

The lesson documents provide information about using the calculator provided with the lessons. The purpose of this supplement is to supply information about another possible technology, namely the TI-83/84 series calculator.

CAUTION: You should note that the interface for the calculator has changed in the past and may well change in the future – accordingly, some of the information given here may prove to be out of date.

Lesson 12

It is not trivial to calculate the F test statistic by hand, so we will use technology to assist in the calculations. Here are the instructions, based on the example in Exercise 1, for which we have the following data:

Brand A	251	244	248	251	261	251	253	246	254	249
Brand B	263	263	266	254	264	258	263	264	261	256
Brand C	269	263	278	267	271	267	271	272	276	266
Brand D	252	249	249	242	247	251	262	249	247	246

1. Begin by entering the data into four lists, with each different group in a different list. The remainder of the instructions assume you used L1 for Brand A, L2 for Brand B, L3 for Brand C, and L4 for Brand D.
2. Run the test, as follows.
 - a. Go to STAT and right arrow over to TESTS.
 - b. Scroll down to the *ANOVA*(option and hit enter.
 - c. This causes an entry ANOVA(to appear on your screen. You complete the entry as shown here, specifying the lists that contain the data. Recall that 2nd 1 gives L₁, and so on.
ANOVA(L₁,L₂,L₃,L₄)
 - d. This creates the following results, where you must scroll down to see all the results.

```
One-way ANOVA
F=43.42554292
p=4.759939E-12
Factor
df=3
SS=2799.5
MS=933.166667
Error
df=36
SS=773.6
MS=21.4888889
Sxp=4.63561095
```

The F test statistic and the p-value are the first two results shown. F is 43.4255, and the p-value is very small. We will reject the null hypothesis.

Note: In addition to the *F*-score and the *p*-value, the calculator reports some of the intermediate calculations involved in the ultimate calculation of the *F*-score. These intermediate calculations are further explained in Section 12.4.

Additional information for the “by hand” section

Calculating the *p*-value

There is an **Fcdf** on the 2nd DISTR menu whose use is quite similar to the **normalcdf** and **χ²cdf** you already know about. The form is **Fcdf(a, b, df1, df2)** where *a* and *b* have the same meaning as for normalcdf, *df1* is the degrees of freedom for the numerator (the *Factor df*), and *df2* is the degrees of freedom for the denominator (the *Error df*). Continuing with our example, we have calculated *F* as 43.4255, *Factor df* as 3, and *Error df* as 36. We use 2nd DISTR to select the **Fcdf** function, then fill in the values to obtain this result:

$$\text{Fcdf}(43.4255, 10000, 3, 36) = 4.76000464\text{E-}12$$

So *F* is 43.4255, and the *p*-value is extremely small

Verifying condition for the standard distributions

Here is the data for the four samples in the golf ball example.

Brand A	251	244	248	251	261	251	253	246	254	249
Brand B	263	263	266	254	264	258	263	264	261	256
Brand C	269	263	278	267	271	267	271	272	276	266
Brand D	252	249	249	242	247	251	262	249	247	246

What must we do to calculate the standard deviations for the four sample? The solution is not difficult, since in order to carry out the ANOVA test you have entered the data into lists L1 through L4. You can use STAT CALC, option **1-VarStats**, to find the results you need. In particular, the indicated commands show the resulting means and standard deviations for the four brands:

1- VarStats L₁ mean 250.8, standard deviation 4.7093
1- VarStats L₂ mean 261.2, standard deviation 3.9101
1- VarStats L₃ mean 270.0, standard deviation 4.5947
1- VarStats L₄ mean 249.4, standard deviation 5.2324