Assignment - 16

1) Bangalore to chennai

$H_0: n_{B \to C} = n_{B \to H}$

$H_A: n_{B \to C} \neq n_{B \to H}$

$n_1 = 1200$

$\bar{x}_1 = 452$

$s_1 = 212$

Bangalore to Hosur

$n_2 = 800$

$\bar{x}_2 = 523$

$s_2 = 185$

2 tailed test

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

$$t = \frac{(452 - 523) - 0}{\sqrt{\frac{212^2}{1200} + \frac{185^2}{800}}}$$

$$t = \frac{-71}{\sqrt{\frac{44,944}{1200} + \frac{34225}{800}}} = \frac{-71}{8.96} = -7.296$$

2) Duracell

$n_1 = 100$

$x_1 = 308$

$s_1 = 84$

Energizer

$n_2 = 100$

$x_2 = 254$

$s_2 = 67$

degree of freedom $= n_1 + n_2 - 1 = 1200 + 800 - 1$

$= 1999$

for beyond critical value.

So rejecting null hypothesis

$\boxed{\text{So, no of people travelling from Bangalore to chennai and Bangalore to hosure are different}}$

(2) Duracell

$n_1 = 100$
$x_1 = 308$
$s_1 = 84$

Energizer

$n_2 = 100$
$x_2 = 254$
$s_2 = 67$

difference between population is 45

$$t = \frac{\bar{y}_1 - \bar{y}_2}{SP\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

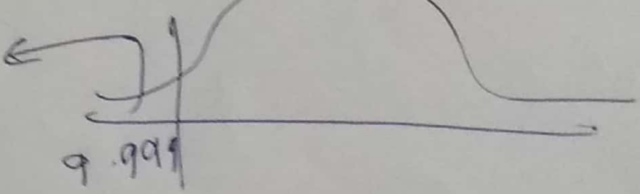
$H_0 : \mu_1 - \mu_2 = 45$
$H_1 : \mu_1 - \mu_2 \neq 45$

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

$\alpha = 10\%$

P value : $P(t > 0.838) = 0.201$
with degree of freedom
$100 + 100 - 2 = 198$

It is in rejection region.
So accepting alternate hypothesis.



$H_1 : \mu_1 - \mu_2 \neq 45$

(3) Price of sugar = 27.50

$n_1 = 14$
$x_1 = 0.317\%$
$s_1 = 0.12\%$

Price of sugar = 20.0

$n_2 = 9$
$x_2 = 0.21\%$
$S_2 = 0.11\%$

$df = n_1 + n_2 - 2$
$= 14 + 9 - 2 = 21$

$H_0 = \mu_1 - \mu_2 = 0$
$H_1 = \mu_1 - \mu_2 \neq 0$

$\boxed{t > t_c}$
H_0 is rejected at $\alpha = 5\%$. null hypothesis rejected

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

$$= \frac{0.107}{\sqrt{0.00247}} = 2.154, \alpha = 5\% \Rightarrow t_{crit}, df = 21 = 2.080$$

$= 2.015$

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(4). Population before education

$n_1 = 15$
$x_1 = 6598$
$s_1 = 844$

population after education

$n_2 = 12$
$x_2 = 6870$
$s_2 = 669$

$df = n_1 + n_2 - 2$
$= 15 + 12 - 2 = 25$

$\cancel{H_0 : \mu_1 - \mu_2 \le 0}$
$\cancel{H_1 : \mu_1 - \mu_2 > 0}$

$H_0 : \mu_1 - \mu_2 = 0$
$H_1 : \mu_1 - \mu_2 \neq 0$

$$t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2} = \frac{(15-1)(844)^2 + (12-1)(669)^2}{15 + 12 - 2}$$

$s_p = 771.90$

$$t = \frac{6598 - 6870}{771.9 \sqrt{\frac{1}{15} + \frac{1}{12}}} = -0.909$$

consider $\alpha = 10\%$, it is a two tail test $\alpha/2$

$t_c = 1.476$

$t < t_c$

so rejecting null hypothesis

(5) Population 1: 1980 Population 2: 1985

$n_1 = 1000$ $n_2 = 100$

$\bar{x}_1 = 53$ $\bar{x}_2 = 43$

$p = 0.53$ $p_2 = 0.43$

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

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

$$= \frac{0.1}{\sqrt{0.0793 \times 0.01}} = 0.02816$$

$z = z_{0.05} = 1.645$

Ho may not be rejected at 10%.

(6). with sweepstakes no sweepstakes

$n_1 = 300$ $n_2 = 700$

$x_1 = 120$ $x_2 = 140$

$\hat{p}_1 = 0.40$ $\hat{p}_2 = 0.20$

$H_0 : P_1 - P_2 \leq 0.10$

$H_1 : P_1 - P_2 > 0.10$

$$z = \frac{(P_1 - P_2) - D}{\sqrt{\frac{P_1(1-P_1)}{n_1} + \frac{P_2(1-P_2)}{n_2}}}$$

$$z = \frac{(0.4 - 0.2) - 0.1}{\sqrt{\frac{0.4 \times 0.6}{300} + \frac{0.2 \times 0.8}{700}}} = \frac{0.1}{0.3207} = 3.118$$

$z_c = z_{0.001} = 3.09 < z$

H_0 may be rejected at any level of significance

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(7)

H_0 : Dice is unbiased

H_1 : Dice is baised

On the basis of hypothesis that dice is unbaised.

Expected frequency $= \frac{132}{6} = 22$ times

No of turns	observed value	expected value	O - E
1	16	22	-6
2	20	22	-2
3	25	22	3
4	14	22	-8
5	29	22	7
6	28	22	6

chi square $x^2 = \frac{\Sigma(O_i - E_i)^2}{E_i} = \frac{1}{22}[(-6)^2 + (-2)^2 + (3)^2 + (-8)^2 + (7)^2 + (6^2)]$

$= 9.01$

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

at 5% $x^2 = 11.07$

$x_0^2 < x_e^2$ $\qquad x_0^2 < 9 < x_e^2$

failed to reject null hypothesis

Dice is baised

H_0: sex and voting are independent
H_1: sex and voting are dependent

(8) Votes sample mean = 10,000

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

$$\chi^2 = \sum \frac{(O-E)^2}{E} = \frac{(2792-2730)^2}{2730} + \frac{(3591-3652)^2}{3652}$$

$$+ \frac{(1486-1547)^2}{1547} + \frac{(2131-2062)^2}{2062}$$

$$\chi^2 = 6.58$$

degree of freedom = (2-1) (2-1) = 1

from table

10% - 2.71

5% - 3.84

1% - 6.64

Expected	mean	Women	Total
Voted	2731	3652	6383
Not voted	~~1547~~ 1547	2070	3617
Total	4278	5722	10000

$3.84 < \chi_2 < 6.64$

1% of < P value < 5%

Reject null hypothesis.

Sex and Voting are dependent in the town.

ref: omega.albany.edu:8008/mat108dir/chi2independence/chi2n-m2h.html

(9) $x_2 = 14.96$, $df = 3$, $n = 100$

$\alpha = 0.05 \rightarrow 5\%$

H_0: All candidates are equally popular

H_1: All candidates are not equally popular

$$E = \frac{41+19+24+16}{4} = 25$$

$$\chi^2 = \frac{\Sigma (O-E)^2}{E}$$

$$= \frac{(41-25)^2}{25} + \frac{(19-25)^2}{25} + \frac{(24-25)^2}{25} + \frac{(16-25)^2}{25}$$

$$= 10.24 + 1.44 + 0.4 + 3.24 = 14.96$$

χ^2 at $df = 3$ at 5% $= 7.82$

$$\chi^2_{14.96} > \chi^2_{7.82}$$

Null hypothesis rejected.

All 4 candidates are not equally popular.

(10)

	Photograph A	B	C	Totals (4000)
Age				
5-6	18	22	20	60
7-8	2	28	40	70
9-10	20	10	40	70
Col Total	40	60	100	200

H_0: No relation b/w age & photo preference

H_1: There is relation b/w age & photo

$$E = \frac{\text{row total} \times \text{col Total}}{\text{grand total}}$$

O	18	22	20	2	28	40	20	10	40
E	12	18	30	14	21	35	14	21	35
O-E	6	4	-10	-12	7	5	6	11	5
$(O-E)^2$	36	16	100	144	49	25	36	121	25
$\frac{(O-E)^2}{E}$	3	0.89	3.33	10.29	2.33	0.71	2.57	5.76	0.71

Chi Square $\chi^2 = 29.60$

$df = (r-1) \times (c-1) = 2 \times 2 = 4$

$\chi^2_{0.001}$ at $df = 4 \rightarrow E$ $= 18.46$

$\chi^2_0 = 29.60$ is bigger than table value. It is Accepted alternate hypothesis

There is a significant relationship between age of child & photograph preference.

(17) $\chi^2 = 19.87$, 1 df, $\alpha < 0.05$

Asch paradigm

	Support	No support
Conform	18	40
Not conform	32	10

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

$$x^2 = \frac{\Sigma(O-E)^2}{E} = 121\left(\frac{1}{29}+\frac{1}{29}+\frac{1}{21}+\frac{1}{21}\right) = 18.10$$

$$df = (n_1-1)(n_2-1) = (2-1)(2-1) = 1$$

χ^2 table is bigger than χ^2 calculated.

There is a significant difference between the support & no support conditions.

(12) $\chi^2 = 10.71$, $df = 2$, $\alpha < 0.01$

	Height short	tall
Leader	12	32
Follower	22	14
unclassifiable	9	6

O	E
12	$\frac{44 \times 43}{95}$
32	$\frac{44 \times 52}{95}$
22	$\frac{36 \times 43}{95}$
14	$\frac{36 \times 52}{95}$
9	$\frac{15 \times 43}{95}$
6	$\frac{15 \times 52}{95}$

Expected frequency table

	Height short	Tall	row
Leader	12 (19.92)	32 (24.08)	44
Follower	22 (16.29)	14 (19.71)	36
unclassifiable	9 (6.79)	6 (8.21)	15
	43	52	95

Chi-square : $3.146 + 2.602 + 1.998 + 1.652 + 0.720 + 0.595 = 10.712$

$df = 2$

10.712 is bigger than χ^2 at 0.01 significance level. Hence there is a relationship between height & leadership qualities.

(13)

	Married	other	Never married
Employed	679	103	114
unemployed	63	10	20
Not in labour force	42	18	25

O	E	O-E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
679	654	679-654	$(25)^2$	$\frac{25^2}{654}$
103	109	103-109	$(-6)^2$	$\frac{6^2}{109}$
114	133	114-133	$(-19)^2$	$\frac{19^2}{133}$
63	68	63-68	$(-5)^2$	$5^2/68$
10	11	10-11	$(-1)^2$	$1/11$
20	14	20-14	$(+6)^2$	$6^2/14$
42	62	42-62	$(-20)^2$	$20^2/62$
18	10	18-10	$(8)^2$	$8^2/10$
25	13	25-13	$(12)^2$	$12^2/13$

$$\chi^2 = \frac{\Sigma(O-E_a)^2}{E} = \frac{(679-654)^2}{654} + \frac{(103-109)^2}{109} + \frac{(114-133)^2}{133} + \frac{(63-68)^2}{68} + \frac{(10-11)^2}{11}$$

$$+ \frac{(20-14)^2}{14} + \frac{(42-62)^2}{62} + \frac{(18-10)^2}{10} + \frac{(25-13)^2}{13} = 30.96$$

$df = (3-1)(3-1) = 4$

$df = 4$, 1%, χ^2 table $= 13.28$

$30.96 > 13.28$, $p < 1\%$.

Rejecting null hypothesis.

Marital Status seems to be related to Job status in town