Chi-squared goodness of fit

AS Further Statistics 1 | Edexcel 8FM0 | 12 questions, 97 marks

Further Maths topic practice

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Name: _____ **Date:** _____ **Score:** _____ **/ 97**

1 A spinner has five equal sections coloured red, blue, green, yellow and white. Amira spins it 150 times and records the colour each time.

Colour	Red	Blue	Green	Yellow	White
Frequency	36	24	33	21	36

She wants to test whether the spinner is fair.

a. Write down suitable hypotheses for the test.

b. Find the expected frequency for each colour if the spinner is fair.

c. State the number of degrees of freedom and the critical value for a test at the 5% level of significance.

(3 marks)

Answer _____

2 The number of people visiting a village library on each weekday was recorded over a period of several weeks.

Day	Monday	Tuesday	Wednesday	Thursday	Friday
Visits	52	38	45	41	64

Test, at the 5% level of significance, whether visits to the library are equally likely on each of the five days. State your hypotheses clearly.

(6 marks)

Answer _____

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3 Oliver rolls an ordinary six-sided dice 300 times. The frequencies of the scores 1 to 5 are shown in the table, but the frequency of a 6 has been smudged.

Score	**1**	**2**	**3**	**4**	**5**	**6**
Frequency	41	58	47	62	39	f

a. Find the value of f.

b. Explain why a test of whether the dice is fair has 5 degrees of freedom.

c. Test, at the 5% level of significance, whether the dice is fair. State your hypotheses and the critical value clearly.

(7 marks)

Answer

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4 A quiz has 5 true or false questions. A teacher believes the 96 students in Year 12 simply guessed every answer, so that the number of correct answers, X, for a student can be modelled by B(5, 0.5). The results were:

Number correct	**0**	**1**	**2**	**3**	**4**	**5**
Number of students	1	7	26	35	21	6

a. Find the expected frequencies under the teacher's model.

b. Test, at the 5% level of significance, whether B(5, 0.5) is a suitable model for X. State your hypotheses and the critical value clearly.

(9 marks)

Answer

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5 A farm shop sells eggs in boxes of 6. Priya checks 100 boxes and records the number of cracked eggs in each box.

Number of cracked eggs	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Number of boxes	38	37	18	5	2	0	0

She wants to test whether a binomial distribution is a suitable model for the number of cracked eggs in a box.

a. Show that a suitable estimate for the probability that an egg is cracked is 0.16

b. Using this estimate, test at the 5% level of significance whether a binomial distribution is a suitable model. State your hypotheses and the critical value clearly.

(9 marks)

Answer

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6 A council helpline manager claims that the number of calls arriving in a minute can be modelled by a Poisson distribution with mean 2. The number of calls in each of 120 randomly chosen minutes is recorded.

Number of calls	**0**	**1**	**2**	**3**	**4**	**5 or more**
Number of minutes	14	30	33	22	12	9

Test, at the 5% level of significance, whether the manager's claim is supported by the data. State your hypotheses and the critical value clearly.

(8 marks)

Answer

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7 Kiran is studying daisies on a school field. She places a 1 m by 1 m square frame at 80 random positions and counts the daisies inside it each time.

Number of daisies	0	1	2	3	4	5	6
Frequency	6	15	22	18	11	5	3

a. Show that the mean number of daisies per square is 2.5

b. Test, at the 5% level of significance, whether a Poisson distribution is a suitable model for the number of daisies in a square. State your hypotheses and the critical value clearly.

c. Give one reason, in context, why a Poisson model might be expected to fit.

(10 marks)

Answer

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8 An editor counts the typing errors on each of 200 pages of a draft novel. The mean number of errors per page is 1.5 and she uses Po(1.5) to model the number of errors on a page. Her results and some of her expected frequencies are shown below.

Number of errors	**0**	**1**	**2**	**3**	**4 or more**
Observed	48	70	46	24	12
Expected	r	66.94	s	25.10	13.13

a. Find the value of r and the value of s, giving your answers to 2 decimal places.

b. Explain why the test has 3 degrees of freedom.

c. The test statistic is 0.89. Test, at the 5% level of significance, whether Po(1.5) is a suitable model. State your hypotheses and the critical value clearly.

(7 marks)

Answer

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9 A garden centre sows 10 seeds in each of 150 trays and counts how many seeds germinate in each tray.

Seeds germinating	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Number of trays	2	10	20	24	30	32	26	6

No tray had fewer than 3 seeds germinate. The manager wants to test whether B(10, p) is a suitable model.

a. Show that the estimate of p from these data is 0.7

Using p = 0.7 the manager finds these expected frequencies.

Seeds germinating	**4 or fewer**	**5**	**6**	**7**	**8**	**9**	**10**
Expected	7.10	15.44	30.02	40.02	35.02	18.16	4.24

b. Explain why the classes 9 and 10 must be combined, and state the number of degrees of freedom for the test.

c. The test statistic is 12.82. Test, at the 1% level of significance, whether B(10, p) is a suitable model. State your hypotheses and the critical value.

d. State, with a reason, whether your conclusion would change at the 5% level.

(8 marks)

Answer

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10 At a school fair, each of 200 visitors throws 4 hoops at a peg. The number of hoops that land on the peg is recorded for each visitor.

Hoops on the peg	**0**	**1**	**2**	**3**	**4**
Number of visitors	18	52	70	46	14

The stall holder, Megan, says the probability that a hoop lands on the peg is 0.4 and that the throws are independent.

a. Test, at the 5% level of significance, whether B(4, 0.4) is a suitable model for the number of hoops on the peg. State your hypotheses and the critical value clearly.

b. Use the data to estimate the probability that a hoop lands on the peg.

c. Using this estimate, the test statistic for a binomial model is 2.21. Stating the degrees of freedom and the critical value, test at the 5% level whether a binomial model with this estimate is suitable.

d. Comment on Megan's claim in the light of both tests.

(10 marks)

Answer

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11 The numbers of goals scored in the 380 matches of a football league season are shown below.

Goals in a match	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Number of matches	30	72	98	78	52	26	20	4

a. Show that the mean number of goals per match is 2.6

b. Test, at the 5% level of significance, whether a Poisson distribution is a suitable model for the number of goals in a match. State your hypotheses and the critical value clearly.

c. Use your model to estimate the number of matches in the season with more than 4 goals, and compare this with the data.

(10 marks)

Answer

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12 The heights of 300 Year 7 pupils were measured by different members of staff and recorded to the nearest millimetre. The last digit of each recorded height was noted.

Last digit	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Frequency	58	19	24	22	21	49	23	25	31	28

a. Test, at the 1% level of significance, whether the last digit is equally likely to be any of 0 to 9. State your hypotheses, the degrees of freedom and the critical value clearly.

b. Identify which digits contribute most to the test statistic and suggest a reason in context.

c. The 107 heights ending in 0 or 5 are removed. Test, at the 5% level of significance, whether the remaining digits are equally likely.

(10 marks)

Answer _____

End of questions | Total 97 marks

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