Math 21 – Summer – Written Project 4 (Chapters 11-13)

1) In a study of a new wonder diet, a sample of 10 patients was taken. Here are there weights before and after.

Before	209	178	169	212	180	192	158	180	211	193
After	196	171	170	207	177	190	159	180	203	183

Test at the 0.01 level of significance the claim that this diet is effective, in other words, that the diet will reduce the weight of a person.

Step 1: State the Hypotheses

d = Before - After

H_0: $\mu_d = 0$

H_1: $\mu_d > 0$

Step 2: State the Level of Significance, α

$\alpha = 0.01$

Step 3: State the Test You Are Performing

Paired Difference Test

Step 4: Compute the Test Statistic and *P*-value (StatCrunch)

$t = 3.01$

$P - value = 0.0074$

Paired T hypothesis test:
$\mu_D = \mu_1 - \mu_2$: Mean of the difference between Before and After
H_0 : $\mu_D = 0$
H_A : $\mu_D > 0$
Hypothesis test results:

Difference	Mean	Std. Err.	DF	T-Stat	P-value
Before - After	4.6	1.5289793	9	3.008543	0.0074

Step 5: Make Decision about H_0, State Conclusion about H_1

Reject H_0. (Because *P*-value < α)

There is sufficient evidence to conclude that the diet will reduce the weight of a person (that the mean difference between the Before and After weights is greater than 0).

2) In 1990, 24.5% of Americans 25 years old and over had not graduated from high school, 48.9% held a high school diploma and 26.6% held at least an Associate's degree. A recent study of 440 Americans 25 years old and over showed that 89 had not graduated from high school, 208 were high school graduates and 143 held at least an Associate's degree. At the 0.05 level, test the claim that the 1990 proportions no longer hold true.

Step 1: State the Hypotheses

H_0: $p_{NoHS} = 0.245, p_{HS} = 0.489, p_{College} = 0.265$

H_1: At least one proportion is different than claimed.

Step 2: State the Level of Significance, α

$\alpha = 0.05$

Step 3: State the Test You Are Performing

Goodness of Fit Test

Step 4: Compute the Test Statistic and *P*-value (StatCrunch)

$\chi^2 = 9.27$

$P - value = 0.0097$

Chi-Square goodness-of-fit results:
Observed: Observed
Expected: Expected

N	DF	Chi-Square	P-value
440	2	9.2749766	0.0097

Observed	Expected
89	107.8
208	215.16
143	117.04

Step 5: Make Decision about H_0, State Conclusion about H_1

Reject H_0. (Because *P*-value < α)

There is sufficient evidence to conclude that at least one proportion is different than claimed.

3) Here are the waiting times, in minutes, at the check-in counters for four different airlines at an airport for randomly selected fliers.

Airline A	Airline B	Airline C	Airline D
3	19	8	7
11	13	11	16
19	11	17	15
11	13	7	9
7		12	
10			

At the 0.05 level of significance, test the claim that the mean waiting time at the checkout counters of the four airlines are equal.

Step 1: State the Hypotheses

H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$

H_1: At least one mean is different than the others.

Step 2: State the Level of Significance, α

$\alpha = 0.05$

Step 3: State the Test You Are Performing

ANOVA

Step 4: Compute the Test Statistic and *P*-value (StatCrunch)

$F = 0.62$

$P - value = 0.6103$

Analysis of Variance results:
Data stored in separate columns.

ANOVA table

Source	DF	SS	MS	F-Stat	P-value
Columns	3	37.153509	12.384503	0.62425386	0.6103
Error	15	297.58333	19.838889		
Total	18	334.73684			

Step 5: Make Decision about H_0, State Conclusion about H_1

Fail to reject H_0. (Because *P*-value > α)

There is not sufficient evidence to conclude that at least one mean is different than the others.

4) In a study of 1054 people who were 60 or older, New York City researchers found that 19 of the 459 women and 11 of the 595 men had lung cancer. At the 0.01 level of significance, test the claim that men over 60 are less likely to get lung cancer than women over 60.

Step 1: State the Hypotheses

#1: Men (Because men are mentioned first in the claim)

H_0: $p_1 = p_2$

H_1: $p_1 < p_2$

Step 2: State the Level of Significance, α

$\alpha = 0.01$

Step 3: State the Test You Are Performing

Two Proportion Test

Step 4: Compute the Test Statistic and *P*-value (StatCrunch)

$z = -2.22$

$P - value = 0.0133$

Two sample proportion hypothesis test:

p_1 : proportion of successes for population 1
p_2 : proportion of successes for population 2
$p_1 - p_2$: Difference in proportions
$H_0 : p_1 - p_2 = 0$
$H_A : p_1 - p_2 < 0$

Hypothesis test results:

Difference	Count1	Total1	Count2	Total2	Sample Diff.	Std. Err.	Z-Stat	P-value
$p_1 - p_2$	11	595	19	459	-0.022906941	0.010330598	-2.2173876	0.0133

Step 5: Make Decision about H_0, State Conclusion about H_1

Fail to reject H_0. (Because *P*-value > α)

There is not sufficient evidence to conclude that men over 60 are less likely to get lung cancer than women.

5) A high school instructor is curious to see the effect that an open-notes policy would have on tests. He allows one of his classes to use their notes on their test, while his other class takes the test without them. Here are the scores.

With Notes

86, 95, 97, 98, 53, 84, 91, 64, 97, 97, 97, 84, 64, 94, 73

Without Notes

70, 92, 97, 50, 81, 97, 84, 61, 98, 98, 58, 23, 69, 84, 91, 78

At the 0.05 level, test the claim that the use of notes produces a higher mean test score.

Step 1: State the Hypotheses

#1: With Notes

H_0: $\mu_1 = \mu_2$

H_1: $\mu_1 > \mu_2$

Step 2: State the Level of Significance, α

$\alpha = 0.05$

Step 3: State the Test You Are Performing

Two Mean Test

Step 4: Compute the Test Statistic and *P*-value (StatCrunch)

$t = 1.24$

$P - value = 0.1135$

Two sample T hypothesis test:
μ_1 : Mean of With Notes
μ_2 : Mean of Without Notes
$\mu_1 - \mu_2$: Difference between two means
$H_0 : \mu_1 - \mu_2 = 0$
$H_A : \mu_1 - \mu_2 > 0$
(without pooled variances)

Hypothesis test results:

Difference	Sample Diff.	Std. Err.	DF	T-Stat	P-value
$\mu_1 - \mu_2$	7.9958333	6.4674105	26.902799	1.2363269	0.1135

Step 5: Make Decision about H_0, State Conclusion about H_1

Fail to reject H_0. (Because *P*-value > α)

There is not sufficient evidence to conclude that the use of notes produces a higher mean test score.

6) A random sample of 483 workers asked how they saved things – in piles, in files, or some combination of both. Here are the results, broken down by gender.

	Piles	Files	Both
Male	78	138	69
Female	30	110	58

At the 0.05 level, test the claim that the technique used is independent of gender.

Step 1: State the Hypotheses

H_0: Technique used is independent of gender.

H_1: Technique used is dependent on gender.

Step 2: State the Level of Significance, α

$\alpha = 0.05$

Step 3: State the Test You Are Performing

Independence Test

Step 4: Compute the Test Statistic and *P*-value (StatCrunch)

$\chi^2 = 10.10$

$P - value = 0.0064$

Contingency table results:
Rows: Gender
Columns: None

	Piles	Files	Both	Total
Male	78	138	69	285
Female	30	110	58	198
Total	108	248	127	483

Chi-Square test:

Statistic	DF	Value	P-value
Chi-square	2	10.104407	0.0064

Step 5: Make Decision about H_0, State Conclusion about H_1

Reject H_0. (Because *P*-value < α)

There is sufficient evidence to conclude that the technique used is dependent on gender.