# Assignment - 16:

1) Two tailed test for difference b/w 2 population.

Population 1: Bangalore to chennai

$n_1 = 1200$

$x_1 = 452$

$S_1 = 212$

Population 2: Bangalore to Hosur

$n_2 = 800$

$x_2 = 523$

$S_2 = 185$

Soln

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} = \frac{(452 - 523) - 0}{\sqrt{\frac{212^2}{1200} + \frac{185^2}{800}}}$$

$$= \frac{-71}{\sqrt{80.234}} = \frac{-71}{8.96} = -7.926$$

P-value : $p(z < -7.926) \simeq 0$

$H_0$ is rejected at any level.

2) Population 1: Duracell

$n_1 = 100$

$x_1 = 308$

$S_1 = 84.$

Population 2: Energizer

$n_2 = 100$

$x_2 = 254$

$S_2 = 67.$

Soln. $H_0 : \mu_1 - \mu_2 \leq 45$

$H_1 : \mu_1 - \mu_2 > 45$

$$t = \frac{(308 - 254) - 45}{\sqrt{\frac{84^2}{100} + \frac{67^2}{100}}} = \frac{9}{\sqrt{115.45}} = 0.838$$

P value : $p(t > 0.838) = 0.201$

$H_0$ may not be rejected

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3) Population 1: Price of Sugar = Rs 27.50

$n_1 = 14$

$x_1 = 0.317\%$

$s_1 = 0.12\%$

Population 2:

Price of Sugar = Rs 20.0

$n_2 = 9$

$x_2 = 0.21\%$

$s_2 = 0.11\%$

Soln $df = (n_1 + n_2 - 2)$

$= (14 + 9 - 2)$

$= 21$

$H_0 : \mu_1 - \mu_2 = 0$

$H_1 : \mu_1 - \mu_2 = 0$

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)_0}{\sqrt{\left[\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}\right]\left[\frac{1}{n_1} + \frac{1}{n_2}\right]}}$$

$$= \frac{0.107}{\sqrt{0.00247}} = 2.154$$

$t_c = 2.080$

$H_0$ is rejected at 95% level.

4) Population 1: Before education

$n_1 = 15$

$x_1 = Rs\ 6598$

$s_1 = Rs\ 844$

Population 2: After reduction

$n_2 = 12$

$x_2 = Rs\ 6870$

$s_2 = 669$

Soln $df = (n_1 + n_2) - 2$

$= (15 + 12) - 2$

$df = 25$

$H_0 : \mu_2 - \mu_1 \leq 0$

$H_1 : \mu_2 - \mu_1 > 0$

$$t = \frac{(\bar{x}_2 - \bar{x}_1) - (\mu_2 - \mu_1)_0}{\sqrt{\left(\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}\right)\left[\frac{1}{n_1} + \frac{1}{n_2}\right]}} = \frac{(6870 - 6598) - 0}{\sqrt{\left[\frac{(15-1)844^2 + (12-1)669^2}{15+12-2}\right]\left[\frac{1}{15} + \frac{1}{12}\right]}}$$

$$= \frac{272}{\sqrt{89375.25}} = 0.91$$

$t_c = t_{0.10} = 1.316$

$H_0$ is rejected at 10% level

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Comparisons of two population proportions when the hypothesised diff is 0

5) Population 1 : 1980

$n_1 = 1000$

$x_1 = 53$

$p_1 = 0.53$

Population 2 : 1985

$n_2 = 100$

$x_2 = 43$

$p_2 = 0.43$

Soln

$$\hat{p} = \frac{x_1 + x_2}{n_1 + n_2} = \frac{53 + 43}{1000 + 100} = \frac{96}{1100} = 0.0872$$

$$z = \frac{(p_1 - p_2) - 0}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} = \frac{0.53 - 0.43}{\sqrt{(0.087)(0.912)\left(\frac{1}{1000} + \frac{1}{100}\right)}}$$

$$= \frac{\cancel{0.1}}{\cancel{\sqrt{0.2496(0.01)}}} = \frac{0.1}{\sqrt{0.0793 \times 0.01}} = 0.02816$$

$Z_c = Z_{0.05} = 1.645$

$H_0$ may not be rejected at 10%.

6) with Sweepstakes

$n_1 = 300$

$x_1 = 120$

$\hat{p}_1 = 0.40$

No sweepstakes

$n_2 = 700$

$x_2 = 140$

$\hat{p}_2 = 0.20$

Soln. $H_0 : p_1 - p_2 \leq 0.1$

$H_1 : p_1 - p_2 > 0.10$

$$Z = \frac{(p_1 - p_2) - D}{\sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}}$$

$$z = \frac{(0.40 - 0.20) - 0.10}{\sqrt{\frac{(0.40)(0.60)}{300} + \frac{(0.20)(0.80)}{700}}} = \frac{0.10}{0.03207} = 3.118$$

$Z_c = Z_{0.001} = 3.09$

$H_0$ is accepted.

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7) A die is thrown 132 times

No., turned up: 1, 2, 3, 4, 5, 6

Freq : 16, 20, 25, 14, 29, 28

Is the die unbiased? Consider the df as −1

Soln Unbiased die turns up $= \frac{132}{6} = 22$ times

| Observed (O) | Expected (E) | $(O-E)^2$ | $\frac{(O-E)^2}{E}$ |
|---|---|---|---|
| 16 | 22 | 36 | 1.64 |
| 20 | 22 | 4 | 0.18 |
| 25 | 22 | 9 | 0.41 |
| 14 | 22 | 64 | 2.91 |
| 29 | 22 | 49 | 2.23 |
| 28 | 22 | 36 | 1.64 |

$\sum \frac{(O-E)^2}{E} = 9.01$

$df = n-1 = 6-1 = 5$

At 5% significance, $x^2 = 11.07$

$\therefore x_o^2 < x_e^2$. There is no evidence against hypothesis that the die is biased.

8) Sample mean = 10,000

Is "gender and voting independent"?

| | Men | Women | Total |
|---|---|---|---|
| Voted | 2792 | 3591 | 6383 |
| Not voted | 1486 | 2131 | 3617 |
| observed | 4278 | 5722 | 10,000 |

$\sum \frac{(O-E)^2}{E} = 6.58$

$x_2 = 6.58$

From table 10% = 2.71

5% = 3.84

1% = 6.64

| Expected | Men | Women | Total |
|---|---|---|---|
| voted | 2731 | 3652 | 6383 |
| Not voted | 1547 | 2070 | 3617 |
| Total | 4278 | 5722 | 10000 |

$3.84 < x_2 < 6.64$

$1\% < p\text{-value} < 5\%$

Ho is rejected

$\therefore$ Sex and voting are dependent in this town.

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9) A Sample of 100 voters which are 4 candidates they would vote in election.

| Higgins | Reardon | White | Charlton |
|---|---|---|---|
| 41 | 19 | 24 | 16 |

Is all candidates are equally popular ?

[chi-Square = 14.96, with 3 df, $\alpha < 0.05$]

Soln

| O | E | O - E | $(O-E)^2$ | $\frac{(O-E)^2}{E}$ |
|---|---|---|---|---|
| 41 | 25 | 16 | 256 | 10.24 |
| 19 | 25 | -6 | 36 | 1.44 |
| 24 | 25 | -1 | 1 | 0.04 |
| 16 | 25 | -9 | 81 | 3.24. |

$\sum\frac{(O-E)^2}{E} = 14.96$

$d_f = n-1$

$4-1 = 3.$

$x_c^2$ at 0.05 level 3 df is 7.82

$x_e^2$ is $> x_o^2$ 95% > 14.96 > 99%

Candidates are not equally prefered

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10) Is there a significant ~~pre~~ relationship b/w agen and photograph preferenc? Chi-Square = 29.6

$d_f = 4$

$x^2 : 0.05$.

| | | A | B | C | |
|---|---|---|---|---|---|
| Age of child | 5-6 yrs | 18 | 22 | 20 | 60 |
| | 7-8 yrs | 2 | 28 | 40 | 70 |
| | 9-10 yrs | 20 | 10 | 40. | 70 |
| | | 40 | 60 | 100 | 200 |

$E = \frac{\text{row total} \times \text{Column total}}{\text{Grand Total}}$

Soln

| O | E | $(O-E)$ | $\frac{(O-E)^2}{}$ | $\frac{(O-E)^2}{E}$ |
|---|---|---|---|---|
| 18 | 12 | 6 | 36 | .3 |
| 22 | 18 | 4 | 16 | 0.89 |
| 20 | 30 | -10 | 100 | 03.33 |
| 2 | 14 | -12 | 144 | 10.29 |
| 28 | 21 | .7 | 49 | 2.33 |
| 40 | 35 | 5 | 25 | 0.71 |
| 20 | 14 | 6 | 36 | 2.57 |
| 10 | 21 | 11 | 121 | 5.76 |
| 40 | 35 | 5 | 25 | 0.71 |

$x^2 = 29.60$

$x_c^2$ is 18.46 at 0.001 df 4

$x_o^2$ is $> x_c^2$

Ho is accepted

∴ There is significant relationship b/w age of child & photograph.

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11) Asch paradigm

| | Support | No Support | Total |
|---|---|---|---|
| confirm | 18 | 40 | 58 |
| not confirm | 32 | 10 | 42 |
| Total | 50 | 50 | 100 |

Is there a significant diff b/w "the support" and "no support" cond$^n$?
Chi-Square = 19.87
df = 1   $p < 0.05$

Soln

| O | E | O-E | $(O-E)^2$ | $\frac{(O-E)^2}{E}$ |
|---|---|---|---|---|
| 18 | 29 | -11 | 121 | 4.17 |
| 40 | 29 | 11 | 121 | 4.17 |
| 32 | 21 | 11 | 121 | 5.76 |
| 10 | 21 | -11 | 121 | 5.76 |

$\Sigma = 19.86$

$\therefore \chi^2 = 19.86$

There is significant diff b/w support and no support condotions.

12) The following table shows the freq with which 43 short people and 52 tall people were categorized as "leaders", "followers" or "unclassifiable". Is there diff b/w height and leadership qualities? [chi-Square = 10.71, with 2 df, $p < 0.01$]

| | Height short | Tall | Total |
|---|---|---|---|
| leaders | 12 | 32 | 44 |
| Followers | 22 | 14 | 36 |
| Unclassifi-able | 9 | 6 | 15 |
| Total | 43 | 52 | 95 |

$\therefore$ 10.712 is bigger than $\chi^2$ at 0.01 significance level.
There is a relationship b/w height and leadership qualities.

Soln

| O | E | (O-E) | $(O-E)^2$ | $\frac{(O-E)^2}{E}$ |
|---|---|---|---|---|
| 12 | 19.92 | -7.92 | 62.72 | 3.148 |
| 32 | 24.08 | 7.92 | 62.72 | 2.60 |
| 22 | 16.29 | 5.71 | 32.6 | 2 |
| 14 | 19.71 | -5.71 | 32.6 | 1.654 |
| 9 | 6.79 | 2.21 | 4.88 | 0.720 |
| 6 | 8.21 | -2.21 | 4.88 | 0.6 |

$\Sigma = 10.712$

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13) The results for men in California age 35–44 can be cross-tabulated by marital status

| | Married | Widow | Never married | Total |
|---|---|---|---|---|
| Employed | 679 | 103 | 114 | 896 |
| Unemployed | 63 | 10 | 20 | 93 |
| Not in force | 42 | 18 | 25 | 85 |
| Total: | 784 | 131 | 159 | 1074 |

Sol:

| O | E | O − E | $(O-E)^2$ | $\frac{(O-E)^2}{E}$ |
|---|---|---|---|---|
| 679 | 654 | 25 | 625 | 0.95 |
| 103 | 109 | −6 | 36 | 0.33 |
| 114 | 133 | −19 | 361 | 2.71 |
| 63 | 68 | −5 | 25 | 0.36 |
| 10 | 11 | −1 | 1 | 0.10 |
| 20 | 14 | 6 | 36 | 2.57 |
| 42 | 62 | −20 | 400 | 6.45 |
| 18 | 10 | 8 | 64 | 6.4 |
| 25 | 13 | 12 | 144 | 11.07 |

$\Sigma = 30.95$

Chi square dist with $(3-1)(3-1)$ $= 2 \times 2 = 4$ df

Since $30.96 > 13.28$ conclude $P << 1\%$ and reject all confidence. Marital status seems to be related to job status in this town.

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