Chapter 13: Inference For Tables: Chi-Square Procedures

13.1 Test For Goodness of Fit.

OBJ: You will determine if a sample dist. is sig. diff. from a pop. dist.

3 Bullets @ bottom of pg. 727.

Chi-Square (χ^2) Tests For Goodness of Fit - A test that det. if the obs. sample dist. is sig. diff from the hypothesized Pop. Dist.

χ^2 - A measure of how far the obs. counts are from the exp. counts.

Example 13.1 - All of it! (Not in class - Look @ later tonight if needed)

This is in

$$\chi^2 = \sum \frac{(OBS - Exp)^2}{Exp}$$ (Chi-Square statistic)

The larger the differences between O and E, the larger χ^2 will be, and the more evidence there will be against H_0.

Degrees of Freedom - One less than the total # of percentages (Groups)

TI-83 Techniques:

	OBS	Exp	$\frac{(O-E)^2}{E}$
①	L_1	L_2	L_3

② sum(L_3) → χ^2

③ χ^2cdf(χ^2, Big #, df)

Show when doing 13.4

Chi-Square Distributions

- A family of distributions that take only pos. values & are skewed right.
- Total Area under a chi-square curve = 1
- As df inc, the curve becomes more symmetrical & looks more normal.
- These Dist. are specified by one parameter, df

⟹

Goodness of Fit Test

Ho: The actual Pop. Prop. are the same as the hypothesized prop.
Ha: " " " " Diff. than " " "

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

Intervals	O	E	$\frac{(O-E)^2}{E}$
↓	↓	↓	↓
			$X^2 =$

- Evaluate df (n-1)
- Find p-value.

Conditions
SRS
All expected counts ≥ 1
No more than 20% of the exp. counts are < 5.

13.4
Table 13.1, Table 13.2, Fig 13.1
13.1

HW: 13.2

Day 2: Class 13.11, 13.13

Quiz Tomorrow (Day 3)

13.2 Inference For Two-Way Tables - (Day 1)

OBJ: You will evaluate the expected counts, df, chi-square value + P-value in a two-way table.

Chi-Square Test For Homogeneity of Populations:

The same test that compares several proportions tests whether the row and column variables are related in any two-way table.

Example 13.4

Two-Way Tables

- Compares several proportions
- Gives counts for both successes + failures
- r × c Dimensions.
- Two categorical variables
- Explanatory Variable: Success or Failure
- Each count occupies a cell of the table (6 cells)

	Relapse	
	No	Yes
Desip.	14	10
Lithium	6	18
Placebo	4	20

H_0: $p_1 = p_2 = p_3$ (No Differences among the prop. of successes for addicts given the 3 Treatments)

H_a: Not all of p_1, p_2, and p_3 are equal. (There is <u>some</u> difference; not <u>all</u> 3 prop. are equal.)

- H_a is many sided.

Expected Counts

The expected count in any cell when H_0 is true is:

$$\text{Expected Count} = \frac{\text{Row Tot} \times \text{Col. Tot}}{\text{Table Tot.}}$$

Why? Below Ex 13.5 to middle of pg 748.

$$X^2 = \sum \frac{(O-E)^2}{E}$$ (over all r×c cells in the table)

★ Although H_a is many sided, the Chi-square test is one-sided because any violation of H_0 tends to produce large values of X^2. Small values of X^2 are <u>not</u> evidence against H_0.

$df = (r-1)(c-1)$ (For a two-way table $df = n-1$ for G.O.F.

<u>Conditions</u>: SRS

All expected counts ≥ 1

No more than 20% of exp. < 5

$\Longrightarrow$

Look @ χ^2 Techniques (step 3) in example 13.7 (From 13.6)

<u>Show TI-84 Techniques</u>

- Enter OBS. counts in matrix A
- $\boxed{\text{Stat}}$ → Tests → χ^2 Test
- Observed : [A]
  Expected : [B] → This is where <u>you</u> are <u>telling</u> the calc to store the exp. values.
- Calculate
- Go Back to Matrix [B] to find the exp. values.

Example 13.6 - Find df, χ^2 value, p-value + use TI-84 to find Exp. values.
- Look @ Pink Box on pg 753.

<u>HW</u>: 13.14, 13.16 (Tomorrow to pg. 756)

"Placed" Into Categories ... "Proportions" by Someone else.

13.2 Inference For Two-Way Tables - Day 2

OBJ: You will use a chi-square test to determine if a single pop. has an association between two categorical variables.

See pg 757

Example 13.9 + TP Below

The Chi-Square Test of Association/Independence

- Ho: There is no ~~relationship~~ Association between 2 cat. variables.
- Two-Way Table from a single SRS.
- Each indiv. classified according to both of two Cat. vars. (
- Expected Counts = $\frac{\text{Row Tot} \times \text{Col. Tot.}}{\text{Table Tot.}}$
- df = $(r-1)(c-1)$
- Conditions: SRS
  All expected counts ≥ 1
  No more than 20% exp. counts < 5.

Example 13.10 - Pick out important info.

13.28

HW: 13.19, 13.21, 13.39

"Fall" into categories ..... "Association" on their own.

1 single Population

13.28)

	Black	Others	Tot
Household	172	2283	2455
Non Household	167	1024	1191
Teachers	86	573	659
	425	3880	4305

a) Household = $\frac{172}{2455} = .07$ Non Household = $\frac{167}{1191} = .140$

Teachers = $\frac{86}{659} = .131$

b)

Expect Count = $\frac{\text{Row Tot} \times \text{Col Tot}}{\text{Table Tot.}}$

	Black	Others
Household	172 (242.36)	2283 (2212.64)
Non Household	167 (117.58)	1024 (1073.42)
Teachers	86 (65.06)	573 (593.94)

c) SRS? ✓
stated

All expected counts ≥ 1 ✓

No more than 20% exp. < 5 ✓

Yes!

Ho: There is no association between race and worker class

Ha: " is " " " " " "

$df = (r-1)(c-1) = (3-1)(2-1) = 2$

d) $X^2 = \sum \frac{(O-E)^2}{E} = 53.19$

p-value = 0 (From calc)

e) Since our p-value of 0 is ≤ ($\alpha = .05$)
Reject Ho and conclude ~~there~~ is association
between worker class and race.