Recall that in past lectures we have discussed how to estimate parameters / test hypotheses with a *single* sample (or two *paired* samples).

In this lecture, let's discuss how to test hypotheses about *two independent samples*.

Illustrative problem: suppose we want to test a new memory treatment. Eight participants are randomly assigned to one of two groups (treatment vs. control) and given a memory test:

Treatment	Control
45	43
55	49
40	35
60	51
$\overline{X}_1 = 50$	$\overline{X}_2 = 44.5$
$SS_1 = 250$	$SS_2 = 155$

Does the treatment group score significantly higher than the control group?

To work this out, let's measure the "effect" of the treatment:

We will compute *Cohen's d*:

$$d = \frac{\text{difference in means}}{\text{standard deviation}}$$

1. computing the difference in means is easy: $\overline{X}_1 - \overline{X}_2$
2. but there are TWO standard deviations!
    - solution: *pool* them

Pooled variance

- weighted average of variances from the two groups, with weights determined by relative sample size
- formula:

$$\hat{\sigma}_p^2 = \frac{SS_1 + SS_2}{df_1 + df_2}$$

So, let's compute Cohen's d for our example:

Note: we interpret d according to the following guidelines:

d	"size" of effect
0.2	small
0.5	medium
0.8	large

So, we have a "medium - to - large" effect. Is it statistically significant?

Independent samples t-test

Example 2: N=16 subjects learned a visual discrimination task on one day and then were tested the following day. Half were allowed to have at least 6 hours sleep, and the other half were kept up all night.

6 hours sleep	No sleep
$N_1 = 8$	$N_2 = 8$
$\overline{X}_1 = 72$	$\overline{X}_2 = 61$
$\overline{SS}_1 = 440$	$\overline{SS}_2 = 456$

Is there a significant difference in performance between the two conditions?

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Example 3: One sample of rats receives a drug that lowers serotonin, whereas another receives placebo. The number of aggressive acts is recorded:

Control	Low serotonin
$N_1 = 10$	$N_2 = 15$
$\overline{X}_1 = 12$	$\overline{X}_2 = 16$
$\overline{SS}_1 = 160.2$	$\overline{SS}_2 = 135.1$

Does the drug result in increased aggression in rats?

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