

MATHEMATICS 360-255-LW

Quantitative Methods II

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XIX – Chi-Square Goodness of Fit

1. The following table lists the frequency distribution for a sample of 50 absences of college students from classes according to the day of occurrence.

Day of the week	Mon	Tue	Wed	Thu	Fri
Number of absences	14	6	4	10	16

Test at the 5% significance level if the number of absences is equally distributed over all days of the week. Try with both approaches, the classical and the p -value.

2. To check a die for fairness, it is rolled 300 times. If the die is fair, then all of the outcomes should be equally likely. Here are the results of the rolls.

Number on die	1	2	3	4	5	6
Number of rolls	57	43	44	53	46	57

At the 5% level of significance, test the claim that the die is fair. Try with both approaches, the classical and the p -value.

3. A study of high school professors asked them how prepared they were to integrate technology into their instructions. Thirteen percent were very well prepared, 26% were well prepared, 51% were somewhat prepared, and 10% were not prepared at all. A random sample of 60 small town high school teachers showed the following results.

Level of Preparedness	Number of Respondents
Very well	5
Well	11
Somewhat	33
Not at all	11

At the 10% level of significance, test the claim that teachers in this small town follow the distribution reported in the study. Try with both approaches, the classical and the p -value.

4. A pair of dice are rolled 200 times. Here are the sums produced by the 200 rolls.

Sum	2	3	4	5	6	7	8	9	10	11	12
Number of Rolls	4	16	17	16	27	43	25	18	15	16	3

At the 1% significance level, can we conclude that the dice are fair? That is, the sums produced by this pair of dice follow the expected distribution? Try with both approaches, the classical and the p -value.

5. A philosophy instructor tells his students on the first day of class that 40% will pass, 30% will fail, and 30% will withdraw that semester if historical patterns hold true. The class began with 38 students. Seventeen of the students passed the class, 6 failed and the rest dropped. At the 5% level of significance, test the claim that the instructor made on the first day of class. Try with both approaches, the classical and the p -value.
6. A 1970 study showed that of Canadian married-couple families, 42.9% had no children, 18.3% had one child, 18.0% had two children, and 20.8% had three or more children. A recent survey of 500 Canadian married-couple, families revealed that 267 had no children, 87 had one child, 96 had two children, and 50 had three or more children. At the 1% level of significance, test the claim that the 1970 proportions are no longer valid. Try with both approaches, the classical and the p -value.

ANSWERS

- H_0 : The number of absences are equally distributed over all days of the week.
 H_A : The number of absences are not equally distributed over all days of the week.
critical value: $\chi^2_{(4,0.05)} = 9.49$ Reject H_0
test statistic: $\chi^2 = 10.40$
 $0.025 < p\text{-value} < 0.05$
- H_0 : The die is fair.
 H_A : The die is not fair.
critical value: $\chi^2_{(5,0.05)} = 11.07$ Fail to Reject H_0
test statistic: $\chi^2 = 4.16$
 $0.50 < p\text{-value} < 0.75$
- H_0 : Teachers in the small town follow the distribution reported in the study.
 H_A : Teachers in the small town do not follow the distribution reported in the study.
critical value: $\chi^2_{(3,0.10)} = 6.25$ Reject H_0
test statistic: $\chi^2 = 6.72$
 $0.05 < p\text{-value} < 0.10$
- H_0 : Sums produced by the pair of dice follow the expected distribution.
 H_A : Sums produced by the pair of dice do not follow the expected distribution.
critical value: $\chi^2_{(10,0.01)} = 23.21$ Fail to reject H_0
test statistic: $\chi^2 = 11.73$
 $0.25 < p\text{-value} < 0.50$
- H_0 : The instructor's claim is valid
 H_A : The instructor's claim is not valid
critical value: $\chi^2_{(2,0.05)} = 5.99$ Fail to reject H_0
test statistic: $\chi^2 = 3.91$
 $0.10 < p\text{-value} < 0.25$
- H_0 : The 1970 proportions are still valid
 H_A : The 1970 proportions are no longer valid
critical value: $\chi^2_{(3,0.01)} = 11.34$ Reject H_0
test statistic: $\chi^2 = 41.51$
 $p\text{-value} < 0.005$