<https://www.mathsisfun.com/data/chi-square-test.html>

Looked at a simplified explanation and worked example to try and understand what Chi squared test is and does.

1. Lay data out in a table
2. Add up rows and columns
3. Calculate “Expected Value” for each entry

Multiply each row total x each column total and divide by overall total.

Observed Results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | A | B | C | D | Total |
| White collar | 90 | 60 | 104 | 95 | 349 |
| Blue collar | 30 | 50 | 51 | 20 | 151 |
| No collar | 30 | 40 | 45 | 35 | 150 |
| Total | 150 | 150 | 200 | 150 | 650 |

Calculations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | A | B | C | D | Total |
| White collar | 349\*150/650 | 349\*150/650 | 349\*200/650 | 349\*150/650 | 349 |
| Blue collar | 151\*150/650 | 151\*150/650 | 151\*200/650 | 151\*150/650 | 151 |
| No collar | 150\*150/650 | 150\*150/650 | 150\*200/650 | 150\*150/650 | 150 |
| Total | 150 | 150 | 200 | 150 | 650 |

Expected Results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | A | B | C | D | Total |
| White collar | 80.54 | 80.54 | 107.38 | 80.54 | 349 |
| Blue collar | 34.85 | 34.85 | 46.46 | 34.85 | 151 |
| No collar | 34.62 | 34.62 | 46.15 | 34.62 | 150 |
| Total | 150 | 150 | 200 | 150 | 650 |

Subtract expected from observed, square it, then divide by expected:

In other words, use formula (O−E)2 **/E** where

* O = **Observed** (actual) value
* E = **Expected** value

Calculations

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | A | B | C | D | Total |
| White collar | (90-80.54)²/80.54 | (60-80.54)²/80.54 | (104-107.38)²/107.38 | (95-80.54)²/80.54 | 349 |
| Blue collar | (30-34.85)²/34.85 | (50-34.85)²/34.85 | (51-46.46)²/46.46 | (20-34.85)²/34.85 | 151 |
| No collar | (30-34.62)²/34.62 | (40-34.62)²/34.62 | (45-46.15)²/46.15 | (35-34.62)²/34.62 | 150 |
| Total | 150 | 150 | 200 | 150 | 650 |

Results

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | A | B | C | D |
| White collar | 1.111 | 5.238 | 0.106 | 2.596 |
| Blue collar | 0.675 | 6.586 | 0.444 | 6.328 |
| No collar | 0.617 | 0.831 | 0.029 | 0.004 |

Add up all the calculated values

1.111 + 5.238 + 0.106 + 2.596 + 0.675 +6.586 + 0.444 + 6.328 + 0.617 + 0.813 + 0.029 +0.004 = 24.57

Chi square = 24.57

## From Chi-Square to p

First we need a "Degree of Freedom"

Degree of Freedom = (rows − 1) × (columns − 1)

3-1 \* 4 – 1 = 6

P = 0.0004098 using https://www.mathsisfun.com/data/chi-square-calculator.html