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Tutorial - 5

Hypothesis testing

Q1. $H_0 : p = 0.7$

$H_1 : p \neq 0.7$

$\alpha = 0.10$

Test stat : Binomial var X with $p = 0.7$ & $N = 15$

$X = 8$ & $n p_0 = 15 \times 0.7 = 10.5$

$P = 2P(X \leq 8 \;\&\; p = 0.7)$

$= 2 \sum_{x=0}^{8} b(x; 15, 0.7)$

$= 2 \times 0.1311$

$= 0.2622$

$P > 0.10$

$\therefore P > \alpha$

Do not reject H_0.

$\therefore$ There is ~~iss~~ not enough reason to doubt the builders claim.

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Q2. $H_0 : p = 0.6$

$H_1 : p > 0.6$

$\alpha = 0.05$

Given, $x = 70, n = 100, p = 0.6$

$$z = \frac{x - np_0}{\sqrt{np_0q_0}}$$

$$z = 2.04$$

$$p = P(z > 2.04)$$

$$p = 0.0207.$$

$p < \alpha$

$\therefore$ New drug is superior.

Q3. $p_1 \rightarrow$ proportion of Mumbai voters

$p_2 \rightarrow$ " " surrounding residents

$$p_1 = \frac{120}{200} = 0.6$$

$$p_2 = \frac{240}{500} = 0.48$$

$$p_p = \frac{120 + 240}{200 + 500} = 0.514$$

$\alpha = 0.05$

$H_0 : p_1 \leq p_2$

$H_1 : p_1 > p_2$

$$z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}_p (1 - \hat{p}_p)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

$z = 2.869$

$P = P(z > 2.869) = 0.0044$

$P < \alpha \rightarrow$ Reject H_0

ie

Proportion of mumbai favouring proposal is higher.

Q4. (a) $H_0 : p = 0.20$

$H_1 : p > 0.20$.

Critical region is right tail

(b) $H_0 : \mu = 3$

$H_1 : \mu \neq 3$

Critical region is both tails.

(c) $H_0 : p = 0.15$

$H_1 : p < 0.15$

Critical region is left tail.

(d) $H_0 : \mu = 500$

$H_1 : \mu > 500$

Critical region is in right tail.

(e) $H_0 : \mu = 15$

$H_1 : \mu \neq 15$

Critical region is in both tails.

Q5. $\mu_1 \rightarrow$ Company A
$\mu_2 \rightarrow$ Company B

$H_0 : \mu_1 = \mu_2$

$H_1 : \mu_1 \neq \mu_2$

$\alpha = 0.05$

$$\bar{x}_1 = \frac{1}{n_1} \cdot \sum_{i=1} x_i$$

$$\bar{x}_1 = 7.95$$

||'y

$$\bar{x}_2 = 10.26$$

$$S_1^2 = \frac{1}{n-1}\left[\sum_{i=1} x_i^2 - n_1 \bar{x}_1^2\right]$$

$$= \frac{10.865}{9} = 1.207$$

||'y $S_2^2 = 0.325$

$\because$ Sample variances are different.
Cannot assume that pop^n variances are equal.
$\therefore$ we use unpooled t-test

Deg of freedom are,

$$v = \frac{\left(\left(\frac{S_1^2}{n_1}\right) + \left(\frac{S_2^2}{n_2}\right)\right)^2}{\frac{1}{n-1}\left(\frac{S_1^2}{n_1}\right)^2 + \frac{1}{n_2-1}\left(\frac{S_2^2}{n_2}\right)^2}$$

$v \simeq 10.3$

$\boxed{v \simeq 10}$

Now,

$$T = \frac{\bar{x}_1 - \bar{x}_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Also, under null hyponesis $\mu_1 - \mu_2 = 0$.

$$\therefore T = \frac{7.95 - 10.26}{\sqrt{\frac{1.807}{10} + \frac{0.325}{10}}} = -5.90$$

$|t| = 5.90$.

Now,

$p = 2 \cdot P(T \geq |t|) = 2 \cdot P(T \geq 5.90)$

p.val < 0.001

ie $p < \alpha$ $\therefore$ we reject null hyponesis.