Discrete Analysis

I. Goodness-of-Fit Test

Sometimes it is of interest to compare population proportions for two different populations. This comparison can be formulated as a goodness-of-fit test. This test generalizes the large sample test on a single proportion to a categorical variable with $r > 2$ levels. For $r = 2$ categories, the goodness-of-fit test and large sample test on a single proportion are identical.

a. Enter Data

The data need to be entered into two columns; one column with the observed values; and one column that specifies group belonging. Make sure that the observations are continuous and that group is nominal.

b. Test and CI

The analysis is run in the distribution of Y platform, which we find through “Analyze” and “Distribution.” Enter group belonging as the Y-variable, and the observed values as the frequency variable, and hit OK. This gives you a histogram and a frequency distribution.

Now use “Test Probabilities” to test your hypothesis. You will have to specify one hypothesized value for each level in your groups. This process should be familiar to you, since we did that same thing when we tested a single proportion. The conclusion of the test is based on Pearson’s p-value.

Confidence intervals are easily obtained for each level of the group by clicking on “Confidence Interval” and choosing confidence level. As always, the test and the confidence interval give the same information, given that they are based on the same level of confidence.

c. Assumptions

The chi-squared goodness-of-fit test is a large sample test, i.e. we need our sample to be sufficiently large for the test results to be valid. As always, it is hard to specify the size of “sufficiently large.” A conservative rule of thumb is that the test is suitable when each expected count is at least five.
II. Comparing two Proportions: Independent Samples

This method is used when we want to compare proportions between two populations. The test is based on the sample proportions achieved from independent random or representative sampling from the populations of interest.

a. Enter Data

Your data must be in one of two forms:

1. Count form: In the first two (or more) columns you must record every combination of the groupings of the two (or more) variables. For example, if you are analyzing Age (Young/Old) versus Income (High/Low), you would have the combinations Young-High, Young-Low, Old-High, and Old-Low. In the last column you should record the count of each group combination.
   Spelling is very important! If in the example above you misspelled Young as Yung, then JMP will analyze the Age variable as if it had three levels: Young, Old, and Yung.

2. Row form: Here, each individual to be counted is recorded as a row of data. In that row, the variables of interest are recorded (in the same columns throughout the data, of course). The count is not necessary because JMP will count for you.
   Again, spelling is very important. A similar problem will result.

b. Run the Test

To analyze, choose “Fit Y by X”. Place either variable of interest in “Y, Response”, and the other in “X, Factor”. If you used count form, place the count variable in the “Freq” cell. If you used row form, you don’t have to do anything else. Press OK.
   The resulting window gives all the relevant analysis. If you wish to switch the variables on the axes, do “Fit Y by X” again and switch the variables in the Y and X cells.
   Various options for the contingency table can be turned on and off by accessing the pull-down menu from the red triangle. This may be useful to make your presentation of the data easier to read.

The conclusion for the test that corresponds to the null hypothesis \( p_1 = p_2 \), is based on the Pearson p-value. As always, reject the null hypothesis if the p-value is smaller than \( \alpha \).

JMP also reports the results of Fisher’s exact test, which does not require large sample sizes. Fisher’s test constructs an exact test and the corresponding p-value by looking at probabilities generated by the hypergeometric distribution (as opposed to tail probabilities of the normal distribution). Since this test is “exact” it is often preferred over Pearson’s test.
c. Assumptions

The test and the standard two sample CI are appropriate when each sample is large. A rule of thumb is that a minimum of 5 successes and 5 failures in each sample is sufficient for the test to be valid.

As mentioned: since Fishers test is based on the binomial distribution, it does not require large samples.