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Section D

Sample Size and Study Design Principles: A Brief Summary

Designing Your Own Study

- When designing a study, there is a tradeoff between:
 - Power
 - α -level
 - Sample size
 - Minimum detectable difference (specific H_A)
- Industry standard—80% power, $\alpha = .05$

Designing Your Own Study

- What if sample size calculation yields group sizes that are too big (i.e., can not afford to do the study) or are very difficult to recruit subjects for study?
 - Increase minimum difference of interest
 - Increase α -level
 - Decrease desired power

Designing Your Own Study

- Sample size calculations are an important part of study proposal
 - Study funders want to know that the researcher can detect a relationship with a high degree of certainty (should it really exist)
- Even if you anticipate confounding factors, these approaches are the best you can do and are relatively easy
- Accounting for confounders requires more information and sample size has to be done via computer simulation—consult a statistician!

Designing Your Own Study

- When would you calculate the power of a study?
 - Secondary data analysis
 - Data has already been collected, sample size is fixed
 - *Pilot study*—to illustrate that low power may be a contributing factor to non-significant results and that a larger study may be appropriate

Designing Your Own Study

- What is this specific alternative hypothesis?
 - *Power or sample size* can only be calculated for a specific alternative hypothesis
 - When comparing two groups this means estimating the true population means (proportions) for each group

Designing Your Own Study

- What is this specific alternative hypothesis?
 - Therefore specifying a difference between the two groups
 - This difference is frequently called minimum detectable difference or effect size, referring to the minimum detectable difference with scientific interest

Designing Your Own Study

- Where does this specific alternative hypothesis come from?
 - Hopefully, not the statistician!
 - As this is generally a quantity of scientific interest, it is best estimated by a knowledgeable researcher or pilot study data
 - This is perhaps the most difficult component of sample size calculations, as there is no magic rule or “industry standard”

FYI—Using Stata to Compute Power

- I promised you in part A of this lecture that I would eventually show you how to compute the power to detect difference in a study that has already been conducted
- The “samps” command is still the command for this—we just need to feed it slightly different information for it to compute power

Calculating Power

- In order to calculate power for a study comparing two population means, we need the following:
 - Sample size for each group
 - Estimated (population) means, μ_1 and μ_2 for each group—these values frame a specific alternative hypothesis (usually minimum difference of scientific interest)
 - Estimated (population) SDs, σ_1 and σ_2
 - α -level of the hypothesis test

Calculating Power

- The blood pressure/oral contraceptive example

Sample Data			
	n	Mean SBP	SD of SBP
OC users	8	132.8	15.3
Non-OC users	21	127.4	18.2

- What is the power of this study to detect a difference in average SBP of 5.4 mmHg?

Calculating Power

- Fill in information below with results from this study
 - Sample size for each group ($n_{OC} = 8$, $n_{NO\ OC} = 21$)
 - Estimated (population) means, $\mu_{OC} = 132.8$ and $\mu_{NO\ OC} = 127.4$
 - Estimated (population) SDs, $\sigma_{OC} = 15.3$ and $\sigma_{NO\ OC} = 18.2$ for each group
 - α -level of the hypothesis test (.05)

Calculating Power

■ Using *sampsi* in Stata

```
. samps i 132.8 127.4, sd1(15.3) sd2(18.2) n1(8) n2(21)
```

Estimated power for two-sample comparison of means

Test $H_0: m_1 = m_2$, where m_1 is the mean in population 1
and m_2 is the mean in population 2

Assumptions:

```
alpha = 0.0500 (two-sided)
m1 = 132.8
m2 = 127.4
sd1 = 15.3
sd2 = 18.2
sample size n1 = 8
n2 = 21
n2/n1 = 2.63
```

Estimated power:

```
power = 0.1268
```

Calculating Power

- In order to calculate power for a study comparing two population proportions, we need the following:
 - Sample size for each group
 - Estimated (population) proportions, p_1 and p_2 , for each group: these values frame a specific alternative hypothesis (it usually is the minimum difference of scientific interest)
 - α -level of the hypothesis test

Calculating Power

- Ulcer drug/healing example

	Healed	Not healed	Total
Drug A	23	7	30
Drug B	18	13	31

- In this study:

$$\hat{p}_{DRUG\ A} = \frac{23}{30} \approx .77$$

$$\hat{p}_{DRUG\ B} = \frac{18}{31} \approx .58$$

Calculating Power

- Fill in information below with results from this study
 - Sample size for each group ($n_{DRUG\ A} = 30$, $n_{DRUG\ B} = 31$)
 - Estimated (population) proportions, $p_{DRUG\ A} = .77$ and $p_{DRUG\ B} = .58$
 - α -level of the hypothesis test (.05)

Calculating Power

- Using the sampsi command
 - `sampsi p_1 p_2 , $n_1(n_1)$ $n_2(n_2)$ alpha(a)`

```
. sampsi .77 .58, n1(30) n2(31) alpha(.05)
```

Estimated power for two-sample comparison of proportions

Test Ho: $p_1 = p_2$, where p_1 is the proportion in population 1
and p_2 is the proportion in population 2

Assumptions:

```
alpha = 0.0500 (two-sided)
p1 = 0.7700
p2 = 0.5800
sample size n1 = 30
n2 = 31
n2/n1 = 1.03
```

Estimated power:

```
power = 0.2525
```

Note: For the above sample size(s) and proportion(s), the normal approximation to the binomial may not be very accurate. Thus, power calculations are questionable.