

CHI-SQUARE TEST OF INDEPENDENCE, ODDS AND RATIOS

Question 1.

We wish to investigate, in a population, if the stress is a risk factor for depression. A sample of 500 people has been observed and the results presented in the next table were obtained:

| | Depression ⁺ | Depression ⁻ |
|-----------------|-------------------------|-------------------------|
| RF ⁺ | 100 | 120 |
| RF ⁻ | 70 | 210 |

Is the stress a risk factor for depression?

1. What is the H₀? H₀:
2. What is the H₁? H₁:
4. Significance level: $\alpha = 0.05$
5. Rejection region: $[3.84, \infty)$
6. Compute the expected contingency table.
7. Calculate the χ^2 parameter

Hint: The test statistic is given by: $\chi^2 = \sum_{i=1}^{LC} \frac{(f_i^o - f_i^t)^2}{f_i^t}$, where f_i^o and f_i^t are observed and expected frequency respectively.

8. Interpret the results from statistical and clinical point of views.

Question 2 (Source: <http://www.brettscaife.net/statistics/introstat/06risk/exercise.html>)

The following data are taken from the paper Caries prevalence in northern Scotland before and 5 years after, water defluoridation (Stephen et al., 1987, BDJ 163: 324-326). They show the social composition of children recruited to two arms of the study one before and one after water defluoridation. What is the probability that we don't know the social class of a child in the fluoridated arm? What is the probability that a child in the defluoridated arm is from social class III?

| Social class | Fluoridated | Defluoridated |
|--------------|-------------|---------------|
| I & II | 16 | 32 |
| III | 45 | 53 |
| IV & V | 32 | 22 |
| Not known | 13 | 19 |
| Total | 106 | 126 |

Question 3

A recent MDentSci project was looking at a number of risk factors thought to be associated with the health of oral implants in a population of elderly patients. One factor considered was smoking. The table below shows the number of healthy and non-healthy implants for smokers and non-smokers. Calculate and interpret the risk ratio and the odds ratio. The patients were selected for the study on the basis of the health of their implants (a case-control study). Which of the two ratios you have calculated would you use to report your results? Why?

A χ^2 test was performed on these data, the results were: $\chi^2 = 2.023$, df (degrees of freedom) = 1, $p = 0.16$. Interpret these results.

| | Healthy implant | | |
|------------|-----------------|----|-------|
| | Yes | No | Total |
| Smoker | 32 | 48 | 80 |
| Non-smoker | 10 | 7 | 17 |
| Total | 42 | 55 | 97 |

Question 4

A study (Erosion of dental enamel among competitive swimmers at a gas-chlorinated swimming pool, Centerwall et al., 1986, Am. J. Epid. 123: 641-647) was carried out to see if swimming in chlorinated water was linked to erosion of dental enamel. 49 swimmers with erosion of dental enamel (cases) were recruited along with 245 swimmers without erosion (controls). The data are summarized below.

| Hours of swimming per week | Erosion of dental enamel | | Total |
|----------------------------|--------------------------|-----|-------|
| | Yes | No | |
| 6 or more | 32 | 118 | 150 |
| less than 6 | 17 | 117 | 134 |
| Total | 49 | 235 | 284 |

Calculate the appropriate ratio to show the effect of excessive swimming on erosion of dental enamel. A test was performed on these data, the results were: $\chi^2 = 4.802$, $df = 1$, $p = 0.03$. Interpret these results.

Question 5

The following data from a prospective study are taken from the paper Dental caries in pre-school children: associations with social class, tooth brushing habit and consumption of sugars and sugar-containing foods (Gibson & Williams 1999, Caries Research 33: 101-113). They show the number of children with caries according to three different risk factors: social class; tooth brushing frequency; and frequency of consumption of sugary foods. Which of these three factors has most impact on the likelihood of a child developing caries?

| Social class | Caries | | Total |
|--------------|--------|------|-------|
| | Yes | No | |
| Manual | 162 | 574 | 736 |
| Non-manual | 64 | 574 | 638 |
| Total | 226 | 1148 | 1374 |

| Brushing frequency | Caries | | Total |
|--------------------|--------|------|-------|
| | Yes | No | |
| 0 or 1 per day | 114 | 477 | 591 |
| >1 per day | 112 | 671 | 783 |
| Total | 226 | 1148 | 1374 |

| Sugary foods | Caries | | Total |
|-----------------------|--------|------|-------|
| | Yes | No | |
| <3 times a day | 61 | 347 | 408 |
| 3 or more times a day | 165 | 801 | 966 |
| Total | 226 | 1148 | 1374 |