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Multiple Comparisons

In the previous video, you learned that there are significant differences between the mean breaking strength for three processes.

The file is Break.jmp. From this test, you know that there are differences, but you don't know which means are different. The means diamonds can help. If two diamonds don't overlap at all, then those means are significantly different. So, here, you can see that the mean for Process 3 is much higher than the means for Processes 1 and 2. However, when you look at the mean diamonds for Process 1 and Process 2, the short hash marks in the diamonds might overlap.

How can you tell if these means are different? When it is unclear which means are different, you can use a multiple comparison procedure. The most basic type of multiple comparison analysis compares all possible pairings of the treatment means. The Each Pair, Student's t method compares all possible pairs of means using pooled two-sample t tests at the 0.05 level (or whatever level you specify). For the Break data, you can see that the p-values for all three of the two-sample t tests are less than 0.05. The means for all three groups are different at a significance level of 0.05.

An interactive tool for comparing individual means, which was developed by JMP founder John Sall, is comparison circles. You can click on a comparison circle to conduct a two-sample t test between the corresponding mean and all of the other means. You learn more about comparison circles in a JMP demo. A word of caution:

When you conduct a two-sample t test for more than two groups, you can make false discoveries. That is, you can conclude that significant differences exist when the observed differences are due to chance. The more tests you perform, the higher the probability of making a false discovery.

There are other multiple comparison techniques that are designed to minimize the false discovery rate. An alternative to the Each Pair, Student's t method, which is recommended when you are comparing several group means, is Tukey's HSD, or Honestly Significant Difference. For this test, the overall error rate, across all of the comparisons, is 0.05. This test is less sensitive than Each Pair, Student's t, but it's much less likely to result in a false discovery. You learn about Tukey's HSD, and other multiple comparison methods, in an upcoming JMP demonstration video.

Note that, instead of comparing group means to one another, you might be interested in identifying group means that are significantly different from the overall mean. If this is your analysis goal, you can use a technique called analysis of means, or ANOM. Suppose that you are studying the breaking strength of three processes. You want to know whether any of the group means are significantly different from the overall mean.

ANOM produces a simple graph, with the overall mean, upper and lower decision limits, and the mean for each process. From this simple graphical output, you can see that the means for both Process 2 and Process 3 are statistically different from the grand mean. The mean for Process 2 is below the overall mean, and the mean for Process 3 is above the overall mean. For more information about analysis of means, and for additional details on the multiple comparison procedures, see the Read About It for this module.

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