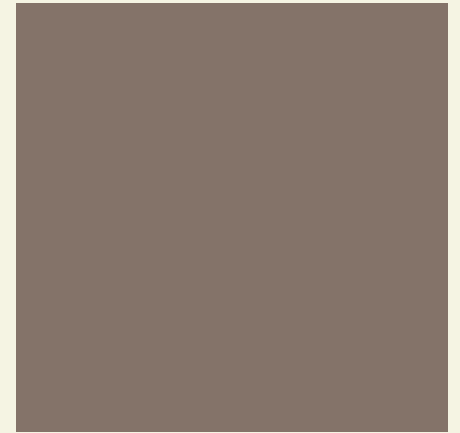# ICCPP-STATISTICS
- Scheffe Test

Vishal Lohchab

Scientific Assistant of

Prof. Dr. Hans-Werner Gessmann

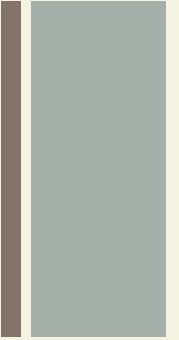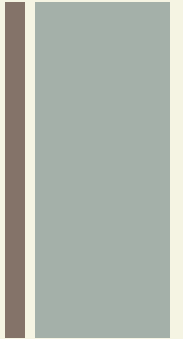*Director ICCPP International*

Henry Scheffé (1907-1977)

Scheffé Test

+ Definition

- The Scheffe Test (also called Scheffe's procedure or Scheffe's method) is a post-hoc test used in Analysis of Variance.
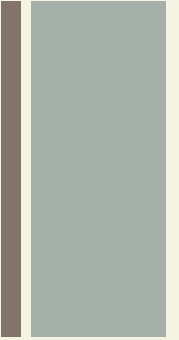
+ Scheffe Test

- It is named for the American statistician Henry Scheffe.

- After you have run ANOVA and got a significant F-statistic (i.e. you have rejected the null hypothesis that the means are the same), then you run Sheffe's test to find out which pairs of means are significant.

+ Scheffe Test

- The Scheffe test corrects alpha for simple and complex mean comparisons.

- Complex mean comparisons involve comparing more than one pair of means simultaneously.

+ Use

- This test is usually calculated with software. Like most statistical tests, you find a critical value and then compare it with a test statistic.

- Reject the null hypothesis if the Scheffe test statistic is greater than the critical value.
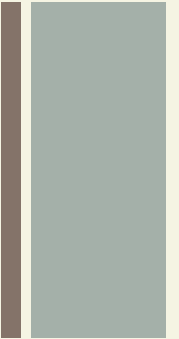
+ Calculating the Test

- Only run this test if you have rejected the null hypothesis in an ANOVA test, indicating that the means are not the same.

- Otherwise, the means are equal and so there is no point in running this test.
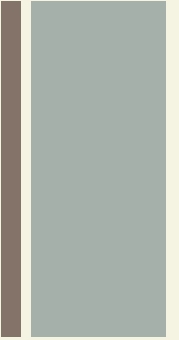
Hypotheses

- The null hypothesis for the test is that all means are the same: H_0: μ i = μ j.

- The alternate hypothesis is that the means are not the same: H_0: μ i $\neq$ μ j.

+ Example

- The steps that follow are for calculating simple pairwise comparisons by hand for four samples A, B, C and D.

- You'll need descriptive statistics data (the sample means) plus data from ANOVA (like mean squared error).
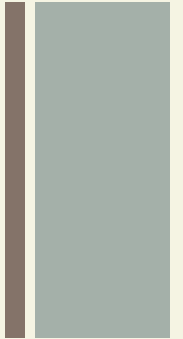
+ Example

- Sample Means for Samples A, B, C, D:

A = 36.00
B = 34.50
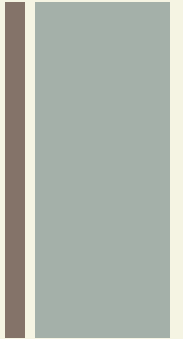C = 35.60
D = 36.20

+

Example

- ANOVA Data (from the ANOVA output)

- F-value = 3.24 (from the f-table, with 3 numerator degrees of freedom and 16 denominator degrees of freedom at an α of 0.05).

- Mean Squared Error: 0.028.

+ Steps

Step 1

- Calculate the absolute values of pair wise differences between sample means. You'll have to figure out all the possible combinations.

- For four samples, there are 6 possible combinations of two: AB AC AD BC BD and CD.

- For example, for AB the absolute difference ($|A-B|$) is $36.00 - 34.50 = 1.50$.

+ Steps

Step 1.1

Differences Between Means (Absolute Values)		
AB	1.50	
AC	0.40	
AD	0.21	
BC	1.10	
BD	1.71	
CD	0.61	

+ Steps

■ Use the following formula to find a set of Scheffe formula values (you will use these in the next Step):

$$\sqrt{(k-1)\,f\text{-value}\;\;MSE\;(1/n_i + 1/n_j)}$$

Where:

+ Steps

Step 2.1

$$\sqrt{(k-1)\,f\text{-value}\ \ MSE\ (1/n_i + 1/n_j)}$$

- (k − 1) is the between samples degrees of freedom. For this set of data, that's 3 (4 − 1 = 3).

- f , 1 * n − k k − ; α = the f-value (from ANOVA). For this set of data, the f-value is 3.24.

- MSE = mean square error (from ANOVA).

+ Steps

Step 2.2

- It's easier than it looks! Once you've found the df and MSE from your ANOVA output, you only need to change the sample sizes in the formula for each comparison.

- (The sample sizes are A = 5, B = 6, C = 4, D = 5).

+ Steps
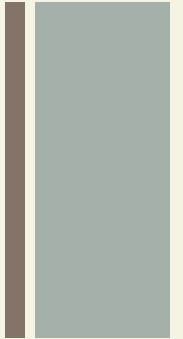
Step 2.3

- For example, comparing A and B we get:

  $\sqrt{(3 * 3.24 * 0.028 *(1/5 + 1/6))} = 0.32$
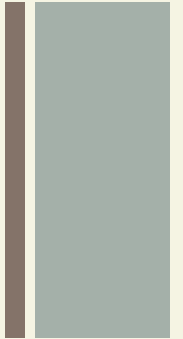
- And comparing A and C we get:

  $\sqrt{(3 * 3.24 * 0.028 *(1/5 + 1/4))} = 0.35$

+ Steps

Step 2.4

Comparison Values	
AB	0.32
AC	0.35
AD	0.33
BC	0.34
BD	0.32
CD	0.35

+ Steps

Step 3

- Compare the values in Step 1 to the values in Step 2 and find any values that are larger than the comparison values.

- Larger values are statistically significant at your chosen alpha level (in this case, 0.05).

- For this example, the only value that is not significant is AD,
because 0.21 is smaller than 0.33.

Step 3

Differences Between Means (Absolute Values)		
AB	1.50	
AC	0.40	
AD	0.21	
BC	1.10	
BD	1.71	
CD	0.61	

Comparison Values		
AB	0.32	
AC	0.35	
AD	0.33	
BC	0.34	
BD	0.32	
CD	0.35	

That's it

References

Scheffé H (1999). The Analysis of Variance. John Wiley & Sons.

https://www.statisticshowto.com/, date 12.10.21, 20:00 h MET

Daniel C, Lehmann E L (1979). "Henry Scheffé 1907–1977". Annals of Statistics. 7 (6): 1149–1161. doi:10.1214/aos/1176344837.

https://en.wikipedia.org/wiki/Henry_Scheff%C3%A9, date 12.10.21, 20:00 h MET