Self Evaluation Problems
Class 2
Answer Key

Suppose we are interested in estimating the mean dollars charged for coronary artery bypass graft (CABG) surgery at a major medical center. From the literature, the standard deviation of expenditures among patients within a hospital is thought to be approximately $3,000.

1) Suppose we want to compare the cost of a CABG procedure between Johns Hopkins and the Mayo Clinic. Assume *s*= $3,000 for both hospitals. If we desire equal sample sizes at each hospital, how large a sample of patients for each institution is needed in order to have 80% power to reject the null $\mathrm{H}_0 : \mu_{\mathrm{H}} = \mu_{\mathrm{MC}}$? Assume a two-sided test with a significance level of 0.05 when the true difference is $1,000.

$$n = \frac{\left(Z_{\alpha/2} + Z_{\beta}\right)^2 \cdot 2\sigma^2}{\Delta^2} = \frac{(1.96 + 0.84)^2 \cdot 2 \cdot 3{,}000^2}{1{,}000^2} = 141 \text{ patients per center}$$

In designing a clinical investigation to evaluate a new digital mammography (DM) system, we must screen about 1,000 women to find 10 cancers. Suppose that we want to estimate the sensitivity of the new DM method to within ±5%. We expect the sensitivity to be around 0.75.

2) How many women will we have to screen?

95% CI: $\hat{p} \pm 1.96\sqrt{\hat{p}\hat{q}/n};\ 1.96\sqrt{\frac{.75(.25)}{\mathrm{n}}} = .05$

***n* = 288 cancers ⇒ 28,800 women**

3) If the guess that sensitivity is 0.75 proves mistaken and sensitivity is really 0.90, how many women should we have to screen?

$$\mathbf{1.96\sqrt{\frac{.90(.10)}{\boldsymbol{n}}} = .05 \Rightarrow \boldsymbol{n} = 138.3 \Rightarrow \text{must screen 13,830 women}}$$

4) What does the difference in results in Problems 2 and 3 tell you about planning screening studies to estimate sensitivity?

±5% means something very different when sensitivity is .75 than when it is .90. Planning is imprecise.

5) Suppose we want to compare the sensitivity of a new DM system to the standard analog mammography system. If the sensitivity of the analogue system is .65, what sample size would be needed in each group in order to detect a 10% improvement in sensitivity with the new DM system? Assume a two-sided test with a 5% significance level and 80% power?

$$n = \frac{\left(Z_{\alpha/2}\sqrt{2\overline{pq}} + Z_{\beta}\sqrt{p_1 q_1 + p_2 q_2}\right)^2}{\Delta^2} = \frac{\left(1.96\sqrt{2(.7)(.3)} + 0.84\sqrt{.65(.35)+(.75)(.25)}\right)^2}{(0.10)^2} = 328$$

patients per hospital

How large is the sample size if 90% power is desired?

$$n = \frac{\left(Z_{\alpha/2}\sqrt{2(.7)(.3)} + Z_{\beta}\sqrt{.65(.35)+(.75)(.25)}\right)^2}{\Delta^2} = \frac{\left(1.96\sqrt{2(.7)(.3)} + 1.28\sqrt{.65(.35)+(.75)(.25)}\right)^2}{(0.10)^2}$$

$=$ 438 patients per hospital

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. sampsi 35000 36000, p(0.8) sd1(3000) sd2(3000)

Estimated sample size for two-sample comparison of means

Test Ho: m1 = m2, where m1 is the mean in population 1
                    and m2 is the mean in population 2
Assumptions:

         alpha =   0.0500  (two-sided)
         power =   0.8000
            m1 =    35000
            m2 =    36000
           sd1 =     3000
           sd2 =     3000
         n2/n1 =     1.00

Estimated required sample sizes:

            n1 =      142
            n2 =      142
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. sampsi 0.65 0.75, p(0.80)

Estimated sample size for two-sample comparison of proportions

Test Ho: p1 = p2, where p1 is the proportion in population 1
                    and p2 is the proportion in population 2
Assumptions:

         alpha =   0.0500  (two-sided)
         power =   0.8000
            p1 =   0.6500
            p2 =   0.7500
         n2/n1 =   1.00

Estimated required sample sizes:

            n1 =      349
            n2 =      349  Note:  Stata uses a correction for continuity which results
                           in a slightly larger sample size


. sampsi 0.65 0.75, p(0.90)

Estimated sample size for two-sample comparison of proportions

Test Ho: p1 = p2, where p1 is the proportion in population 1
                    and p2 is the proportion in population 2
Assumptions:

         alpha =   0.0500  (two-sided)
         power =   0.9000
            p1 =   0.6500
            p2 =   0.7500
         n2/n1 =   1.00

Estimated required sample sizes:

            n1 =      460
            n2 =      460  Note:  Stata uses a correction for continuity which results
                           in a slightly larger sample size
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