

Notation:

- $X^2$ : calculated value of the test statistic,
- $\nu$ : degrees of freedom,
- $\alpha$ : significance level of hypothesis test hence
- $\chi_{\nu, 1-\alpha}^2$ : value of the  $1 - \alpha$ th quantile of the  $\chi^2$  distribution on  $\nu$  degrees of freedom.
- $H_0$ : Null hypothesis,  $H_A$ : alternative hypothesis.
- $N$ : total number of observations,  $O$ : observed count,  $E$ : expected count where, more specifically,
- $O_{ij}$ : observed count in cell specified by row  $i$  and column  $j$ ,
- $O_{i\cdot}$ : sum of counts in row  $i$ , i.e. the marginal row total where
 
$$O_{i\cdot} = O_{i1} + O_{i2} + \dots + O_{ic} = \sum_{j=1}^c O_{ij},$$
- $O_{\cdot j}$ : sum of counts in column  $j$ , i.e. the marginal column total where
 
$$O_{\cdot j} = O_{1j} + O_{2j} + \dots + O_{cj} = \sum_{i=1}^r O_{ij}.$$
- $\pi_{ij}$  probability of observing an individual with characteristics corresponding to row  $i$  and column  $j$ .  $\pi_{i\cdot}$ : marginal probability of observing an individual with characteristics corresponding to row  $i$ ,  $\pi_{\cdot j}$ : marginal probability of observing an individual with characteristics corresponding to column  $j$ . Estimates of these values are given by  $\hat{\pi}_{ij}$ ,  $\hat{\pi}_{i\cdot}$ ,  $\hat{\pi}_{\cdot j}$  respectively.
- $P(A_1 \cap A_2)$ : probability that both event  $A_1$  and  $A_2$  are observed.
- $X^2 = \sum_{i=1}^r \sum_{j=1}^c \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$ : general form of the  $\chi^2$  test statistic