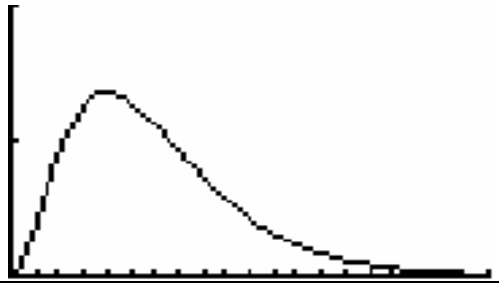
Chapter 13 Overview

Definition of IRONY: difference between actual (observed) results and expected results.

Our new distribution….new shape…new calculations….same principle

Some Basics: The chi-square (χ^2) distribution is NOT symmetric like the normal curve from which our z test statistic was born. It is also NOT exactly like our t distribution which varies with the degrees of freedom and approaches normal when df gets large. It looks more like….	

Chi-square is used with categorical variables for specific purposes…

1) **Test for "Goodness of Fit":** (calculator can help by using lists but this one is NOT built into the stat feature). DF = # categories – 1 (as before) Goodness of fit tests are likely to be performed by people who have a theory of what the proportions should be in each category. However, the only null hypothesis available is that the theory is true.

Example 1: Labor unions listed 5 items and asked employees to mark the ONE they felt was MOST IMPORTANT. We want to determine IF these responses "fit" last year's responses or are they different.

Example 2: A large group of employees (250+) has birthdays recorded by zodiac sign. Since there are 12 signs of the zodiac, we should EXPECT 1/12 of the employees to have each of the signs.

Conditions for a goodness of fit test are: SRS and sufficiently large expected cell counts. Be careful NOT to look at observed counts by mistake.

2) **Test for "homogeneity":** means "things are the same." This is actually a generalization of the z test for 2 proportions to be used when we are examining more than 2 categories. The info is presented in a two way table with r rows and c columns. There are row totals and column totals AND DF = (r – 1)(c – 1). A test of homogeneity is appropriate for data from MULTIPLE samples. The calculator can perform this test.

3) **Test for "Independence"**: Are 2 categorical variables associated OR are they INDEPENDENT from each other. This question can be answered using the stat feature of the calculator by performing a chi-square test. Independent from the chapter on Probability means that knowing or changing one outcome has no effect on the other outcome. IF the previous outcome and observed outcome are close then the change had

not significant effect and the events are independent. Calculations are the same as for the homogeneity test and can be done on the calculator. The real difference is where the data came from.

Example 1: Is the arrangement of letters on the keyboard independent from the amount of time required to learn typing. Null hypothesis: the variables are independent Alternate Hypothesis: the variables are NOT independent.

Example 2: We have records about 500 + individuals with respect to tatoo status (yes or no) and hepatitis status (yes or no. Can we conclude the variables are associated??

NOTE: Since a test of independence determines whether there is a significant association between two categorical variables it is appropriately applied to data from a SINGLE sample.

Some other independence examples to consider…which of these pairs do you believe are independent in the population of U.S. students?
a) hair color and eye color
b) type of music preferred and ethnicity
c) gender and color of shirt
d) type of movie preferred and gender
e) eye color and class year
f) class year and whether taking statistics
g) age over 40 and having gray hair

As before:
Check conditions
State the hypotheses
Computer the test statistic
Calculate the P-value, draw a sketch
Conclusion in context of the situation.

How to:
The chi-square test makes use of the comparisons (by subtraction) of observed outcomes vs. expected outcomes. Certain values are EXPECTED
a) if someone tells you what should happen or makes a specific claim (usually %) OR
b) if you have prior experience or knowledge and are relying on that to produce (the same) expected result OR
c) if a result can be determined by the laws of probability…expected for coin toss is ½ while expected for die roll is 1/6. You could say the die is "FAIR" if the observed results are approximately equal to the expected results.

Summary:

Goodness of Fit: used to compare a single sample proportion against a publicized model.

Homogeneity: used to examine whether things have changed or stayed the same or whether the proportions that exist between two populations are the same, or when comparing data from MULTIPLE samples.
Independence: determine if two categorical variables are associated or NOT (INDEPENDENT). The thinking is similar in objective to linear regression with quantitative variables.

Homogeneity and Independence are determined by the same chi-square test procedure. Luckily the steps for the chi-square test of independence are much the same as the steps in the chi-square test of homogeneity. Mega information may be present and is best displayed in matrix form

Only experience with problems will help you to determine the setting that is present. For a few situations we will gather our own data and then perform the necessary test.