Name: Solutions

Date: 5/15/2025

Math 130
Quiz 19

1. (10 points) In order to study people's perception on whether a college education is important, people from 3 countries were polled and asked "*Do you believe a college education is important?*". The number of people who said yes and who said no to this question from each country is listed in the table below. Test whether the proportions of people in each country who feel a college education is important are the same at the $\alpha = 0.07$ significance level. Use the p-value method.

	U.S.	Spain	Argentina	
Yes, a college education is important	34 / 40.607	21 / 21.498	63 / 55.895	118
No, a college education is not important	51 / 44.393	24 / 23.502	54 / 61.105	129
	85	45	117	247

Hyp. Test

H_0: $p_{u.s.} = p_{spain} = p_{Argentina}$

H_1: Not all p's are equal

$p_{u.s.}$ = The percentage of all people in the U.S. that believe a college education is important

$p_{Argentina}$ = ---- Argentina

Test start

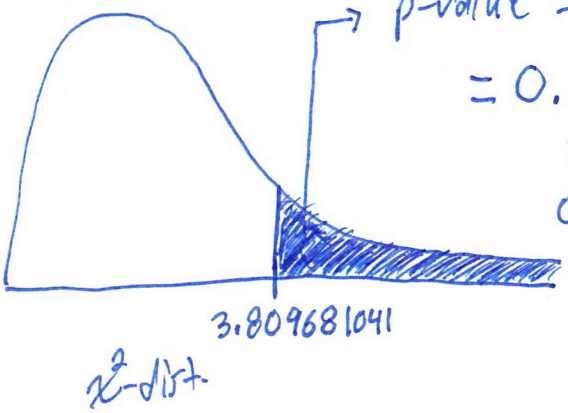
$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

$$= \frac{(34-40.607)^2}{40.607} + \cdots + \frac{(54-61.105)^2}{61.105}$$

$$= 3.809681041$$

p-value

$\alpha = 0.07$ $\quad df = (r-1)(c-1) = (2-1)(3-1) = (1)(2) = 2$



p-value $= P(\chi^2 > 3.809681041)$

$= 0.148846378\overline{7}$

Is p-value $< \alpha$?

$0.148846378\overline{7} < 0.07$?

No!

Conclusion

Do not reject H_0!

Not enough evidence to say that the percentages of all people in each country who believe a college education is important are not all the same.

Extra Credit: (10 points) In order to investigate the effectiveness of different diets, 40 people were randomly selected who were on various diets for a year. The amount of weight the people lost and what diets they were on is summarized in the table below. Use a 0.05 significance level to test the claim that a person's average weight loss is the same for the various diet plans listed in the table. Use the rejection region method.

												$\bar{x}_i$	s_i	n_i
Weight Watchers	16	62	35	23	18	33	37	25	21	42		31.2	13.87	10
Atkins	41	59	55	17	48	41	29	44	37	49		42	12.33	10
Jenny Craig	22	26	32	17	32	25	28	19	11	17		22.9	6.94	10
Nutrisystem	28	31	24	11	18	23	23	39	31	28		25.6	7.72	10

$n = 10+10+10+10 = 40$ $\quad \bar{x} = \frac{31.2+42+22.9+25.6}{4} = 30.425$

$$MST = \frac{n_1(\bar{x}_1-\bar{x})^2 + n_2(\bar{x}_2-\bar{x})^2 + n_3(\bar{x}_3-\bar{x})^2 + n_4(\bar{x}_4-\bar{x})^2}{k-1}$$

$$= \frac{10(31.2-30.425)^2 + 10(42-30.425)^2 + 10(22.9-30.425)^2 + 10(25.6-30.425)^2}{4-1}$$

$$= 714.9583333$$

$$MSE = \frac{(n_1-1)s_1^2 + (n_2-1)s_2^2 + (n_3-1)s_3^2 + (n_4-1)s_4^2}{n-k}$$

$$= \frac{(10-1)(13.87)^2 + (10-1)(12.33)^2 + (10-1)(6.94)^2 + (10-1)(7.72)^2}{40-4}$$

$$= 113.04195$$

Hypo Test

H_0: $\mu_{WW} = \mu_A = \mu_{JC} = \mu_N$

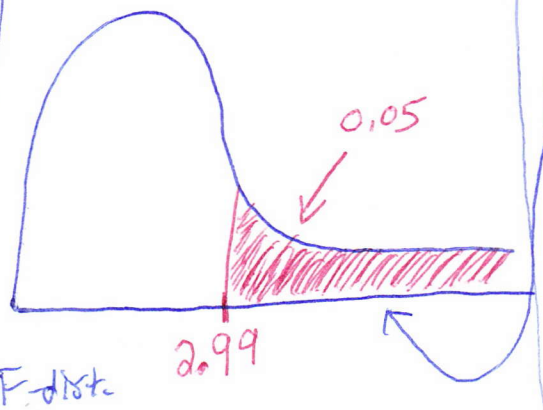
H_1: Not all μ's are equal

μ_{WW} = The average weight loss of all people who have ever been on weight watchers

μ_N = Nutrisystem

Rejection Region

$\alpha = 0.05$ $\quad df_1 = k-1 = 4-1 = 3$ $\quad df_2 = n-k = 40-4 = 36$ (use 25)



Test Stat

$F = \frac{MST}{MSE} = \frac{714.9583333}{113.04195} = 6.324716915$

Conclusion

Reject H_0!

Evidence suggests that a person's average weight loss is not the same for the various diet plans listed in the table.

Some formulas you may need:

$$\chi^2 = \sum \frac{(O-E)^2}{E} \qquad E = \frac{(row\ \ total)(column\ \ total)}{grand\ \ total} \qquad df = (r-1)(c-1)$$

$$df_1 = k-1 \qquad df_2 = n-k$$

$$MST = \frac{\sum n_i (\bar{x}_i - \bar{x})^2}{k-1}$$

$$MSE = \frac{\sum (n_i - 1) s_i^{\ 2}}{n-k}$$

$$F = \frac{MST}{MSE}$$