19 Hypothesis Testing 2

Ex 1 Company claims their cars can accelerate from 0 to 60 mph in 6 seconds. A random sample of 33 cars has a mean acceleration of 7.2 seconds. At $\alpha = 0.05$, can you reject the claim? (Assume pop. standard deviation of 2.5 seconds).

A State hypothesis : $H_0 : \mu \leq 6$

$H_a : \mu > 6$

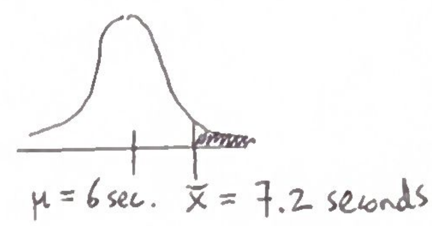
Check conditions : 10% condition There are $N \geq 10 \cdot 33$ cars by that company ✓.

Normal / Large Sample $n = 33 \geq 30$ ✓.

Compute P = pnorm(7.2, mean = 6, sd = $\frac{2.5}{\sqrt{33}}$, lower.Tail = FALSE)

= pnorm($\frac{7.2-6}{2.5/\sqrt{33}}$ lower.Tail = FALSE)

= ~~0.32~~ 0.0029



Conclude Since P = ~~0.32 >~~ 0.0029 < $\alpha = 0.05$, we reject H_0. There is convincing evidence the mean acceleration of the company's cars is > 6 seconds.

Hypothesis Testing for mean μ (σ unknown)

State $H_0 : \mu = \mu_0$, $\mu \geq \mu_0$, $\mu \leq \mu_0$

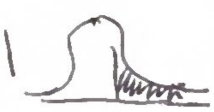
$H_a : \mu \neq \mu_0$, $\mu < \mu_0$, $\mu > \mu_0$

Check 10% condition : $N \geq 10n$

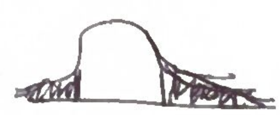
Normal / Large Sample : Pop. is normally distributed or $n \geq 30$

Compute P-value P = pt($\frac{\bar{x}-\mu_0}{s_x/\sqrt{n}}$, df = n−1) ... left-tail

P = pt($\frac{\bar{x}-\mu_0}{s_x/\sqrt{n}}$, df = n−1, lower.Tail = FALSE) ... right-Tail



$P = 2\cdot$ pt($\frac{\bar{x}-\mu_0}{s_x/\sqrt{n}}$, df = n−1) ... two-tailed



Conclude : If $P \geq \alpha$, we fail to reject H_0. If $P < \alpha$, we reject H_0.

Ex 2 Used car dealer claims the mean price of used cars sold in the past 12 months is at least \$21,000. You find that a random sample of 14 used cars sold in the past 12 months have a mean ~~of~~ price of \$19,200 and sd of \$3000. Is there enough evidence to reject the dealer's claim at $\alpha = 0.05$? Assume the pop. is normally distributed.

A State $H_0: \mu \geq 21000$

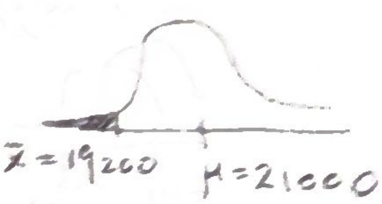
$H_a: \mu < 21000$

Check 10% Condition: There are $N \geq 10 \cdot 14 = 140$ used cars sold in last 12 months ✓.

Normal / large sample: Pop. is assumed to be normal ✓.

Compute $P = pt\left(\frac{19200 - 21000}{3000/\sqrt{14}}, df = 13\right)$

$= 0.021.$



Conclude Since $P = 0.021 < \alpha = 0.05$, we reject H_0.

There is convincing evidence that mean price of used cars sold in last 12 months is < \$21,000.

Hypothesis Testing for proportion p

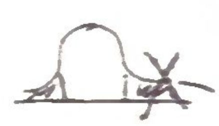
State $H_0: p = p_0,\ p \geq p_0,\ p \leq p_0$

$H_a: p \neq p_0,\ p < p_0,\ p > p_0.$

Check 10% Condition: $N \geq 10n$

Large Counts: np_0 and $n(1-p_0)$ are ≥ 10.

Compute P-value $P = pnorm\left(\hat{p}, mean = p_0, sd = \sqrt{\frac{p_0(1-p_0)}{n}}\right)$ ... left-Tail



$P = pnorm\left(\hat{p}, mean = p_0, sd = \sqrt{\frac{p_0(1-p_0)}{n}}, lower.tail = FALSE\right)$ ... right-Tail

$P = 2 \cdot pnorm\left(\hat{p}, mean = p_0, sd = \sqrt{\frac{p_0(1-p_0)}{n}}\right)$ ... Two-Tail

Conclude: If $P < \alpha$, we reject H_0. If $P \geq \alpha$, we fail to reject H_0.

Ex News claim ≥ 29% of US employees have changed jobs in the past 3 years. In a random sample of 180 US employees, 43 have changed jobs in the past 3 years. At the $\alpha = 0.10$ level, is there enough evidence to ~~support~~ counter the news' claim?

A State $H_0: p \geq 0.29$, $H_a: p < 0.29$.

Check: 10% Condition: There are $N \geq 10 \cdot 180 = 1800$ US employees ✓.

Large Counts: $n \cdot p_0 = 180 \cdot 0.29 = 52.2 \geq 10$, $n \cdot (1-p_0) = 180 \cdot 0.71 = 127.8 \geq 10$ ✓.

Compute: $P = pnorm\left(\frac{43}{180}, mean = 0.29, sd = \sqrt{\frac{0.29(0.71)}{180}}\right) = 0.065.$

Conclude: Since $P = 0.065 < \alpha = 0.10$, ~~there is~~ we reject H_0. There is convincing evidence that < 29% of US employees changed jobs in past 3 yrs.