Comparing Two Groups

t-test

Business Intelligence/ Analytics

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Institutional Research
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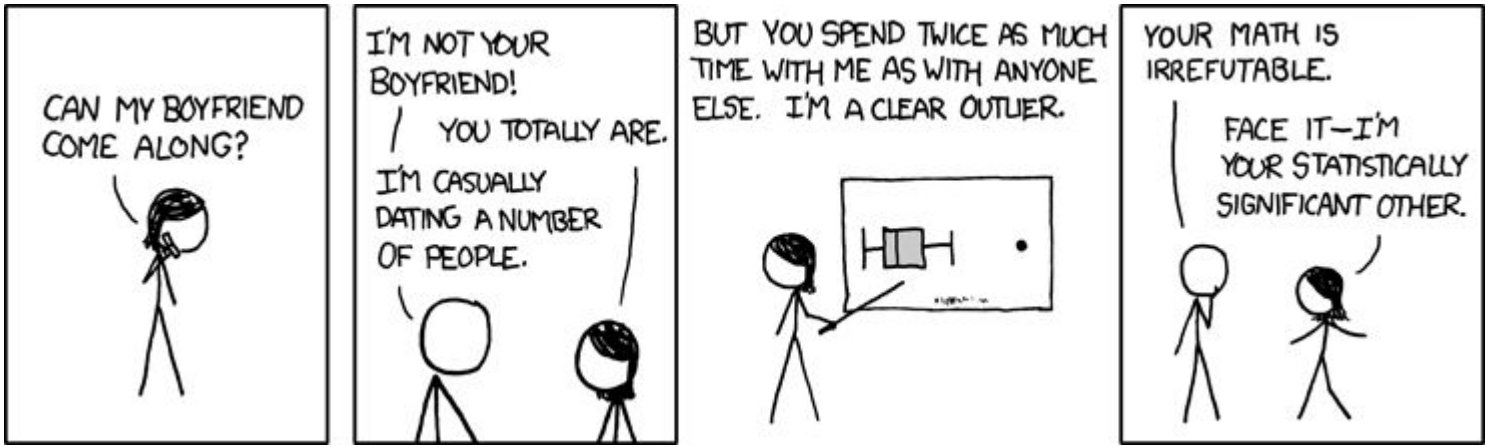
Am I significant???



https://xkcd.com/539/

Are these two things different?

Differences in means (e.g. GPA 3.2 vs 3.34)

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Difference in proportions (e.g. 50% vs 72%)

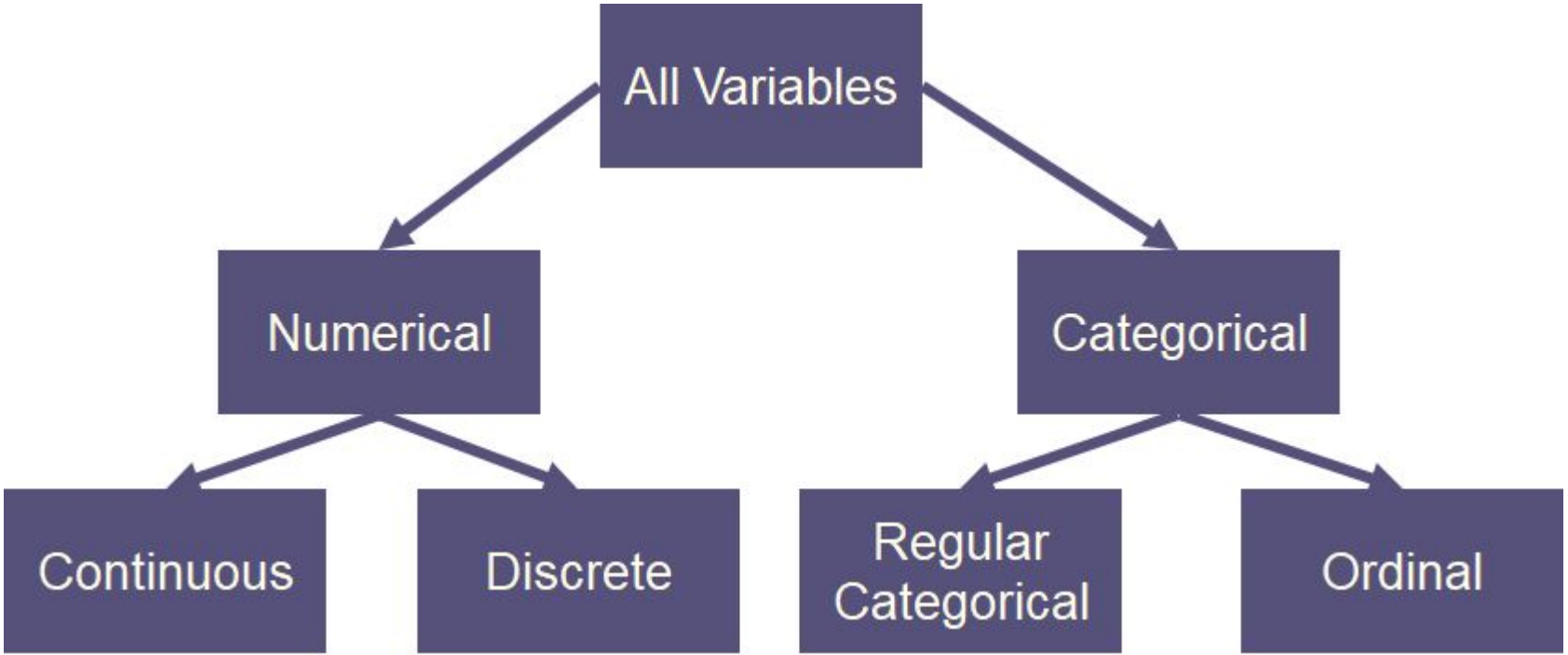
Differences in distributions (e.g. counts of each race per group)

There's a test for that

Statistics provides us with several tools

But the first question is what kind of data do we have?

Use your data as your guide



First Question-What is the “treatment”

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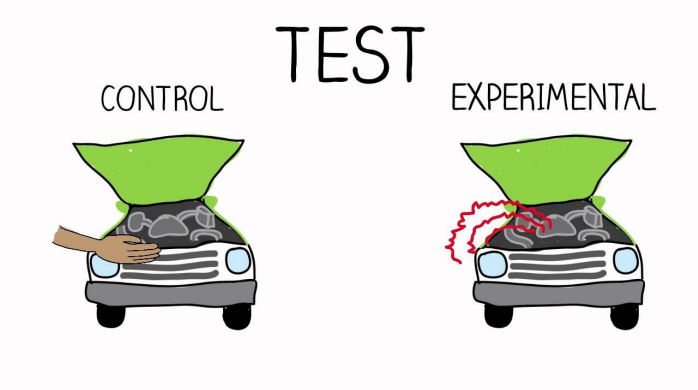
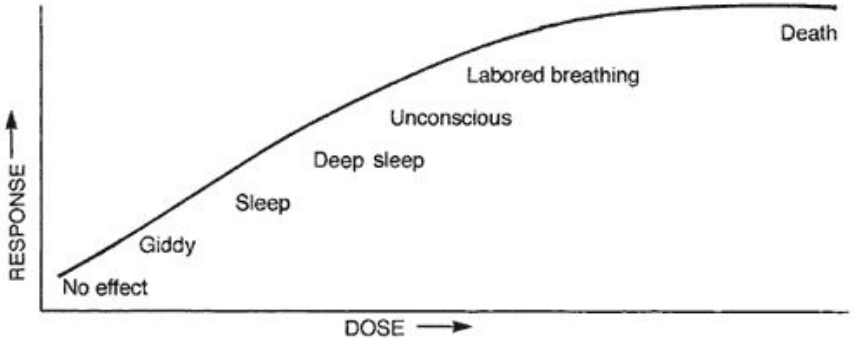
Categorical



Numeric



Second Question-What is the “response”

Continuous

Ratios

Counts

Now we can choose a test...

Treatment	Number of Groups	Response	Test
Categorical	2	Continuous	T-test
Categorical	>2	Continuous	ANOVA
Categorical	2	Ratio	Proportion Test
Categorical	>2	Counts	Chi-Square
Continuous	>=2	Continuous	Regression

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Now we can choose a test…

Treatment	Number of	Response	Test
Cat			
Cat			
Cat			
Cat			
Cor			

ALWAYS EXCEPT…

Most of these tests assume

- Errors are independent and identically distributed

The birth of the t-test

William Sealy Gosset

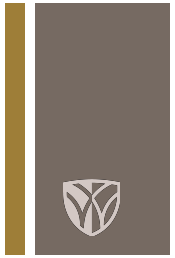
The birth of the t-test

The birth of the t-test

Needed to compare means of **Two Treatments** with a **Continuous** Response

E.g. Alcohol content between two batches

Comparing two (unpaired) means



Comparing Two Independent Groups

Typically what we are interested in...

E.g. Grades between people who took class A vs Class B

Comparing two (paired) means

Comparing The Same Group Twice

Same people see both treatments

E.g. Comparing quotes from a mechanic on the same set of cars

What does the test tell us…

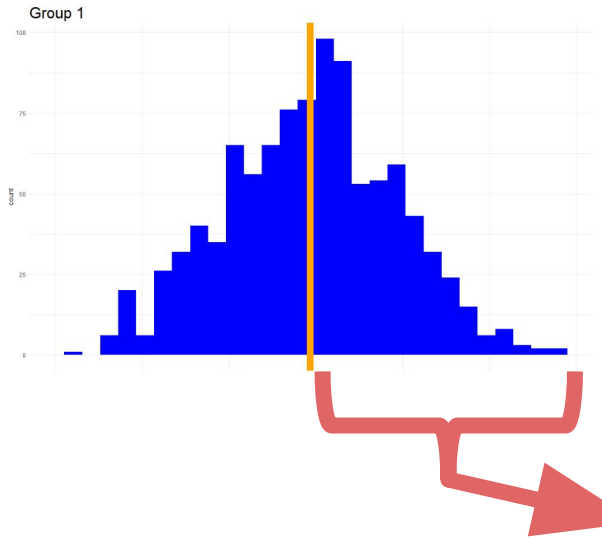
Question: Are the means of these two groups the same?

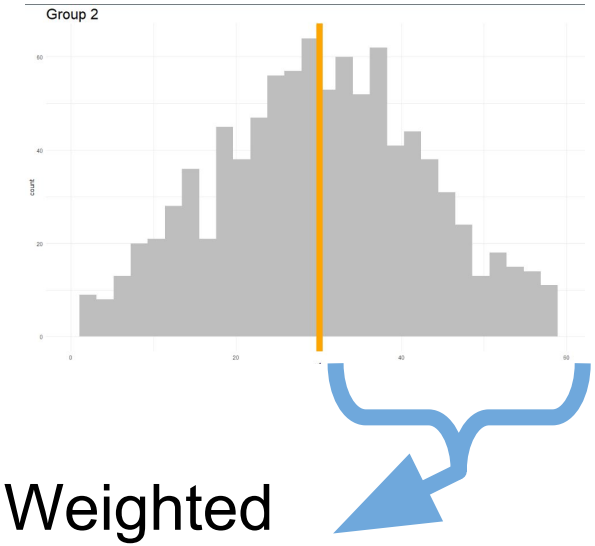
Confidence Intervals

P-Value

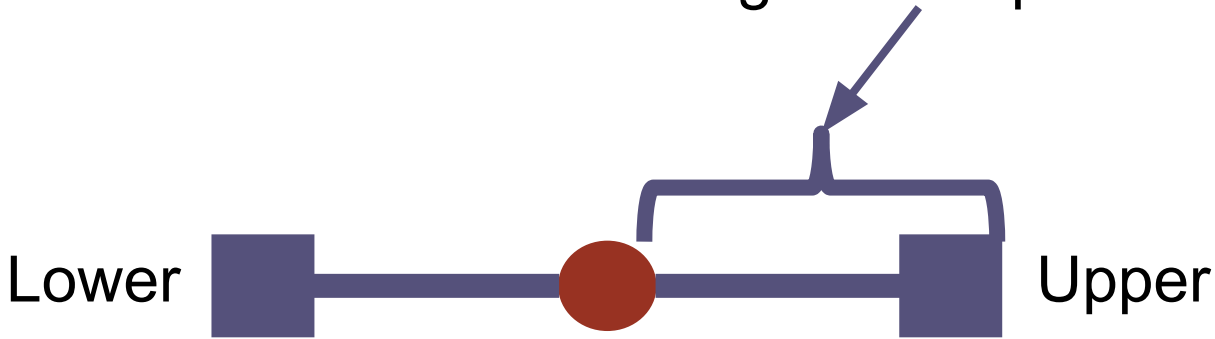
Confidence Intervals

Repeating this experiment many times, 95%* of the confidence intervals calculated will contain the true population mean





Multiplier * Weighted
Avg of the Spread



Avg Group 1 - Avg Group 2

Confidence Intervals

$$Avg_1 - Avg_2 \pm 1.96 * s_p * \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$$

Avg_1 = Average of Group 1
Avg_2 = Average of Group 2
s_p = Pooled standard deviation
n_1 = Number of Samples in Group 1
n_2 = Number of Samples in Group 2

If **Zero is included** in the interval then there is not evidence of a difference

P-Values

A **P-Value** is the probability of observing a result **as or more extreme** than the one I found if the experiment is **repeated many times**

P-Value Thresholds

P-Value thresholds are arbitrary

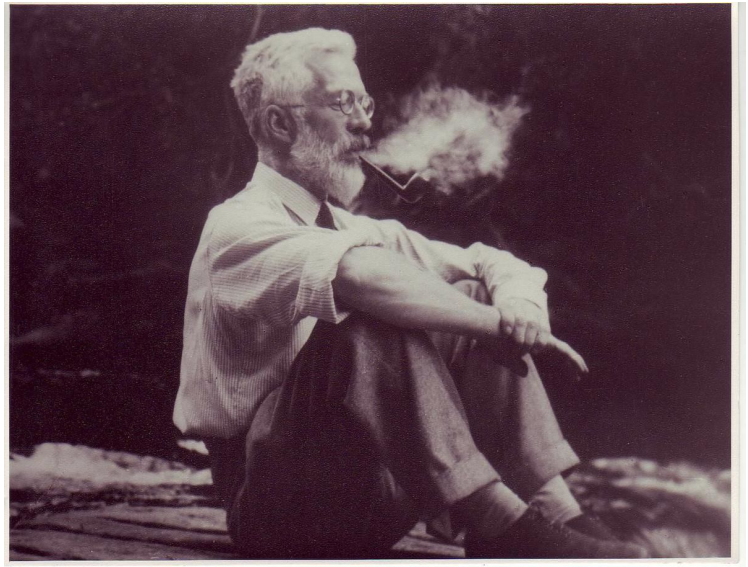
By convention $p < 0.05$ or $p < 0.10$ is acceptable

Be sure to state what level you use!

Let's Practice!

https://www.youtube.com/watch?v=-yZ97arTPGU

P-Value Thresholds



“The value for which P=0.05, or 1 in 20, is 1.96 or nearly 2; it is convenient to take this point as a limit in judging whether a deviation ought to be considered significant or not. “ - RA Fischer

P-Value Thresholds

One Tail P Value (Higher or Lower)

$\mu_1 > \mu_2$ or $\mu_1 < \mu_2$

Two Tail P Value (Mean Values are Different)

$\mu_1 \neq \mu_2$