

$$\begin{aligned} \text{chi2}(a, b) &= \frac{\left(n_{ab} - N \cdot \frac{n_a}{N} \cdot \frac{n_b}{N} \right)^2}{N \cdot \frac{n_a}{N} \cdot \frac{n_b}{N}} \\ &\stackrel{\text{rank}}{=} \frac{\left(n_{ab} - \frac{1}{N} \cdot n_a \cdot n_b \right)^2}{n_a \cdot n_b} \end{aligned}$$