Post for today.

# 7. Historically 20% of orders are returned.

\( H_0: p = 0.2 \quad p = \text{population fraction returned} \)

\( H_a: p \neq 0.2 \quad \text{Two-sided alternative} \)

2-sided means

\[ \text{Symmetrically placed.} \]

\( \text{Aggressive is twice usual one-sided} \)

\( p \text{-value} \).
Data: \( n = 100 \)  # RETURNED = 33.

\( p\)-value = \( P(\text{data more against } H_0 \text{ than we got}) \)

\[ \approx P(|z| > \frac{33 - 20}{\sqrt{100 \cdot 0.2}}) \]

\( p \) : \( H_0 \)

\[ \frac{13}{10 \cdot 4} = 3.25 \]

\( P(|z| > 3.25) \approx 0.05 \)

\( P(Z \leq -3.2) \)

\( \sqrt{0.0006} = -3.2 \)

Interpretation: little over \( \frac{1}{1000} \) samples of \( n = 100 \) would show this or more departure (in either direction).
Type 2 Error Probability

P(Decision Rejected | H₀ : μ = μ₀) = 0.01

P(Decision for Democracy | H₀ : μ = 0.52) = 0.01

P(Decision for Non-Democracy | H₀ : μ ≤ 0.48) = 0.01

P(Declare for Republic | H₀ : μ = 0.48) = 0.01

H₀: μ = 0.52

H₁: μ ≤ 0.48

α = 0.05

P = fraction who voted

P vote up. Need to call AN election.

Even if 20% support majority will lose.
REQUIRED SAMPLE SIZE \( n = \left( \frac{\sqrt{p_0 (1 - p_0)} + \sqrt{p_1 (1 - p_1)}}{p_0 - p_1} \right)^2 \)

\[ m = \left( \frac{\sqrt{0.48 (0.52)} + \sqrt{0.52 (0.48)}}{0.48 - 0.52} \right)^2 = 3387.63 \]

ROUND UP 3388

\[ H_0 \quad < \quad H_\text{A} \]

\[ p_0 \quad p_1 \]

\[ 0.48 \quad 0.52 \]

\[ 0.99 \quad 2.3 \]

\[ \alpha = 0.01 \]

\[ z_\alpha = 2.33 \]
As for $\theta_1$,

\[ \theta_1 = -2.33 \]

\[ \frac{3.01}{3.1} = \frac{0.03}{3} \]

Go back up and put these into "M".

\[ \left( \frac{2.33}{0.4} \right)^2 = \left( \frac{2.33}{4} \right)^2 = \frac{2.33}{0.4}^2 = 25.25 \]

Also, \( C = 30 \sqrt{0.86} + 0.5 + m \beta \)
\[
= 2.33 \sqrt{4.88 \cdot 2} + 3387.63 (0.48) \times \frac{3388}{2}
\]

**To KEEP EVERYBODY HAPPY**

Bump up to \( n = 3389 \)

\( c = \frac{3388}{2} + 1 \)

#5. Sample of 900 X-ray orders, \( n = 900 \)

Find 80 of the 900 ordered up additional images.

Suppose that we've been pressured to reduce the rate \( p \) of return orders to below .12.

\( H_A: p < .12 \quad H_0: p = .12 \)
ONE-SIDED $H_A \ll H_0$.

$P$-VALUE = $P(X \leq 80 \text{ if } \hat{p} = \hat{p} = .12)$ \text{ using new form.}

MORE EXTREME IN DIRECTION OF $H_A$.

\[ \sim P(Z \leq \frac{80 - 900 (.12)}{\sqrt{900 (.12) (.88)}}) = P(Z \leq \frac{80 - 108}{30 \sqrt{.12 \cdot .88}}) \]

\[ = P(Z < -2.87) \]
-2.8 \frac{0.02}{0.0021}

SO P-VALUE = 0.0021

AROUND 2/1000 YOU'D SEE X \leq 50 \text{(OF 900)}

(EVIDENCE SUGGESTING HA MAY BE CORRECT - THAT NEW FORMS REDUCE ADD'L X-RAYS)

EVEN IF THE RATE WITH NEW FORMS REMAINED AT 12%.

PROBABLY I'D GO WITH NEW FORMS.
4. JOURNAL REQUIRE $P$-VALUE < 0.001

IN ORDER TO SUBMIT

$H_0$: OUR MED HAS NO EFFECT

$H_A$: MED HAS DESIRED EFFECT.

DRUG COMPANY WANTS TO OVERWHELMINGLY REJECT $H_0$.
WANT $P$-VALUE VERY LOW.

BY TAKING $P$-VALUE < 0.001 AS A BARRIER
TO PUBLICATION THE JOURNAL SCREENS OUT 999
STUDIES ON WORTHLESS MEDS.