An Approximate Score Confidence Interval for The Difference of Proportions in Two Independent Populations

Assumptions
1. The data are $Y_1$ from a $b(n_1, p_1)$ population and $Y_2$ from a $b(n_2, p_2)$ population.
2. $Y_1$ and $Y_2$ are independent.

Formulas
A level $L$ confidence interval for $p_1 - p_2$ is

$$\left(\tilde{p}_1 - \tilde{p}_2 - \hat{\sigma}(\tilde{p}_1 - \tilde{p}_2) z_{1+L} / \sqrt{2}, \tilde{p}_1 - \tilde{p}_2 + \hat{\sigma}(\tilde{p}_1 - \tilde{p}_2) z_{1+L} / \sqrt{2}\right),$$

where $\tilde{p}_1 = \frac{y_1 + 0.25z_{1+L}^2/(1+L)^2}{n_1 + 0.5z_{1+L}^2/(1+L)^2}$, and $\tilde{p}_2 = \frac{y_2 + 0.25z_{1+L}^2/(1+L)^2}{n_2 + 0.5z_{1+L}^2/(1+L)^2}$, $\hat{\sigma}(\tilde{p}_1 - \tilde{p}_2) = \sqrt{\frac{\tilde{p}_1(1-\tilde{p}_1)}{n_1} + \frac{\tilde{p}_2(1-\tilde{p}_2)}{n_2}}$ is the estimated standard error of $\tilde{p}_1 - \tilde{p}_2$, and $z_{1+L}$ may be obtained from a table of normal quantiles (click here).

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