

Chi-Squared (Contingency Tables) Q2a [10 marks]

(17/6/21)

Exam Boards

OCR : -

MEI: Statistics a

AQA: -

Edx: S1 (Year 1)

The table below shows data that have been collected for 1000 people (in an area where there are a lot of ladders) to test the theory that walking under a ladder brings bad luck.

On a particular day, each person is asked whether they walked under a ladder, and whether they experienced bad luck that day.

Walked under ladder?	Yes	No	
Experienced Bad luck?			Totals
Yes	51	84	135
No	269	596	865
Totals	320	680	1000

(i) Test the hypothesis that walking under ladders brings bad luck, assuming a 5% significance level. [8 marks]

(ii) Discuss any practical difficulties with the data. [2 marks]

Solution

(i) H_0 : There is no association between walking under ladders and experiencing bad luck

H_1 : There is an association between walking under ladders and experiencing bad luck

[1 mark]

The table of expected frequencies is:

Walked under ladder?	Yes	No	
Experienced Bad luck?			Totals
Yes	43	92	135
No	277	588	865
Totals	320	680	1000

where $320 \times \frac{135}{1000} = 43$

[2 marks]

[dealing with the smallest observed frequency first, so that any rounding errors appear in the larger cells]

$$\begin{aligned} \text{Then } X^2 &= \frac{(51-43)^2}{43} + \frac{(84-92)^2}{92} + \frac{(269-277)^2}{277} + \frac{(596-588)^2}{588} \\ &= \frac{64}{43} + \frac{64}{92} + \frac{64}{277} + \frac{64}{588} = 2.524 \text{ (3dp) [2 marks]} \end{aligned}$$

d.f. = $(2 - 1) \times (2 - 1) = 1$, so that the critical value of χ^2 at the 5% level is 3.841 [1 mark]

As $2.524 < 3.841$, H_0 is accepted: there is not sufficient evidence at the 5% level to conclude that there is any association between walking under ladders and experiencing bad luck [2 marks]

[Had H_1 been accepted, we would then have to examine the data to establish whether bad luck was more or less likely if a ladder had been walked under.]

(ii)

- subjective nature of 'bad luck'

- individuals are allowed to choose whether to walk under ladders: it might be the case that people who are cautious tend to avoid walking under ladders, and experience less 'bad luck' generally (as they are more cautious)

- individuals might walk under more than one ladder in the course of the day (and so be more prone to bad luck)

- individuals walking under their ladder earlier in the day may be prone to more bad luck

[Unusual points, such as the last two, are very unlikely to appear on mark schemes, and so might not attract any marks.]

[2 marks, for 2 points]