Follow Ideas Through Chapters 6 - 8

Consider $\mu = E[X]$

Chapter 6

$$\boxed{\bar{X} \approx \text{Normal}\left(\mu, \sigma/\sqrt{n}\right)}$$

is Unbiased Estimator for $\mu = E[X]$

(and s^2 estimates σ^2)

If σ is unknown then standardize with s

$$\frac{\bar{X} - \mu}{s/\sqrt{n}} \sim t(n-1) \approx \text{Normal if } n \geq 30 \text{ ("big")}$$

$(1-\alpha)$ CI is

$$\frac{\bar{x} - \mu}{s/\sqrt{n}} \approx \pm\, qt(\alpha/2, n-1)$$

solve for μ

Chapter 7

If n is big (& σ unknown) then

$$\boxed{\mu \approx \bar{x} \pm s/\sqrt{n} \cdot qnorm(\alpha/2)}$$

is $(1-\alpha)$ Confidence Interval for μ

solve for α

If n is small (& σ unknown) then

$$\boxed{\mu \approx \bar{x} \pm s/\sqrt{n} \cdot qt(\alpha/2, n-1)}$$

is $(1-\alpha)$ Confidence Interval for μ

solve for α

Chapter 8

$$\boxed{2 \cdot pnorm\left(\frac{\bar{x} - \mu_0}{s/\sqrt{n}}\right) = \cancel{\alpha}\, p}$$

is p-value for testing against $H_0: \mu = \mu_0$

$$\boxed{z_{\bar{x}} = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}}$$

is the "z-score" of $\bar{x}$ vs μ_0

$$\boxed{z_\alpha = qnorm(\alpha)}$$

is the "α-level cutoff"

$$\boxed{2 \cdot pt\left(\frac{\bar{x} - \mu_0}{s/\sqrt{n}}, n-1\right) = \cancel{\alpha}\, p}$$

is p-value for testing against $H_0: \mu = \mu_0$

$$\boxed{t_{\bar{x}} = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}}$$

is the "t-score" of $\bar{x}$ vs μ_0

$$\boxed{n-1 = \#\text{ "degrees of freedom"}}$$

Population Proportion: $X \sim \text{Binomial}(n, p)$

Chapter 6

$$\boxed{\hat{p} = X/n}$$ is Unbiased Estimator for p

$$\boxed{\hat{p} \approx \text{Normal}\left(p, \sqrt{pq/n}\right)} \leftarrow \begin{cases} \mu = p \\ \sigma = \sqrt{pq/n} \end{cases}$$

Chapter 7

$$\left.\begin{matrix} \hat{p} = x/n \\ \hat{q} = 1-\hat{p} \end{matrix}\right\} \rightarrow \boxed{p \approx \hat{p} \pm \sqrt{\hat{p}\hat{q}/n} \cdot \text{qnorm}(\alpha/2)}$$

is $(1-\alpha)$ Confidence Interval for p

solve for α

Chapter 8

$$\boxed{2 \cdot \text{pnorm}\left(\frac{\hat{p} - p_0}{\sqrt{p_0 q_0/n}}\right) \approx \cancel{\alpha}\ p}$$

Note: Hyp. Test uses $\boxed{p_0 q_0/n}$ instead of $\boxed{\hat{p}\hat{q}/n}$

is p-value for testing against

$H_0: p = p_0$

[Note: p-value could also be computed more directly via pbinom

(1-tailed Hyp. Test) $\begin{cases} p = \text{pbinom}(x, n, p_0) & \text{if } x < np_0 \\ 1 - \text{pbinom}(x, n, p_0) & \text{if } x > np_0 \end{cases}$]

Variance $\sigma^2 = \text{Var}[X]$

Chapter 6

$$\boxed{\begin{aligned} S^2 &= \frac{1}{n-1} \sum_i (X_k - \bar{X})^2 \\ &= \frac{1}{n-1}\left[\sum_i X_k^2 - \frac{1}{n}\left(\sum_i X_k\right)^2\right] \end{aligned}}$$

is Unbiased Estimator for σ^2

$$\boxed{\frac{(n-1)S^2}{\sigma^2} \sim \chi^2(n-1)}$$

"Chi Squared with n-1 deg. of freedom"

solve for σ^2

Chapter 7

$$\boxed{\frac{(n-1)S^2}{\text{qchisq}(1-\alpha/2,\ n-1)} < \sigma^2 < \frac{(n-1)S^2}{\text{qchisq}(\alpha/2,\ n-1)}}$$

is $(1-\alpha)$ Confidence Interval

[We did not do Hypothesis Testing for Variance...]