(a) Calculate the X^2test statistic by hand

H0: The variables are statistically independent
Ha: The variables are statistically dependent

If H0 is true, then we would expect f observed = f expected

f observed = fo = observed frequency = the raw count

f expected = fe = what we would expect for independent samples

f1e = $\frac{row\ total}{grand\ total} * column\ total$

$$\frac{27}{42} * 21 = 13.5$$

$$\frac{27}{42} * 13 = 8.36$$

$$\frac{27}{42} * 8 = 5.14$$

$$\frac{15}{42} * 21 = 7.5$$

$$\frac{15}{42} * 13 = 4.64$$

$$\frac{15}{42} * 8 = 2.85$$

First, we calculate CHI-SQUARE TEST

	Not Stopped	Bribe requested	Stopped/ given warning	**Total**
Upper class	fo= 14	fo= 6	fo= 7	27
	fe= 13.5	fe= 8.36	fe= 5.14	
Lower class	fo= 7	fo= 7	fo= 1	15
	fe= 7.5	fe= 4.64	fe= 2.85	
Total	21	13	8	42

Then we calculate the X^2test statistic by hand

$$x^2 = \sum \frac{(fo - fe)^2}{fe}$$

$$= \frac{(14-13.5)^2}{13.5} + \frac{(6-8.36)^2}{8.36} + \frac{(7-5.14)^2}{5.14} + \frac{(7-7.5)^2}{7.5} + \frac{(7-4.64)^2}{4.64} + \frac{(1-2.85)^2}{2.85}$$

Answer:

x^2 = 3.79

(b) Calculate the p-value from the test statistic

df = (rows -1) (columns -1)

df = (3-1) (2-1)

p-value = pchisq(3.79, df = 2, lower.tail=FALSE)

p-value = 0.1503183

If p ≤ α we conclude that the evidence supports the alternative hypothesis Ha.
If p > α we cannot reject the null hypothesis H0.

What we conclude from α = .1
Our p-value is greater than α, therefore we cannot reject our null hypothesis. The variables are not statistically dependent.

(c) Calculate the standardized residuals for each cell and put them in the table below.

	Not Stopped	Bribe requested	Stopped/ given warning	
Upper class	0.32	-1.64	1.24	
Lower class	-0.32	1.65	-1.52	

$$z11 = \frac{14 - 13.5}{\sqrt{13.5\left(1 - \frac{27}{42}\right)(1 - \frac{21}{42})}} = 0.32$$

$$z12 = \frac{6 - 8.36}{\sqrt{8.36\left(1 - \frac{27}{42}\right)(1 - \frac{13}{42})}} = -1.64$$

$$z13 = \frac{7 - 5.14}{\sqrt{5.14\left(1 - \frac{27}{42}\right)(1 - \frac{8}{42})}} = 1.24$$

$$z14 = \frac{7 - 7.5}{\sqrt{7.5\left(1 - \frac{15}{42}\right)(1 - \frac{21}{42})}} = -0.32$$

$$z15 = \frac{7 - 4.64}{\sqrt{4.64\left(1 - \frac{15}{42}\right)\left(1 - \frac{13}{42}\right)}} = 1.65$$

$$z16 = \frac{1 - 2.85}{\sqrt{2.85\left(1 - \frac{15}{42}\right)\left(1 - \frac{8}{42}\right)}} = -1.52$$

(d) The standardized residuals help us to identify how far away is each observed value from the predicted value (fo from fe). The standardized residuals are small and denote that the expected values are not so distant from the observed values.