

# JMP® Introductory Lab Activities

## Activity 16: $\chi^2$ Goodness-of-Fit Test



**Data Set:** Denim.jmp

### Summary

As you may remember from the lab activity **Exploring Categorical Data**, Denim is a data set from an experiment conducted by a company that manufactures bluejeans. Denim naturally contains starch, creating stiffness in the fabric. The denim the company uses is washed using various treatments to make it feel worn. Although the feel of the fabric is important, the company is also concerned about the strength of the treated fabric.

In this lab you'll calculate the  $\chi^2$  Goodness-of-Fit test statistic by hand, and then will conduct the  $\chi^2$  Goodness-of-Fit test in JMP. You'll compare results, and will summarize your analysis and conclusions in a report (required output and discussion is in italics).

### The Denim Data

Open the file **Denim.jmp** from the **Sample Data** directory. Recall that this data contains information on 98 samples of denim.

**Thread Wear** is an ordinal variable, created by taking the numerical values in **Thread Wear Measured** and dividing them into bins, or categories.

*Look at the data table and describe in your report how binning the "Thread Wear Measured" variable appears to have been done.*

The Thread Wear column was created using a formula. To view this formula, right-click on the Thread Wear column and select **Formula**.

Use **Analyze > Distribution** to make a bar graph (histogram) of **Thread Wear**. This will produce a histogram and a frequencies table, with both counts and probabilities. Add a **mosaic plot** and a **count axis** to your histogram (these options are available under the red triangle next to **Thread Wear**).

*Copy the graphs and frequencies into your report.*

### The $\chi^2$ Goodness-of-Fit Test

Suppose that the thread wear counts 1 through 10 are equally likely. Since the Low category was created by combining the thread wear ratings of 1 to 4 out of a scale of 10, it might be reasonable to assign a hypothesized value of 0.4 (4 of the possible 10 values) to the category Low.

*What are the hypothesized probabilities for the other two categories?*

To conduct a chi-square (written  $\chi^2$ ) goodness-of-fit test, you'll need the following information:

- The **expected** counts for each category (calculated by multiplying your hypothesized probabilities by the total number of trials).
- Your **observed** counts in each category.

*Calculate the chi-square statistic for the thread wear example using a calculator (show your work).*

1. *For each category of thread wear:*

- *Subtract:*  $(\text{observed} - \text{expected})$
- *Square:*  $(\text{observed} - \text{expected})^2$
- *Divide:*  $\frac{(\text{observed} - \text{expected})^2}{\text{expected}}$

2. *Find the sum of all these values. This sum is the chi-square test statistic.*

$$\chi^2 = \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}}$$

### The $\chi^2$ Goodness-of-Fit Test in JMP®

Use the red triangle next to **Thread Wear** to select **Test Probabilities**. Fill in the hypothesized values for the categories (from above), and click on the **Done** button.

JMP calculates two chi-square test statistics and the associated p-values (reported as **Prob>Chisq**).

*Copy the **Frequencies** table and the **Test Probabilities** table into your report. Include only the Pearson Chi-Square Test results. Did these results agree with the values you calculated by hand?*

To be statistically significant at a significance level of 0.05, you should have a p-value or probability less than 0.05.

*What was your p-value? Were your results statistically significant? Remember to report your answers in the context of the problem.*