

1. A random sample of people is taken to find if there is a relationship between parent and child obesity. A sample of 100 obese and 100 non-obese children was taken and then the obesity statuses of their parents were recorded. The observed results are shown.

**OBSERVED VALUES**

	OBESE Child	NON-OBESE Child	Total
OBESE Parent	68	58	126
NON-OBESE Parent	32	42	74
Total	100	100	200

Calculate the **expected values** for this sample: **EXPECTED VALUES**

	OBESE Child	NON-OBESE Child
OBESE Parent	$\frac{126 \cdot 100}{200} = 63$	$\frac{126 \cdot 100}{200} = 63$
NON-OBESE Parent	$\frac{74 \cdot 100}{200} = 37$	$\frac{74 \cdot 100}{200} = 37$

- (a) State the null hypothesis and alternate hypothesis for this test:

$H_0$ : The obesity of a parent and obesity of their child are independent factors.  
 $H_1$ : The obesity of a parent and the obesity of their child are not independent factors.

- (b) Determine the  $\chi^2_{calc}$  value for the test. (SHOW WORK!)

$$\chi^2_{calc} = \sum \frac{(f_o - f_e)^2}{f_e} = \frac{(68-63)^2}{63} + \frac{(58-63)^2}{63} + \frac{(32-37)^2}{37} + \frac{(42-37)^2}{37}$$

$\chi^2_{calc} = 2.15$

Use the critical values table to find the  $\chi^2_{crit}$  value at the 5% significance level.

$\chi^2_{crit} = 3.841$

- (d) Is there a relationship between a child obesity and parental obesity? How valid would you consider your findings?

Because  $\chi^2_{calc} = 2.15 < \chi^2_{crit} = 3.841$ , we accept  $H_0$  and conclude that child obesity and parental obesity are independent factors.

2. A student conducted a chi-squared test for independence to determine if there is a relationship between job satisfaction and whether or not a person had a college degree. The following data was obtained:

**OBSERVED VALUES**

	SATISFIED	NOT SATISFIED	Total
COLLEGE DEGREE	272	618	890
NO COLLEGE DEGREE	238	292	530
Total	510	910	1420

Use your calculator to determine the following information:

- (a) The  $\chi^2_{calc}$  value: 29.7 (b) The p-value:  $5.06 \times 10^{-8}$   
 p-value < significance level  $\therefore$  reject  $H_0$

- (c) At the 5% significance level, what is the relationship between job satisfaction and having a college degree?

$\chi^2_{calc} < \chi^2_{crit}$  accept  $H_0$   
 $\chi^2_{calc} > \chi^2_{crit}$  reject  $H_0$

$\chi^2_{calc} 29.7 > \chi^2_{crit} 3.841$   
 $\therefore$  Reject  $H_0$  and conclude that level of education and job satisfaction are independent factors.

Yates':  
 $\sum \frac{(|f_o - f_e| - 0.5)^2}{f_e}$

$H_0$ : Level of education and job satisfaction are independent factors.  
 $H_1$ : Level of education and job satisfaction are not independent factors.

3. A survey was conducted to determine how occupation is related to education. Based on a random sample of 500 employed men and women, their occupation and education background was recorded and tabulated as shown:

	OCCUPATION			
	White Collar	Blue Collar	Services	Farming
At least 12 years of education	196	146	31	7
Less than 12 years of education	21	70	20	9

(a) Based on the table of observed values, above, find the values of a, b, c and d in the table of expected values shown below:

	OCCUPATION				
	White Collar	Blue Collar	Services	Farming	TOTALS
At least 12 years of education	164.92	<b>b</b>	38.76	12.16	380
Less than 12 years of education	<b>a</b>	<b>c</b>	12.24	<b>d</b>	120
TOTALS	217	216	51	16	<b>500</b>

$a = \underline{52.08}$     $b = \underline{164.16}$     $c = \underline{51.84}$     $d = \underline{3.84}$

(b) Write a suitable null hypothesis and alternate hypothesis for this data.

$H_0$ : Level of education and occupation are independent factors  
 $H_1$ : Level of education and occupation are not independent factors.

(c) Calculate the number of degrees of freedom, and write down the  $\chi^2_{crit}$  value at the 5% significance level.

$d.f. = \frac{(2-1)(4-1)}{(1)(3)} = 3$        $\chi^2_{crit} @ 3 \text{ d.f. and } 5\% \text{ sig. level} = 7.815$

(d) Calculate the value of  $\chi^2_{calc}$  to 3 significant figures.

$\chi^2_{calc} = \frac{(196 - 164.92)^2}{164.92} + \frac{(146 - 164.16)^2}{164.16} + \frac{(31 - 38.76)^2}{38.76} + \frac{(7 - 12.16)^2}{12.16} + \frac{(21 - 52.08)^2}{52.08} + \frac{(70 - 51.84)^2}{51.84}$

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(e) What conclusion can you draw regarding education and occupation?

Because  $\chi^2_{calc} = 48.4$  is greater than  $\chi^2_{crit} = 7.815$ , reject the null hypothesis and conclude that level of education and occupation are not independent factors. The p-value =  $1.77 \times 10^{-10} = 0.000000177$  and is less than the significance level of 0.05. Because the p-value is less than the significance level this confirms the conclusion to reject the null hypothesis.