

13.7: Chapter 13 Exercises

? Chapter 13 Exercises

For exercises 1-6, show all 5 steps for hypothesis testing:

- State the hypotheses.
- Compute the test statistic.
- Compute the critical value or p-value.
- State the decision.
- Write a summary.

1. A real estate agent suggests that the median rent for a one-bedroom apartment in Portland has changed from last year's median of \$825 per month. A sample of 12 one-bedroom apartments shows these monthly rents in dollars for a one-bedroom apartment; 820, 720, 960, 660, 735, 910, 825, 1050, 915, 905, 1050, 950. Is there enough evidence to claim that the median rent has changed from \$825? Use $\alpha = 0.05$.

2. The median age in the United States is 38 years old. The mayor of a particular city believes that her population is considerably "younger." At $\alpha = 0.05$, is there sufficient evidence to support her claim. The data below represent a random selection of persons from the city.

40	36	27	72	12	30	52	45	10	24
22	25	43	39	48	25	95	29	19	30
50	37	18	36	15	60	38	42	41	61

3. A meteorologist believes that the median temperature for the month of July in Jacksonville, Florida, is higher than the previous July's 81°F. The following sample shows the temperatures taken at noon in Jacksonville during July. Is there enough evidence to support the meteorologist's claim? Use $\alpha = 0.05$.

79	85	81	95	80	98	82	81	76	84	90	93
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4. A sample of 10 Kitti's hog-nosed bats' weights in grams is shown below. Test the claim that median weight for all bumblebee bats is not equal to 2 grams, using a 1% level of significance.

Weight	2.22	1.6	1.78	1.52	1.61	1.98	1.56	2.24	1.55	2.28
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5. Test to see if the median assessed property value (in \$1,000s) changed between 2010 and 2016. Use the sign test and $\alpha = 0.05$.

Ward	A	B	C	D	E	F	G	H	I	J	K
2010	184	414	22	99	116	49	24	50	282	25	141
2016	161	382	22	190	120	52	28	50	297	40	148

6. A company institutes an exercise break for its workers to see if this will improve job satisfaction. Scores for 10 workers were sampled from a questionnaire before and after the exercise break was implemented. Higher scores indicate a higher job satisfaction. Use the sign test to see if the exercise break increased the job satisfaction scores. Use $\alpha = 0.05$.

Before	34	28	29	45	26	27	24	15	15	27
After	33	36	29	50	37	29	25	20	18	28

7. Rank the following data set: -15, -25, -5, -5, -8, -15, -2, -4, -5

8. Rank the following data set: 6, 3, 0, 2, 3, 5, 4, 8, 9, 5, 6, 5, 7.9

9. Rank the following data set: 1, 2, 9, 3, 5, 1, 2, 8, 6

10. Rank the following data set: 5, -1, 2, 0, 1, -1, 0, 3, 9, 6, 1, 1, 4

For exercises 11-20, show all 5 steps for hypothesis testing:

- State the hypotheses.
- Compute the test statistic.
- Compute the critical value or p-value.
- State the decision.
- Write a summary.

11. A manager wishes to see if the time (in minutes) it takes for their workers to complete a certain task will decrease when they are allowed to wear earbuds at work. A random sample of 20 workers' times were collected before and after. Test the claim that the time to complete the task has decreased at a significance level of $\alpha = 0.01$ using the Wilcoxon Signed-Rank test. You obtain the following sample data.

Before	After	Before	After
69	62.3	61.7	56.8
71.5	61.6	55.9	44.7
39.3	21.4	56.8	50.6
67.7	60.4	71	63.4
38.3	47.9	80.6	68.9
85.9	77.6	59.8	35.5

Before		After		Before		After	
67.3		75.1		72.1		77	
59.8		46.3		49.9		38.4	
72.1		65		56.2		55.4	
79		83		63.3		51.6	

12. Doctors developed an intensive intervention program for obese patients with heart disease. Subjects with a BMI of 30 kg/m² or more with heart disease were assigned to a three-month lifestyle change of diet and exercise. Patients' Left Ventricle Ejection Fraction (LVEF) are measured before and after intervention. Larger numbers indicate a healthier heart. Test to see if the intervention program significantly increased the LVEF. Use the Wilcoxon Signed-Rank test with $\alpha = 0.05$.

Before	44	49	50	49	57	62	39	41	52	42
After	56	58	64	60	63	71	49	51	60	55

13. An adviser is testing out a new online learning module for a placement test. They wish to test the claim that the new online learning module increased placement scores at a significance level of $\alpha = 0.05$. You obtain the following paired sample of 19 students who took the placement test before and after the learning module. Use the Wilcoxon Signed-Rank test.

Before	After	Before	After	Before	After	Before	After
55.8	57.1	11.4	20.6	42.6	51.5	46.1	57
51.7	58.3	30.6	35.2	61.2	76.6	72.8	66.1
76.6	83.6	53	46.7	26.8	28.6	42.2	38.1
47.5	49.5	21	22.5	11.4	14.5	51.3	42.4
48.6	51.1	58.5	47.7	56.3	43.7		

14. Dating couples were matched according to who asked the other person out first. Their age was then compared. Is there a significant difference in the age of dating couples based on who asked out the other person first? Dependent samples, use $\alpha = 0.05$ and the Wilcoxon Signed-Rank test.

First Asked	18	43	32	27	15	45	21	22
Accepted	16	38	35	29	14	46	25	28

15. In Major League Baseball, the American League (AL) allows a designated hitter (DH) to bat in place of the pitcher, but in the National League (NL), the pitcher has to bat. However, when an AL team is the visiting team for a game against an NL team, the AL team must abide by the home team's rules and thus, the pitcher must bat. A researcher is curious if an AL team would score differently for games in which the DH was used. She samples 20 games for an AL team for which the DH was used, and 20 games for which there was no DH. The data are below. Use the Mann-Whitney test with $\alpha = 0.05$.

With Designated Hitter				Without Designated Hitter			
0	5	4	7	3	6	5	2
1	2	7	6	12	4	0	1
6	4	2	10	6	3	7	8
1	2	7	5	4	0	5	1
8	4	11	0	2	4	6	4

16. A professor wants to know whether there is a difference in comprehension of a lab assignment among students depending on if the instructions are given all in text, or if they are given primarily with visual illustrations. She randomly divides her class into two groups of 15 and gives one group instructions in text and the second group instructions with visual illustrations. The following data summarizes the scores the students received on a test given after the lab. Is there evidence to suggest that a difference? Use the Mann-Whitney test with $\alpha = 0.05$.

Text			Visual Illustrations		
57.3	87.3	67.2	59.0	76.7	88.2
45.3	75.2	54.4	57.6	78.2	43.8
87.1	88.2	93.0	72.9	64.4	97.1
61.2	67.5	89.2	83.2	89.0	95.1
43.1	86.2	52.0	64.0	72.9	84.1

17. "Durable press" cotton fabrics are treated to improve their recovery from wrinkles after washing. "Wrinkle recovery angle" measures how well a fabric recovers from wrinkles. Higher is better. Here are data on the wrinkle recovery angle (in degrees) for a random sample of fabric specimens. A manufacturer wants to see if there is a difference in the wrinkle recovery angle for two different fabric treatments, Permafresh and Hylite. Test the claim using a 5% level of significance. Use the Mann-Whitney test.

Permafresh				Hylite			
144	102	131	118	139	146	139	146
136	127	137	148	131	138	138	142
117	137	147	129	133	142	138	137

Permafresh					Hylite				
133	137	148	135		146	137	138	138	133
124	139	164	142		139	140	141	140	141

18. A researcher is curious what year in college students make use of the gym at a university. They take a random sample of 30 days and count the number of sophomores and seniors who use the gym each day. Is there evidence to suggest that a difference exists in gym usage based on year in college? Use the Mann-Whitney test with $\alpha = 0.01$.

Sophomores						Seniors				
189	208	167	154	217		209	199	186	210	221
209	198	143	208	220		204	214	230	170	197
188	197	165	207	231		198	201	165	183	235
201	177	186	193	201		187	199	189	194	197
190	165	180	245	200		192	195	200	211	205
199	155	165	188	187		200	190	218	210	229

19. A movie theater company wants to see if there is a difference in the movie ticket sales in San Diego and Portland per week. They sample 20 sales from San Diego and 20 sales from Portland and count the number of tickets sold over a week. Use the Mann-Whitney test to test the claim using a 5% level of significance.

San Diego					Portland			
223	243	231	235		233	228	209	214
221	182	217	211		219	212	214	222
206	229	219	239		226	216	223	220
215	214	234	221		226	219	221	223
226	233	239	232		219	211	218	224

20. A new over-the-counter medicine to treat a sore throat is to be tested for effectiveness. The makers of the medicine take two random samples of 25 individuals showing symptoms of a sore throat. Group 1 receives the new medicine and Group 2 receives a placebo. After a few days on the medicine, each group is interviewed and asked how they would rate their comfort level 1-10 (1 being the most uncomfortable and 10 being no discomfort at all). The results are below. Is there sufficient evidence to conclude that there is a difference? Use the Mann-Whitney test and $\alpha = 0.01$.

Group 1						Group 2				
3	5	6	7	5		4	5	8	3	5
3	4	5	7	7		2	7	8	2	4
3	2	5	8	8		1	2	2	3	2
7	7	8	4	8		1	3	5	5	1
4	8	3	9	10		6	4	7	8	1

Answers to Odd-Numbered Exercises

- H_0 : Median = 825; H_1 : Median \neq 825; Test Statistic = 4; p-value = 0.5548. Do not reject H_0 . There is not enough evidence to support the claim that the median rent has changed from last year's median of \$825 per month.
- H_0 : Median = 81; H_1 : Median $>$ 81; Test Statistic = 7; p-value = 0.0547. Do not reject H_0 . There is not enough evidence to support the claim that the median temperature for the month of July in Jacksonville, Florida, is higher than the previous year's of 81°F.
- H_0 : There is no change in the median assessed property value between 2010 and 2016. H_1 : There is a change in the median assessed property value between 2010 and 2016. Test Statistic = 2; p-value = 0.1797. Do not reject H_0 . There is not enough evidence to support the claim that is a change in the median assessed property value between 2010 and 2016.
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Ordered Data	Rank
-25	1
-15	2.5
-15	2.5
-8	4
-5	6
-5	6
-5	6
-4	8
-2	9

9.

Ordered Data	Rank
	0
	1
	2
	2
	3
	3.5
	3.5
	4
	5
	5
	7
	7
	7
	6
	9.5
	9.5
	6
	7
	11
	8
	12
	9
	13

11. H_0 : The time to complete the task will not decrease when workers are allowed to wear earbuds. H_1 : The time to complete the task will decrease when workers are allowed to wear earbuds. $w_s = 27.5$; $CV = 43$. Reject H_0 . There is enough evidence that allowing the workers to wear earbuds significantly decreased the time for workers to complete tasks.

13. H_0 : The new online learning module did not increase student's placement scores. H_1 : The new online learning module increased student's placement scores. $w_s = 74.5$; $CV = 53$. Do not reject H_0 . There is not enough evidence to support the claim that the new online learning module increased students' placement scores.

15. H_0 : An American League team would score the same for games in which the designated hitter was used. H_1 : An American League team would score differently for games in which the designated hitter was used. $U = 181$; $text{CV} = 127$. Do not reject H_0 . There is not enough evidence to support the claim that an American League team would score differently for games in which the designated hitter was used.

17. H_0 : There is no difference in the wrinkle recovery angle for two different fabric treatments, Permafresh and Hylite. H_1 : There is a difference in the wrinkle recovery angle for two different fabric treatments, Permafresh and Hylite. $z = -1.4048$; $CV = \pm 1.96$. Do not reject H_0 . There is not enough evidence to support the claim that there is a difference in the wrinkle recovery angle for two different fabric treatments, Permafresh and Hylite.

19. H_0 : There is no difference in the movie ticket sales in San Diego and Portland per week. H_1 : There is a difference in the movie ticket sales in San Diego and Portland per week. $U = 144.5$; $CV = 127$. Do not reject H_0 . There is not enough evidence to support the claim there is a difference in the movie ticket sales in San Diego and Portland per week.

"Ford didn't comment. He was listening to something. He passed the Guide over to Arthur and pointed at the screen. The active entry read 'Earth. Mostly harmless.'

...Earth, a world whose entire entry in the Hitchhiker's Guide to the Galaxy comprised the two words 'Mostly harmless.'"

(Adams, 2002)

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