

1.5 Fisher's Exact Test

Example 1

From: Handbook of Biological Statistics by John H. McDonald Department of Biological Sciences University of Delaware

The eastern chipmunk trills when pursued by a predator, possibly to warn other chipmunks. Burke da Silva et al. (2002) released chipmunks either 10 or 100 meters from their home burrow, then chased them (to simulate predator pursuit). Out of 24 female chipmunks released 10 m from their burrow, 16 trilled and 8 did not trill. When released 100 m from their burrow, only 3 female chipmunks trilled, while 18 did not trill.

Giving the following table.

distance * trill Crosstabulation					
		trill			
			.00	1.00	Total
distance	10.00	Count	8	16	24
		% within distance	33.3%	66.7%	100.0%
		% within trill	30.8%	84.2%	53.3%
	100.00	Count	18	3	21
		% within distance	85.7%	14.3%	100.0%
		% within trill	69.2%	15.8%	46.7%
Total	Count		26	19	45
	% within distance		57.8%	42.2%	100.0%
	% within trill		100.0%	100.0%	100.0%

Do the data provide sufficient evidence that female chipmunks trill more often when they are chased close to their burrow than when chased further away. The proportion of trilling was observed to be 0.66 within 10 m and 0.14 within 100 m distance.

A test for independence would indicate if these proportions indicate a significant difference between the trilling probability for the two distances.

The sample size should be considered too small for a χ^2 or likelihood ratio test for independence, since one cell has less than 5 observations.

Fisher's Exact Test is the better alternative for such small sample sizes.

When testing two binary variables for independence (especially with small sample sizes) Fisher's Exact Test is the best choice. The P-value is not based on a test statistic, which for large sample sizes has some approximate distribution, but the P-value is the directly calculated probability (using the hypergeometric distribution) for the observed data (or a more extreme outcome) if the two variables were truly independent (H_0 is true). In the calculation it is assumed that the row and column totals are fixed (which is usually not true), but the obtained P-value is still an improvement over the P-value for the χ^2 or likelihood ratio test for independence for small sample sizes.

SPSS Commands for Fisher's Exact Test:

1. Data>Weight Cases
Weight by Frequency Variable: freq
OK

2. Analysis>Descriptive Statistics>Crosstabs
Row(s): distance
Column(s): trill

3. Statistics popup:
Check Chi-square

4. Cells popup:
Counts: check Observed
Percentages: check Row
check Column

Chi-Square Tests					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	12.597 ^a	1	.000		
Continuity Correction ^b	10.541	1	.001		
Likelihood Ratio	13.512	1	.000		
Fisher's Exact Test				.001	.000
Linear-by-Linear Association	12.317	1	.000		
N of Valid Cases	45				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.87.

b. Computed only for a 2x2 table

Applying Fisher's exact test, the proportion of chipmunks trilling is significantly higher ($P < 0.001$ - used one-sided P) when they are closer to their burrow.