StT 200 3pm 4 5:30pm 2-17-10.


1) Learn use of table of standard normal which links: value z with \( \Pr(Z \leq z) \).

\[ z = 1.96 \]

\[ \Pr(Z < 1.96) = 0.9750 \]
RULE OF THUMB

\[ 0.025 + 0.95 = 0.975 \]

\[ 0.025 \]

\[ 0.95 \]

\[ 0.975 \]

\[ \frac{2.0}{2.0} \]

\[ 0.9772 \]

IT'S CLEAR THAT 2.0 RULE OF THUMB IS NOT ACCURATE TO 4 DECIMALS.

HOW ABOUT 1.96

\[ 3 \]

\[ 0.06 = 0.9770 \]

\[ 1.96 \]
So 1.96 is the better rule of thumb.

\[ P(\hat{p} \in \left( \hat{p} \pm 1.96 \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \right) ) \to 0.95 \]

Application: How unusual is getting 73 heads in 100 tosses?

We focus on \( P(\# H \geq 73 \text{ in 100 tosses}) \).

Depending on the application we may be focused on left tail & \( P(X = 27) \) \( X = \# \text{FEMALE BIRTHS} \),
or right tail & \( P(X \geq 73) \) \( X = \# \text{MALE BIRTHS} \),
or two tailed & \( P(X \geq 73 \text{ or } X \leq 27) \)
Example 1. Drug company. BP REDUCER.

$X = \# \text{in } n = 100 \text{ whose BP drops by some fixed increment} - \text{it can happen.}$

Say background info says around 15% drop BP (no medij). From a sample of $n = 100$ suppose we find that 26 have BP drop.

$H_0 \text{ null hypothesis: } \mu = 0.15$

If true the medij is doing nothing.

$H_a \text{ alternative hypothesis: } \mu > 0.15 \quad \rho = 0.149999$

If true the medij of medij maybe gets study results published.
Some journals will not publish unless

\( P\text{-value} < 0.00001 \)

In this case \( P\text{-value} = P(\#\text{BP drop in 100} \geq 26 \mid \rho = 0.15) \)

Check whether \( P\text{-value} \leq 0.00001 \).

\[
P \left( X \geq 26 \right) \approx P \left( Z > \frac{26 - 15}{\sqrt{100 \cdot 0.15 \cdot 0.85}} \right) = P \left( Z > 3.08 \right)
\]

\( Z \) distribution.

Conclusion: \( P\text{-value} = 0.0010 \).
P-value is (always) the probability that the null hypothesis model would have (by luck of the draw) produced data as bad for \( H_0 \) as your data is.

Better said: How rare is \( H_1 \) in direction against \( H_0 \).

\[ H_0: \ p = 0.15^- \ (\text{Med makes no change}) \]
\[ H_A: \ p > 0.15^- \ (\text{Med incr freq of BP drops to a level above 15}) \]
Example 2: Shipment, \( p = \text{fraction defective} \)

We've contracted with the shipper to "may reject shipment if test of \( H_0: p = 0.1 \) \( H_A: p > 0.1 \). Unacceptability has \( p\)-value \( \leq 0.001 \) for \( n = 400 \).

Suppose you find \( x = 37 \) accept shipment \( 37 < 40 \).

Suppose find \( x = 80 \).

\[ p\text{-value is } P(X \geq 80 \mid p = 0.1) = P \left( Z > \frac{80 - 40}{\sqrt{400 \cdot 0.1}} \right) \]

\[ = P \left( Z > \frac{40}{20 \cdot 0.3} \right) = P \left( Z > \frac{2}{0.3} \right) = P (Z > 6.66) \]

Tiny \( \text{off table \ reject shipment!} \)
For $z \sim \infty$, $P(Z > z) \sim \frac{e^{-z^2/2}}{\sqrt{2\pi}}$

$\text{P-VALUE IS } \sim \frac{e^{-6.66^2/2}}{6.66 \sqrt{2\pi}} \quad \text{SMALL!!}$

$\pi \approx 3.14159$