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, α = .05

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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

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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!

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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

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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

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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

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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"

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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 "sampsi" command is still the command for this—we just need to feed it slightly different information for it to compute power

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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

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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?

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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, μ_{OC} = 132.8 and $\mu_{NO\ OC}$ = 127.4
  - Estimated (population) SDs, σ_{OC} = 15.3 and $\sigma_{NO\ OC}$ = 18.2 for each group
  - α-level of the hypothesis test (.05)

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Calculating Power

- Using *sampsi* in Stata

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

Estimated power 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)
            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
```

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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

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Calculating Power

- Ulcer drug/healing example

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

- In this study:

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

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

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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)

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Calculating Power

- Using the sampsi command
  - sampsi p_1 p_2, n1(n_1) n2(n_2) alpha(a)

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

Estimated power 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)
            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.
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