

autoQs Solution for Level 1 Question 1

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 island location and deaths from cancer

H_1 : Island location and deaths from cancer are associated

Observed and expected counts (given in the question)

Observed counts, O

	Cancer deaths	Deaths other causes	Total
Island A	180	680	860
Island B	104	660	764
Total	284	1340	1624

Expected counts (under null hypothesis), E

	Cancer deaths	Deaths other causes	Total
Island A	150.4	709.6	860
Island B	133.6	630.4	764
Total	284	1340	1624

Calculating the test statistic

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

$$\text{Therefore } X^2 = (180 - 150.4)^2/150.4 + (680 - 709.6)^2/709.6 + (104 - 133.6)^2/133.6 + (660 - 630.4)^2/630.4 = 15.008$$

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, $X^2 = 15.008$, is greater than the critical value, 3.84, and so we **reject** the null hypothesis of no association. There is therefore evidence of an association between island location and death from cancer. There are more observed cancer deaths than expected on Island A - this island seems to be hazardous with respect to death from cancer.