Multiple choice

Scenario 11-2

To test the effectiveness of a certain computer software's random number generator, I randomly select 1000 numbers from a standard Normal distribution. I classify these 1000 numbers according to whether their values are at most –2, between –2 and 0, between 0 and 2, or at least 2. The results are given in the following table. The expected counts, based on the 68-95-99.7 rule, are given as well.

Observed Count	18	492	468	22
Expected Count	25	475	475	25

To test to see if the distribution of observed counts differs significantly from the distribution of expected counts, we use a χ^2 test.

1.

Use Scenario 11-2. For this test, the x^2 statistic has approximately a chi-square (χ^2) distribution. How many degrees of freedom does this distribution have?

a. 3.
b. 4.
c. 7.
d. 999.
e. 1000.

2.

Use Scenario 11-2. The value of the χ^2 statistic is found to be 3.03. The *P*-value of the test is

a. greater than 0.20.
b. between 0.10 and 0.20.
c. between 0.05 and 0.10.
d. between 0.01 and 0.05.
e. less than 0.01.

3.

Scenario 11-3

An ambitious reporter for a large university newspaper suspects that Mr. Hazzard, a new statistics teacher, is grading his introductory statistics students too harshly. From school records the reporter determines that over the past 2 years the proportions of students in *all* sections of introductory statistics (taught by many different teachers) received grades of A, B, C, D, or F in the following proportions: A: 0.20; B: 0.30; C: 0.30; D: 0.10; and F: 0.10. The reporter then takes an SRS of 90 students who took introductory statistics with Mr. Hazzard in the past two years and gathers the following information:

Grade	A	B	C	D	F
Number of students	12	26	28	15	9

Use Scenario 11-3. Which of the following expressions represents the expected count of the grade category D?

a. $\dfrac{90}{5}$

b. $(0.10)(90)$

c. $(0.10)(15)$

d. $\dfrac{15^2}{90}$

e. $\dfrac{(15-9)^2}{90}$

4.

. Use Scenario 11-3. The computed value of the χ^2 statistic for the reporter's test is 6.074, which produces a *P*-value of 0.1937. Which of the following is an appropriate conclusion?

a. Reject H_0: there is convincing evidence from the test that the grade distribution of the new teacher is different from that of other teachers.

b. Accept H_a: there is convincing evidence from the test that the grade distribution of the new teacher is harsher than that of other teachers.

c. Fail to reject H_0: there is insufficient evidence from the test to conclude that the grade distribution of the new teacher is different from that of other teachers.

d. Fail to reject H_a: there is convincing evidence from the test that the grade distribution of the new teacher is less harsh than that of other teachers.

e. Accept H_0: there is convincing evidence from the test that the grade distribution of the new teacher is different from that of other teachers.

5.

Which of the following is a condition that must be satisfied to use a chi-square goodness-of-fit test?
a. The expected count for each category is at least 5.
b. The sample size is greater than 30.
c. The expected count is the same for each category.
d. The number of categories is small relative to the number of observations.
e. The population distribution is approximately Normal.

Free Response Questions

1. Computer software generated 500 random numbers that should look like they are from the uniform distribution on the interval 0 to 1. They are categorized into five groups: (1) less than or equal to 0.2 (2) greater than 0.2 and less than or equal to 0.4, (3) greater than 0.4 and less than or equal to 0.6, (4) greater than 0.6 and less than or equal to 0.8, and (5) greater than 0.8. The counts in the five groups are 113, 95, 108, 99, and 85, respectively.

   a. The probabilities for these five intervals are all the same. What is this probability?
   b. Compute the expected count for each interval for a sample of 500.
   c. Perform the goodness of fit test and summarize your results. Report the χ^2 statistic, the P-value and write an appropriate conclusion.

2.

For 1000 shoppers donating blood at a mall, the frequencies of blood types were as shown in the table below. Consider this an SRS of all mall shoppers.

Blood Type	O	A	B	AB
Observed	465	394	96	45
Expected				

Theory says that these blood types should be as follows: Type O = 50%, Type A = 35%, Type B = 10% and Type AB = 5%. (The Alpha level = .10) Here are the hypotheses we will test:

   Ho: Mall shoppers have the same blood type proportions as the general public
   Ha: Mall shoppers DO NOT have the same blood type proportions as the general public

a) Compute the expected counts – fill in the table above.
b) Use the results of part (a) to show the entire calculation of the chi-square statistic.

c) What is the p-value of this test? _____

d) What is the conclusion of this test (write a sentence in context of the problem).

Answers:

MC

1. a
2. a
3. b
4. c
5. a

Free Response

_____

1. Goodness of Fit Test – Equal Proportions

a) Since there are 5 groups, the probability is $1/5 = 0.2$

b) Since there are 500 numbers generated, expected counts are $500(0.2) = 500/5 = 100$

c) The χ^2 statistic is 4.84. There are 4 degrees of freedom here, so the p-value is .3041.

Conclusion: Since the p-value is high (p>.05), we fail to reject the null hypothesis. So we can conclude that the random numbers are uniformly distributed among the 5 groups.

2.

Answer

For 1000 shoppers donating blood at a mall, the frequencies of blood types were as shown in the table below. Consider this an SRS of all mall shoppers.

Blood Type	O	A	B	AB
Observed	465	394	96	45
Expected	500	350	100	50

Theory says that these blood types should be as follows: Type O = 50%, Type A = 35%, Type B = 10% and Type AB = 5%. (The Alpha level = .10) Here are the hypotheses we will test:

Ho: Mall shoppers have the same blood type proportions as the general public
Ha: Mall shoppers DO NOT have the same blood type proportions as the general public

a) Compute the expected counts – fill in the table above.

b) Use the results of part (a) to show the entire calculation of the chi-square statistic.

$$x^2 = \frac{(465-500)^2}{500} + \frac{(394-350)^2}{350} + \frac{(96-100)^2}{100} + \frac{(45-50)^2}{50}$$

$$2.45 \quad + \quad 5.53 \quad + \quad .16 \quad + \quad .5 = 9.56$$

$$x^2 = 8.64$$

c) What is the p-value of this test? From the table_____.025 ≤ P ≤ .05_____

d) What is the conclusion of this test (write a sentence in context of the problem).

With a p value of between .025 and .05 and an Alpha Level of .10 we reject the null. We have reason to believe the blood types for the mall shoppers differs from that of the population blood type distribution.