

- A. KEY INTRO POINT #1** →  $\chi^2$  (or chi squared) is used as an ANALYSIS technique
- B. KEY INTRO POINT #2** → the  $\chi^2$  (or chi squared) Test of Independence is used to determine whether two characteristics are RELATED or INDEPENDENT
- C. KEY INTO POINT #3** → Chi-square test is designed to analyze **categorical** data. That means that the data has been counted and divided into categories. It will not work with continuous data (such as height in inches).
- D. Basic Concepts of HYPOTHESIS TESTING** →
- a. Watch video #1 → <http://www.youtube.com/watch?v=UApFKiK4Hi8&feature=related>
  - b. Key Point #1 (at 2:35 min) →
  - c. Key Point #2 (at 6:40 min, and at 8:30 min) →
  - d. Key Terms & Symbols → (at 8:50 min) →
- E. How To Calculate the Chi Squared Value**
- a. Watch Video #2 → <http://www.youtube.com/watch?v=s1xEB9XknBI&feature=relmfu>
  - b. Notes → Null hypothesis is \_\_\_\_\_.
  - c. (3:30 min) When observed gets **close to** expected, then  $\chi^2$  \_\_\_\_\_.
  - d. (3:30 min) When observed gets **close to** expected, then  $\chi^2$  \_\_\_\_\_.
  - e. (3:50 min) As observed and expected get further apart, then  $\chi^2$  \_\_\_\_\_.

f.  $\chi^2$  calculation:

	1 <sup>st</sup> Qtr	2 <sup>nd</sup> Qtr	3 <sup>rd</sup> Qtr	4 <sup>th</sup> Qtr
Observed				
Expected				
Difference				
$\frac{(\text{difference})^2}{\text{expected}}$				
sum				

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

g. CONCLUSION to hypothesis test → \_\_\_\_\_ . WHY???

### F. How To Test with the Chi Squared Test of Independence

a. Watch Video #3 → [http://www.youtube.com/watch?v=LE3AlyY\\_cn8&feature=related](http://www.youtube.com/watch?v=LE3AlyY_cn8&feature=related)

b. Notes → (0:10 min) → purpose of Chi Squared Test of Independence →

c. Our null Hypothesis is → \_\_\_\_\_ .

d. Alternative Hypothesis is → \_\_\_\_\_ .

e. Expected Values Calculation:

	Expected					Observed			
	Blue	Green	Pink			Blue	Green	Pink	
Boys				300					300
Girls				200					200
	120	180	200	500		120	180	200	500

f.  $\chi^2$  calculation →

g. Conclusions from the  $\chi^2$  value →

**G. How To Test with the Chi Squared Test of Independence (Example #2)**

a. Watch Video #4 → <http://www.youtube.com/watch?v=xEiQn6sGM20&feature=fvwrel>

b. Our null Hypothesis is → \_\_\_\_\_.

c.  $\chi^2$  calculation →

		Self Esteem		
		High	Medium	Low
High Academic Performance	Observed			
	Expected			
	Difference			
	$\frac{(\text{difference})^2}{\text{expected}}$			
	Sum =			
	$\chi^2 = \sum \frac{(O - E)^2}{E} =$			

		Self Esteem		
		High	Medium	Low
Low Academic Performance	Observed			
	Expected			
	Difference			
	$\frac{(\text{difference})^2}{\text{expected}}$			
	Sum =			
	$\chi^2 = \sum \frac{(O - E)^2}{E} =$			

d. Degrees of Freedom →

e. Alpha ( $\alpha$ )

f. Sketch of Distribution →

g. Conclusions from the  $\chi^2$  value →

**H. How To Test with the Chi Squared Test of Independence (Example #2)**

a. Watch Video #4 → <http://www.youtube.com/watch?v=xEiQn6sGM20&feature=fvwrel>

# Chi Squared Test for Independence

## Lesson 70

1. A Chi-square test is designed to analyze **categorical** data. That means that the data has been counted and divided into categories. It will not work with continuous data (such as height in inches). For example, if you want to test whether attending class influences how students perform on an exam, using test scores (from 0-100) as data would not be appropriate for a Chi-square test. However, arranging students into the categories "Pass" and "Fail" would. Additionally, the data in a Chi-square grid should not be in the form of percentages, or anything other than frequency (count) data. Thus, by dividing a class of 54 into groups according to whether they attended class and whether they passed the exam, you might construct a data set like this:

	Pass	Fail
Attended	25	6
Skipped	8	15

2. Formulate a hypothesis about the relationship between Political view and Opinion of Nuclear Power from the following survey of 100 students. Use a chi-square test for independence showing contingency table to evaluate your hypothesis and make inference about the results of this study.

Opinion	Political Views		
	Democrat	Republican	Independent
<b>Approve</b>	10	15	20
<b>Disapprove</b>	9	2	16
<b>Undecided</b>	8	2	18

- (a) What is your hypothesis?
  - (b) What is the value of the chi-square statistics?
  - (c) What conclusion did you make?
  - (d) What inference can you make?
3. Medical researchers classified each of a group of men as "high" or "low" blood pressure and then watched them for 5 years. (Men with systolic blood pressure 140mm Hg or more were "high"; the others were "low".) The results of the study are below:

	Died	Survived
<b>Low Blood Pressure</b>	21	2655
<b>High Blood Pressure</b>	55	3283

# Chi Squared Test for Independence

## Lesson 70

4. A public opinion poll surveyed a simple random sample of 1000 voters. Respondents were classified by gender (male or female) and by voting preference (Republican, Democrat, or Independent). Results are shown in the [contingency table](#) below. Is there a gender gap? Do the men's voting preferences differ significantly from the women's preferences? Use a 0.05 level of significance.

	Voting Preferences			Row total
	Republican	Democrat	Independent	
Male	200	150	50	400
Female	250	300	50	600
Column total	450	450	100	1000

5. Mr. Acosta, a sociologist, is conducting a study to see whether there is a relationship between the age of a young adult (18-35 years old) and the type of movie preferred. The table below records the responses of the 178 adults surveyed. Test whether age and movie type preference are independent at the 0.05 level of significance.

Movie Genre	From 18 to 24	From 25 to 30	From 31 to 35	Row Totals
Musical	3	7	9	19
Science Fiction	28	19	15	62
Action/Adventure	23	18	12	53
Comedy	24	31	41	96
Column Totals	78	75	77	230

Null Hypothesis: \_\_\_\_\_

Alternate Hypothesis: \_\_\_\_\_

Conclusion: \_\_\_\_\_

# Chi Squared Test for Independence | Lesson 70

6. The personnel department at Jupiter Scientific Labs is doing a study in employee job satisfaction. The table below records the responses of 325 employees given a test designed to diagnose the level of job satisfaction stratified by salary class. Test the hypothesis that job satisfaction and salary are independent at the 0.05 level.

Satisfaction	Under \$25000	\$25000-\$35000	Over \$35000	Row Totals
High	20	18	12	50
Medium	100	67	38	205
Low	41	16	13	70
Column Totals	161	101	63	325

Null Hypothesis: \_\_\_\_\_

Alternate Hypothesis: \_\_\_\_\_

Conclusion: \_\_\_\_\_

7. The counseling unit at Will Rock University is interested in the relationship between anxiety level and the need to succeed. The following table displays the results of a random sample of 200 college freshmen given tests to measure their anxiety and their need to succeed. Test the hypothesis that anxiety level and need to succeed are independent at the 0.01 level of significance.

Need to Succeed	High Anxiety	Medium Anxiety	Low Anxiety	Row Totals
High	30	40	5	
Medium	17	50	33	
Low	3	10	12	
Column Totals				

Null Hypothesis: \_\_\_\_\_

Alternate Hypothesis: \_\_\_\_\_

Conclusion: \_\_\_\_\_

# Chi Squared Test for Independence

## Lesson 70

8. After a large fund drive to help the Boston City Library, the following data were obtained from a random sample of contributors to the library fund. Test the claim that the amount contributed to the library fund is independent of ethnicity at the 0.01 level of significance.

Ethnic Group	\$1-\$50	\$51-\$100	\$101-\$150	\$151-\$200	Over \$200	Row Totals
A	310	715	201	105	42	
B	619	511	312	97	22	
C	402	624	217	88	35	
D	544	571	309	79	29	
Column Totals						

Null Hypothesis: \_\_\_\_\_

Alternate Hypothesis: \_\_\_\_\_

Conclusion: \_\_\_\_\_

9. Mr. Diggs, an archeologist, is investigating the raw materials used in the manufacture of stone tools at two different excavation sites at the Burnt Mesa Pueblo. From the data in the following table, test Mr. Diggs' claim that type of raw material used for tool construction and excavation site are independent at the 0.01 level of significance.

Material	Site A	Site B	Row Totals
Basalt	3657	1238	
Obsidian	497	68	
Pedernal Chert	3606	232	
Other	357	36	
Column Totals			

Null Hypothesis: \_\_\_\_\_

Alternate Hypothesis: \_\_\_\_\_

Conclusion: \_\_\_\_\_