Optimal Data Analysis
Vol. 4 (December 15, 2015), 171-172

2155-0182/10/$3.00

Chi-Square Corner Cells Test: Two Wrongs Don't Make a Right

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For an application involving two ordered attributes the chi-square four corner cells (CSFC) test is described as a "quick preliminary test" in lieu of factorial ANOVA. In this procedure a 2 x 2 contingency table is constructed using only the highest and lowest possible values of both measures: chi-square is used to obtain *p*, and phi to estimate the correlation between variables. The example[1] used to illustrate this methodology violates two crucial assumptions underlying chi-square.

Enthusiasm and control were treated as having been measured on categorical scales (Table 1), and their association was assessed by chi-square analysis[1]: χ^2 (df = 1, N = 28) = 20.2, $p < 0.0001$. The null hypothesis of no association is rejected, and it is concluded that enthusiasm and control are associated. For these data, *phi* = 0.85.

Table 1: CSFC-Based Contingency Table for Extreme Values of two Ordered Attributes[1]

	Enthusiasm	
Control	High	Low
High	0	3
Low	24	1

The metric assumption motivating applicability of the chi-square test is that data are categorical, not ordered. Graduated indices of perceived control, and of enthusiasm, are obviously ordered—not categorical. Violation of this essential assumption of chi-square is widely seen in the literature, and found in many introductory statistics and methods texts.[2,3]

The minimum expectation assumption motivating use of the chi-square test must be met in order for the estimated Type I error rate to be valid.[4] In this application three of the cells violate the minimum expectation, rendering the use of chi-square and of indices based on chi-square (such as phi) invalid with these data.[2,4] While a chance- and maximum-centered index of strength of effect is provided by the *ESS* statistic (here, *ESS* = 96.0), these data cannot be considered categorical. This is not an issue for UniODA, since the use of ordered data, *a priori* hypotheses, and/or individual weighting are all possible in the context of explicitly maximized model accuracy, and of exact Type I error—for any attribute metric and application.[2,3]

References

[1]Rosenthal R, Rosnow RL (1984). *Essentials of behavioral research: Methods and data analysis*. New York, NY: McGraw-Hill (pp. 46-47).

2155-0182/10/$3.00

[2]Yarnold PR, Soltysik RC (2005). *Optimal data analysis: A guidebook with software for Windows*. Washington, DC: APA Books.

[3]Yarnold PR, Soltysik RC (In Review). *Maximizing predictive accuracy*. Chicago, IL: ODA Books.

[4]Yarnold JK (1970). The minimum expectation in χ^2 goodness of fit tests and the accuracy of approximations for the null distribution. *Journal of the American Statistical Association*, *65*, 864-886. URL: http://www.jstor.org/stable/2284594

Author Notes

The study analyzed de-individuated data and was exempt from Institutional Review Board review. No conflict of interest was reported.

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