POLITICAL SCIENCE 205
INTRODUCTION TO RESEARCH METHODOLOGY

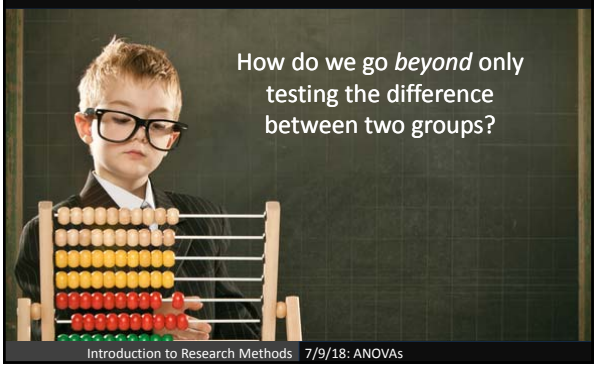
ANOVA
Monday, July 9

Agenda

I. A Brief Refresher
II. One-Way ANOVAs
III. Practicing with ANOVAs

Week 4, Day 1

Lecture Question



T-Tests Reviewed

Independent Variable	Dependent Variable
Two categories (nominal or ordinal)	Interval-ratio variables

Definition: The difference in the average scores between two independent groups on the same variable.

What does a T-Test give us?

Definition: The difference in the average scores between two independent groups on the same variable.

This is the **T-Test for Dependent Samples.** We will only refer to this t-test for the rest of the quarter. Remember, you need:

1. An independent variable with only two categories
2. A dependent variable that is interval-ratio

- **T-value**

Our **test statistic** that we calculated from the equation. The equation calculates a standardized number to evaluate two group means on the normal curve.

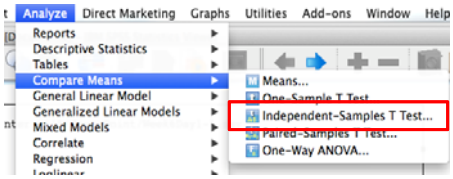
- **Degrees of freedom**

The degrees of freedom helps us find our **critical value** to interpret our T-value. For the t-test, the degrees of freedom is always calculated as $(n_1\text{-}1) + (n_2\text{-}1)$. We use the appendix (p. 403) to find our **critical value** needed to reject the null hypothesis.

- **Significance value**

Only calculated by SPSS, the significance value tells us if our t-value is higher or lower than our **critical value**, without having to calculate the t-value or degrees of freedom on your own.

Using SPSS to calculate a T-Test

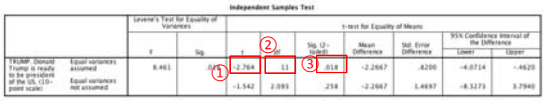


Analyze > Compare Means > Independent Samples T Test…

Note: You won't ever be asked to calculate a t-value by hand OR evaluate a t-value using the appendix.

Interpreting the SPSS T-Test

Hypothesis: There is a difference between a) Democrats and b) Republicans on their beliefs that Donald Trump is ready to be president.



① T-value — When comparing **party ID** on the **belief that Trump is ready to be president**, my t-value is **-2.764**.

② Degrees of freedom — The degrees of freedom for this t-test is **11**.

③ Significance value — There is a **1.8%** chance that the difference between **Democrats** and **Republicans** on this question was random. The relationship is **significant**.

Significance Values

Definition: Significance values tells us if our hypothesized relationship is due to random chance.

Every single **test statistic** we calculate in the remaining weeks of the class (T-Tests, ANOVAs, Chi-square, Correlations, Regressions) will have significance values. They are all interpreted in the same exact manner, no matter the test.

0 < Significance Values < 1

Relationships exist only if your significance value is under .05.

If your significance value is above .05, then the relationship does not exist.

Interpretation of Significance

Significance Value	Relationship	Interpretation
.00	Significant!	There is a **0%** probability the relationship is due to chance. **The relationship exists!**
.00-.05	Significant!	There is **between a 0% and 5%** probability the relationship is due to chance. **The relationship exists!**
.05	Significant!	There is a **5%** probability the relationship is due to chance. **The relationship exists!**
> .05	Not significant!	There is **more than a 5%** probability the relationship is due to chance. **The relationship does not exist!**

How do we get the percentage?

.03 = 3% **.78 = 78%**

Please note: You can indeed write about insignificant relationships in your research!

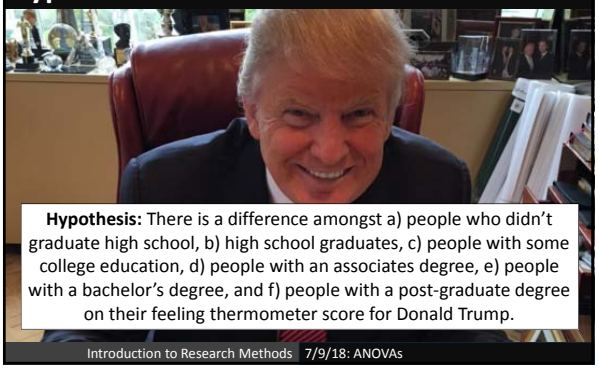
One-Way ANOVAs

One-Way ANOVAs test the difference in the average scores on **one variable** (dependent variable) between **multiple groups** (**multiple categories** of one independent variable).

Assumptions for the One-Way ANOVA

1. Independent variable has more than two categories (nominal or ordinal)
2. Dependent variable is interval-ratio.

Hypothesis



Hypothesis: There is a difference amongst a) people who didn't graduate high school, b) high school graduates, c) people with some college education, d) people with an associates degree, e) people with a bachelor's degree, and f) people with a post-graduate degree on their feeling thermometer score for Donald Trump.

Non-Directional Hypotheses

Like T-tests, ANOVAs only use **non-directional hypotheses**… thereby using a two-tailed test.

F-Statistic

Named after the guy who invented it, the **F-Statistic** is our **test statistic** for **One-Way ANOVAs.**

So what does it do?

$$F = \frac{Variability_{(between)}}{Variability_{(within)}}$$




$Variability_{(between)}$ = The variability between groups is due to genuine differences between the groups.

$Variability_{(within)}$ = The variability within groups is due to random chance.

In short, this equation compares the difference between groups to differences we see by chance.

The F-Statistic for Our Hypothesis

$F = 1.079$

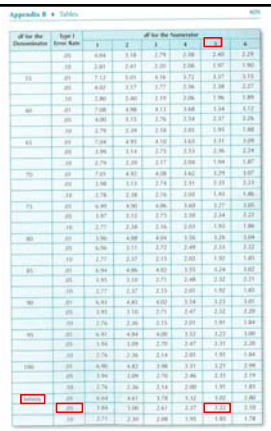
Use the appendix on page 406 to find the F-statistic needed to reject the null hypothesis

Hypothesis: There is a difference amongst education on their feeling thermometer score for Donald Trump.

We need to calculate the degrees of freedom for both numerator & denominator:

$df_{(numerator)}$ = # of groups – 1
= 6 – 1 = 5

$df_{(denominator)}$
= # of observations – # of groups
= 1197 - 6 = 1191



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The F-Statistic for Our Hypothesis

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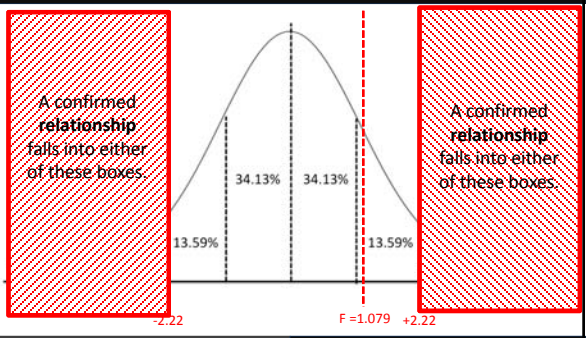
$df_{(numerator)}$ = # of groups – 1
= 6 – 1 = 5

$df_{(denominator)}$
= # of observations – # of groups
= 1197 - 8 = 1191

$F = 2.22$

This is our value needed to reject the null hypothesis

Interpreting the Critical Value



What does an ANOVA give us?

Definition: The test the difference in the average scores on **one variable** (dependent variable) between **multiple groups** (multiple categories of an independent variable).

This is the **One-Way ANOVA.** We will use this ANOVA for the rest of the quarter. Remember, you need:

1. An independent variable with more than two categories
2. A dependent variable that is interval-ratio

- F-statistic

Our **test statistic** that we calculated from the equation. The equation compares the differences between groups to differences we see by random chance.

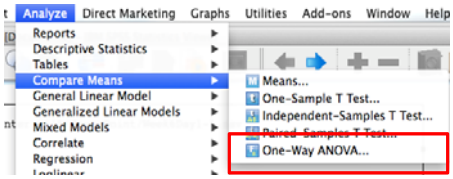
- Degrees of freedom

The degrees of freedom helps us find our **critical value** to interpret our T-value. For the f-statistic, we calculate two values for this: numerator and denominator. We use the appendix (p. 406) to find our **critical value** needed to reject the null hypothesis.

- Significance value

Only calculated by SPSS, the significance value tells us if our f-statistic is higher or lower than our **critical value**, without having to calculate the f-statistic or degrees of freedom on your own.

Using SPSS to calculate an ANOVA



Analyze > Compare Means > One-Way ANOVA

Note: You won't ever be asked to calculate a F-statistic by hand OR evaluate a F-statistic using the appendix.

Interpreting the SPSS F-Statistic

Hypothesis: There is a difference amongst a) people who didn't graduate high school, b) high school graduates, c) people with some college education, d) people with an associates degree, e) people with a bachelor's degree, and f) people with a post-graduate degree on their feeling thermometer score for Donald Trump.

therm_trump: Feeling thermometer (100 - very warm; 50 - no feeling; 0 - very cold) - Donald Trum

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	11368.929	5	2273.786	1.709	.130
Within Groups	1584532.63	②1191	1330.422	①	③
Total	1595901.56	1196			

①F-statistic — When comparing **education** on the **feeling thermometer for Donald Trump**, my f-statistic is **1.709**.

②Degrees of freedom — The first degrees of freedom (between groups) is **5**, the second (within groups) is **1191**.

③Significance value — There is a **13.0%** probability that the difference amongst **education** on the **feeling thermometer for Donald Trump** is random. The relationship does not exist, we accept the null.

Practicing with ANOVA

Test Statistic	When do we do it?	Independent Variable	Dependent Variable
T-Test (Independent Samples T-Test)	Non-directional hypothesis comparing two groups on one variable.	Two categories ONLY (nominal/ordinal)	Interval-ratio variables
ANOVA (One-Way ANOVA)	Non-directional hypothesis comparing multiple categories on one variable.	More than two categories (nominal/ordinal)	Interval-ratio variables

Activity 4, Part A