Week 2: Sample Size and Power
Statistical Power:
Prospective view: **How many participants do I need for my study? And why does it matter?**
Study design principles:

- Need a well-defined research question
- Clearly specified hypotheses
- Clearly defined population so that you know your sample is suitable.
- Determine which measures to use for IV(s) and DV(s)
- Determine optimal experimental design
- Determine how many participants to recruit

How many participants do I need & why do I care? I managed to recruit n participants, is that enough?

- Null hypothesis= no effect. Will either be true or false.

		State of H_0 in population	
		True	**False**
State of H_0 in sample	**True**	Correct	Type II error
	False	Type I error	Correct

- We accept or reject a hypothesis based on what we know from a *sample* but want to make inference about the state of play in a *population*
- If our conclusion (accept or reject H_0) agrees with the (unseen) population then we are correct but otherwise we have made an *error*
- If the null hypothesis is false we reject it. If it's true we don't reject it.

Why does it matter? ***Hypothesis Test Principles***

- Null hypothesis- no effect in the population. Either going to be true or false in the population.
    - If null hypothesis is true, no effect. And we don't reject it.
    - If null hypothesis is false, there is an effect. And we reject the null hypothesis.
    - We want these patterns to repeat in our population.
    - <u>If the null hypothesis is true in the population (there is no effect), but is false (there is an effect) in the sample, this is a Type I error.</u>
    - <u>If the null hypothesis is false in the population (there is an effect), but is true (there is no effect) in the sample, this is a Type II error.</u>

Types of Error:

- First everyone believed there was an effect, when there wasn't. Next they believed there was no effect, when there was. (Type I & Type II errors respectively).
    - ➢ Belief that there's an effect when there is NOT – Type I
    - ➢ Belief that there's NO effect when THERE IS- Type II
- **Type I error: we reject H_0 based on sample information when it is actually true in the population.** Effect in sample, but no effect in population.
- **Type II error: we accept H_0 based on sample information when it is actually false in the population.** No effect in sample, but effect in population.

- Probability(Type I error) = α
- Pr(Type II error) = β
- Pr(not Type II error) = 1 – β = power
  - Probability to detect an effect that is there.

Controlling Error:

- **We control type I error probability directly through choice of significance level. (Set *p* at 0.05).**
- **We control type II error probability indirectly through sample size + other design factors.**
- All else held constant, increasing sample size will increase power.
- Increasing power leads to reduced probability of making a type II error. More likely to detect an effect with a larger sample size.

Why is this important? *Ethics and Power:*

- Unethical to pursue research if we aren't confident that we'll come to a definitive conclusion.
- Resources may be wasted, subjects unnecessary effort, discomfort, money.

A hypothetical example: influence of emotional intelligence on Psych QoL

- From a larger sample of individuals on whom we had emotional intelligence scores (TeiQue) we randomly selected n=10 with low EI scores and n=10 with high EI scores and asked them to complete a psychological QoL scale (WHO)
- We then compared QoL-Psych between the EI groups with low and high scores

Group Statistics

	EI group	N	Mean	Std. Deviation	Std. Error Mean
Psych QoL	Low EI	10	126.7221	18.91615	5.98181
	High EI	10	143.0947	25.79266	8.15636

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Psych QoL	Equal variances assumed	1.523	.233	-1.619	18	.123	-16.37256	10.11475	-37.62287	4.87775
	Equal variances not assumed			-1.619	16.509	.124	-16.37256	10.11475	-37.76126	5.01614

- p=0.1 therefore do not reject H_0 and conclude that psych QoL does not differ between individuals with high and low EI scores.

But…

- Cohen's D is defined as:

$$D = \frac{\mu_L - \mu_H}{\sigma_p}$$

D=-16.37/22.35=-0.73

D ≥ 0.8 is considered a large effect size and