Chapter 15—Power

15.1 The statement on skiing is intended to point out that just because two things are different doesn't mean that the larger (better, greater, etc.) one will always come out ahead. To take a different example, one treatment might be better than another for anorexia, but I would be very surprised if the difference was statistically significant every time, or even that its mean was always greater than the other mean. I just hope that it is significant *most* of the time.

15.3 Power for socially desirable responses:

Assume the population mean = 4.39 and the population standard deviation = 2.61

a) Effect size:

$$\gamma = \frac{\mu_1 - \mu_0}{\sigma} = \frac{4.39 - 3.87}{2.61} = \frac{0.52}{2.61} = .20$$

b) delta:

$$\delta = .20\sqrt{36} = 1.20$$

c) power = .22

15.5 For Exercise 15.3 we would need δ approximately equal to 2.50, 2.80, and 3.25 for power of .70, .80, and .90, respectively.

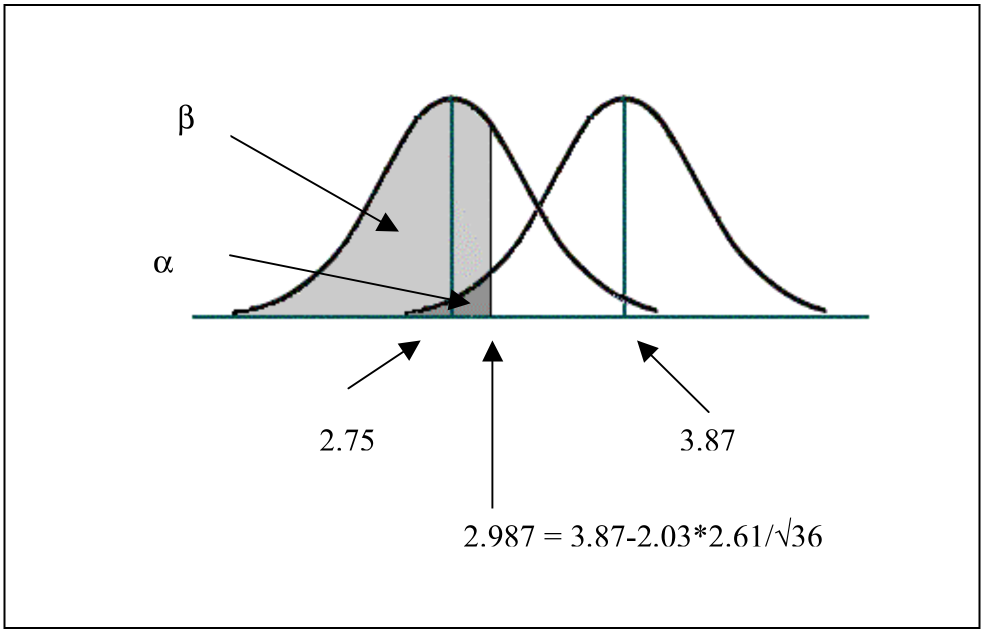
$$\delta = \gamma\sqrt{N}$$

$$2.50 = .20\sqrt{N} \text{ therefore } N = \left(\frac{2.50}{.20}\right)^2 = 156.25$$

$$2.80 = .20\sqrt{N} \text{ therefore } N = \left(\frac{2.80}{.20}\right)^2 = 196$$

$$3.25 = .20\sqrt{N} \text{ therefore } N = \left(\frac{3.25}{.20}\right)^2 = 264.06$$

15.7 Diagram of Exercise 15.6:



15.9 Avoidance behavior in rabbits using a one-sample *t* test:

a) For power = .50 we need δ = 1.95.

$$\gamma = \frac{\mu_1 - \mu_0}{\sigma} = \frac{5.8 - 4.8}{2} = \frac{1.0}{2} = .50$$

$$\delta = \gamma\sqrt{N}$$

$$1.95 = .5\sqrt{N} \text{ therefore } N = \left(\frac{1.95}{.50}\right)^2 = 15.21$$

b) For power = .80 we need δ = 2.80.

$$\delta = \gamma\sqrt{N}$$

$$2.8 = .5\sqrt{N} \text{ therefore } N = \left(\frac{2.8}{.50}\right)^2 = 31.36$$

Because subjects come in whole units, we would need 16 subjects for power = .50 and 32 subjects for power = .80

15.11 Avoidance behavior in rabbits with unequal sample sizes:

$$\gamma = .50$$

$$N = \bar{N}_h = \frac{2N_1N_2}{N_1 + N_2} = \frac{2(20)(15)}{20 + 15} = 17.14$$

$$\delta = \gamma\sqrt{N/2} = .5\sqrt{\frac{17.14}{2}} = 1.46$$

With δ = 1.46, power = .31

15.13 Cognitive development of LBW and normal babies at 1 year—modified data:

a) Power calculations

$$\gamma = \frac{\mu_1 - \mu_0}{\sigma} = \frac{25 - 28}{8} = -.375$$

$$\delta = \gamma\sqrt{\frac{N}{2}} = -.375\sqrt{\frac{20}{2}} = -1.19$$

With δ = -1.19, power = .22

b) *t* test:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_p^2}{N_1} + \frac{s_p^2}{N_2}}} = \frac{25 - 28}{\sqrt{\frac{64}{20} + \frac{64}{20}}} = -1.19$$

[$t_{.05}(38) = \pm 2.205$] Do not reject the null hypothesis.

c) The *t* is numerically equal to δ, although *t* is calculated from statistics and δ is calculated from parameters. In other words, δ is equal to the *t* we would get if the data came out with statistics equal to the parameters,

15.15 The significant *t* with the smaller *N* is more impressive, because that test had less power than the other, so the underlying difference is probably greater.

> The fact that a significant difference with a small *N* is more impressive should not lead the student to conclude that small sample sizes are to be preferred.

15.17 Social awareness of ex-delinquents—which subject pool would be better to use?

$\bar{X}_{\text{Normal}} = 38 \quad N = 50$

$\bar{X}_{\text{College}} = 35 \quad N = 100 \qquad \bar{X}_{\text{Dropout}} = 30 \quad N = 25$

$$\gamma = \frac{38-35}{\sigma} \qquad \gamma = \frac{38-30}{\sigma}$$

$$\overline{N}_h = 66.67 \qquad \overline{N}_h = 33.33$$

$$\delta = \frac{3}{\sigma}\sqrt{\frac{66.67}{2}} \qquad \delta = \frac{8}{\sigma}\sqrt{\frac{33.33}{2}}$$

$$= \frac{17.32}{\sigma} \qquad = \frac{32.66}{\sigma}$$

Assuming equal standard deviations, the H. S. dropout group of 25 would result in a higher value of δ, and therefore higher power.

15.19 Total Sample Sizes Required for Power = .60, α = .05, Two-Tailed (δ = 2.20)

Effect Size	**γ**	**One-Sample *t***	**Two-Sample *t* *(per group)***	**Two-Sample *t* *(overall)***
Small	0.20	121	242	484
Medium	0.50	20	39	78
Large	0.80	8	16	32

15.21 When can power = β?

The mean under H_1 should fall at the critical value under H_0. The question implies a one-tailed test. Thus the mean is 1.645 standard errors above μ_0, which is 100.

$\mu = 100 + 1.645\sigma_X$

$= 100 + 1.645(15)/\sqrt{25}$

$= 104.935$

When μ = 104.935, power would equal β.

15.23 The power of the comparison of TATs of parents of schizophrenic and normal subjects.

$$s_p^2 = \frac{3.523+2.412}{2} = 2.968; \quad s_p = \sqrt{2.968} = 1.723$$

$$\gamma = \frac{\mu_1 - \mu_2}{\sigma} = \frac{3.55-2.10}{1.723} = \frac{1.45}{1.723} = 0.842$$

$$\delta = \gamma\sqrt{\frac{N}{2}} = 0.842\sqrt{\frac{20}{2}} = 2.66$$

Power = .75

15.25 Aronson's research on stereotype threat.

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2} = \frac{(11-1)3.17^2 + (12-1)3.02^2}{11 + 12 - 2} = 9.56$$

$$s_p = 3.09$$

$$\hat{d} = \frac{\bar{X}_1 - \bar{X}_2}{s_p} = \frac{9.64 - 6.58}{3.09} = 0.99$$

$$n_h = \frac{2n_1n_2}{n_1 + n_2} = \frac{2(11)(12)}{11 + 12} = 11.48$$

$$\delta = d\sqrt{\frac{n}{2}} = 0.99\sqrt{\frac{11.48}{2}} = 0.99\sqrt{5.74} = 0.99(2.396) = 2.37$$

From Appendix D5 the power of this experiment, if these are accurate estimates of the parameters, is .658.