

Unit 7 *Chi-Squared*

Text Answers

7.2 Significance Testing

1. Calculated $\chi^2 = \frac{58}{17} \approx 3.412$
From χ^2_3 , critical region, > 7.815 .
At the 5% significance level there is insufficient evidence to support the claim that the die is not fair.
2. Calculated $\chi^2 = 5.5$
From χ^2_5 , critical region, > 11.070 .
At the 5% significance level there is insufficient evidence to support the claim that the die is biased.
3. Calculated $\chi^2 = 10.94$
From χ^2_4 , critical region, 9.488.
At the 5% significance level there is some evidence to support the claim that the number of absentees is dependent on the day of the week.
4. Calculated $\chi^2 = 13.2$
From χ^2_6 , critical region, > 12.592 .
At the 5% significance level there is some evidence to support the claim that the number of accidents is dependent on the day of the week.

7.3 Contingency Tables

1. $\chi^2 = 23.79$; critical $\chi^2 = 9.210$ (2 degrees of freedom); evidence that proportion favouring expenditure on road improvements does depend on area.
2. $\chi^2 = 7.97$; critical $\chi^2 = 9.488$ - no evidence to suggest that patients attending the Centre depend on social class;
 $\chi^2 = 18.05$; critical $\chi^2 = 15.507$ (8 degrees of freedom), so there is evidence to suggest that the reason for visits to the surgery is not independent of social class.
3. (a) $\chi^2 = 14.77$; critical $\chi^2 = 13.277$ (4 degrees of freedom) so there is evidence to suggest that the number of books borrowed depends on the day of the week.
(b) $\chi^2 = 16.93$; critical $\chi^2 = 13.277$ (4 degrees of freedom) so there is evidence to suggest that the length of employment is not independent of grade.
4. $\chi^2 = 17.01$; critical $\chi^2 = 5.991$ (2 degrees of freedom) so there is evidence to suggest that the proportion of transferred cases is not independent of the surgeon.

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5. (a) $\chi^2 = 12.03$; critical $\chi^2 = 7.815$ (3 degrees of freedom) so evidence to suggest that the work is associated with the type of question.
- (b) Binomial and Poisson, since they have nearly equal responses.
- (c) Consider the numbers who did not attempt the different types of questions; this gives the contingency table:

	<i>Contingency table</i>	<i>Binomial fit</i>	<i>Normal fit</i>	<i>Poisson fit</i>	
<i>Attempted</i>	29	23	15	23	90
<i>Did not attempt</i>	1	7	15	7	30
	30	30	30	30	120

This 2×4 contingency table gives χ^2 values of

$$\begin{aligned} \frac{(29 - 22.5)^2}{22.5} + \frac{(1 - 7.5)^2}{7.5} + \frac{(23 - 22.5)^2}{22.5} + \frac{(7 - 7.5)^2}{7.5} + \frac{(15 - 22.5)^2}{22.5} + \frac{(15 - 7.5)^2}{7.5} \\ + \frac{(23 - 22.5)^2}{22.5} + \frac{(7 - 7.5)^2}{7.5} \approx 17.59 \end{aligned}$$

$\chi^2 = 17.59$; critical $\chi^2 = 7.815$ (3 degrees of freedom) so evidence to suggest that the proportion of candidates attempting a question is associated with type of question.

- (d) Clearly the students had a better understanding of 'contingency table' questions (only 1 did not attempt this); also, of those who attempted the other questions, they were more successful at the 'Normal fit' questions.