NeuroTech 2021 ANOVA Exploration

Basic Information and Example of ANOVA

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What is ANOVA?

- Analysis of Variance (ANOVA) “is a collection of statistical models and their associated estimation procedures (such as the "variation" among and between groups) used to analyze the differences among means”
- Can help to figure out if survey or experiment results are significant - helps to figure out if you need to reject the null hypothesis or accept the alternate hypothesis
- Generalizes a t-test beyond 2 means

Types of Appropiate Data

- Dependent variable: continuous (interval or ratio)
- Independent variable: categorical (nominal or ordinal)

Assumptions and Requirements

- Independence of observations.
- The dependent variable is normally distributed in each group that is being compared in the one-way ANOVA
- Can tolerate non normal data with only small effect on type 1 error
- There is homogeneity of variances. This means that the population variances in each group are equal.

Mathematical Overview

Broad overview of what ANOVA is doing:

- Find variance between the groups
- Find variance within the groups
- F = between_groups / within_groups
- Larger F is, more likely the groups have different means and therefore reject the Null Hypothesis

Standard for Reporting the Results

- Show the degerees of freedom: F(b,w) = proportion
- b: degrees of freedom for variance between groups: number of groups - 1
- w: degrees of freedom for variance within groups: total number of observations - number of groups

Measure of Effect Size

- Eta squared

Sources

- https://en.wikipedia.org/wiki/Analysis_of_variance
- https://www.statisticshowto.com/probability-and-statistics/hypothesis-testing/anova/
- https://statistics.laerd.com/statistical-guides/one-way-anova-statistical-guide-2.php
- https://www.statisticssolutions.com/manova-analysis-anova/

Example

Data set source: https://college.cengage.com/mathematics/brase/understandable_statistics/7e/students/datasets/owan/frames/owan04.html

The following data represent business startup costs (thousands of dollars) for shops.

X1 = startup costs for pizza

X2 = startup costs for baker/donuts

X3 = startup costs for shoe stores

X4 = startup costs for gift shops

X5 = startup costs for pet stores

Null Hypothesis (H_0): The startup costs for all business are the same

```
data = readtable("anovaData.csv") %import data
```

data = 16×5 table

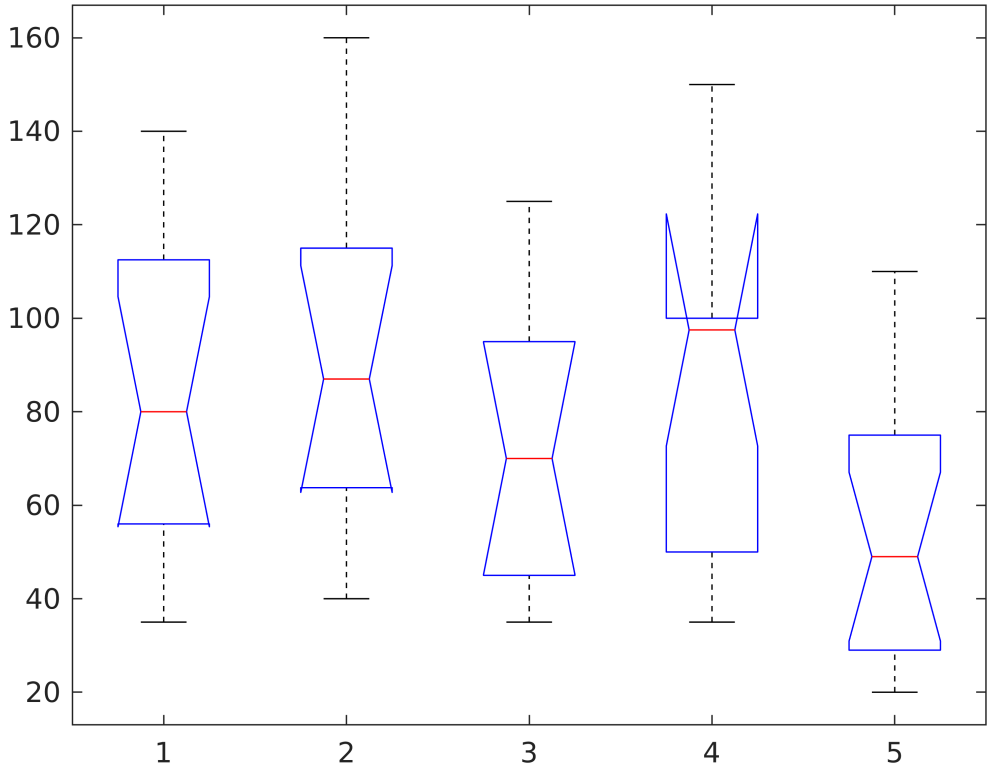
	X1	X2	X3	X4	X5
1	80	150	48	100	25
2	125	40	35	96	80
3	35	120	95	35	30
4	58	75	45	99	35
5	110	160	75	75	30
6	140	60	115	150	28
7	97	45	42	45	20
8	50	100	78	100	75
9	65	86	65	120	48
10	79	87	125	50	20
11	35	90	NaN	NaN	50
12	85	NaN	NaN	NaN	75
13	120	NaN	NaN	NaN	55

	X1	X2	X3	X4	X5
14	NaN	NaN	NaN	NaN	60
15	NaN	NaN	NaN	NaN	85
16	NaN	NaN	NaN	NaN	110

```
x_vals = [data.X1, data.X2, data.X3, data.X4, data.X5]; %put data into matrix
p = anova1(x_vals) %use MATLAB ANOVA function
```

ANOVA Table

Source	SS	df	MS	F	Prob>F
Groups	14298.2	4	3574.56	3.25	0.0184
Error	60560.8	55	1101.1		
Total	74859	59			




```
p = 0.0184
```

Looking at the anova table, we see F(4, 55) = 3.25. Since the F value is larger, we will reject the Null hypothesis.