

What is ANOVA

- Anova (Analysis of variance) is a method to compare 3 of more means
- Independent variable is categorical while dependent is continuous
- One way Anova: Used for when only one categorical factor affecting the variable of interest. Ex: Effect of type of water on plant growth.
- Two way Anova: When there are 2 independent variables.
- Ex: Saltwater vs freshwater and to be watered in the morning or afternoon on plant growth

### What does it calculate

- Variability between groups / degrees of freedom between groups = MSB
- Variability within groups / degrees of freedom within groups = MSW
- F ratio = MSB/MSW
- When you do an ANOVA test a F statistic is calculated for each hypothesis.

# **ANOVA Hypothesis**

- The population must be close to normal
- Samples must be independent
- Population variances must be roughly equal
- Groups must have equal sample sizes
- Ho: all group means are equal
- Ha: at least one group means differs
- P-value found in f-distribution
- top probability, bottom cumulative



# Differences between 1 and 2 way

# One way ANOVA Excel

Go to Data, and then click on data analysis

Select "ANOVA: Single Factor"

Type the number of rows

Highlight Desired Data (Do not highlight the categories of the data) to fill the value for the input range

Press ok and the result will be in a new sheet

The p value depends on if your data is the column or the roll

### One way ANOVA Excel

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Anova: Single	Factor					
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Groups	Count	Sum	Average	Variance		
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Column 2	6	146	24.3333333	254.266667		
Column 3	6	310	51.6666667	614.266667		
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#### Calculator Commands for 1 way ANOVA

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#### Excel commands for one way

Effects of types of water (Salt, fresh, wastewater) and the states (Oregon, Wyoming) in which the plant is grown on plant growth

Fabricated Data:

	Salt water	Wastewater	Freshwater
	32	23	53
	45	12	23
Oregon	42	42	25
	56	43	66
	32	3	55
Wyoming	12	23	88

Plant growth (km)

### Excel Commands for 2 way ANOVA

Highlight Desired Data

Go to Data, and then click on data analysis

Select "ANOVA: Two-Factor With Replication"

- Highlight Desired Data (Highlight the categories of the data) to fill the value for the input range
- Type the number of rows for the category
- Press ok and the result will be in a new sheet
- The p value depends on if your data is the column or the roll

### Two way ANOVA Excel

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#### P-value interpretation

- Sample: Your rows, so the categorical on the side of the matrix independent from each other or not.
- Columns: Your columns, so the categorical on the top or bottom of the matrix independent from each other or not.
- Interaction : If your columns and rows are independent from each other or not

#### **Tests Used Last Year**

Types of Statistical Testing Used by MAMS Seniors During Their IRPs



# Conclusion

Reject the null hypothesis if p value < alpha level

- Accept the alternative hypotheses that is at least one of the mean is different due to significant statistical evidence.
- Fail to reject the null hypothesis if p value > alpha level
- Do not have convincing statistical evidence for the alternative.
- Do tests after to compare categories to find which one is significantly different

# Reference

https://www.investopedia.com/terms/a/anova.asp

https://education.ti.com/en/customer-support/knowledge-base/ti-83-84-plus-family/product-usage/34611

https://www.statology.org/two-way-anova-excel/

https://en.wikipedia.org/wiki/F-distribution (the goat)