Lecture 15: Multiple Comparisons

**Multiple Comparisons**

*Confidence interval using Student’s t.

*Least Significant Difference, LSD.

**Least Significant Difference**

\[ t^* \sqrt{MS_{Error} \left( \frac{1}{n_i} + \frac{1}{n_j} \right)} \]

\[ = \frac{2.131 \sqrt{187.73 \left( \frac{1}{6} + \frac{1}{6} \right)}}{6} \]

\[ = 2.131(7.9106) = 16.86 \]

**Comparison**

| Comparison          | \(|Y_{i*} - Y_{j*}| \geq LSD?\) |
|---------------------|---------------------------------|
| 1.25 to 1.75        | 61 > 16.86 statistically significant |
| 1.25 to 2.25        | 63 > 16.86 statistically significant |
| 1.75 to 2.25        | 2 < 16.86 not statistically significant |

**Conclusion**

*The differences in mean volumes for 1.25 compared to 1.75 and 1.25 compared to 2.25 are statistically significant (no zero in the CI).

*The difference in mean volumes for 1.75 compared to 2.25 is not statistically significant (zero in the CI).

**Multiple Comparisons**

*When making several 95% pair-wise comparisons, each comparison has a 5% chance of a Type I error.

*The more comparisons, the greater the chance that at least one will result in a Type I error.

**3 Comparisons**

*For the 3 comparisons, we have 95% confidence in any one comparison but only about 85% confidence in the set of 3 comparisons.
Lecture 15: Multiple Comparisons

Lots of Comparisons

*20 comparisons – we expect to see 1 of those 20 comparisons result in a Type I error.
*100 comparisons – we expect to see 5 of those 100 comparisons result in a Type I error.

Lots of Comparisons

*How do we know which statistically significant comparisons are identifying true differences and which are Type I errors?
*We don’t know!

Alternative Method

*Use a method of multiple comparisons that holds the chance of a Type I error for at least one comparison to 0.05.

Tukey’s HSD

*Tukey’s Honestly Significant Difference (HSD)

\[ Q \sqrt{MS_{Error}} \left( \frac{1}{n_i} + \frac{1}{n_j} \right) \]

Tukey’s HSD

*Q = 2.59747

\[ Q \sqrt{MS_{Error}} \left( \frac{1}{n_i} + \frac{1}{n_j} \right) \]

= \[ 2.59747 \sqrt{7.9106} \]

= 20.55

Honestely Significant Difference

| Comparison | \(|Y_{i+} - Y_{j+}| \geq \text{HSD?} \) |
|------------|--------------------------------------|
| 1.25 to 1.75 | 61 > 20.55, statistically significant |
| 1.25 to 2.25 | 63 > 20.55, statistically significant |
| 1.75 to 2.25 | 2 < 20.55, not statistically significant |