

Answers may vary due to rounding.

### Goodness of fit test.

#### Computer instruction

Enter observed values in column 1 and expected values in column 2.

Click on Calc<Calculator.

Type c3 in the box Store Results.

Type the formula  $(c1-c2)**2 / c2$  in the large box. Hit enter.

Click on Calc<column statistics

Click on sum.

Type c3 in the input variable box. The value printed is the  $\chi^2$  calculated.

The  $\chi^2$  table on MINITAB works the same way as the  $t$ - table. MINITAB always reads to the left.

1. An official of a plastics industry claimed that the industry employed 30% white women, 5% minority women, 50% white men, and 15% minority men. To test the claim, an affirmative action committee randomly sampled 150 employees and obtained the following information:

Category	observed
White females	40
Minority females	15
White males	80
Minority males	15

Test the official's claim at a 5% level of significance [ $\chi^2 = 10.889$ ,  $df=3$ ,  $p$ -value = 0.123, Rho]

2. A computer science major claimed to have written a program that would randomly generate integers from 1 to 100. The program generated the following data.

[ $\chi^2 = 6.40$ ,  $df=9$ ,  $p$ -value = .3007, FtRho]

Integers	Observed
1-10	6
11-20	6
21-30	13
31-40	9
41-50	13
51-60	11
61-70	8
71-80	12
81-90	10
91-100	12

3. Given below are the frequencies observed from 310 tosses of a die. Do these data cast doubt on the fairness of the die at the 5% significance level? [ $\chi^2 = 13.225$ ,  $df = 5$ ,  $p\text{-value} = .0214$ ,  $Rho$ ]

Face No.	1	2	3	4	5	6
Frequency	38	61	54	65	55	37

4. A shipment of assorted nuts is labeled as having 45% walnuts, 20% hazelnuts, 20% almonds, and 15% pistachios. By randomly picking several scoops of nuts from this shipment, an inspector find the following counts.

	Walnuts	Hazelnuts	Almonds	Pistachios	Total
Counts	92	69	32	42	235

Could these findings be a strong basis for an accusation of mislabeling? Test at the 5% significance level. [ $\chi^2 = 18.165$ ,  $df = 3$ ,  $p\text{-value} = 0.0004$ ,  $Rho$ ]

### Chi-Square Tests of Independence

Minitab will perform all necessary calculations for chi-square tests on contingency tables, presenting the expected values, the value of the test statistic, degrees of freedom and the p-value.

- Enter the observed frequencies into rows and columns just as they are given in the contingency table.
  - Go to the main header and click on **STAT>Tables>Chi-Square Test**
  - In **Columns containing the tables**, enter the columns at which your contingency table is contained.
  - Click on **OK**.
1. In a genetic study of chromosome structures, 132 individuals are classified according to the type of structural chromosome aberration and carriers in their parents. The following counts are obtained.

	Carrier		
Type of Aberration	One Parent	Neither Parent	Total
Presumably innocuous	28	19	47
Substantially unbalanced	35	50	85
Total	63	69	132

- Test the null hypothesis that type of aberration is independent of parental carrier. [ $\chi^2 = 4.106$ ,  $df = 1$ ,  $p\text{-value} = 0.043$ ,  $Rho$ ]
- Perform the directional test
- Construct a 95% confidence interval for the difference in proportion for presumably innocuous for one parent and neither parent. [.0047, .3243]

2. A personnel administrator provided the following data as an example of hiring to fill 12 positions from among 40 male and 40 female applicants.

Applicant	Selected	Not Selected	Total
Male	7	33	40
Female	5	35	40

- (a) Does this sample indicate a selection bias in favour of males? [ $\chi^2 = 0.392$ ,  $df = 1$ ,  $p\text{-value} = 0.531$ , FtRho]
- (b) Construct a 95% confidence interval for the difference in proportions of selected males and females. [-.1115, .2067] Interpret the confidence interval.

3. Over the years pollsters have found that the public's confidence in big business has been closely tied to the economic climate of the country. When businesses are growing and employment is increasing public confidence is high. When the opposite occurs, public confidence is low. In one study, Harvey Kahalas (1981) explored the relationship between confidence in big business and job satisfaction. He hypothesized that there is a relationship between the level of confidence and job satisfaction and that this relationship holds true for both union and nonunion workers. To test his hypotheses he used the sample data given in the tables below:

**Union Members**

Job Satisfaction

Confidence in Major Corporations	Very Satisfied	Moderately Satisfied	Little dissatisfied	Very Dissatisfied
A great deal	30	19	6	6
Only some	99	77	20	9
Hardly any	38	32	14	15

**NonUnion Members**

Job Satisfaction

Confidence in Major Corporations	Very Satisfied	Moderately Satisfied	Little dissatisfied	Very Dissatisfied
A great deal	111	52	13	5
Only some	246	142	37	18
Hardly any	73	51	19	9

Perform a hypothesis test on each of these data sets at the 5% significance level. Does the data support Kahalas's theory? [ $\chi^2 = 13.359$ ,  $df = 6$ ,  $p\text{-value} = 0.033$ , Rho] [ $\chi^2 = 8.298$ ,  $df = 6$ ,  $p\text{-value} = 0.2171$ , FtRho]

4. Applicants for public assistance are allowed an appeals process when they feel unfairly treated. At such a hearing, the applicant may choose self-representation or representation by an attorney. The appeal may result in an increase, decrease, or no change of the aid recommendation. Court records of 320 appeals cases provided the following data.

Amount of Aid

Type of Representation	Increased	Unchanged	Decreased
Self	59	108	17
Attorney	70	63	3

- (a) Are the patterns of the appeals decision significantly different between the two types of representation? [ $\chi^2 = 15.734$ ,  $df = 2$ ,  $p\text{-value} < .0001$ , Rho]  
 (b) Construct a 95% confidence interval for the difference in proportion for increased aid for self representation and attorney representation. [.0848, .299] Interpret.

5. A survey was conducted by sampling 400 persons who were questioned regarding union membership and attitude toward decreased national spending on social welfare programs. The cross-tabulated frequency counts are presented.

	Support	Indifferent	Opposed
Union	112	36	28
NonUnion	84	68	72
Total	196	104	100

Can these observed differences be explained by chance or are there real differences of attitude between the populations of members and non-members at the 5% significance level? [ $\chi^2 = 27.847$ ,  $df = 2$ ,  $p\text{-value} < .0001$ , Rho]

6. In a Study of possible genetic influence of parental hand preference, a sample of 400 children was classified according to each child's handedness and the handedness of the biological parents. Do these findings demonstrate an association between the handedness of parents and their biological offspring at the 5% significance level? [ $\chi^2 = 10.653$ ,  $df = 2$ ,  $p\text{-value} = 0.005$ , Rho]

Handedness of Biological Offspring

Parents' Handedness Father x Mother	Right	Left	Total
Right x Right	303	37	340
Right x Left	29	10	39
Left x Right	16	6	22
Total	348	52	401