CHAPTER

10 Chi-Square Tests

Calculator Note 10A: Activity 10.1a—Generating a Chi-Square Distribution

For Activity 10.1a, "Generating a Chi-Square Distribution," you can use the command **randInt(1,6,60)→L1** to store 60 rolls of a die in list **L1**. **randInt(** is found by pressing [MATH], arrowing to **PRB**, and selecting **5:randInt(**. Then use the program FREQTABL to create a list of observed frequencies in list **L3**. (See pages 13–14 of these Calculator Notes for information about **FREQTABL**.) Now you can enter the expected frequencies into list **L4** and calculate χ^2 as described in Calculator Note 10B.

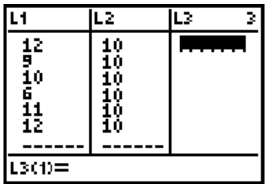
You can also use the program **CHISQR**, which will roll 60 dice, calculate χ^2 for the results, and store the value of χ^2 in a list as many times as you ask it to.

```
PROGRAM:CHISQR
ClrList L1
Disp "HOW MANY TRIALS?"
Input N
For(I,1,N)
0→X:0→Y:0→Z:0→U:0→V:0→W
For(R,1,60)
randInt(1,6)→S
If S=1
U+1→U
If S=2
V+1→V
If S=3
W+1→W
If S=4
X+1→X
If S=5
Y+1→Y
If S=6
Z+1→Z
End
sum(({U,V,W,X,Y,Z}-10)^2/10)→L1(I)
End
```

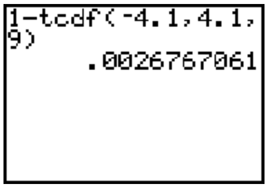
Calculator Note 10B: Calculating the Chi-Square Statistic Step-by-Step Using Tables

The TI-83 Plus and TI-84 Plus's List Editor screen can help calculate the chi-square test statistic.

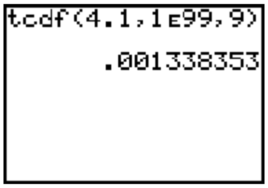
a. Enter the observed frequencies into list **L1**, and enter the expected frequencies into list **L2**.



b. Define list L3 as $(observed - expected)^2/expected$, or $(L_1 - L_2)^2/L_2$.

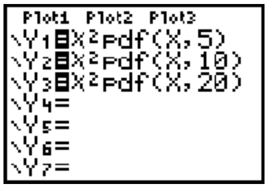


c. The sum of list L3 gives the value of χ^2. Find the **sum(** command by pressing [2nd] **[LIST]**, arrowing over to **MATH**, and selecting **5:sum(**.



Calculator Note 10C: Graphing a Chi-Square Distribution χ^2pdf(

The student book leads you through an examination of chi-square distribution using simulations of dice with different numbers of sides. On your calculator, you can similarly graph and explore the chi-square probability density function for different degrees of freedom. You find the function by pressing [2nd] **[DISTR]** and selecting χ^2**pdf(** from the **DISTR** menu. Enter the function in the form χ^2**pdf(X,** *degrees of freedom***)**.



[−5, 40, 5, −0.1, 0.2, 0.1]

Exploring the probability density function illustrates that as the degrees of freedom increases, the chi-square distribution approaches a normal distribution. You'll come to recognize that the mean of a chi-square distribution equals the number of degrees of freedom of the distribution.

Calculator Note 10D: Calculating the *P*-Value for a Chi-Square Distribution χ^2cdf(

You can use your calculator to precisely calculate the *P*-value associated with a given value of χ^2. To do this, enter an expression in the form χ^2**cdf(**χ^2**,1E99,** *degrees of freedom***)**. You find the χ^2**cdf(** command by pressing [2nd] **[DISTR]** and selecting χ^2**cdf(** from the **DISTR** menu. For example, you calculate the *P*-value for the M&M's example on pages 682–683 of the student book with χ^2**cdf(12.33,1E99,5)**.

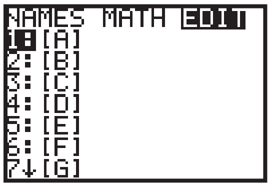
This is a more exact method than approximating the *P*-value from a chi-square table.

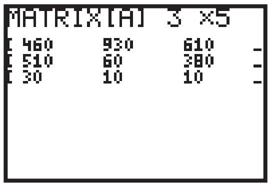
Calculator Note 10E: Performing a Chi-Square Test of Homogeneity or a Chi-Square Test of Independence χ^2-Test

The TI-83 Plus and TI-84 Plus can perform a chi-square test of homogeneity by using a chi-square test of independence for data stored in a two-way table—the calculations are identical for both tests. However, it is critical to understand that there are different conditions for the two tests and that the calculation of the expected values arises from very different situations.

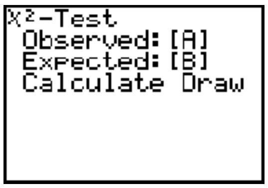
The TI-83 Plus and TI-84 Plus conduct a chi-square test of independence with the χ^2-**Test** command. You find this command by pressing STAT, arrowing over to TESTS, and selecting C:χ^2-**Test**. The example here uses the data from the family values example on pages 698–699 of the student book.

a. First, enter the two-way table in a matrix. Press 2nd [MATRIX], arrow over to the EDIT menu, and select a matrix. Enter the dimensions of the matrix, in this case 3 × 5, and enter the observed values.

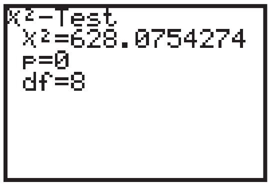


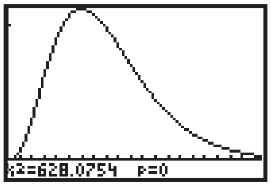


b. Start the χ^2-**Test**. Enter the name of the matrix with the observed frequencies, and name a second matrix in which the expected frequencies will be stored.

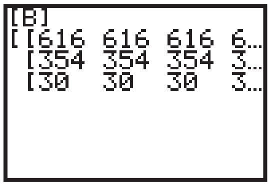


c. Selecting **Calculate** gives the value of the test statistic, χ^2, the P-value, **p**, and the degrees of freedom, **df**. Selecting **Draw** gives χ^2, **p**, and a shaded distribution but not the degrees of freedom. In this case, no shaded area is visible because $p = 0$.





d. To check the expected frequencies, display matrix [B]. To do this, press 2nd [**MATRIX**] and select **2:[B]** from the **NAMES** menu. Then press ENTER. Scroll right and left to read the entire matrix. In some cases, it may be easier to inspect the matrix if you first round the values to one decimal place. To do this, enter **round([B],1)** on the Home screen. You find the **round(** command by pressing MATH, arrowing over to **NUM**, and selecting **2:round(**.



As with all tests, you should use your calculator as an aid in the complete solution. A complete solution includes a check of the conditions, a statement of the hypotheses, a summary of the calculations, and a written conclusion.

