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1. (a) H_0 : The ~~Number of company~~ distribution of opinions between voters from three employee positions of a company is the same.

H_1 : The distribution of opinions between votos from three employee positions of a company is not the same.

Responses	Support	Against	Total
Number of Employee	220	180	400
$E_i = np$	$400 \times \frac{60}{100} = 240$	$400 \times \frac{40}{100} = 160$	400

At $\alpha = 0.05$, $v = 2-1 = 1$, critical value $= \chi^2_{0.05;1} = 3.841$

Critical region $= \chi^2 > 3.841$

$$\chi^2 = \sum_{i=1}^{2} \frac{(|O_i - E_i| - 0.5)^2}{E_i} = \frac{(|220-240|-0.5)^2}{240} + \frac{(|180-160|-0.5)^2}{160}$$

$$= 1.5844 + 2.3766$$

$$= 3.9609$$

$\therefore$ since $\chi^2 = \cancel{3.961}$ 3.9609 > 3.841, reject H_0 at $\alpha = 0.05$ and we can conclude that the distribution of opinions between votes from three employee positions of a company is not the same.

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1. (b) H_0: The responses are not related to the group of the employee.

H_1: The responses are related to the group of the employee.

At $\alpha = 0.05$, $v = (3-1)(2-1) = 2$, critical value $= \chi^2_{0.05;2} = 5.991$
rejection value $= \chi^2 > 5.991$

$$\chi^2 = \sum_{i=1}^{3}\sum_{j=1}^{2} \frac{(O_{ij} - E_{ij})^2}{E_{ij}} = \frac{(134-143)^2}{143} + \frac{(126-117)^2}{117} + \frac{(64-\cancel{59}\,55)^2}{\cancel{59}\,55} + \frac{(36-45)^2}{45} + \frac{(22-22)^2}{22} + \frac{(18-18)^2}{18}$$

$= 0.5664 + 0.6923 + 1.4727 + 1.8 + 0 + 0$
$= 4.5314$

$\therefore$ since $\chi^2 = 4.5314 < 5.991$, it is failed to reject H_0 at $\alpha = 0.05$.
Hence, the responses are not related to the group of employee.

O_{ij} ~~Blue-collar~~		Responses support	Against	Total
	Blue-collar	134 (143)	126 (117)	260
Employee	white-collar	64 (55)	36 (45)	100
	managers	22 (22)	18 (18)	40
	Total	220	180	400

$E_{11} = \frac{260(220)}{400} = 143$ $\quad E_{21} = \frac{100(220)}{400} = 55$ $\quad E_{31} = \frac{40(220)}{400} = 22$

$E_{12} = \frac{260(180)}{400} = 117$ $\quad E_{22} = \frac{100(180)}{400} = 45$ $\quad E_{32} = \frac{40(180)}{400} = 18$

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Qu 1.(c) ~~H_0 = The distribution of responses between ~~blue-collar~~ and ~~non-b~~ the group of blue-collar and non-blue-collar is the same.~~

~~H_1 = The distribution of responses between the group of blue-collar ~~of respon~~ and non-blue collar is not the same.~~

		Responses		
		support	Against	Total
	Blue-collar	134 (143)	(117) 126	260
Employee	Non-Blue-collar	86 (77)	(63) 54	140
		220	180	400

At $\alpha = 0.05$, $v = (2-1)(2-1) = 1$, critical value $= \chi^2_{0.05;1} = 3.841$

rejection region $= \chi^2 > 3.841$

~~H_0~~ H_0 = The distribution of responses is ~~not~~ differs among the group of blue-collar and non-blue collar

H_1 = The distribution of responses is not differs among the group of blue-collar and non-blue collar

$$\chi^2 = \sum_{i=1}^{2} \frac{(|O_i - E_i| - 0.5)^2}{E_i} = \frac{(|134-143|-0.5)^2}{143} + \frac{(|126-117|-0.5)^2}{117} + \frac{(|86-77|-0.5)^2}{77} + \frac{(|54-63|-0.5)^2}{63}$$

$= ~~0.5052 + 0.6175 + 0.9383 + 1.1468~~$

$= ~~3.2078~~$ 3.2079

~~∴ Since $\chi^2 = 3.2078 < 3.841$, H_0 is failed to be rejected.~~ Hence

∴ since $\chi^2 = 3.2079 < 3.841$, it is failed to reject H_0 at $\alpha = 0.05$.

And we conclude that the distribution of responses is differs among the group of blue-collar and non-blue-collar.

$E_{11} = \frac{260(220)}{400} = 143$ $\qquad E_{21} = \frac{140(220)}{400} = 77$

$E_{12} = \frac{260(180)}{400} = 117$ $\qquad E_{22} = \frac{140(180)}{400} = 63$

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2. (a) i.

Litter size (Rx)	Brain Weight (Ry)	d = rx - ry	d^2
3 (1)	0.440 (10)	-9	81
4 (2.5)	0.417 (4)	-1.5	2.25
4 (2.5)	0.429 (8)	-5.5	30.25
5 (4)	0.430 (9)	-5	25
6 (5)	0.422 (6)	-1	1
7 (6)	0.424 (7)	-1	1
8 (7.5)	0.414 (3)	4.5	20.25
8 (7.5)	0.409 (1)	6.5	42.25
9 (9)	0.410 (2)	7	49
11 (10)	0.421 (5)	5	25
Σrx : 65	ΣRy : 4.216		Σd^2 = 277

$$r_s = 1 - \frac{6\Sigma d^2}{n(n^2-1)}$$

$$= 1 - \frac{6(277)}{10(10^2-1)}$$

$$= -0.6788$$

~~∴ There is a moderate degree strong High high degree of disagrement between the rankings of litter size and brain weight, Higher litter size of 1 month will Brain weight higher indicate that Brain weight increase, litter size icrease too.~~

∴ There is a high degree of disagrement between the rankings of litter size and brain weight. As the litter size increase, the brain weight decreases.

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2.(a) ii.

Body Weight (Rx)	Brain weight (Ry)	x^2	y^2	xY
9.614 (10)	0.440 (10)	92.4290	0.1936	4.2302
9.155 (7)	0.417 (4)	83.8140	0.1739	3.8176
9.613 (9)	0.429 (8)	92.4098	0.1840	4.1240
9.230 (8)	0.430 (9)	85.1929	0.1849	3.9689
8.421 (6)	0.422 (6)	70.9132	0.1781	3.5537
7.868 (5)	0.424 (7)	61.9054	0.1798	3.3360
7.040 (3)	0.414 (3)	49.5616	0.1714	2.9146
7.253 (4)	0.409 (1)	52.6060	0.1673	2.9665
6.930 (2)	0.410 (2)	48.0249	0.1681	2.8413
6.658 (1)	0.421 (5)	44.3290	0.1772	2.8030
$\Sigma rx = 81.782$	$\Sigma ry = 4.216$	$\Sigma x^2 = 681.1858$	$\Sigma y^2 = 1.7783$	$\Sigma xy = 34.5558$

$$r = \frac{n\Sigma xy - (\Sigma x)(\Sigma y)}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y)^2]}}$$

$$= \frac{10(34.5558) - (81.782)(4.216)}{\sqrt{[10(681.1858) - (81.782)^2][10(1.7783) - (4.216)^2]}}$$

$$= \frac{0.7651}{\sqrt{(123.5050)(0.0083)}}$$

$$= 0.7535$$

∴ There is a strong positive correlation between body weight and brain weight. As the body weight increase, the brain weight will increase.

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~~2(c)ii.~~ Independent variable = litter size
2(b) Dependent variable = ~~brown~~ brain weight (grams)

Litter size (Rx)	Brain weight (Ry)	x^2	xy
3 (1)	0.440 (10)	9	1.32
4 (2.5)	0.417 (4)	16	1.668
4 (2.5)	0.429 (8)	16	1.716
5 (4)	0.430 (9)	25	2.15
6 (5)	0.422 (6)	36	2.532
7 (6)	0.424 (7)	49	2.968
8 (7.5)	0.414 (3)	64	3.312
8 (7.5)	0.409 (1)	64	3.272
9 (9)	0.410 (2)	81	3.69
11 (10)	0.421 (5)	121	4.631
$\Sigma x = 65$	$\Sigma y = 4.216$	$\Sigma x^2 = 481$	$\Sigma xy = 27.259$

$n = 10$ $y^2 =$ 1.7783

$$b = \frac{n(\Sigma xy) - \Sigma x(\Sigma y)}{n\Sigma x^2 - (\Sigma x)^2} = \frac{10(27.259) - 65(4.216)}{10(481) - (65)^2} = \frac{-1.45}{585} = -0.0025$$

$$a = \frac{\Sigma Y}{n} - b\frac{\Sigma X}{n} = \frac{4.216}{10} - (-0.0025)\left(\frac{65}{10}\right) = 0.4216 + 0.0163 = 0.4379$$

$$Y' = a + bX = 0.4379 - 0.0025X$$

∴ The average change in the predicted brain weight is -0.0025 (grams) due to change of 1 units of litter size.

The ~~av~~ predicted brain weight is 0.4379 (grams) when the litter size is 0 unit.

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2.(c) i. $Y' = 0.4379 - 0.0025X$
$= 0.4379 - 0.0025(2)$
$= 0.4329$ (grams)

∴ since the value of X (2) falls outside the range of dataset, the estimate is obtained by extrapolation technique, hence the estimate is considered as less accurate ~~or un~~ and ~~unreliable~~ unreliable.

2.(c) ii. $Y' = 0.4379 - 0.0025X$
$= 0.4379 - 0.0025(10)$
$= 0.4129$

∴ since the value of $X(10)$ falls within the range of data set, the estimate is obtained by interpolation ~~tea~~ technique and hence the estimate is considered as accurate and reliable.

~~$Y' = 0.4379 - 0.0025$~~

~~∴ The average change in the estimated brain weight is -0.0025 (grams) due to change of 1 units of ~~little~~ litter size. The estimated brain weight is 0.4379 (grams) when the litter size is 0 unit.~~

2.(d) ~~n=10, $\Sigma X = 65$~~ Litter size = x
Brain weight = y

$n=10$, $x=65$, $y=4.216$, $xy=27.259$, $x^2=481$, $y^2=1.7783$

$$r = \frac{10(27.259) - (65)(4.216)}{\sqrt{[10(481) - (65)^2][10(1.7783) - (4.216)^2]}}$$

$= -0.6563$

$r^2 = (-0.6563)^2$
$= 0.4307$
$= 43.07\%$

∴ About 43.07% at the total variation ~~of~~ in brain weight, that is explained or accounted ~~by~~ for by the total variation in litter size. Hence, the regression line is not considered as a line of good fit.