CHAPTER 11 FORM B

Name_____ Course Number:_____ Section Number:_____

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

Provide an appropriate response.

1) Describe the null hypothesis for the test of independence. List the assumptions for the χ^2 test of independence. What is the major difference between the assumptions for this test and the assumptions for the previous tests we have studied?

2) Define categorical data and give an example.

Perform the indicated goodness–of–fit test.

3) In studying the responses to a multiple–choice test question, the following sample data were obtained. At the 0.05 significance level, test the claim that the responses occur with the same frequency.

Response	A	B	C	D	E
Frequency	12	15	16	18	19

4) Among the four northwestern states, Washington has 51% of the total population, Oregon has 30%, Idaho has 11%, and Montana has 8%. A market researcher selects a sample of 1000 subjects, with 450 in Washington, 340 in Oregon, 150 in Idaho, and 60 in Montana. At the 0.05 significance level, test the claim that the sample of 1000 subjects has a distribution that agrees with the distribution of state populations.

According to Benford's Law, a variety of different data sets include numbers with leading (first) digits that follow the distribution shown in the table below. Test for goodness–of–fit with Benford's Law.

Leading Digit	1	2	3	4	5	6	7	8	9
Benford's law: distribution of leading digits	30.1%	17.6%	12.5%	9.7%	7.9%	6.7%	5.8%	5.1%	4.6%

5) When working for the Brooklyn District Attorney, investigator Robert Burton analyzed the leading digits of the amounts from 784 checks issued by seven suspect companies. The frequencies were found to be 0, 12, 0, 73, 482, 186, 8, 23, and 0, and those digits correspond to the leading digits of 1, 2, 3, 4, 5, 6, 7, 8, and 9, respectively. If the observed frequencies are substantially different from the frequencies expected with Benford's Law, the check amounts appear to result from fraud. Use a 0.05 significance level to test for goodness–of–fit with Benford's Law. Does it appear that the checks are the result of fraud?

Use a χ^2 test to test the claim that in the given contingency table, the row variable and the column variable are independent.

6) Responses to a survey question are broken down according to employment status and the sample results are given below. At the 0.10 significance level, test the claim that response and employment status are independent.

	Yes	No	Undecided
Employed	30	15	5
Unemployed	20	25	10

7) 160 students who were majoring in either math or English were asked a test question, and the researcher recorded whether they answered the question correctly. The sample results are given below. At the 0.10 significance level, test the claim that response and major are independent.

	Correct	Incorrect
Math	27	53
English	43	37

Solve the problem.

8) Use a 0.01 significance level to test the claim that the proportion of men who plan to vote in the next election is the same as the proportion of women who plan to vote. 300 men and 300 women were randomly selected and asked whether they planned to vote in the next election. The results are shown below.

	Men	Women
Plan to vote	170	185
Do not plan to vote	130	115

Provide an appropriate response.

9) The table below summarizes results from an experiment in which subjects were classified as asthmatic or nonasthmatic and then given a treatment. After the treatment, they were again classified as asthmatic or nonasthmatic. How many subjects appeared to be unaffected by the treatment one way or the other?

		Before Treatment	
		Asthmatic	Nonasthmatic
After Treatment	Asthmatic	9	2
	Nonasthmatic	15	6

A) 8 B) 17 C) 15 D) 32

10) The table below summarizes results from an experiment in which subjects were classified as asthmatic or nonasthmatic and then given a treatment. After the treatment, they were again classified as asthmatic or nonasthmatic. Identify the discordant pairs of results.

		Before Treatment	
		Asthmatic	Nonasthmatic
After Treatment	Asthmatic	7	6
	Nonasthmatic	13	12

A) The discordant pairs of results are (1) the 13 subjects who were asthmatic before the treatment and nonasthmatic after the treatment, and (2) the 12 subjects who were nonasthmatic before the treatment and nonasthmatic after the treatment.

B) The discordant pairs of results are (1) the 6 subjects who were nonasthmatic before the treatment and asthmatic after the treatment, and (2) the 13 subjects who were asthmatic before the treatment and nonasthmatic after the treatment.

C) The discordant pairs of results are (1) the 13 subjects who were nonasthmatic before the treatment and asthmatic after the treatment and (2) the 6 subjects who were asthmatic before the treatment and nonasthmatic after the treatment.

D) The discordant pairs of results are (1) the 6 subjects who were nonasthmatic before the treatment and asthmatic after the treatment, and (2) the 7 subjects who were asthmatic before the treatment and asthmatic after the treatment.

11) The table below summarizes results from an experiment in which subjects were classified as asthmatic or nonasthmatic and then given a treatment. After the treatment, they were again classified as asthmatic or nonasthmatic.Using the appropriate frequencies, find the value of the test statistic. Round to three decimal places if necessary.

		Before Treatment	
		Asthmatic	Nonasthmatic
After Treatment	Asthmatic	9	2
	Nonasthmatic	15	6

A) 9.941 B) 8.471 C) 9.882 D) 0.701

Find the test statistic χ^2 by McNemar's test.

12) categorical data: a =25, b = 15, c = 20, d = 10

A) 0.457 B) 5.600 C) 1.029 D) 2.314

1) The null hypothesis is that the row and column variables in a contingency table are independent; that is, they are not related. (The alternate hypothesis is that the row and column variables are dependent.) The assumptions are: 1) the sample data are randomly selected; 2) the sample data are frequency counts in the two−way table; and 3) each cell in the contingency table has an expected frequency E of at least 5. The major difference is that these assumptions do not require that the parent population be normally distributed.
2) Categorical data are data that can be separated into different nonnumeric names or labels at the nominal level of measurement. Examples will vary. Possible answer: Colors of recently manufactured hybrid vehicles.
3) H_0: The proportions of responses are all equal.
   H_1: The proportions of responses are not all equal.
   Test statistic: $\chi^2 = 1.875$. Critical value: $\chi^2 = 9.488$. Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the responses occur with the same frequency.
4) H_0: The distribution of the sample agrees with the distribution of state populations.
   H_1: The distribution of the sample does not agree with the distribution of state populations.
   Test statistic: $\chi^2 = 31.938$. Critical value: $\chi^2 = 7.815$. Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the distribution of the sample agrees with the distribution of the state populations.
5) H_0: Leading digits are from a population with a distribution that conforms to Benford's Law.
   H_1: Leading digits are not from a population distributed in accordance with Benford's Law.
   Test statistic $\chi^2 = 3701.725$ (by TI−84+, using high precision & verified by STATDISK). Critical value: $\chi^2 = 15.507$. P−value < 0.005 (by Table A−4); P−value = 0.0000 (by STATDISK). There is sufficient evidence to warrant rejection of the claim that the leading digits are from a population with a distribution that conforms to Benford's Law. It does appear that the checks are the result of fraud.
6) H_0: Employment status and response are independent.
   H_1: Employment status and response are dependent.
   Test statistic: $\chi^2 = 5.942$. Critical value: $\chi^2 = 4.605$.
   Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that response and employment status are independent.
7) H_0: Major and response are independent.
   H_1: Major and response are dependent.
   Test statistic: $\chi^2 = 6.502$. Critical value: $\chi^2 = 2.706$.
   Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that response and major are independent.
8) H_0: The proportion of men who plan to vote in the next election is the same as the proportion of women who plan to vote.
   H_1: The proportions are different.
   Test statistic: $\chi^2 = 1.552$. Critical value: $\chi^2 = 6.635$.
   Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the proportion of men who plan to vote in the next election is the same as the proportion of women who plan to vote.
9) C
10) B
11) B

12) A