The Chi-Square Distribution: Homework

EXERCISE 1

A recent debate about where in the United States skiers believe the skiing is best prompted the following survey. Test to see if the best ski area is independent of the level of the skier.

U.S. Ski Area	Beginner	Intermediate	Advanced
Tahoe	20	30	40
Utah	10	30	60
Colorado	10	40	50

TABLE 1

EXERCISE 2

Car manufacturers are interested in whether there is a relationship between the size of car an individual drives and the number of people in the driver's family (that is, whether car size and family size are independent). To test this, suppose that 800 car owners were randomly surveyed with the following results. Conduct a test for independence.

Family Size	Sub & Compact	Mid-size	Full-size	Van & Truck
1	20	35	40	35
2	20	50	70	80
3 - 4	20	50	100	90
5+	20	30	70	70

TABLE 2

EXERCISE 3

College students may be interested in whether or not their majors have any effect on starting salaries after graduation. Suppose that 300 recent graduates were surveyed as to their majors in college and their starting salaries after graduation. Below are the data. Conduct a test for independence.

Major	< $50,000	$50,000 - $68,999	$69,000 +
English	5	20	5
Engineering	10	30	60
Nursing	10	15	15
Business	10	20	30
Psychology	20	30	20

TABLE 3

EXERCISE 4

Some travel agents claim that honeymoon hot spots vary according to age of the bride and groom. Suppose that 280 East Coast recent brides were interviewed as to where they spent their honeymoons. The information is given below. Conduct a test for independence.

Location	20 - 29	30 - 39	40 - 49	50 and over
Niagara Falls	15	25	25	20
Poconos	15	25	25	10
Europe	10	25	15	5
Virgin Islands	20	25	15	5

TABLE 4

EXERCISE 5

A manager of a sports club keeps information concerning the main sport in which members participate and their ages. To test whether there is a relationship between the age of a member and his or her choice of sport, 643 members of the sports club are randomly selected. Conduct a test for independence.

Sport	18 - 25	26 - 30	31 - 40	41 and over
racquetball	42	58	30	46
tennis	58	76	38	65
swimming	72	60	65	33

TABLE 5

EXERCISE 6

A major food manufacturer is concerned that the sales for its skinny French fries have been decreasing. As a part of a feasibility study, the company conducts research into the types of fries sold across the country to determine if the type of fries sold is independent of the area of the country. The results of the study are below. Conduct a test for independence.

Type of Fries	Northeast	South	Central	West
skinny fries	70	50	20	25
curly fries	100	60	15	30
steak fries	20	40	10	10

TABLE 6

EXERCISE 7

According to Dan Lenard, an independent insurance agent in the Buffalo, N.Y. area, the following is a breakdown of the amount of life insurance purchased by males in the following age groups. He is interested in whether the age of the male and the amount of life insurance purchased are independent events. Conduct a test for independence.

Age of Males	None	< $200,000	$200,000 - $400,000	$401,001 - $1,000,000	$1,000,000 +
20 - 29	40	15	40	0	5
30 - 39	35	5	20	20	10
40 - 49	20	0	30	0	30
50 +	40	30	15	15	10

TABLE 7

EXERCISE 8

Suppose that 600 thirty–year–olds were surveyed to determine whether or not there is a relationship between the level of education an individual has and salary. Conduct a test for independence.

Annual Salary	Not a high school graduate	High school graduate	College graduate	Masters or doctorate
< $30,000	15	25	10	5
$30,000 - $40,000	20	40	70	30
$40,000 - $50,000	10	20	40	55
$50,000 - $60,000	5	10	20	60
$60,000 +	0	5	10	150

TABLE 8

EXERCISE 9

A Psychologist is interested in testing whether there is a relationship between personality types and majors majors. The results of the study are shown below. Conduct a Test of Independence. Test at a 5% level of significance.

	Open	Conscientious	Extrovert	Agreeable	Neurotic
Business	41	52	46	61	58
Social Science	72	75	63	80	65

TABLE 9

EXERCISE 10
Do men and women select different breakfasts? The breakfast ordered by randomly selected men and women at a popular breakfast place is shown below. Conduct a test of independence. Test at a 5% level of significance

	French Toast	Pancakes	Waffles	Omelettes
Men	47	35	28	53
Women	65	59	55	60

TABLE 10

EXERCISE 11
Is there a relationship between the distribution of community college statistics students and the distribution of university statistics students in what technology they use on their homework? Of the randomly selected community college students 43 used a computer, 102 used a calculator with built in statistics functions, and 65 used a table from the textbook. Of the randomly selected university students 28 used a computer, 33 used a calculator with built in statistics functions, and 40 used a table from the textbook. Conduct an appropriate hypothesis test using a 0.05 level of significance.

EXERCISE 12
A fisherman is interested in whether the distribution of fish caught is independent of the fishing lake. Of the 191 randomly selected fish caught in Green Valley Lake, 105 were rainbow trout, 27 were other trout, 35 were bass, and 24 were catfish. Of the 293 randomly selected fish caught in Echo Lake, 115 were rainbow trout, 58 were other trout, 67 were bass, and 53 were catfish. Perform the hypothesis test at a 5% level of significance.

Try these true/false questions.

EXERCISE 13
As the degrees of freedom increase, the graph of the chi-square distribution looks more and more symmetrical.

EXERCISE 14
The standard deviation of the chi-square distribution is twice the mean.

EXERCISE 15
The mean and the median of the chi-square distribution are the same if df=24.

EXERCISE 16
In general, if the observed values and expected values of a Test for Independance are not close together, then the test statistic can get very large and on a graph will be way out in the right tail.

EXERCISE 17
The degrees of freedom for a Test for Independence are equal to the sample size minus 1.

EXERCISE 18
The Test for Independence uses tables of observed and expected data values.

EXERCISE 19
The test to use when determining if the college or university a student chooses to attend is related to his/her socioeconomic status is a Test for Independence.

EXERCISE 20
In a Test of Independence, the expected number is equal to the row total multiplied by the column total divided by the total surveyed.

EXERCISE 21
In a Test for Independance, if the p-value is 0.0113, in general, do not reject the null hypothesis.

EXERCISE 22
For a Chi-Square distribution with degrees of freedom of 17, the probability that a value is greater than 20 is 0.7258.

EXERCISE 23
If *df*=2, the chi-square distribution has a shape that reminds us of the exponential.