AP Statistics – Chapter 11 Practice Test: The Chi-Square Distributions

Part II, Free Response – Show all work and communicate completely and clearly.

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	Total
Frequency	465	394	96	45	1000

   In the general population, the blood type distribution is as follows:
   Type O = 45%, Type A = 40%, Type B = 10%, Type AB = 5%,.
   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 for this table.
   b. Use the results of part (a) to compute the chi-square statistic – show the entire calculation from the chi-square formula.
   c. What is the p-value of this test?
   d. What is the conclusion of this test (write a sentence or two in context of the problem).

3. A study of the career plans of young women and men sent questionnaires to all 390 members of the senior class in the College of Business Administration at the University of Illinois. One question asked which major within the business program the student had chosen. Here are the data from the students who responded:

Major/Gender	Female	Male
Accounting	68	56
Administration	91	40
Economics	7	8
Finance	61	59

   This is an example of a single sample classified according to two categorical variables (gender and major).

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   a. Verify that the expected cell counts satisfy the requirement for use of chi-square.
   b. Compute the expected count for the female economics cell of the table. SHOW WORK.
   c. Test the null hypothesis that there is no relationship between the gender of students and their choice of major. Give the χ^2 statistic and the P-value.
   d. State your conclusion in a sentence or two.

AP Statistics – Chapter 11 Practice FR Solutions

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. Goodness of Fit Test – Unequal Proportions

a) Using the percentages given and multiplying them by the sample size (1000), we get the following expected counts:

Type O = 450, Type A = 400, Type B = 100, Type AB = 50,

b) The formula for χ^2 statistic is $\chi^2 = \sum \frac{(\text{obs} - \text{exp})^2}{\text{exp}}$. For this data, the calculation is

$$\frac{(465-450)^2}{450} + \frac{(394-400)^2}{400} + \frac{(96-100)^2}{100} + \frac{(45-50)^2}{50} = 1.25$$

c) There are 3 degrees of freedom here, so the p-value is .7410.

d) Since the p-value is high (p>.05), we fail to reject the null hypothesis. We can conclude that the blood types for mall shoppers are consistent with the population blood type distribution.

3. Test of Association Between Categorical Variables – Two-Way Table

a) All of the expected counts are more than 5 (See Matrix B after running the test). So we are OK to use the chi-square test.

b) Expected counts are found by

$$\frac{(row\ tot)(col\ tot)}{table\ tot} = \frac{(15)(227)}{390} = 8.731$$

c) There are 3 degrees of freedom here, so χ^2 = 10.907 and the p-value is .0122

d) Since the p-value is less than .05, we reject the null hypothesis. So we can conclude that there is a relationship between gender and their choice of business major. Stated another way, men and women are different in their choices of business majors.