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 a goodness–of–fit test. What assumptions are made when using a goodness–of–fit test?

2) In the Chi–Square test of independence, the formula used is $\chi^2 = \dfrac{\Sigma(O - E)^2}{E}$. Discuss the meaning of O and E and explain the circumstances under which the χ^2 values will be smaller or larger. What is the relationship between a significant χ^2 value and the values of O and E?

Perform the indicated goodness–of–fit test.

3) In studying the occurrence of genetic characteristics, the following sample data were obtained. At the 0.05 significance level, test the claim that the characteristics occur with the same frequency.

Characteristic	A	B	C	D	E	F
Frequency	28	30	45	48	38	39

4) You roll a die 48 times with the following results.

Number	1	2	3	4	5	6
Frequency	3	12	15	14	3	1

Use a significance level of 0.05 to test the claim that the die is fair.

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, 18, 0, 79, 476, 180, 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 gender and the sample results are given below. At the 0.05 significance level, test the claim that response and gender are independent.

	Yes	No	Undecided
Male	25	50	15
Female	20	30	10

7) The table below shows the age and favorite type of music of 668 randomly selected people.

	Rock	Pop	Classical
15–25	50	85	73
25–35	68	91	60
35–45	90	74	77

Use a 5 percent level of significance to test the null hypothesis that age and preferred music type are independent.

Solve the problem.

8) At a high school debate tournament, half of the teams were asked to wear suits and ties and the rest were asked to wear jeans and t–shirts. The results are given in the table below. Test the hypothesis at the 0.05 level that the proportion of wins is the same for teams wearing suits as for teams wearing jeans.

	Win	Loss
Suit	22	28
T–shirt	28	22

3

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. Explain why McNemar's test ignores the frequencies of 7 and 12.

		Before Treatment	
		Asthmatic	Nonasthmatic
After Treatment	Asthmatic	7	2
	Nonasthmatic	28	12

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. Using a 0.05 significance level, find the critical value.

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

A) 5.024   B) 6.635   C) 7.879   D) 3.841

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 values of the test statistic and critical value for a 0.05 significance level, what do you conclude?

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

A) Fail to reject the null hypothesis that the following proportions are equal: (1) The proportion of asthmatics who were nonasthmatic after the treatment; 1) the proportion of nonasthmatics who were asthmatic after the treatment. The treatment does not appear to be effective.

B) Fail to reject the null hypothesis that the following proportions are unequal: (1) The proportion of asthmatics who were nonasthmatic after the treatment; 1) the proportion of nonasthmatics who were asthmatic after the treatment. The treatment does not appear to be effective.

C) Reject the null hypothesis that the following proportions are unequal: (1) The proportion of asthmatics who were nonasthmatic after the treatment; 1) the proportion of nonasthmatics who were asthmatic after the treatment. The treatment appears to be effective.

D) Reject the null hypothesis that the following proportions are equal: (1) The proportion of asthmatics who were nonasthmatic after the treatment; 1) the proportion of nonasthmatics who were asthmatic after the treatment. The treatment appears to be effective.

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

12) categorical data: a =50, b = 60, c = 85, d = 15

A) 4.267   B) 4.303   C) 3.972   D) 5.673

1) A goodness-of-fit test is used to test the hypothesis that an observed frequency distribution fits some claimed distribution. The assumptions are 1) the sample data are randomly selected; 2) the sample data consists of frequency counts for the different categories; and 3) for each of the categories, the expected frequency is at least 5.

2) The O represents the observed frequencies. The E represents the expected frequencies based on the assumption of independence. The χ^2 value will be smaller when the difference between observed and expected frequencies is small and will be larger when the difference between observed and expected frequencies is large. The χ^2 value will be significant when there is a significant difference between the observed and expected values.

3) H_0: The proportions of occurrences are all equal.

   H_1: Those proportions are not all equal.

   Test statistic: $\chi^2 = 8.263$. Critical value: $\chi^2 = 11.071$. Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the characteristics occur with the same frequency.

4) H_0: The die is fair (all numbers occur with equal frequency).

   H_1: The die is not fair.

   Test statistic: $\chi^2 = 25$. Critical value: $\chi^2 = 11.070$. Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the die is fair.

5) H_0: Leading digits are from a population that conforms to Benford's Law.

   H_1: Leading digits are not from a population distributed in accordance with Benford's Law.

   Test statistic $\chi^2 = 3580.8858$ (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: Gender and response are independent.

   H_1: Gender and response are dependent.

   Test statistic: $\chi^2 = 0.579$. Critical value: $\chi^2 = 5.991$.
   Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that response and gender are independent.

7) H_0: Age and preferred music type are independent.

   H_1: Age and preferred music type are dependent.

   Test statistic: $\chi^2 = 12.954$. Critical value: $\chi^2 = 9.488$.
   Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that age and preferred music type are independent.

8) H_0: The proportion of wins is the same for teams wearing suits as for teams wearing jeans.

   H_1: The proportions are different.

   Test statistic: $\chi^2 = 1.440$. Critical value: $\chi^2 = 3.841$.
   Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the proportion of wins is the same for teams wearing suits as for teams wearing

9) When using McNemar's test, we are testing for a difference in proportion between two different categories. The subjects with the same status before and after the test will not help in detecting differences.

10) D

11) D

12) C