PSY 2317 Transparency Copies
Chapter 6

Effect Size
Statistical Power
Power & Effect Size

Hypothesis testing can yield 2 results:

- Reject the null hypothesis
  Support the research hypothesis

- Fail to reject the null hypothesis
  Results are inconclusive

Statistical power is

the probability that the research hypothesis will be supported (statistically significant)

IF it is in fact true.
What Influences Power?

- Sample size
  The bigger the more power

- Treatment effect size
  The bigger the more power

- \( \alpha \) Level
  The bigger the more power
  But -- the greater the risk of Type I error!

- Population variance (standard deviation)
  The smaller the more power
  because effect size will be increased
  But -- if you reduce the variance -
  can you generalize?

- 1 tail vs 2 tail test

- type of statistical test used
Two BIG Points

● Statistical significance ≠ Importance

● The bigger the effect
  The fewer subjects needed
The smaller the standard deviation the larger the effect size.

\[ d = \frac{\mu_1 - \mu_2}{\sigma} \]

- \( d = 0.20 \) small effect
- \( d = 0.50 \) medium effect
- \( d = 0.80 \) large effect
Fail to reject Null
Inconclusive

\( \mu_2 \)

Reject Null
Support Research

\( \mu_1 \)
Fail to reject Null
Inconclusive

Reject Null
Support Research

$\mu_2$  \hspace{1cm} $\mu_1$
Fail to reject Null
Inconclusive

Reject Null
Support Research

$\beta$

$\mu_2$

$\mu_1$

$\alpha = .05$

$\mu_1$

$\mu_2$
EXAMPLE

64 students are asked to rate the attractiveness of a person in a photo after they are told that the person has positive personality qualities.

Pop 1 - Students told of positive personality qualities
Mean predicted to be 208

Pop 2 - Those not told about personality
\[ \mu_2 = 200 \quad \sigma_2 = 48 \]

Research hypothesis \( \mu_1 > \mu_2 \)

Null hypothesis \( \mu_1 = \mu_2 \)

Comparison Distribution
A distribution of means
normal in shape
\[ \mu_M = 200 \]

\[ \sigma_M = \frac{\sigma_2}{\sqrt{N}} = \frac{48}{\sqrt{64}} = \frac{48}{8} = 6 \]

Cutoff One-tailed test high
Use \( \alpha = .05 \)
\[ Z = 1.64 \]
Pop 1

power

\[ \mu_1 \]

\[ \mu_2 \]

\[ Z = 1.64 \]

\[ X = 209.84 \]

\[ Z = .31 \]

\[ \alpha = .05 \]

Pop 2

\[ \mu_1 \ = 208 \]

\[ \mu_2 \ = 200 \]

X = 209.84

1.64

.31

.05
EXAMPLE continued

Convert the cutoff $Z$ score to a raw score

$$X = Z \left( \sigma_M \right) + \mu_M$$

$$= 1.64 \times 6 + 200$$

$$= 209.84$$

Extend the cutoff and draw in the normal curve for pop 1 distribution of means (the treatment distribution)

Convert the raw score 209.84 to a $Z$ score for the treatment distribution

$$Z = \frac{X - \mu_M}{\sigma_M} = \frac{209.84 - 208}{6}$$

$$= \frac{1.84}{6} = .31$$

Determine the area under the treatment distribution that corresponds to power (to the right of cutoff)

Area mean to $Z = .31$ is 12.17

Power is area in tail $= 37.83\%$
Example Continued

EFFECT SIZE

\[
d = \frac{\mu_1 - \mu_2}{\sigma} = \frac{208 - 200}{48} = \frac{8}{48} = .17
\]

Note:

\( \sigma \) is the original standard deviation of the general population