



Hypothesis Testing

D State Hypothesis.

$$H_0 = p = 0.05$$

$$H_a = p \neq 0.05$$

Two tailed test

2) Alpha is. $\alpha = 0.10$

as two tailed test.

$$\frac{1}{2} \times 0.10 = 0.05$$

$$z_{0.5} = 1.645. z_{\text{critical}}$$

Step 4 = For To reject the null hypothesis
the observed value must be
greater than 1.645 or -1.645 .

Step 5 - $P = \frac{46}{384} = 0.165$

Step 6. Calculate z value by.

$$z = \frac{\hat{P} - P}{\sqrt{\frac{P \cdot Q}{n}}}$$

$$= \frac{0.165 - 0.05}{\sqrt{\frac{(0.05) - (0.95)}{200}}}$$

$$= \frac{0.115}{0.045} = 0.255.$$

The observed value of 'Z' is 0.255 which is not to be rejection region (Observed $Z = 0.255 <$ Table $Z_{0.05} = 1.645$).

So we can accept the null hypothesis.

So we can conclude that about 5% of the nation's children had autism.

Hypothesis Testing Problem 2.

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A Company with a fleet of 150 cars found that the emission system of 7 out of the 22 cars tested failed to meet pollution guidelines.

a) Write hypothesis to test if more than 20% of the entire fleet might be out of compliant.

b) Test the hypothesis based on the binomial distribution and report the p-value.

c) Is the test significant at 10%, 5% and 1% level.

Ans. Hypothesis \rightarrow More than 20% of the fleet is out of compliant.

$$H_0 = 20 \cdot 0.20$$

$$H_a = 20 \cdot 0.020 \cdot 0.20$$

$$n = 22$$

$$x = 7$$

Step 1 - This is not satisfied, since

$$p_0 = (22 \cdot 0.20) = 4.4 < 10$$

$$n(1-p_0) = 22(1-0.20) = 17.6 \geq 10$$

Thus all conditions are not satisfied
Test should not be proceeded with.

Hypothesis Testing

Problem 3

→ 44% of the adult population had never smoked.

$$\text{H}_0: p = 0.44\% \quad H_0 = p = 44\%$$

$$H_a: p > 44\% \quad H_a = p > 44\%$$

$$\alpha = 0.02, x = 891, n =$$

H_a : More than 44% of the population ~~had~~ ^{had} smoked.

So this will be a one tailed test.

$$\alpha = 0.02$$



$$Z_{\text{score}} = \frac{\hat{p} - p}{\sqrt{\frac{p \cdot q}{n}}}$$

$$p = 0.44 \quad x = 891$$

$$q = 1 - p = 1 - 0.44 = 0.56$$

$$\hat{p} = \frac{463}{891} = 0.519$$

$$\begin{matrix} 0.09 \\ 0.9164 \\ 0.7 \end{matrix}$$

$$Z_{\text{score}} = \frac{0.519 - 0.44}{\sqrt{\frac{0.44 \times 0.56}{891}}} = 4.75$$

$$Z_{\text{score}} = 4.75$$

$$Z_{\text{critical}} = 2.20$$

We will reject the null hypothesis as $Z_{\text{critical}} < Z_{\text{score}}$.

PROBLEM 4.

LENSEData
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→ Null hypothesis \rightarrow The distance from the lens to the object & distance from the lens to real image is not same.

Alt hypothesis:- The distance from the lens to the object and distance from the lens to real is not same.

$$H_0 = u_A = v_B$$

$$H_a = u_A \neq v_B$$

Step 2 \rightarrow Z score.

Step 3 $\rightarrow \alpha = 0.05$.

This is a two tailed test

$$\frac{\alpha}{2} = \frac{0.05}{2} = 0.025$$

Step 4 \rightarrow Decision Rule.

Fail O.R If $|z\text{-critical}| < z\text{score}$ then we will reject the null hypothesis.

Step 5 - Collecting the data

$$\bar{s}_1 = 28.6 \text{ cm}$$

$$s_1 = 0.1 \text{ cm}$$

$$n_1 = 25$$

for distance from lens to Real image s_{2+}

$$\bar{s}_2 = 13.8 \text{ cm}$$

$$s_2 = 0.5 \text{ cm}$$

$$n_2 = 25$$

For Z score $= \frac{\bar{s}_1 - \bar{s}_2}{\sqrt{\frac{(s_1)^2}{n_1} + \frac{(s_2)^2}{n_2}}}$

$$\sqrt{\frac{(s_1)^2}{n_1} + \frac{(s_2)^2}{n_2}}$$

cont Problem 4.

LENSE

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$$= \frac{26.6 - 13.8}{\sqrt{\frac{(0.1)^2 + (0.5)^2}{25}}}$$

$$= \frac{12.8}{0.102}$$

$$Z\text{-Score} = 125.51$$

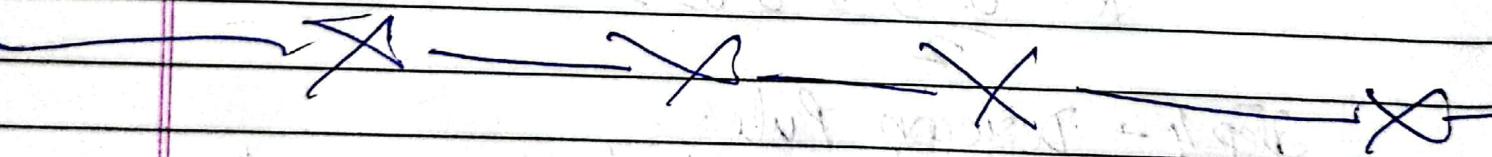
Now using Z table:

$$Z_{\text{critical}} = 1.96$$

P-value < 0.001

$Z_{\text{critical}} < Z_{\text{score}}$

We will reject null hypothesis.



Problem 5.

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Ans →

$$n = 52, \bar{x} = 98.2846, s^2 = 0.6824 \\ \alpha = 0.02 \quad H_0 = \mu = 98.6$$

$$H_0 = \mu = 98.6 \\ H_a = \mu \neq 98.6$$

this would be a 2 tailed test.

$$\text{so } \alpha = \frac{0.02}{2} = 0.01$$

$$t\text{-score} = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$$

$$= \frac{98.2846 - 98.6}{\frac{0.6824}{\sqrt{52}}} \\ = \frac{-0.3154}{0.052} \\ = -6.06$$

$$\therefore t\text{-score} = 3.333$$

using t table,

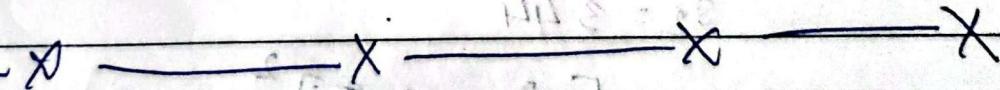
$$t\text{-critical} = 2.008$$

$$P\text{-value} = 0.0016 \cdot 0.0016$$

$$t\text{-critical} < t\text{-score} = 2.008 < 3.333$$

$$P\text{-value} < \text{significance level} = 0.0016 < 0.02$$

we will reject null hypothesis.



Problem 6:

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Cal.

$$H_0 = \mu_A = \mu_B$$

$$H_a = \mu_A \neq \mu_B$$

Default $\alpha = 0.05$.

Two tailed test $\alpha = 0.05 = 0.025$.

t-test cost.

t-test =

$$df = \left[\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2} \right]^{-2}$$

$$\left[\frac{\left(\frac{s_1^2}{n_1} \right)^2}{n_1 - 1} + \frac{\left(\frac{s_2^2}{n_2} \right)^2}{n_2 - 1} \right]$$

$$t_{\text{test}} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2 + s_2^2}{n_1 + n_2}}}$$

For sample of regular tank.

$$\mu_A = \bar{x}_1 = 23.1$$

$$n_1 = 10$$

$$s_1 = 3.72, \bar{x}_1 = \mu_A = 23.1$$

For sample of premium tank.

$$\bar{x}_2 = \mu_B = 25.1$$

$$n_2 = 10$$

$$s_2 = 3.44$$

$$DF = 2$$

$$\left[\frac{s_1^2 + s_2^2}{n_1 + n_2} \right]^{-2}$$

→ Contd Prob 6.

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$$DF_{full} = \frac{\left[\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2} \right]^2}{\left[\frac{(\frac{s_1^2}{n_1})^2}{n_1-1} + \frac{(\frac{s_2^2}{n_2})^2}{n_2-1} \right]}$$

$$= \frac{(1.38 + 1.18)^2}{\frac{(1.38)^2}{9} + \frac{(1.18)^2}{9}}$$

$$= \frac{6.55}{0.36}$$

$$DF = 18$$

$$\begin{aligned} t - test &= \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \\ &= \frac{23.1 - 25.1}{\sqrt{\frac{(3.72)^2}{10} + \frac{(3.41)^2}{10}}} \end{aligned}$$

$$t - test = 1.24$$

$$t - critical = 2.10$$

$$P = 0.22$$

t - critical is t-score.

~~as p > 0.05~~ Reject null hypothesis.

$$2.10 > 1.24$$

we will accept the null hypothesis.

For P-value > significance value.
 $0.22 \geq 0.05$:

we will accept the null hypothesis

80,

Q. There is no difference between the mileage of regular and premium-
tank of the car.

$$m_A = m_B$$

Problem 1

Cereal

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for Sample of children

$$\bar{x}_1 = M_A = 46.8$$

$$x_1 = 19$$

$$S_1 = 6.41$$

for Sample of Adult

$$\bar{x}_2 = M_B = 10.16$$

$$x_2 = 29$$

$$\bar{S}_2 = 7.47$$

$$Df = \left[\frac{s_1^2}{\bar{x}_1} + \frac{s_2^2}{\bar{x}_2} \right]^2$$

$$\left[\frac{(s_1)^2}{\bar{x}_1} \cdot \frac{(s_2)^2}{\bar{x}_2} \right]$$

$$\therefore \frac{(2.16 + 1.92)^2}{\frac{(2.16)^2}{18} + \frac{(1.92)^2}{28}} = \frac{16.41}{0.38}$$

$$\therefore Df = 43.$$

Now

$$t\text{-test} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(s_1)^2 + (s_2)^2}{x_1 + x_2}}}$$

$$\frac{6.41 - 7.47}{\frac{(6.41)^2 + (7.47)^2}{19 + 29}} = \frac{36.38}{1.96}$$

$$t_{\text{test}} = 18.10$$

$$t_{\text{critical}} = 2.01$$

$$P\text{-value } 0.0001$$

Here, $t_{\text{critical}} < t_{\text{test}}$

$$2.01 < 18.10$$

P-value < significance value

$$0.0001 < 0.05$$

So, we will reject the null hypothesis.

Sugar content in cereal brand
of children and adult are not
equal.