# Practice questions: Chi-square test of independence

Test your knowledge of the [chi-square test of independence](https://www.scribbr.com/statistics/chi-square-test-of-independence/) with these practice questions. You can find the [answers and calculations](#_jvu0vfxjuuh1) here.

## Questions

### Question 1

A dog trainer wants to know if golden retrievers and French bulldogs are equally good at learning how to skateboard. She tries to train 40 golden retrievers and 60 French bulldogs to skateboard and finds the following:

|  | **Skateboards** | **Can’t skateboard** |
| --- | --- | --- |
| **Golden retrievers** | 20 | 20 |
| **French bulldogs** | 50 | 10 |

Should she reject the null hypothesis that the dog’s breed is unrelated to their skateboarding ability?

1. She should reject the null hypothesis.
2. She should fail to reject the null hypothesis.

### Question 2

A restaurant reviewer wants to know if three popular burger restaurants are equally recommended by their customers. At each of the three restaurants, he asks 25 random customers whether they would recommend the restaurant to a friend. He finds the following:

|  | **Would recommend** | **Would not recommend** |
| --- | --- | --- |
| **Tasty Burgers** | 20 | 5 |
| **Burger Prince** | 22 | 3 |
| **Burger Town** | 18 | 7 |

Should he reject the null hypothesis that the proportion of customers recommending the restaurant is the same for the three restaurants?

1. He should reject the null hypothesis.
2. He should fail to reject the null hypothesis.

## Answers

Here you can find the answers to the [practice questions](#_rhzoydocze6j).

### Answer 1

**Correct Answer = a** -She should reject the null hypothesis.

**Step 1: Calculate the expected frequencies**

|  | Skateboards | Can’t skateboard | Row total |
| --- | --- | --- | --- |
| Golden retrievers | 20**(40 \* 70) / 100 = 28** | 20**(40 \* 30) / 100 = 12** | 40 |
| French bulldogs | 50(**60 \* 70) / 100 = 42** | 10**(60 \* 30) / 100 = 18** | 60 |
| Column total | 70 | 30 | *N* = 100 |

**Step 2: Calculate chi-square**

| **Intervention** | **Outcome** | **Observed** | **Expected** | ***O - E*** | **(*O - E*)2** | **(*O - E*)2 / *E*** |
| --- | --- | --- | --- | --- | --- | --- |
| Golden retrievers | Skateboards | 20 | 28 | -8 | 64 | 2.29 |
| Can’t skateboard | 20 | 12 | 8 | 64 | 5.33 |
| French bulldogs | Skateboards | 50 | 42 | 8 | 64 | 1.52 |
| Can’t skateboard | 10 | 18 | -8 | 64 | 3.56 |

Χ2 = 2.29 + 5.33 + 1.52 + 3.56 = 12.7

**Step 3: Find the critical chi-square value**

Since there are two dog breed and two outcomes there is (2 - 1) \* (2 - 1) = 1 degree of freedom.

For a test of significance at α = .05 and *df* = 1, the Χ2 critical value is 3.84.

**Step 4: Compare the chi-square value to the critical value**

Χ2 = 12.7

Critical value = 3.84

The Χ2 value is greater than the critical value*.*

**Step 5: Decide whether the reject the null hypothesis**

The Χ2 value is greater than the critical value. Therefore, the dog trainer should **reject** the null hypothesis that a dog’s breed is **unrelated** to whether they can learn to skateboard. Her data suggests that a larger proportion of french bulldogs can learn to skateboard than golden retrievers.

### Answer 2

**Correct Answer = b -** He should fail to reject the null hypothesis.

**Step 1: Calculate the expected frequencies**

|  | Would recommend | Would not recommend | Row total |
| --- | --- | --- | --- |
| Tasty Burgers | 20**(25 \* 60) / 75 = 20** | 5**(25 \* 15) / 75 = 5** | 25 |
| Burger Prince | 22**(25 \* 60) / 75 = 20** | 3**(25 \* 15) / 75 = 5** | 25 |
| Burger Town | 18**(25 \* 60) / 75 = 20** | 7**(25 \* 15) / 75 = 5** | 25 |
| Column total | 60 | 15 | 75 |

**Step 2: Calculate chi-square**

| **Intervention** | **Outcome** | **Observed** | **Expected** | ***O - E*** | **(*O - E*)2** | **(*O - E*)2 / *E*** |
| --- | --- | --- | --- | --- | --- | --- |
| Tasty Burgers | Would recommend | 20 | 20 | 0 | 0 | 0 |
| Would not recommend | 5 | 5 | 0 | 0 | 0 |
| Burger Prince | Would recommend | 22 | 20 | 2 | 4 | 0.2 |
| Would not recommend | 3 | 5 | -2 | 4 | 0.8 |
| Burger Town | Would recommend | 18 | 20 | -2 | 4 | 0.2 |
| Would not recommend | 7 | 5 | 2 | 4 | 0.8 |

Χ2 = 0 + 0 + 0.2 + 0.8 + 0.2 + 0.8 = 2

**Step 3: Find the critical chi-square value**

Since there are three restaurants and two outcomes there are (3 - 1) \* (2 - 1) = 2 degrees of freedom.

For a test of significance at α = .05 and *df* = 2, the Χ2 critical value is 5.99.

**Step 4: Compare the chi-square value to the critical value**

Χ2 = 2

Critical value = 5.99

The Χ2 value is less than the critical value*.*

**Step 5: Decide whether the reject the null hypothesis**

The Χ2 value is less than the critical value. Therefore, the restaurant reviewed should **not reject** the null hypothesis the proportion of customers recommending the restaurant is **the same** for the three restaurants