Assignment 18

1. Is the following experiment a multinomial experiment? One-hundred people are asked what kind of music they listen to most. They can say any genre of music they want.

2. Is the following experiment a multinomial experiment? Five hundred cars are observed on the freeway and placed into one of four categories: Domestic, Japanese, European, and other.

3. Is the following experiment a multinomial experiment? Researchers are planning to ask randomly chosen students which profession they find most prestigious: Doctor, Lawyer, or Teacher. They will stop the researcher once one of the three categories has one hundred people who vote it as being most prestigious.

4. Researchers sample a random selection of divorced workers at a corporation and test if the percentage of divorces that involve blue collar workers is 50%; white collar workers is 45%; and executives is 5% . Does the data collected below fit the sample size requirement for a one-way χ^2 test?

Blue-collar	White-collar	Executives
50	35	4

5. Does the following data set based on the classification of randomly excavated pottery pieces fit the sample size requirement for a one-way χ^2 test? Assume the hypothesis to be tested is $\rho_B = \rho_M = \rho_P = \rho_O$

Pot Category	Number Found
Burnished	133
Monochrome	460
Painted	183
Other	61
Total	837

6. Use the χ^2 table to find the following critical values:
   a. $\chi^2_{0.05}$ with 15 degrees of freedom
   b. $\chi^2_{0.005}$ with 40 degrees of freedom
   c. $\chi^2_{0.10}$ with 22 degrees of freedom
   d. $\chi^2_{0.025}$ with 50 degrees of freedom

7. Find the rejection region for a one-dimensional $\chi^2 - test$ with the following conditions:
   a. k = 4; $\alpha = 0.01$
   b. k = 6; $\alpha = 0.05$
   c. k = 5; $\alpha = 0.10$

8. Use the table of data below and find the χ^2 test stat that would be used to test the claim that: $\rho_1 = \rho_2 = \rho_3$.

Group 1	Group 2	Group 3
75	74	78

Summary data to assist in the calculations:

$\frac{(O-E)^2}{E}$	0.00587	0.03671	0.07195

9. Use the table of data below and find the χ^2 test stat that would be used to test the claim that: $\rho_A = \rho_B = \rho_C = \rho_D$.

A	B	C	D
87	56	88	94

10. Use the table of data below and find the χ^2 test stat that would be used to test the claim that: $\rho_A = 0.25, \rho_B = 0.10, \rho_C = 0.60, \rho_D = 0.05$.

A	B	C	D
140	80	250	30

11. M&M candies' web site claims each package of Milk Chocolate M&M's should contain 24% blue, 14% brown, 16% green, 20% orange, 13% red, and 14% yellow M&M's. Use a 1% significance level and the data (that was actually observed by a researcher named Josh Madison) to determine if M&M's really fill their bags of candy with these proportions:

Blue	Brown	Green	Orange	Red	Yellow
481	371	483	544	372	369

12. The US government reports that the percent of uninsured in the country is 13%. The percent who purchase health insurance on their own is 20%, and the percent who purchase insurance through their employer is 67%. A random survey of Americans reveals the set of results below. Does the data provide evidence to contradict the government's claim?

uninsured	private	employer
315	252	1533

13. The romance novel industry claims that 90 percent of romances were read in softcover/paperback format, 7 percent listened to audiobook versions, and 3 percent read in electronic/e-book format. A recent survey of Amazon sales produced the below table of results. Use a 2.5% significance level to test the claim that romance sales on Amazon differ from the industry's claim.

Paperback	Audio	E-book
1267	108	75

14. The candy Skittles comes in five colors/flavors Green, Orange, Red, Purple, and Yellow. The company claims that each bag of Skittles has an equal number of each color. Use a 10% level of significance and the data below to test the company's claim.

Green	Orange	Red	Purple	Yellow
43	50	44	44	52

15. A professor at FIU claims his grade distribution is as follows: 10% A, 15% B, 25% C, 50% D or F. Use the data below and a 5% level of significance to test the professor's claim.

A	B	C	D or F
7	30	60	103

Assignment 19

16. The following report is from a researcher at the University of Chicago. Laumann and co-researcher Dr. Amy Derick, of the University of Chicago, surveyed 2492 tattooed people to determine if year of birth was a predictive factor for tattoos: 986 of the group were aged 18 to 29; 657 of them were aged 30 to 40; and only 411 were aged 40 to 50. Four hundred thirty-eight had obtained their first tattoo before age18. Use a 10% significance level to test if all age groups have the same proportion of tattooed members.

17. The table below has data from a 2009 Canadian Journal of Human Sexuality study. The data shows gender differences in response to partner influence and social expectation questions among students who had ever had sexual intercourse. The sample for this study included only students who had ever had sexual intercourse (30.7% of the total sample) yielding 2145 respondents after corrections. The age range for the study sample was 13 to 21 years old (mean = 15.8, standard deviation = 1.19). The vast majority were 14 to 17 years old (93%) and 45% were 16 years old. Less than 2% were aged 13 or 19 to 21.

Did you use a condom the last time you had intercourse?	Male	Female	Total
Yes	700	744	1444
No	244	457	701
Total	944	1201	2145

a. Find E_{21} (the expected value for the cell in the second row and first column)

b. Find E_{22}

c. Finish finding the expected values and use a 2.5% significance level to test the claim that condom use and gender are independent.

18. The table below has data from a 2009 Canadian Journal of Human Sexuality study. The data shows gender differences in response to partner influence and social expectation questions among students who had ever had sexual intercourse. The sample for this study included only students who had ever had sexual intercourse (30.7% of the total sample) yielding 2145 respondents after corrections. The age range for the study sample was 13 to 21 years old (mean = 15.8, standard deviation = 1.19). The vast majority were 14 to 17 years old (93%) and 45% were 16 years old. Less than 2% were aged 13 or 19 to 21. Use the results and a 1% significance level to test the claim that unwanted sex and gender are independent.

Have had sex when did not want to	Male	Female	Total
Yes	826	883	1709
No	118	318	436
Total	944	1201	2145

19. Use the table below, which is from a study on vitamin C intake and the common cold, to test if vitamin C intake and colds are independent.

Status	Vitamin C Group	Placebo Group	Total
Children free of colds	21	11	32
Children developing colds	36	35	71
Total	57	46	103

20. Use the table below, which is from a study on heart disease and smoking, and a 0.005 significance level to test if smoking and heart disease are related.

Risk Factor	Heart Disease	No Heart Disease	Total
Smoker	25	10	35
Nonsmoker	14	51	65
Total	39	61	100

21. The table below lists the marital status for a random selection of government employees along with their job status. Use the table and a 5% significance level to test if job grade and marital status are independent (note: the test statistic is $\chi^2 = 67.397$).

	Marital status				
Job grade	Single	Married	Divorced	Widowed	Total
Low-skilled	58	874	15	8	955
Blue collar	222	3927	70	20	4269
White collar	50	2396	34	10	2490
Supervisor	7	533	7	4	551
total	337	7730	126	42	8235

22. The table below has data from a 2009 Canadian Journal of Human Sexuality study. The data shows gender differences in response to partner influence and social expectation questions among students who had ever had sexual intercourse. The sample for this study included only students who had ever had sexual intercourse (30.7% of the total sample) yielding 2145 respondents after corrections. The age range for the study sample was 13 to 21 years old (mean = 15.8, standard deviation = 1.19). The vast majority were 14 to 17 years old (93%) and 45% were 16 years old. Less than 2% were aged 13 or 19 to 21. Use the results and a 2.5% significance level to determine if the number of sexual partners and gender are related.

Number of partners	Male	Female	Total
1	428	640	1068
2	163	226	389
3	95	131	226
4+	258	204	462
total	944	1201	2145

Table to calculate $\sum \frac{(O-E)^2}{E}$:

O – E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
-42.0196	1765.647	3.756535
-8.1963	67.17933	0.392403
-4.4611	19.90141	0.200093
54.6769	2989.563	14.70373
42.0196	1765.647	2.952685
8.1963	67.17933	0.308445
4.4611	19.90141	0.157274
-54.6769	2989.563	11.55699

Assignment 20

23. True or False: In general, nonparametric tests are less powerful than our parametric tests.

24. Use the binomial table to calculate the following binomial probability: $P(x \geq 6)$ for $n = 7,\ p = 0.50$

25. Use the binomial table to calculate the following binomial probability: $P(x \geq 5)$ for $n = 9,\ p = 0.50$

26. Use the binomial table to calculate the following binomial probability: $P(x \geq 8)$ for $n = 8,\ p = 0.50$

27. Use the binomial table to calculate the following binomial probability: $P(x \geq 10)$ for $n = 15,\ p = 0.50$

28. Use the binomial table to calculate the following binomial probability: $P(x \geq 15)$ for $n = 25,\ p = 0.50$

29. Use the normal approximation to calculate the probability that $P(x \geq 17)$ for $n = 30,\ p = 0.50$.

30. Use the normal approximation to calculate the probability that $P(x \geq 21)$ for $n = 39,\ p = 0.50$.

31. Use the normal approximation to calculate the probability that $P(x \geq 19)$ for $n = 32,\ p = 0.50$.

32. An oceanographer believes the median wave height off of South Florida's coast is more than 1.9 feet. Wave heights were measured for a random selection of 20 days. At the 5% significance level, use the sign test to determine if there is enough evidence to reject the claim?

2.3	1.5	1.4	2.2	1.3	1.0	3.0	1.9	2.2	1.5
1.2	2.2	2.1	1.6	2.0	1.7	1.7	2.9	1.4	1.2

33. I like to eat at PF. Chang's, but I believe that the median sodium content of their dishes is higher than 2,300 mg (the recommended daily sodium intake for a normal person). Below, I have included the sodium content for a random selection of ten dinner entrees served at PF. Chang's. Use the sign test to test my claim at the 1% significance level.

6,774	6,475	3,202	2,450	5,141	3,306	3,484	1,362	2,262	2,532

34. I'm a little surprised by this result, so I argue that I couldn't reject the null because the sign test is such a weak test. Is there any validity to this argument?

35. As I said, I do like to eat at PF. Chang's, but I also believe that the median calorie content of their dishes is higher than 1,142 calories (half the recommended daily calorie intake for a normal person my size and age). Below, I have included the calorie content for a random selection of ten dinner entrees served at PF. Chang's. Use the sign test to test my claim at the 2% significance level.

1122	1281	2110	558	681	603	1485	1236	774	858

Assignment 21

36. I claim that half the class should be able to finish exam 3 for STA 3123 on-line, which has 29 questions and a 200 minute time limit, in less than 145 minutes. A random selection of completion times is included below. Use a 5% significance level and the sign test to test my claim.

132	135	152	199	103	77	199	104	76

37. A critic of soccer complains that half of all the games played have less than 2 goals scored in the regulation 90 minutes of play. Use the sample of match results below from a random selection of professional games around the globe, the sign test, and a 10% significance level to test the critic's claim.

4	3	5	4	1	3	1	2	2	5	3	0

38. A consumer affairs reporter claims that the median price for the pairs of jeans in typical fashion magazines is $153.00. A random selection of fashion magazines produces the following prices. Use a 5% significance level and the sign test to test the reporter's claim.

$192	$160	$202	$550	$172	$125	$19.99	$49.50	$64.00	$202	$178	$216

39. A researcher claims that the "freshman fifteen" is a myth. The "freshman fifteen" is a reference to the amount of body weight gained by the typical student during their freshman year. The researcher claims that the median weight change is zero. Use the data below which is the weight change for a random selection of students and the sign test to test the researcher's claim at a 10% significance level.

2	4	8	-4	11	2	-2	-7	7	-2	6	4	5	4	3

40. Use the following information and the sign test to determine if the median salary for college professors at FIU exceeds $72,000 (72k): Among 50 randomly chosen professors, 42 had salaries higher than 72k, seven had salaries less than 72k, and one had a salary equal to 72k.

41. Use the following information, a 10% significance level, and the sign test to determine if the median waiting time in doctor's offices in Vienna, Austria is less than 18 minutes: Among 168 doctor's visits, 92 have less than 18 minutes of wait-time and 76 have more than 18 minutes of wait-time.

42. Use the following information, a 1% significance level, and the sign test to determine if the median exam grade is 75%: Among 192 randomly selected exams, 66 are below a 75%, 22 are equal to a 75%, and 104 are above a 75%.

43. Rank the following set of data values:

65	13	54	28	14	90	34	27	14	67
12	57	13	89	15	78	72	13	92	22

44. Find the critical value(s) and the rejection region for the following Wilcoxon Rank-Sum Tests:
   a. Left-tailed test (D1 is shifted to the left of D2) with 2.5% significance and $n_1 = 7, n_2 = 8$.
   b. Right-tailed test (D1 is shifted to the right of D2) with 5% significance and $n_1 = 10, n_2 = 9$.
   c. Two-tailed test with 10% significance and $n_1 = 9, n_2 = 8$.
   d. Two-tailed test with 5% significance and $n_1 = 5, n_2 = 5$.

45. The results of independent random samples from two populations are shown below.

Sample A: 41.5, 52.0, 44.7, 43.1, 45.5, 51.1
Sample B: 36.1, 41.3, 44.0, 53.3, 57.3, 49.1, 51.2, 56.1

Calculate the rank sum for each sample. Which would be used as the test statistic in a Wilcoxon rank sum test?

46. At a local community college students have the option of using the TI-83 graphing calculators in their STA 2023 course. About the half of the population of students uses the calculators. The data below lists the completion times for students taking the third exam in that course. At the 5% significance level, test the claim that the probability distributions associated with the two types of students are equivalent.

Calculators	26	35	36	69	54	58	38	73	80	82
No Calculators	25	45	62	102	75	70	82	67	36	90

47. Let's now try to determine if one group of students does better than the other group regardless of how long they take to finish the exam. At the 5% significance level, test the claim that the probability distributions associated with the calculator group is shifted to the right of the other group (again the data is a random selection of the students who took the third exam).

Calculators	69	75	94	46	70	86	81	96	73	74
No Calculators	100	100	83	56	93	75	99	82	68	78

48. In a genetic inheritance study discussed by Margolin [1988], samples of individuals from several ethnic groups were taken. Blood samples were collected from each individual and several variables measured. We shall compare the groups labeled "Native American" and "Caucasian" with respect to the variable MSCE (mean sister chromatid exchange). At the 5% significance level, test the claim that the probability distributions associated with the two groups are equivalent. The data is as follows:

Native American: 8.50, 9.48, 8.65, 8.16, 8.83, 7.76, 8.63
Caucasian: 8.27, 8.20, 8.25, 8.14, 9.00, 8.10, 7.20, 8.32, 7.70

49. Suppose a verbal comprehension test is given to independent samples of educationally handicapped (EH) and educable mentally retarded (EMR) children. The scores from the test are given in the table below. At the 2.5% significance level, test the claim that the probability distributions associated with the EH group is shifted to the right of the other group.

Educationally Handicapped (EH)	77	78	70	72	65	74	
Educable Mentally Ret. (EMR)	60	62	70	76	68	72	70

50. To study the effects of prolonged in-halation of cadmium, researchers exposed 10 dogs to cadmium oxide while 10 dogs serving as controls were not exposed to this substance. At the end of the experiment, they determined levels of hemoglobin of the 20 dogs, as shown in the table below.

Hemoglobin Determinations (grams/dl) in 20 Dogs										
Exposed to Cadmium Oxide:	14.6	15.8	16.4	14.6	14.9	14.3	14.7	17.2	16.8	16.1
Controls:	15.5	17.9	15.5	16.7	17.6	16.8	16.7	16.8	17.2	18.0

Use a 2.5% significance level to test whether the levels of hemoglobin for the dogs exposed to cadmium oxide is to the left of that of the population of dogs which were not.

Assignment 22

51. A strength training program is designed to improve core strength. To test its effectiveness, 12 patients are timed in seconds while holding a position called the plank before and after a 3 week strength program. Use the results below, the Wilcoxon Sign-Rank Test, and a 1% significance level to test the claim that the program increases core strength.

Pre-Program	38	47	63	50	41	30	35	34	44	43	46	52
Post-program	67	92	120	75	69	60	68	65	131	122	120	135

52. Remember the PF. Chang's sodium problem? I believed that the median sodium content of their dishes is higher than 2,300 mg (the recommended daily sodium intake for a normal person). We analyzed the data using the sign test, but we were unable to reject the null. I have included the sodium content for a random selection of ten dinner entrees served at PF. Chang's. This time, use the Wilcoxon Sign-Rank test to test my claim at the 5% significance level.

6,774	6,475	3,202	2,450	5,141	3,306	3,484	1,362	2,262	2,532

53. An English teacher wants to test if her grammar instruction is effective. Ten students are pre and post tested by counting the number of errors missed by the students reading an essay. Use the results below, the Wilcoxon Sign-Rank Test, and a 1% significance level to test the claim that the program produces some change in the student's ability to spot errors in written work.

Pre-test	12	14	5	21	17	18	4	7	13	10	
Post-test	8	11	0	12	7	10	1	2	4	7	

54. A fitness researcher has decided to test the weight loss effects of a sprinting program versus a traditional jogging plan. Each participant engaged in the running programs for 3 months, but some did the jogging first and other did the sprinting first. Use the results below, the Wilcoxon Sign-Rank Test, and a 5% significance level to test the claim that the sprinting program produces more weight loss than the jogging.

Sprinting weight loss	10	6	5	12	15	12	4	8	9	
Jogging weight loss	8	4	0	12	8	10	1	2	11	

55. A lot of test prep programs claim that they will improve student scores, but a retake may improve test scores without the expensive test prep. Eight students took the LSAT twice to see if there was an improvement on the second attempt. Use the results below, the Wilcoxon Sign-Rank Test, and a 5% significance level to test the claim that there is a difference between the two attempts. What do these results say about the test prep industry?

1^{st} score	161	143	142	152	145	147	143	155
2^{nd} score	165	148	150	154	145	152	150	159

56. Clothing manufacturers use a wear-testing machine to measure different fabrics' ability to withstand abrasion. The wear of the material is measured by weighing the clothing after it has been through the wear-testing machine. A manufacturer wants to determine if there is a difference between the average weight loss among four different materials. The experiment is done by using four samples of each kind of material. The samples were tested in a completely randomized order. The weights are listed below. Use the data below, the Kruskal-Wallis H-test, and a 1% significance level to determine if at least one fabric is significantly different from the others.

Fabric			
A	B	C	D
1.93	2.55	2.40	2.33
2.38	2.72	2.68	2.40
2.20	2.75	2.31	2.28
2.25	2.70	2.28	2.25

57. A study was conducted to determine the factor that reduces blood pressure the most, medication, diet, or exercise. Fifteen patients at a hospital with comparable levels of high blood pressure are randomly assigned to each treatment group. After eight weeks, the drop in systolic blood pressure for each patient was measured. Use the data below, the Kruskal-Wallis H-test, and a 5% significance level to test the claim that all three of the treatments produce the same drop in blood pressure.

Treatment		
Medication	Exercise	Diet
11	7	12
10	8	6
8	4	10
14	2	8
13	3	5

58. Glue Strength: Four adhesives that are used to fix porcelain to teeth are tested in a completely randomized design. The experiment bonds porcelain to teeth and then a machine is used to pry the tooth from the porcelain. The amount of force needed to do this for each bond is recorded. Use the data below, the Kruskal-Wallis H-test, and a 2.5% significance level to construct an ANOVA table to test the claim that there is a significant difference between the bonding strengths.

Adhesive			
204	197	264	248
181	223	226	138
203	232	249	220
262	207	255	304
230	223	237	268
288	197	240	276

59. The effects of four types of graphite coater on light-box readings are to be studied. Since readings will differ from day to day, observations are taken on each of the four types every day. The results are as follows:

	Graphite coater type			
Day	M	A	K	L
1	4	4.8	5	4.6
2	4.8	5	5.2	4.6
3	4	4.8	5.6	5

Use the Friedman $F_r - Test$ at the 5% level test the claim that all of the graphite coaters produce the same average light-box readings.

60. Test anxiety can hinder academic performance, so a researcher wants to compare the effectiveness of three treatments to reduce test anxiety. The procedure is used on 5 different students. Use the resulting data below, the Friedman $F_r - Test$, and a 1% significance level to test the claim that the three different methods reduce anxiety equally.

	Anxiety level on a visual-analogue scale		
Subject	Beta Blocker	Valerian Root	Meditation
1	2.7	1.3	1
2	3.9	3.6	3.1
3	4.1	4.2	3.9
4	4.3	4.1	4
5	2.9	2.8	2.2

61. Grocery costs vary for different families, but a researcher wants to study the weekly cost of groceries for typical Florida families at four different grocery chains in South Florida. To do this the researcher looks at weekly costs for groceries at the four stores for four different families. Each family will visit a different one of the four stores to shop each week for a month. The families will randomly be assigned to the stores each week. Use the resulting data below, the Friedman $F_r - Test$, and a 2.5% significance level to test the claim that the four stores have different average grocery prices.

	Store			
Family	Publix	Target	Costco	Whole Foods
1	210	195	200	315
2	300	250	275	400
3	176	171	189	223
4	148	127	130	162

Answers:

1. No, there is not a clearly defined k, the fixed number of possible outcomes.
2. Yes with n = 500 and k = 4
3. No, there is no fixed number of trials (i.e. – no n).
4. No, because one of the expected cell counts is below 5:

Blue-collar	White-collar	Executives
50	35	4
89*.5 = 44.5	89*.45 = 40.5	89*.05 = 4.45

5. Yes, because $\rho_B = \rho_M = \rho_P = \rho_O$ implies the expected value will be based on (category total)/4 and each of these expectations is greater than 5.
6. a. 24.9958, b.66.7659, c. 30.8133, d. 71.4202
7. a. 11.3449, b. 11.0705, c. 7.77944
8. χ^2 = 0.11453
9. χ^2 = 10.8154

$$\frac{(O-E)^2}{E} \Rightarrow$$

0.4069	7.8469	0.5608	2.0008

10. χ^2 = 29.1333

$$\frac{(O-E)^2}{E} \Rightarrow$$

1.8	18	8.3333	1

11. $H_0 : \rho_{Blue} = .24, \rho_{Brown} = .14, \rho_{Green} = .16, \rho_{Orange} = .20, \rho_{Red} = .13, \rho_{Yellow} = .14$

H_A : At least one proportion differs significantly.

Test Stat: 48.170

Critical Value: 15.0863

Reject the null, support the alternative.

The sample data allows us to reject M&M's claim. At least one color appears significantly more or less than reported.

12. $H_0 : \rho_{UI} = .13, \rho_{PR} = .20, \rho_{EP} = .67$

H_A : At least one proportion differs significantly.

Test Stat: 84.945

Critical Value: 5.99147

Reject the null, support the alternative.

The sample data allows us to reject the government's claim.

13. $H_0 : \rho_P = .90, \rho_A = .07, \rho_E = .03$

H_A : At least one proportion differs significantly.

Test Stat: 24.333

Critical Value: 7.37776

Reject the null, support the alternative.

The sample data allows us to reject the industry's claim.

14. $H_0 : \rho_g = \rho_o = \rho_r = \rho_p = \rho_y$

H_A : At least one proportion differs significantly.

Test Stat: 1.4421

Critical Value: 7.77944

Do not reject the null, do not support the alternative.

The sample data does not allow us to reject Skittle's claim.

15. $H_0 : \rho_A = .10, \rho_B = .15, \rho_C = .25, \rho_F = .50$

H_A : At least one proportion differs significantly.

Test Stat: 10.54

Critical Value: 7.81473

Reject the null, support the alternative.

The sample data allows us to reject the professor's claim.

16. $E_i = 623$

$H_0 : \rho_1 = \rho_2 = \rho_3 = \rho_4$

H_A : At least one proportion differs significantly.

Test Stat: 340.44

Critical Value: 6.251

Reject the null, support the alternative.

The sample data allows us to reject the claim that the age groups have equal proportions of tattooed members.

17. A. 308.1
    B. 392.49
    C.

H_0 : The two categories are independent.

H_a : The two categories are dependent.

$TestStat : \chi^2 = 35.783$

$CriticalValue = \chi^2_{0.025,1} = 5.02$

$Conclusion$: The categories seem to be related.

18. H_0 : The two categories are independent.

    H_a : The two categories are dependent.

    $TestStat : \chi^2 = 63.768$

    $CriticalValue = \chi^2_{0.01,1} = 6.63$

    Conclusion: The data allows us to reject the claim of independence. The categories seem to be related.

    Expected values:

752.119	956.881
191.881	244.119

19. H_0 : The two categories are independent .

    H_a : The two categories are dependent.

    $TestStat : \chi^2 = 1.987$

    $CriticalValue = \chi^2_{0.05,1} = 3.841$

    $Conclusion$: The data does not allow us to reject the claim of independence. The categories do not seem to be related.

    Expected values:

17.709	14.291
39.291	31.709

20. H_0 : The two categories are independent .

    H_a : The two categories are dependent.

    $TestStat : \chi^2 = 23.802$

    $CriticalValue = \chi^2_{0.005,1} = 7.879$

    $Conclusion$: The data supports the claim. The categories seem to be related.

    Expected values:

13.65	21.35
25.35	39.65

21. H_0 : The two categories are independent.
H_a : The two categories are dependent.
$TestStat : \chi^2 = 67.397$
$CriticalValue = \chi^2_{0.05,9} = 16.919$
$Conclusion$: The data allows us to reject the claim of independence.

22. H_0 : The two categories are independent.
H_a : The two categories are dependent.
$TestStat : \chi^2 = 34.028$
$CriticalValue = \chi^2_{0.025,3} = 9.348$
$Conclusion$: The data allows us to support the claim of dependence.

23. True
24. 1 - $P(x \le 5)$ = 0.063
25. 1 - $P(x \le 4)$ = 0.500
26. 1 - $P(x \le 7)$ = 0.004
27. 1 - $P(x \le 9)$ = 0.151
28. 1 - $P(x \le 14)$ = 0.212
29. $P(z \ge 0.55) = 0.2912$
30. $P(z \ge 0.32) = 0.3745$
31. $P(z \ge 0.88) = 0.1894$
32. $H_0 : \eta \le 1.9$
$H_a : \eta > 1.9$
$TestStat : S = 8$
P-value: $n = 19, p = 0.50, P(x \ge 8)$ = 0.820
Since $\rho > \alpha$, do not reject the null; the sample data does not support the claim.
33. $H_0 : \eta \le 2,300$
$H_a : \eta > 2,300$
$TestStat : S = 8$
P-value: $n = 10, p = 0.50, P(x \ge 8)$ = 0.055
Since $\rho > \alpha$, do not reject the null; the sample data does not support the claim.
34. Yes, whenever you do not reject the null with a weak test, it is possible that you could have rejected the null with a more powerful test. It seems especially likely in this instance since the p-value is only 5.5% and so many of our data values where well above 2,300 mg. We will visit this data again with a more powerful test to see if we can do better.

35. $H_0 : \eta \le 1{,}142$

$H_a : \eta > 1{,}142$

$TestStat : S = 4$

P-value: $n = 10,\ p = 0.50, P\left(x \ge 4\right)$ = 0.828

Since $\rho > \alpha$, do not reject the null; the sample data does not support the claim.

36. $H_0 : \eta \ge 145$

$H_a : \eta < 145$

$TestStat : S = 6$

P-value: $n = 9,\ p = 0.50, P\left(x \ge 6\right)$ = 0.254

Since $\rho > \alpha$, do not reject the null; the sample data does not support the claim.

37. $H_0 : \eta \ge 2$

$H_a : \eta < 2$

$TestStat : S = 3$

P-value: $n = 10,\ p = 0.50, P\left(x \ge 3\right)$ = 0.945

Since $\rho > \alpha$, do not reject the null; the sample data does not support the claim.

38. $H_0 : \eta = 153$

$H_a : \eta \ne 153$

$TestStat : S_+ = 8$

P-value: $n = 12,\ p = 0.50, 2 * P\left(x \ge 8\right)$ = 0.388

Since $\rho > \alpha$, do not reject the null; the sample data does not allow us to reject the claim.

39. $H_0 : \eta = 0$

$H_a : \eta \ne 0$

$TestStat : S_+ = 11$

P-value: $n = 15,\ p = 0.50, 2 * P\left(x \ge 11\right)$ = 0.118

Since $\rho > \alpha$, do not reject the null; the sample data does not allow us to reject the claim.

40. Conclusion: Reject the null, support the alternative.

$H_A : \eta > 72k$

$H_0 : \eta \le 72k$

$$z = \frac{\left(S_{\min} + 0.5\right) - \frac{n}{2}}{\frac{\sqrt{n}}{2}} = \frac{\left(7 + 0.5\right) - \frac{49}{2}}{\frac{\sqrt{49}}{2}} = -4.86$$

$Critical value : -1.645$

41. Conclusion: Do not reject the null, do not support the alternative.

$H_A: \eta < 18$

$H_0: \eta \geq 18$

$$z = \frac{(S_{\min} + 0.5) - \frac{n}{2}}{\frac{\sqrt{n}}{2}} = \frac{(76 + 0.5) - \frac{168}{2}}{\frac{\sqrt{168}}{2}} = -1.16$$

$Critical value: -1.282$

42. Conclusion: Reject the null, support the alternative.

$H_A: \eta \neq 75$

$H_0: \eta = 75$

$$z = \frac{(S_{\min} + 0.5) - \frac{n}{2}}{\frac{\sqrt{n}}{2}} = \frac{(66 + 0.5) - \frac{170}{2}}{\frac{\sqrt{170}}{2}} = -2.84$$

$Critical value: -2.576$

43.

Data	65	13	54	28	14	90	34	27	14	67
Rank	14	3	12	10	5.5	19	11	9	5.5	15
Data	12	57	13	89	15	78	72	13	92	22
Rank	1	13	3	18	7	17	16	3	20	8

44. A. $T_1 < 39$ B. $T_2 < 69$ C. $T_2 < 54$ or $T_2 > 90$ D. T < 18 or T > 37

45. Sample A: 3, 11, 6, 4, 7, 9 $T_1 = 40$

Sample B: 1, 2, 5, 12, 14, 8, 10, 13 $T_2 = 65$

Since $n_1 < n_2$, our test stat is $T_1 = 40$.

46. $H_0: D_1 \textit{ and } D_2 \textit{ are identical}$

$H_A: D_1$ is shifted either to the left or right of D_2

Ranks	2	3	4.5	12	8	9	6	14	16	17.5
	1	7	10	20	15	13	17.5	11	4.5	19

Test stat: T = $T_1 = 92$

Critical Value: T < 79 or T >131

Conclusion: Do not reject the null, do not support the alternative.

The data does not allow us to reject the claim…

47. $H_0: D_1$ *and* D_2 *are identical*

$H_A: D_1$ is shifted to the right of D_2

Ranks	4	8.5	16	1	5	14	11	17	6	7
	19.5	19.5	13	2	15	8.5	18	12	3	10

Test stat: T = $T_1 = 89.5$

Critical Value: T > 127

Conclusion: Do not reject the null, do not support the alternative.

The data does not support the claim…

48. $H_0: D_1$ *and* D_2 *are identical*

$H_A: D_1$ is shifted either to the left or right of D_2

Ranks	11	16	13	6	14	3	12			
	9	7	8	5	15	4	1	10	2	

Test stat: T = $T_1 = 75$

Critical Value: $T \le 41$ or $T \ge 78$

Conclusion: Do not reject the null, do not support the alternative.

The data does not allow us to reject the claim…

49. $H_0: D_1$ *and* D_2 *are identical*

$H_A: D_1$ is shifted to the right of D_2

Ranks	12	13	6	8.5	3	10				
	1	2	6	11	4	8.5	6			

Test stat: T = $T_1 = 52.5$

Critical Value: T > 56

Conclusion: Do not reject the null, do not support the alternative.

The data does not support the claim…

50. $H_0: D_1$ *and* D_2 *are identical*

$H_A: D_1$ is shifted to the left of D_2

Ranks	2.5	8	10	2.5	5	1	4	16.5	14	9
	6.5	19	6.5	11.5	18	14	11.5	14	16.5	20

Test stat: T = $T_1 = 72.5$

Critical Value: T < 79

Conclusion: Reject the null, support the alternative.

The data supports the claim…

51. The calculations:

Pre-Program	38	47	63	50	41	30	35	34	44	43	46	52
Post-program	67	92	120	75	69	60	68	65	131	122	120	135
Differences	-29	-45	-57	-25	-28	-30	-33	-31	-87	-79	-74	-83
Absolute Diff	29	45	57	25	28	30	33	31	87	79	74	83
Rank	3	7	8	1	2	4	6	5	12	10	9	11

$\begin{matrix} H_0 : \eta_d \geq 0 \\ H_A : \eta_d < 0 \end{matrix}$, $T_- = 78, T_+ = 0$, Test stat = 0. Critical Value = $T_0 = 9$,

Since the test stat is below the critical value we reject the null and support the claim.

52. The calculations:

Sodium	6,774	6,475	3,202	2,450	5,141	3,306	3,484	1,362	2,262	2,532
Diff	4474	4175	902	150	2841	1006	1184	-938	-38	232
Abs Dif	4474	4175	902	150	2841	1006	1184	938	38	232
Rank	10	9	4	2	8	6	7	5	1	3

$\begin{matrix} H_0 : \eta_d > 0 \\ H_A : \eta_d \leq 0 \end{matrix}$, $T_- = 6, T_+ = 49$, Test stat = 6. Critical Value = $T_0 = 10$,

Since the test stat is below the critical value we reject the null and support the claim. We have a better result this time since the Wilcoxon Signed Ranks test is more powerful than the sign test.

53. The calculations:

Pre-test	12	14	5	21	17	18	4	7	13	10
Post-test	8	11	0	12	7	10	1	2	4	7
Diff	4	3	5	9	10	8	3	5	9	3
Abs Dif	4	3	5	9	10	8	3	5	9	3
Rank	4	2	5.5	8.5	9	7	2	5.5	8.5	2

$\begin{matrix} H_0 : \eta_d = 0 \\ H_A : \eta_d \neq 0 \end{matrix}$, $T_- = 0, T_+ = 55$, Test stat = 0. Critical Value = $T_0 = 3$,

Since the test stat is below the critical value we reject the null and support the claim.

54. The calculations:

Sprinting weight loss	10	6	5	12	15	12	4	8	9
Jogging weight loss	8	4	0	12	8	10	1	2	11
Differences	2	2	5	0	7	2	3	6	-2
Abs Diff	2	2	5	0	7	2	3	6	2
Rank	2.5	2.5	6		8	2.5	5	7	2.5

$\begin{matrix} H_0 : \eta_d < 0 \\ H_A : \eta_d \geq 0 \end{matrix}$, $T_- = 2.5, T_+ = 33.5$, Test stat = 2.5. Critical Value = $T_0 = 5$,

Since the test stat is below the critical value we reject the null and support the claim.

55.The calculations:

1st score	161	143	142	152	145	147	143	155
2nd score	165	148	150	154	145	152	150	159
Diff	-4	-5	-8	-2	0	-5	-7	-4
Abs Dif	4	5	8	2		5	7	4
Rank	2.5	4.5	7	1		4.5	6	2.5

$H_0 : \eta_d = 0$
$H_A : \eta_d \neq 0$, $T_- = 28, T_+ = 0$, Test stat = 0. Critical Value = $T_0 = 2$,

Since the test stat is below the critical value we reject the null and support the claim.

56.The calculations:

Fabric							
A		B		C		D	
1.93	1	2.55	12	2.40	10.5	2.33	8
2.38	9	2.72	15	2.68	13	2.40	10.5
2.20	2	2.75	16	2.31	7	2.28	5.5
2.25	3.5	2.70	14	2.28	5.5	2.25	3.5
	15.5		57		36		27.5

$H_0 : \eta_1 = \eta_2 = ... = \eta_k$
H_A : At least 2 medians differ significantly, Test Stat: $H = 10.119$, C.Value = 11.345

Since the test stat is less than the critical value we do not reject the null and cannot support the claim.

57.The calculations:

Treatment					
Medication		Exercise		Diet	
11	12	7	6	12	13
10	10.5	8	8	6	5
8	8	4	3	10	10.5
14	15	2	1	8	8
13	14	3	2	5	4
	59.5		20		40.5

$H_0 : \eta_1 = \eta_2 = ... = \eta_k$
H_A : At least 2 medians differ significantly, Test Stat: $H = 7.805$, C.Value = 5.991

Since the test stat is more than the critical value we reject the null and the claim.

58.The calculations:

Adhesive							
204	6	197	3.5	264	20	248	16
181	2	223	9.5	226	11	138	1
203	5	232	13	249	17	220	8
262	19	207	7	255	18	304	24
230	12	223	9.5	237	14	268	21
288	23	197	3.5	240	15	276	22
	67		46		95		92

$H_0 : \eta_1 = \eta_2 = ... = \eta_k$

H_A : At least 2 medians differ significantly

Test Stat: $H = 5.313$, C.Value = 9.348

Since the test stat is less than the critical value we cannot reject the null and cannot support the claim.

59. The calculations:

	Graphite coater type							
Day	M		A		K		L	
1	4	1	4.8	3	5	4	4.6	2
2	4.8	2	5	3	5.2	4	4.6	1
3	4	1	4.8	2	5.6	4	5	3
		4		8		12		6

$H_0 : \eta_1 = \eta_2 = ... = \eta_k$

H_A : At least 2 medians differ significantly

Test Stat: $F_r = 7.00$, C.Value = 7.815

Since the test stat is less than the critical value we cannot reject the null and cannot reject the claim.

60. The calculations:

	Anxiety level on a visual-analogue scale					
Subject	Beta Blocker		Valerian Root		Meditation	
1	2.7	3	1.3	2	1	1
2	3.9	3	3.6	2	3.1	1
3	4.1	2	4.2	3	3.9	1
4	4.3	3	4.1	2	4	1
5	2.9	3	2.8	2	2.2	1
		14		11		5

$H_0 : \eta_1 = \eta_2 = ... = \eta_k$

H_A : At least 2 medians differ significantly

Test Stat: $F_r = 8.4$, C.Value = 9.210

Since, the test stat is less than the critical value we cannot reject the null and cannot reject the claim.

61. The calculations:

	Store							
Family	Publix		Target		Costco		Whole Foods	
1	210	3	195	1	200	2	315	4
2	300	3	250	1	275	2	400	4
3	176	2	171	1	189	3	223	4
4	148	3	127	1	130	2	162	4
		11		4		9		16

$H_0 : \eta_1 = \eta_2 = \ldots = \eta_k$

H_A : At least 2 medians differ significantly

Test Stat: $F_r = 11.1$, C.Value = 9.348

Since, the test stat is more than the critical value we reject the null and support the claim.