

# Assignment 3

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## Exercise 1

Sixty-five pregnant women at a high risk of pregnancy-induced hypertension participated in an randomized controlled trial comparing 100 mg of aspirin daily and a matching placebo during the third trimester of pregnancy (Schiff et al., 1989). The observed rates of hypertension are shown in the following table:

	Aspirin treated (Y=1)	Placebo (Y=0)	Total
Hypertension (D=1)	4	11	15
No hypertension (D=0)	30	20	50
Total	34	31	65

Do these data suggest that daily aspirin reduces the risk of hypertension in the last trimester of pregnancy? Do a statistical test in order to answer this question. If you find a significant result: calculate the relevant odds ratio for comparing the two groups.

The statistical test chosen to compare the two groups is the chi-square test.

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$
$$E = \frac{\text{rowtotal} * \text{columntotal}}{\text{overalltotal}}$$
$$DOF = 1$$

From the table given in the question, 'E' for each value can be calculated as

$$E(4) = \frac{15 * 34}{65} = 7.84$$
$$E(30) = \frac{50 * 34}{65} = 26.15$$
$$E(11) = \frac{15 * 31}{65} = 7.15$$
$$E(20) = \frac{50 * 31}{65} = 23.84$$

The value of  $\chi^2$  is given by

$$\chi^2 = \frac{14.7456}{7.84} + \frac{14.8225}{7.15} + \frac{14.8225}{26.15} + \frac{14.7456}{23.84} = 5.1392$$

The value of c is calculated with assuming  $\alpha = 5\%$  as  $c=3.84$ .

As  $\chi^2 > c$ , we reject the null hypothesis. It means that the aspirin is not equal to placebo which indirectly means aspirin reduces the risk of hypertension.

$$p_0 = P(Y = 1|D = 0)$$
$$p_1 = P(Y = 1|D = 1)$$
$$p_0 = 30/50 = 0.6$$
$$p_1 = 4/15 = 0.267$$
$$\text{OddsRatio} = \frac{p_1/(1 - p_1)}{p_0/(1 - p_0)} = \frac{0.267/0.733}{0.6/0.4}$$
$$= 0.2428$$

## Exercise 2

- Does heavy coffee drinking has an influence on CHD?

**Table: 1**

	Heavy coffee drinkers (Y=1)	Moderate and non-drinkers (Y=0)	Total
CHD (D=1)	38	39	77
Non-cases (D=0)	752	889	1641
Total	790	928	1718

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

$$E = \frac{\text{rowtotal} * \text{columntotal}}{\text{overalltotal}}$$

$$DOF = 1$$

From the table, 'E' for each value can be calculated as

$$E(38) = \frac{77 * 790}{1718} = 35.4$$

$$E(752) = \frac{1641 * 790}{1718} = 754.59$$

$$E(39) = \frac{77 * 928}{1718} = 41.59$$

$$E(889) = \frac{1641 * 928}{1718} = 886.4$$

The value of  $\chi^2$  is given by

$$\chi^2 = \frac{6.76}{35.4} + \frac{6.7}{41.59} + \frac{6.7}{754.59} + \frac{6.76}{886.4} = 0.3686$$

The value of c is calculated with assuming  $\alpha = 5\%$  as  $c = 3.84$ . As  $\chi^2 < c$ , we do not reject the null hypothesis. It means that the cases of CHD in coffee drinkers has no difference between heavy drinkers and moderate to non-drinkers. Thus coffee drinking has no influence on CHD.

- Does heavy smoking has an influence on CHD?

**Table: 2**

This table is formulated using the values given in Table B in the question.

	Heavy smokers (Y=1)	Others (Y=0)	Total
CHD (D=1)	36	30	66
Non-cases (D=0)	22	63	85
Total	58	93	151

From the table, 'E' for each value can be calculated as

$$E(36) = \frac{66 * 58}{151} = 25.35$$

$$E(30) = \frac{66 * 93}{151} = 40.65$$

$$E(22) = \frac{85 * 58}{151} = 32.65$$

$$E(63) = \frac{85 * 93}{151} = 52.35$$

The value of  $\chi^2$  is given by

$$\chi^2 = \frac{113.4225}{25.35} + \frac{113.4225}{40.65} + \frac{113.4225}{32.65} + \frac{113.4225}{52.35} = 12.90$$

The value of c is calculated with assuming  $\alpha = 5\%$  as  $c = 3.84$ . As  $\chi^2 > c$ , we reject the null hypothesis. It means that the cases of CHD in smokers has a difference between heavy smokers and others. Thus heavy smoking has a significant influence on CHD.

$$p_0 = P(Y = 1|D = 0)$$

$$p_1 = P(Y = 1|D = 1)$$

$$p_0 = 22/85 = 0.2588$$

$$p_1 = 36/66 = 0.5454$$

$$\begin{aligned} OddsRatio &= \frac{p_1/(1-p_1)}{p_0/(1-p_0)} = \frac{0.5454/0.4546}{0.2588/0.7412} \\ &= 3.436 \end{aligned}$$

3. (a) Does drinking coffee influence CHD on heavy smokers?

**Table: (3a) Heavy Smokers**

	Coffee use		Total
	heavy (Y=1)	other (Y=0)	
CHD cases (D=1)	25	11	36
Non-cases (D=0)	14	8	22
Total	39	19	58

From the table, 'E' for each value can be calculated as

$$E(25) = \frac{36 * 39}{58} = 24.2$$

$$E(11) = \frac{36 * 19}{58} = 11.79$$

$$E(14) = \frac{22 * 39}{58} = 14.79$$

$$E(8) = \frac{22 * 19}{58} = 7.2$$

The value of  $\chi^2$  is given by

$$\chi^2 = \frac{0.64}{24.2} + \frac{0.6241}{11.79} + \frac{0.6241}{14.79} + \frac{0.64}{7.2} = 0.21$$

The value of c is calculated with assuming  $\alpha = 5\%$  as  $c = 3.84$ . As  $\chi^2 < c$ , we do not reject the null hypothesis. It means that the cases of CHD in heavy smokers has no difference between heavy coffee drinkers and moderate to non-drinkers. Thus coffee drinking has no influence on CHD in heavy smoking individuals.

- (b) Does drinking coffee influence CHD on other smokers?

**Table: (3b) Other Smokers**

	Coffee use		Total
	heavy (Y=1)	other (Y=0)	
CHD (D=1)	15	15	30
Non-cases (D=0)	21	42	63
Total	36	57	93

From the table, 'E' for each value can be calculated as

$$\begin{aligned} E(15) &= \frac{30 * 36}{93} = 11.61 & E(15) &= \frac{30 * 57}{93} = 18.38 \\ E(21) &= \frac{63 * 36}{93} = 24.38 & E(42) &= \frac{63 * 57}{93} = 38.61 \end{aligned}$$

The value of  $\chi^2$  is given by

$$\chi^2 = \frac{11.49}{11.61} + \frac{11.42}{18.38} + \frac{11.42}{24.38} + \frac{11.49}{38.61} = 2.37$$

The value of c is calculated with assuming  $\alpha = 5\%$  as  $c = 3.84$ . As  $\chi^2 < c$ , we do not reject the null hypothesis. It means that the cases of CHD in other smokers has no difference between heavy coffee drinkers and moderate to non-drinkers. Thus coffee drinking has no influence on CHD in other smoking and non-smoking individuals.

## CONCLUSION:

From the table 1, heavy coffee drinking does not affect CHD based on the  $\chi^2$  value. From table 2, heavy smoking affects CHD based on the  $\chi^2$  value. From table 3a and 3b, smoking along with coffee drinking has no effect of CHD.

Analyzing all the four possibilities that can influence CHD in individuals, it is concluded that only smoking has an influence on CHD.