Q: If we do not know the population proportion / mean, how do we estimate them?

| | population proportion $p_x$ (8.1, 8.2, 9.1, 9.2) | population mean $\mu_x$ (8.3, 9.3) |
|---|---|---|
| point estimate | sample proportion $\hat{p}$ | sample mean $\bar{X}$ |

| Confidence interval | | |
|---|---|---|
| Assumption | * $\begin{cases} n\hat{p} \geq 15 \\ n(1-\hat{p}) \geq 15 \end{cases}$ * categorical * random | * $n > 30$ * quantitative * random |
| margin of error (MOE) | $z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$ | $\sigma_x$ known: $z_{\frac{\alpha}{2}} \left(\frac{\sigma_x}{\sqrt{n}}\right)$<br>$\sigma_x$ unknown: $t_{\frac{\alpha}{2}, n-1} \left(\frac{s}{\sqrt{n}}\right)$ |
| $(1-\alpha)$ confidence interval | $\hat{p} \pm z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$ | $\sigma_x$ known: $\bar{x} \pm z_{\frac{\alpha}{2}} \left(\frac{\sigma_x}{\sqrt{n}}\right)$<br>$\sigma_x$ unknown: $\bar{x} \pm t_{\frac{\alpha}{2}, n-1} \left(\frac{s}{\sqrt{n}}\right)$ |

| Hypothesis testing | | |
|---|---|---|
| Assumption | * $\begin{cases} np_0 \geq 15 \\ n(1-p_0) \geq 15 \end{cases}$ * categorical * random | * $n > 30$ * quantitative * random |
| test statistic | $z^* = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$ | $t^* = \frac{\bar{x} - \mu_0}{\left(\frac{s}{\sqrt{n}}\right)}$ |