

autoQs Solution for Level 1 Question 5

Advice: sequence of steps

We should carry out a chi-squared test of no association by following this sequence

- Specify the hypotheses to be tested
- Calculate (if not provided already) the expected counts (under the null hypothesis) for each cell in the table
- Calculate the test statistic X^2
- Determine the critical value by looking in statistical tables – we usually look for the value relating to a 5% significance level, and degrees of freedom v , where v is calculated as $(r - 1) \times (c - 1)$, for r rows and c columns in the table (only count the rows and columns with actual data in them, not headings or totals)
- If the test statistic is greater than or equal to the critical value, then **reject** the null hypothesis at the 5% significance level (there is evidence of an association between the two factors); else **do not reject** the null hypothesis at the 5% significance level (there is no evidence of an association between the two factors)
- If there is a significant result, then compare the observed and expected counts to see which cells of the table have the greatest differences, and comment on these to give an indication of the type of association

The Solution

Stating the hypotheses

H_0 : There is no association between pollution and birthweight

H_1 : Pollution and birthweight are associated

Observed and expected counts (given in the question)

Observed counts, O

	Low birthweight	Normal birthweight	Total
Pollution	84	338	422
No pollution	24	62	86
Total	108	400	508

Expected counts (under null hypothesis), E

	Low birthweight	Normal birthweight	Total
Pollution	89.72	332.28	422
No pollution	18.28	67.72	86
Total	108	400	508

Calculating the test statistic

The test statistic is (given in the question) $X^2 = \sum \frac{(O-E)^2}{E}$

$$\text{Therefore } X^2 = (84 - 89.72)^2/89.72 + (338 - 332.28)^2/332.28 + (24 - 18.28)^2/18.28 + (62 - 67.72)^2/67.72 = 2.736$$

Determining the critical value

We are told that the critical value (for the 5% significance level) is 3.84 (degrees of freedom 1, because we have 2 rows and 2 columns of data).

Conclusions

Our test statistic, $X^2 = 2.736$, is less than the critical value, 3.84, and so we **do not reject** the null hypothesis of no association. There is therefore no evidence of an association between pollution and birthweight.