Chi-square Tests

1-way Classification: Goodness of Fit Test

Example Question: Are the 3 groups independent of each other (i.e., the same proportion of people in each group?

	Group 1	Group 2	Group 3	Total
Observed	50	10	30	(50+10+30) = 90
Expected	90/3 =30	90/3 =30	90/3 =30	90

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$, where O = observed values, and E = expected values

$$\chi^2 = \frac{(50-30)^2}{30} + \frac{(10-30)^2}{30} + \frac{(30-30)^2}{30} = 26.6$$

2-way Classification: Contingency Test

Example Question: Is Category 1 independent of Category 2?

		Category A			Total
		Group A1	Group A2	Group A3	
Category B	Group B1	15 (E=22.2)	5 (E=4.4)	20 (E=13.3)	40
	Group B2	35 (E=27.8)	5 (E=5.6)	10 (E=16.7)	50
Total		50	10	30	90

$$E_{ij} = \frac{R_i C_j}{N}$$, where R = row, C = column, N =Total, for ith row and jth column

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$, where O = observed values, and E = expected values

$$E_{12} = \frac{40 \cdot 10}{90} \qquad E_{23} = \frac{50 \cdot 30}{90}$$

$$\chi^2 = \frac{(15-22.2)^2}{22.2} + \frac{(35-27.8)^2}{27.8} + \frac{(5-4.4)^2}{4.4} + \frac{(5-5.6)^2}{5.6} + \frac{(20-13.3)^2}{13.3} + \frac{(10-16.7)^2}{16.7} \approx 10.3$$