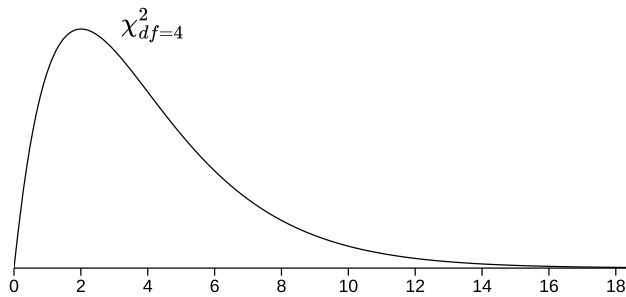


1. A χ^2 distribution with 4 degrees of freedom is shown.



- a. Describe the shape of the χ^2 distribution.
- b. The standard normal distribution (z) and t -distributions include positive and negative values of the test statistic. Explain why this is not the case for χ^2 distributions.
- c. The standard normal distribution (z) is symmetric and t -distributions are roughly symmetric. Explain why this is not the case for χ^2 distributions.

2. Two independent random samples of adults aged 18-34 and adults aged 35 and older were asked about their preferred type of vacation. The results are given in the table.

	Beach Vacation	Mountain Vacation	City Vacation	Total
18 – 34	58	25	13	
35 and older	34	57	21	
Total				

- Complete the table with the totals for each row and column.
- What proportion of all adults in the sample preferred a beach vacation? Give your answer as a fraction and a decimal.
- If there were no difference in the preferred type of vacation for each age group, what proportion of each age group would you expect to prefer a beach vacation?
- Calculate the expected number of adults in the sample aged 18-34 who prefer a beach vacation.
- Calculate the expected number of adults in the sample aged 35 and older who prefer a beach vacation.
- What proportion of all adults in the sample preferred a city vacation?
- Calculate the expected number of adults aged 35 and older who prefer a city vacation.

3. The Pew Research Center conducted a study on how teens and parents approached screen time. Separate random samples of U.S. teens and parents were asked to complete an online survey. One question asked participants to rate the amount of time they spent on their smartphones as “too much”, “about the right amount” or “too little”. The responses for teens and parents are given in the table. The researchers would like to know if there is a difference in the distribution of screen time use between teens and parents.

	Teens	Parents	Total
Too Much	595	697	1292
About the Right Amount	785	683	1468
Too Little	73	73	146
Total	1453	1453	2906

- a. Explain why chi-square test for homogeneity is appropriate in this situation?
- b. Which category will contribute least to the χ^2 test statistic? How do you know?
- c. Calculate the χ^2 test statistic and the number of degrees of freedom. Show your work.
- d. Calculate the associated p -value. Is there convincing statistical evidence that there is a difference in the distribution of screen time use between teens and parents?

4. A restaurant owner has two different pizza shops on opposite ends of town: Crispy Crust Pizzeria and Slice Haven. The owner wants to determine whether the distribution of online order preference (pick-up vs. delivery) differs between the two pizza shops. The owner collected data from 200 randomly selected online orders at each shop and recorded whether the order was for pick-up or delivery. The results are summarized in the table:

	Pick-up	Delivery
Crispy Crust Pizzeria	123	77
Slice Haven	148	52

- a. Write the hypotheses for a chi-square test for homogeneity that could be used to investigate the owner's claim.
- b. What other hypothesis test could be used to investigate the owner's claim? Write the appropriate hypotheses for this test.

5. A market researcher wants to determine whether the distribution of preferred payment methods is the same across different age groups. Random samples of customers are selected from three age groups, and their preferred payment method is recorded. The results are shown in the table.

Payment method	Under 30	30-49	50+	Total
Credit card	48	52	40	140
Debit card	32	36	42	110
Mobile pay	20	18	12	50
Total	100	106	94	300

The researcher plans to perform a chi-square test for homogeneity. What is the expected count for customers under 30 who prefer Debit Card if the null hypothesis is true?

- A) 36.7
- B) 32.0
- C) 34.5
- D) 110.0

6. A public health researcher wants to determine whether the distribution of exercise habits is the same across different age groups. Participants are randomly selected from each of three age groups (18–29, 30–49, and 50+) and then classified into one of the following exercise categories:

- No regular exercise
- 1–2 days per week
- 3–4 days per week
- 5 or more days per week

The researcher plans to compare the exercise habit distributions across the age groups. Which of the following gives the appropriate null and alternative hypotheses for this test?

- A) H_0 : The mean number of exercise days per week is the same for all age groups.
 H_a : At least one age group has a different mean number of exercise days per week.
- B) H_0 : The distribution of exercise habits is the same for all age groups.
 H_a : At least one age group has a different distribution of exercise habits.
- C) H_0 : Exercise habits and age group are independent.
 H_a : Exercise habits and age group are associated.
- D) H_0 : The proportions in each exercise category are equal across all categories.
 H_a : At least one exercise category has different proportions.