	5	4.5
5	14	4	10	6
6	13	1	12	7
7	11	12	-1	1
8	8	10	-2	2.5

Step 1:
Find the difference between each pair of scores, keeping track of the sign of the difference. Thus, for subject one, 15 - 10 = 5. For subject two, 12 - 14 = -2. The results of this step are shown in the column entitled **difference**, in the table above.

Step 2:
Rank the differences, ignoring their sign. Thus the smallest difference is -1, so this gets a rank of 1. The next smallest difference is -2, but there are two of these; therefore they get the average of ranks 2 and 3: 2.5. The results of this step are shown in the column entitled **rank**. Ignore any difference-scores of zero, which occur if a subject's pair of scores is identical.

Step 3:
Add together the ranks belonging to scores with a positive sign. Here, the positive-signed ranks sum to 22.
Add together the ranks belonging to scores with a negative sign. Here, the negative-signed ranks sum to 6.

Step 4:
"Test Statistic" is the *smaller* sum of ranks; so here, T = 6.
N is the number of differences, omitting zero differences. Here, N = 8 - 1 = 7.

Step 5:
From a table, find the critical value of T_0, for your N. Your obtained T has to
be *smaller* than this critical value, for it to be statistically significant.
In our example, the critical value of T_0 for an N of 7 is 2. Our obtained T.S. of 6
is bigger than this, and so we would conclude that there was no statistically
significant difference between our two conditions. Worker productivity appears to be
unaffected by the presence or absence of background music.