

Chi-square testing of Independence

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Is there an association between the Taco Tongue and the Evil Eyebrow? Below is the data for a random sample of 600 Senior students. Do we have convincing evidence that the ability to do the Taco Tongue and Evil Eyebrow are associated for all Seniors? A random sample is collected and the data is summarized below:

	Yes Brow	No Brow	
Yes Tongue	180	300	480
No Tongue	20	100	120
	200	400	600

1. Describe what it means for two events to be independent.

Solution: Knowing whether or not one event occurs does not change the probability of the other event. This is why expected counts are calculated the way they are.

2. Calculate the expected counts

	Yes Brow	No Brow	
Yes Tongue	$(480/600)200$		480
No Tongue			120
	200	400	600

3. Do the data provide significant evidence that there is an association between the ability to Taco Tongue and Evil Eyebrow for all Seniors? Use $\alpha = 0.05$.

Solution: STATE: $\alpha = 0.05$

H_0 : Taco Tongue and Evil Eyebrow are not associated for all seniors (independent)

H_a : Taco Tongue and Evil Eyebrow are associated for all Seniors (not independent)

PLAN: Carrying out a chi-square test for independence.

Conditions:

Random: \checkmark . We can generalize to population

10% (Independence): \checkmark . Sampling without replacement is ok.

Large counts: \checkmark . Ensures the sampling distribution is χ^2 .

DO: Test statistic: $\chi^2_{calc} = \sum \frac{(O-E)^2}{E}$

Work: ... = 18.75 P-value: P-value = $P(\chi^2_1 > 18.75) = 0.000015$. (note: $df = (r - 1)(c - 1) = (2 - 1)(2 - 1)$). Draw picture here!

Conclude: Assuming that there is no association between the evil eye and taco tongue there is a 0.000015 probability of getting a χ^2 of 18.75 or greater purely by chance. Because $0.000015 < 0.05 = \alpha$ we reject H_0 and do have convincing evidence of an association between Taco Tongue & Evil Eyebrow for all seniors.