Using the TI-83/84 Plus
Chapter 11: Additional Hypothesis Tests

Here we see how to use the TI 83/84 to perform Chi-Squared and ANOVA tests.

These tests can be conducted by pressing the `STAT` button, highlighting `TESTS`, and selecting the appropriate option (given below) from the menu of options. Each topic has its own page or you can go directly to the videos.

  Select χ^2 `GOF-Test...` **Play Video ▷**

  Select χ^2`-Test...` **Play Video ▷**

  Select `ANOVA` **Play Video ▷**

  `STAT` button, highlight `EDIT`, select `1:Edit...`, press ENTER. **Play Video ▷**

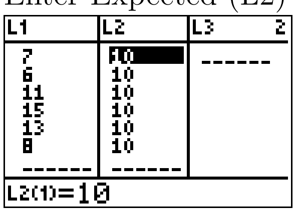
Chi-Squared Test for Goodness of Fit: (TI-84 only)*

Play Video ▷

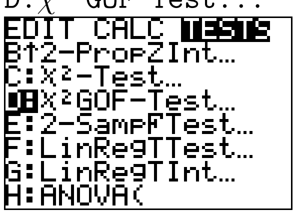
1. You must first enter the list of observed frequencies and expected frequencies into lists.
   See **Entering Data Into Lists** on the last page of this document.
2. Press the `STAT` button and highlight `TESTS`.
3. Scroll down to χ^2 `GOF-Test...` and hit `ENTER`.
4. Enter the name of the list (L_1) containing the observed frequencies.
5. Enter the name of the list (L_2)containing the expected frequencies.
6. Enter the degrees of freedom (`df`).
7. Highlight `Calculate` and hit enter.
8. It gives you the test statistic (χ^2), the P-value for the test statistic (`p`), the degrees of freedom, and a list of contributions to the χ^2 test statistic (`CNTRB`). This is the list of $\frac{(O_i - E_i)^2}{E_i}$ values that you sum to get the test statistic. You can scroll through this list by hitting the right arrow key. **Warning:** The P-value may be given in scientific notation.
   For example `2.143 E-6` $= 2.143 \times 10^{-6} = 0.000002143$.
9. If you highlight `Draw` and hit `ENTER`, you get a graph of the χ^2-distribution and the shaded area represents the P-value.

Preliminary Example from Chapter 11.1: Here we tested to see if the number of outcomes in 60 rolls of a six-sided die fit our expectations from a fair die. We'll use a 0.05 significance level. In that example we calculated the test statistic and got $\chi^2 = 6.4$. That was smaller than the critical value of 11.07 so we failed to reject the null hypothesis. Here's how you do this with the calculator.

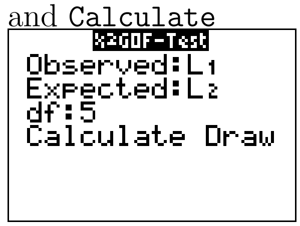
Enter Observed (L1)
Enter Expected (L2)



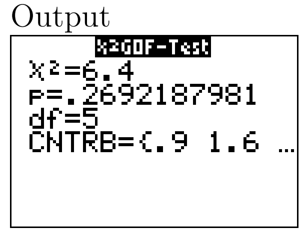
`STAT` → TESTS
D:χ^2 GOF-Test...



Enter the lists, df
and Calculate



Output
Output



Conclusion: The P-value (0.269) is greater than α. We fail to reject the null hypothesis and don't have enough evidence to conclude that this die is not fair.

***NOTE:** Not all TI-83's and 84's have the χ^2 `GOF-Test...` function. You can create your own function as demonstrated at https://www.youtube.com/watch?v=UGEukx2EaEk. It's a little tricky but you only have to create it once. You can also build the table in the calculator but that is probably easier to do by hand. Once you get the test statistic you can compare it to the critical value or you can get the P-value by pressing `2nd` then `VARS` to access the `DISTR` (distributions) menu. Scroll down to the χ^2`cdf` option then hit `ENTER`.

usage: χ^2`cdf(test stat, 10000, df)`   example: χ^2`cdf(6.4,1000,5) = 0.269`

Chi-Squared Test of Independence:

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1. You must first enter the table of observed frequencies into a Matrix.

   (a) Press [2^{nd}] [x^{-1}]. This takes you to the `MATRIX` menu. Scroll over to `EDIT`.

   (b) Scroll down to a matrix you want and hit enter.

   (c) Enter the size as `# of rows x # of columns`.

   (d) Enter the values from the observed frequencies contingency table.

2. Press the [`STAT`] button and highlight `TESTS`.

3. Scroll down to χ^2`-Test...` and hit [`ENTER`].

4. Enter the name of the matrix you created (`[A]`) containing the observed frequencies.

5. Enter any clear matrix or another matrix of the same size (this will later be filled with the expected frequencies).

6. Highlight `Calculate` and hit enter.

7. It gives you the test statistic (χ^2), the P-value for the test statistic (`p`) and the degrees of freedom. If you go back to look at the second matrix you entered into this test, it now contains the expected frequency in each cell. **Warning:** The P-value may be given in scientific notation.
   For example `2.143 E⁻6` $= 2.143 \times 10^{-6} = 0.000002143$.

8. If you highlight `Draw` and hit [`ENTER`], you get a graph of the χ^2-distribution and the shaded area represents the P-value.

Preliminary Example from Chapter 11.2: Here we tested whether grade in a stats class was independent of gender. We were given the contingency table below left, and spent some time calculating the expected frequencies in the table below right (you won't have to do this with the calculuator).

Observed Values - Contingency Table

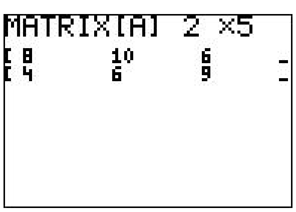
	A	B	C	D	F
Male	8	10	6	9	9
Female	4	6	9	6	5

Expected Frequencies (E_i's)

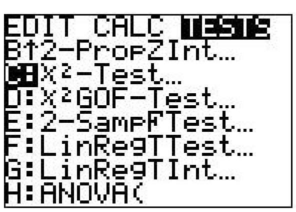
	A	B	C	D	F
Male (Expected)	7.0	9.3	8.8	8.8	8.2
Female (Expected)	5.0	6.7	6.3	6.3	5.8

We'll let the calculator get the test statistic, P-value, and table of expected frequencies.

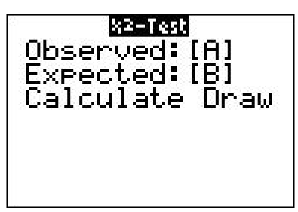
[2^{nd}] [x^{-1}] →`EDIT`
Enter Observed ([A])



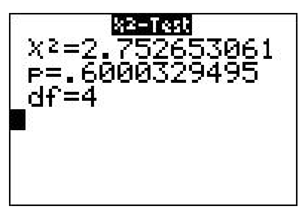
[`STAT`] → TESTS
`D:`χ^2 `GOF-Test...`



Enter Matrix [A] & [B]
and `Calculate`



Output
Output



Conclusion: The P-value (0.6000) is greater than α. We fail to reject the null hypothesis and don't have enough evidence to conclude that the variables are dependent.

ANOVA:

Play Video ▷

1. You must first enter the list of values from the different data sets into different lists.
   See **Entering Data Into Lists** on the last page of this document.

2. Press the `STAT` button and highlight `TESTS`.

3. Scroll down to `ANOVA(` and hit `ENTER`.

4. You get a line that starts `ANOVA(`

5. You have to enter the lists separated by commas and then close with a right).
   `ANOVA(L1, L2, L3)` and hit `ENTER`.

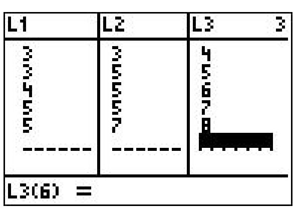
6. It gives you the test statistic (F), the P-value for the test statistic (`p`). It gives some more stuff as well but that's enough for us. **Warning:** The P-value may be given in scientific notation.
   For example `2.143 E`$^-$`6` $= 2.143 \times 10^{-6} = 0.000002143$.

Over-Simplified Example, Case 1, from 11.3:

	Sample 1	Sample 2	Sample 3
	3	3	4
	3	5	5
	4	5	6
	5	5	7
	5	7	8
$\bar{x}_i$	4	5	6

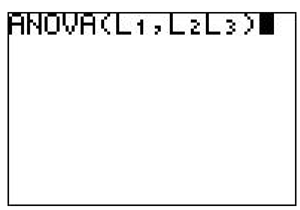
Here we test for a difference in means between three samples. In the book we calculated the test statistic ($F = 2.72$) and let software determine the P-value. Here we'll let the calculator do both.

`STAT` → EDIT
Enter Lists

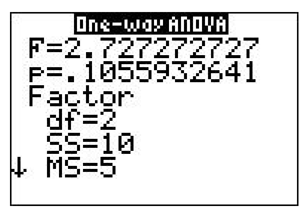


`STAT` → TESTS
`ANOVA(`

Enter `L1, L2, L3 )`
→ `ENTER`



Output
Output



Conclusion: The P-value (0.106) is greater than α. We fail to reject the null hypothesis. There is not enough evidence to conclude that the population means are different.

Entering Data into Lists:

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1. Press the STAT button.
2. Highlight the EDIT option (using the arrows) and hit ENTER.
3. Choose a list (from L_1, $L_2, \ldots,$ L_6) using the arrows and enter the values by column. Hit Enter or the down-arrow to move down the column.
4. You can **clear** a list by highlighting the list name and hitting the Clear button.