

# Math 308 Assignment 7

## Exercises 3.9

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The null hypothesis is that the difference in proportions is zero. However, performing the permutation test gave a  $p$ -value of 0.002, allowing us to reject the null at 1% confidence. Thus, the difference in proportions is statistically significant.

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The  $p$ -value is 1, which does not let us reject the null hypothesis that the presence of competition has no value on the height change of the seedlings.

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**Null Hypothesis** Voting preference is independent of age.

**Alternative hypothesis** Voting preference depends on age.

Age	Response		
	For	Against	All
18-29	172	52	224
30-49	313	103	416
50+	258	119	377
All	743	274	1017

Table 1: Observed values

Multiplying column marginal fractions by row marginal totals, we can get the expected values:

Age	Response	
	For	Against
18-29	164	60
30-49	304	112
50+	275	102

Table 2: Expected values

Then, we calculate the  $\chi^2$  test statistic:  

$$c = \sum_{i,j}^{\text{all cells}} \frac{(\text{observed}_{i,j} - \text{expected}_{i,j})^2}{\text{expected}_{i,j}} = 6.33$$

Under the null,  $C$  follows a  $\chi^2$  distribution with  $(3-1) \times (2-1) = 2$  degrees of freedom; i.e.  $C \sim \chi^2_2$ . So, the  $p$ -value is  $P(C > c) = \int_c^\infty \frac{e^{-t/2}}{2} dt \approx 0.042$ .

Thus, we can reject the null at 5% significance, but not at 1% significance.

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a)

We are testing for homogeneity since we want to know whether the distribution of fin ray counts differs from lake to lake.

b)

**Null hypothesis** Fin ray distributions are the same from lake to lake.

**Alternative hypothesis** Fin ray distributions are different from lake to lake.

Habitat	Ray Count						All	
	36	35	34	33	32	31		
Guadalupe	14	30	42	78	33	14	211	<b>22</b>
Cedro	11	28	53	66	27	9	194	
San Clemente	10	17	61	53	22	10	173	<b>25</b>
All	71	110	190	230	114	64	779	

Habitat	Ray Count					
	$\geq 36$	35	34	33	32	$\leq 31$
Guadalupe	19	30	51	62	31	17
Cedro	18	27	47	57	28	16
San Clemente	16	24	42	51	25	14

Table 3: Expected Values

$c = \sum_{i,j}^{\text{all cells}} \frac{(\text{observed}_{i,j} - \text{expected}_{i,j})^2}{\text{expected}_{i,j}} = 41.77,$   
 where  $C \sim \chi^2_{10}$ . So,  $p = P(C > c) = \int_c^\infty \frac{t^{10/2-1} e^{-t/2}}{2^{10/2} \Gamma(10/2)} dt = \int_c^\infty \frac{t^4 e^{-t/2}}{768} dt = 8 \times 10^{-6}.$  So, we can reject the null.

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Happiness		
	Female	Male
Not too happy	109	61
Pretty happy	406	378
Very happy	205	210

Table 4: Happiness against gender table