# Chapter 5

- The sampling distribution of $\bar{Y}$
  - $\mu_{\bar{Y}} = \mu$, $\sigma_{\bar{Y}} = \sigma/\sqrt{n}$
  - If $Y \sim N(\mu, \sigma^2)$, then $\bar{Y} \sim N(\mu, \sigma^2/n)$
  - Central Limit Theorem
- Normal Approximation to the Binomial Distribution
  - $Y \overset{\text{approx}}{\sim} N(np, np(1-p))$ and $\hat{p} \overset{\text{approx}}{\sim} N(p, p(1-p)/n)$
  - Continuity connection
  - $np \geq 5$ and $n(1-p) \geq 5$

# Chapter 6

- Student's $t$ distribution
  - $t$ Table
- Confidence intervals for $\mu$

  - Two-sided
  - One-sided: upper and lower
  - Conditions
  - Summary

  $1 - \alpha$ confidence interval for $\mu$:

  - Two-sided: $\bar{Y} \pm t_{n-1}(\alpha/2) \times \mathrm{SE}_{\bar{Y}}$
  - Upper one-sided: $(-\infty, \bar{Y} + t_{n-1}(\alpha) \times \mathrm{SE}_{\bar{Y}})$
  - Lower one-sided: $(\bar{Y} - t_{n-1}(\alpha) \times \mathrm{SE}_{\bar{Y}}, \infty)$

  where

$$\mathrm{SE}_{\bar{Y}} = \frac{s}{\sqrt{n}}$$

- Interpretation of a confidence interval
- Planning a study to estimate $\mu$
- Confidence intervals for $\mu_1 - \mu_2$

  - Two-sided
  - One-sided: upper and lower
  - Conditions
  - Summary

$1-\alpha$ confidence interval for $\mu_1-\mu_2$:

* Two-sided: $(\bar{Y}_1-\bar{Y}_2) \pm t_\nu(\alpha/2) \times \mathrm{SE}_{\bar{Y}_1-\bar{Y}_2}$
* Upper one-sided: $(-\infty, (\bar{Y}_1-\bar{Y}_2) + t_\nu(\alpha) \times \mathrm{SE}_{\bar{Y}_1-\bar{Y}_2})$
* Lower one-sided: $((\bar{Y}_1-\bar{Y}_2) - t_\nu(\alpha) \times \mathrm{SE}_{\bar{Y}_1-\bar{Y}_2}, \infty)$

where the degrees of freedom $\nu$ will be given and

$$\mathrm{SE}_{\bar{Y}_1-\bar{Y}_2} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

# Chapter 7

- Two-sample $t$ test
  - Two-sided
  - One-sided: left and right
  - $p$-value and critical value
  - Conditions
  - Summary

| $H_0$ | $H_A$ | Test statistic | Rejection region | $p$-value |
|---|---|---|---|---|
| $\mu_1-\mu_2=c$ | $\mu_1-\mu_2\neq c$ | $T=\frac{(\bar{Y}_1-\bar{Y}_2)-c}{\mathrm{SE}_{\bar{Y}_1-\bar{Y}_2}} \overset{H_0}{\sim} t_\nu$ with | $\lvert T\rvert > t_\nu(\alpha/2)$ | $2\times P(t_\nu > \lvert T\rvert)$ |
| $\mu_1-\mu_2\geq c$ | $\mu_1-\mu_2<c$ | $\nu=\frac{(\mathrm{SE}_1^2+\mathrm{SE}_2^2)^2}{\mathrm{SE}_1^4/(n_1-1)+\mathrm{SE}_2^4/(n_2-1)}$ | $T<-t_\nu(\alpha)$ | $P(t_\nu<T)$ |
| $\mu_1-\mu_2\leq c$ | $\mu_1-\mu_2>c$ | | $T>t_\nu(\alpha)$ | $P(t_\nu>T)$ |

- Type I and type II errors, power
- How are $H_0$ and $H_A$ chosen

# Chapter 8

- One-sample $t$ test
  - Two-sided
  - One-sided: left and right
  - $p$-value and critical value
  - Conditions
  - Summary

| $H_0$ | $H_A$ | Test statistic | Rejection region | $p$-value |
|---|---|---|---|---|
| $\mu = c$ | $\mu \neq c$ | $T = \frac{\bar{Y}-c}{\mathrm{SE}_{\bar{\mathrm{Y}}}} \overset{H_0}{\sim} t_{n-1}$ | $\lvert T\rvert > t_{n-1}(\alpha/2)$ | $2 \times P(t_{n-1} > \lvert T\rvert)$ |
| $\mu \geq c$ | $\mu < c$ | | $T < -t_{n-1}(\alpha)$ | $P(t_{n-1} < T)$ |
| $\mu \leq c$ | $\mu > c$ | | $T > t_{n-1}(\alpha)$ | $P(t_{n-1} > T)$ |

- Paired-sample
    - One-sample for differences
    - Conditions

# Chapter 9

- Confidence intervals for $p$
    - Two-sided
    - One-sided: upper and lower
    - Conditions
    - Summary
- The Chi-square goodness-of-fit test
    - The null and alternative hypotheses
    - Conditions