

## CHI-SQUARE TEST FOR HOMOGENEITY OF POPULATIONS

*This test is used to determine if a single categorical variable has the same distribution in 2 (or more) distinct populations from 2 (or more) samples.*

To determine if there was an association between race and opinions about schools, researchers surveyed 3 randomly selected groups of parents and asked them “Are high schools in your state doing an excellent, good, fair or poor job or don’t you know enough to say?”.

	<b>Black Parents</b>	<b>Hispanic Parents</b>	<b>White Parents</b>	<b>TOTAL</b>
<b>Excellent</b>	12	34	22	<b>68</b>
<b>Good</b>	69	55	81	<b>205</b>
<b>Fair</b>	75	61	60	<b>196</b>
<b>Poor</b>	24	24	24	<b>72</b>
<b>Don’t Know</b>	22	28	14	<b>64</b>
<b>TOTAL</b>	<b>202</b>	<b>202</b>	<b>201</b>	<b>605</b>

### DETERMINE EXPECTED COUNTS:

$$\text{Expected Count} = (\text{Row Total})(\text{Column Total}) / \text{Sample Size}$$

	<b>Black Parents</b>		<b>Hispanic Parents</b>		<b>White Parents</b>	
	Actual	Expected	Actual	Expected	Actual	Expected
<b>Excellent</b>	12	22.7	34	22.7	22	22.6
<b>Good</b>	69	68.5	55	68.5	81	68.1
<b>Fair</b>	75	65.4	61	65.4	60	65.1
<b>Poor</b>	24	24.0	24	24.0	24	23.9
<b>Don’t Know</b>	22	21.4	28	21.4	14	21.3

### H STATE NULL AND ALTERNATIVE HYPOTHESES

$H_0$  : There is no relationship between race and opinions about schools

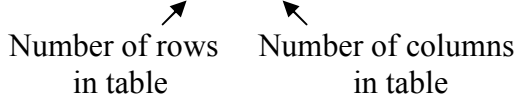
$H_a$  : There is a relationship between race and opinions about schools

### A DETERMINE THAT CONDITIONS FOR TEST ARE ACCEPTABLE:

- SRS... unknown though the samples were random
- Counts (not percents)... yes
- Every expected count  $\geq 1$  and  $80\% \geq 5$ ... yes

## T PERFORM TEST USING...

### FORMULA/TABLE E:

- a) Chi-Square Statistic:  $X^2 = \sum (O_i - E_i)^2 / E_i =$   
 $(12 - 22.7)^2 / 22.7 + (34 - 22.7)^2 / 22.7 + \dots + (14 - 21.3)^2 / 21.3 = 22.43$
- b) Degrees of Freedom =  $(r - 1)(c - 1) = (5 - 1)(3 - 1) = 8$   
  
Number of rows in table      Number of columns in table
- c) P-Value
- i) Table E  
Any  $X^2$  statistic  $> 21.95$  (df = 8) has a P-value  $< .005$
- ii) Calculator:  
 $X^2$  cdf (22.43, 100, 8)  $\rightarrow p = .004$

### CALCULATOR:

- a) Store observed counts in a [R,C] matrix:  
MATRIX  $\rightarrow$  EDIT  $\rightarrow$  1: [A]  $\rightarrow$  5 X 3  $\rightarrow$  Enter Counts  $\rightarrow$  QUIT
- b) Perform  $X^2$  Test:  
STAT  $\rightarrow$  TESTS  $\rightarrow$  C:  $X^2$  - Test  $\rightarrow X^2 = 22.4$ , P-value = .004

### NOTE:

If MATRIX [A] = Observed Counts, MATRIX [B] = Expected Counts

## S STATE CONCLUSION IN CONTEXT:

There is significant evidence (P-value  $< .005$ ) to reject  $H_0$  and conclude that there is a relationship between race and opinions about schools... to determine specific comparisons, use 2-way table techniques. For example, a greater percentage of Whites consider schools *good* compared to Hispanics etc.