For 2x2 tables, the Chi Square statistic is the square of the z-statistic used to test equality of proportions

blue = observed
brown = expected

$n_1 \hat{p}_1$ $n_1 \bar{p}$	$n_2 \hat{p}_2$ $n_2 \bar{p}$
$n_1 (1-\hat{p}_1)$ $n_1 (1-\bar{p})$	$n_2 (1-\hat{p}_2)$ $n_2 (1-\bar{p})$
n_1	n_2

Hyp. Test for Proportions:

$H_0: p_1 = p_2$

$H_a: p_1 \neq p_2$

Use

$$\bar{p} = \frac{n_1 p_1 + n_2 p_2}{n_1 + n_2}$$

for SE $= \sqrt{\bar{p}(1-\bar{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$

Note $\hat{p}_1 - \bar{p} = \left(\frac{n_2}{n_1+n_2}\right)(\hat{p}_2 - \hat{p}_1)$

Upper left cell:
$$\frac{(E-O)^2}{E} = \frac{\left[n_1 \left(\frac{n_2}{n_1+n_2}\right)(\hat{p}_2 - \hat{p}_1)\right]^2}{n_1 \bar{p}}$$

$$= \left[\frac{n_1 n_2}{n_1 + n_2}\right](\hat{p}_2 - \hat{p}_1)^2 \left[\frac{n_2}{n_1+n_2} \cdot \frac{1}{\bar{p}}\right]$$