11.4 Putting it all together Which Method? MATH 241 THOMPSON

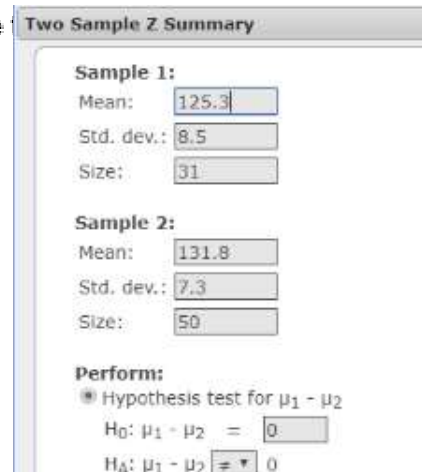
1)

Use the following information to complete steps **(a)** through **(d)** below.

A random sample of size $n_1 = 31$ results in a sample mean of 125.3 and a sample standard deviation of 8.5. An independent sample of size $n_2 = 50$ results in a sample mean of 131.8 and sample standard deviation of 7.3. Does this constitute sufficient evidence to conclude that the population means differ at the $\alpha = 0.005$ level of significance?

(a) What type of test should be used?

- A. A hypothesis test regarding two population standard deviations.
- B. A hypothesis test regarding the difference between two population proportions from independent samples.
- C. A hypothesis test regarding the difference of two means using a matched-pairs design.
- ✓ D. A hypothesis test regarding the difference of two means using Welch's approximate



(b) Determine the null and alternative hypotheses. Choose the correct answer below.

- A. $H_0: \mu_1 \leq \mu_2$; $H_1: \mu_1 \neq \mu_2$
- B. $H_0: \mu_1 = \mu_2$; $H_1: \mu_1 > \mu_2$
- ✓ C. $H_0: \mu_1 = \mu_2$; $H_1: \mu_1 \neq \mu_2$
- D. $H_0: \mu_1 = \mu_2$; $H_1: \mu_1 \leq \mu_2$

(c) Use technology to calculate the P-value. Round P value up

.001 (Round to three decimal places as needed.)

Hypothesis test results:

Difference	n_1	n_2	Sample mean	Std. err.	Z-stat	P-value
$\mu_1 - \mu_2$	31	50	-6.5	1.8429447	-3.5269642	0.0004

(d) Draw a conclusion based on the hypothesis test. Choose th

- A. There is not sufficient evidence to reject the null hypothesis because the P-value > α.
- B. There is sufficient evidence to reject the null hypothesis because the P-value > α.
- ✓ C. There is sufficient evidence to reject the null hypothesis because the P-value < α.
- D. There is not sufficient evidence to reject the null hypothesis because the P-value < α.

2) Use the following information to complete steps **(a)** through **(d)** below.

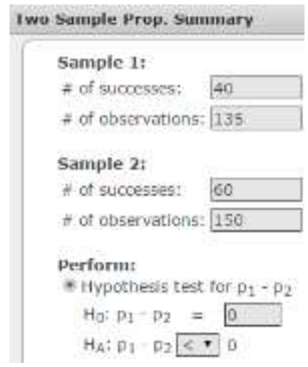
A random sample of $n_1 = 135$ individuals results in $x_1 = 40$ successes. An independent sample of $n_2 = 150$ individuals results in $x_2 = 60$ successes. Does this represent sufficient evidence to conclude that $p_1 < p_2$ at the $\alpha = 0.01$ level of significance?

(a) What type of test should be used? **STAT – PROPORTION – TWO SAMPLE – WITH SUMMARY**

- ✓ A. A hypothesis test regarding the difference between two population proportions from independent samples.
- B. A hypothesis test regarding the difference between two population proportions from dependent samples.
- C. A hypothesis test regarding the difference of two means using a matched-pairs design.
- D. A hypothesis test regarding two population standard deviations.

(b) Determine the null and alternative hypotheses. Choose the correct answer below.

- A. $H_0: p_1 = p_2$; $H_1: p_1 > p_2$
- B. $H_0: p_1 > p_2$; $H_1: p_1 < p_2$
- ✓ C. $H_0: p_1 = p_2$; $H_1: p_1 < p_2$
- D. $H_0: p_1 = p_2$; $H_1: p_1 \neq p_2$



(c) Use technology to calculate the P-value.

.034 (Round to three decimal places as needed.)

(d) Draw a conclusion based on the hypothesis test. Choose the correct answer below.

- A. There is sufficient evidence to reject the null hypothesis because the P-value $< \alpha$.
- ✓ B. There is not sufficient evidence to reject the null hypothesis because the P-value $> \alpha$.

3) The data table represents the measure of a variable before and after a treatment. Does the sample evidence suggest that the treatment is effective in decreasing the value of the response variable? Use the $\alpha = 0.01$ level of significance. Complete parts **(a)** through **(d)**.

Individual	1	2	3	4	5
Before, x_i	41	31	54	46	36
After, y_i	36	33	48	46	35

(a) What type of test should be used? Choose the correct answer below.

- A. A hypothesis test regarding two population standard deviations.
- B. A hypothesis test regarding the difference of two means using Welch's approximate t.
- C. A hypothesis test regarding the difference between two population proportions from independent samples.
- ✓ D. A hypothesis test regarding the difference of two means using a matched-pairs design.

(b) Determine the null and alternative hypotheses. Let $\mu_d = \mu_x - \mu_y$. Choose the correct answer below.

- A. $H_0: \mu_d = 0$; $H_1: \mu_d < 0$
- ✓ B. $H_0: \mu_d = 0$; $H_1: \mu_d > 0$

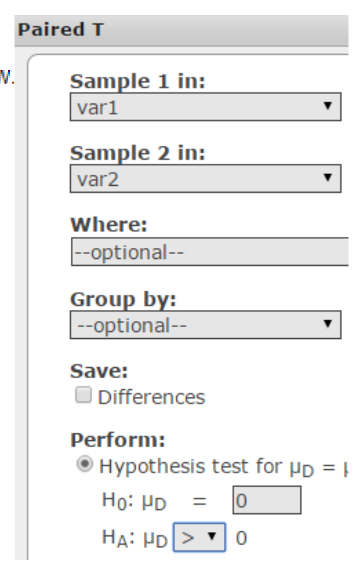
(c) Use technology to calculate the P-value.

.129 (Round to three decimal places as needed.)

(d) Draw a conclusion based on the hypothesis test. Choose the correct answer below.

STATS – T-STATS - PAIRED

- A. There is sufficient evidence to reject the null hypothesis because the P-value $< \alpha$.
- B. There is sufficient evidence to reject the null hypothesis because the P-value $> \alpha$.
- ✓ C. There is not sufficient evidence to reject the null hypothesis because the P-value $> \alpha$.



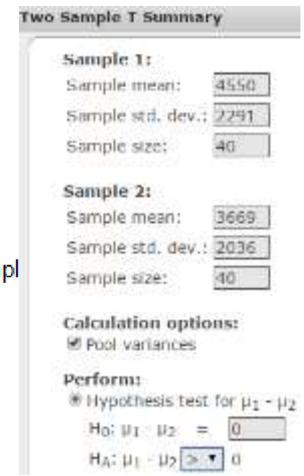
4) Automobile collision insurance is used to pay for any claims made against the driver in the event of an accident. This type of insuran will typically pay to repair any assets that your vehicle damages.

A random sample of 40 collision claims of 20- to 24-year-old drivers results in a mean claim of $4550 with a standard deviation of $2291. An independent random sample of 40 collision claims of 30- to 59-year-old drivers results in a mean claim of $3669 with a standard deviation of $2036. Using the concept of hypothesis testing, determine if a higher insurance premium should be paid by 20- 24-year-old drivers. Use a $\alpha = 0.05$ level of significance, and let population 1 be 20- to 24-year old drivers and population 2 be 30- to 59-year old drivers. Complete parts **(a)** through **(e)** below.

(a) Collision claims tend to be skewed right. Why do you think this is the case?

- A. There are a few very large collision claims relative to the majority of claims. ✔
- B. There are no very large collision claims.
- C. There are many large collision claims relative to the majority of claims.

T- STATS – TWO SAMPLE



(b) What type of test should be used?

- A. A hypothesis test regarding the difference of two means using a matched-pairs design.
- B. A hypothesis test regarding the difference of two means using Welch's approximate t. ✔
- C. A hypothesis test regarding two population standard deviations.
- D. A hypothesis test regarding the difference between two population proportions from independent sampl

(c) Determine the null and alternative hypotheses. Choose the correct answer below.

- A. $H_0: \mu_1 = \mu_2$; $H_1: \mu_1 \leq \mu_2$
- B. $H_0: \mu_1 = \mu_2$; $H_1: \mu_1 \neq \mu_2$
- C. $H_0: \mu_1 \neq \mu_2$; $H_1: \mu_1 > \mu_2$
- D. $H_0: \mu_1 = \mu_2$; $H_1: \mu_1 > \mu_2$ ✔

(d) Use technology to calculate the P-value.

.037 (Round to three decimal places as needed.)

Check P value

- D. There is sufficient evidence to reject the null hypothesis because the P-value < α. ✔

5) A student wants to determine if there is a difference in the pricing between two stores for health and beauty supplies. She recorded prices from both stores for each of 10 different products. Assuming that the conditions for conducting the test are satisfied, determine if there is a price difference between the two stores. Use the $\alpha = 0.01$ level of significance. Complete parts **(a)** through **(d)** below.

	A	B	C	D	E	F	G	H	I	J
Store 1	5.94	7.44	3.74	1.72	1.71	2.87	4.79	3.13	2.92	3.72
Store 2	5.92	7.95	3.96	1.76	1.91	2.44	4.78	3.79	2.95	3.61

- C. A hypothesis test regarding the difference of two means using a matched-pairs design. ✔
- D. A hypothesis test regarding the difference of two means using Welch's approximate t.

STATS – T-STATS - PAIRED

(b) Determine the null and alternative hypotheses. Choose the correct answer below.

- A. $H_0: \mu_d \neq 0$; $H_1: \mu_d = 0$
- B. $H_0: \mu_d = 0$; $H_1: \mu_d > 0$
- C. $H_0: \mu_d = 0$; $H_1: \mu_d \neq 0$ ✔
- D. $H_0: \mu_d = 0$; $H_1: \mu_d < 0$

(c) Use technology to calculate the P-value.

.295 (Round to three decimal places as needed.)

(d) Draw a conclusion based on the hypothesis test. Choose the correct answer below.

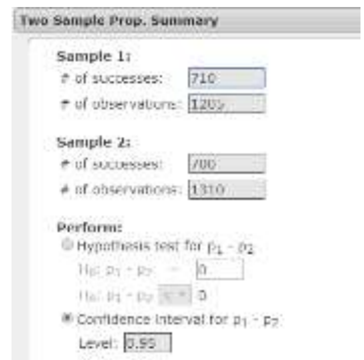
- B. There is not sufficient evidence to reject the null hypothesis because the P-value > α. ✔

6) The research group asked the following question of individuals who earned in excess of $100,000 per year and those who earned less than $100,000 per year: "Do you believe that it is morally wrong for unwed women to have children?" Of the 1,205 individuals who earned in excess of $100,000 per year, 710 said yes; of the 1,310 individuals who earned less than $100,000 per year, 690 said yes. Construct a 95% confidence interval to determine if there is a difference in the proportion of individuals who believe it is morally wrong for unwed women to have children.

The lower bound is .024. (Round to three decimal places as needed.)

The upper bound is .101. (Round to three decimal places as needed.) Proportion Stats Two Sample

Because the confidence interval does not include 0, there is sufficient evidence at the $\alpha = 0.05$ level of significance to conclude that there is a difference in the proportions. It seems that the proportion of individuals who earn over $100,000 that feel it is morally wrong for unwed women to have children is greater than the proportion of individuals who earn less than $100,000 that feel it is morally wrong for unwed women to have children.



7) For the study given below, explain which statistical procedure would most likely be used for the research objective. Assume all model requirements for conducing the appropriate procedure have been satisfied.

Does hotel chain A charge more than hotel chain B for a one-night stay?

Choose the correct answer below.

- A. A two-sample z-test of independent proportions is most likely appropriate because the mean price is a good measure of how much a hotel chain charges, the research objective involves a comparison of two things, and one would likely select hotels independently.
- ✔ B. A matched-pairs t-test on the difference of means is most likely appropriate because the mean price is a good measure of how much a hotel chain charges, the research objective involves a comparison of two things, and one would likely select hotels paired by location.
- C. A two-sample t-test of independent means is most likely appropriate because the mean price is a good measure of how much a hotel chain charges, the research objective involves a comparison of two things, and one would likely select hotels independently.
- D. Two confidence intervals for two means are likely appropriate because the mean price is a good measure of how much a hotel chain charges, the research objective involves a comparison of two things, and one would likely select hotels paired by location.

8) Assuming all model requirements for conducting the appropriate procedure have been satisfied, what proportion of registered voters is in favor of a tax increase to reduce the federal debt? Explain which statistical procedure would most likely be used for the research objective given.

Choose the correct answer below.

- A. The correct procedure is a confidence interval for a single mean. The goal is to determine the mean number of voters that favor a tax increase. There is no comparison being made, so the best procedure to use is a confidence interval.
- B. The correct procedure is a hypothesis test for two proportions with independent sampling. The goal is to determine the proportion of the population that favor a tax increase, so the proportion of voters in favor is compared to the proportion opposed. The sampling is independent because each voter is only asked one question.
- ✔ C. The correct procedure is a confidence interval for a single proportion. The goal is to determine the proportion of the population that favors a tax increase. There is no comparison being made and there is only one population, so rather than hypothesis testing, it is appropriate to use a confidence interval.
- D. The correct procedure is a hypothesis test for a single proportion. The goal is to determine whether the proportion of voters who favor a tax increase is higher than the proportion of voters who oppose an increase. The only population being addressed is the voters, so the best procedure is a hypothesis test for a single proportion.

> The objective of the problem is to determine the proportion of the registered voters that support a tax increase. Since the goal is to determine a parameter of a population, and not to draw a comparison between two populations, a confidence interval for a single proportion is the best procedure to use.

EXTRA EXAMPLES:

Use the following information to complete steps **(a)** through **(d)** below.

A random sample of size $n_1 = 31$ results in a sample mean of 123.3 and a sample standard deviation of 8.5. An independent sample of size $n_2 = 50$ results in a sample mean of 129.8 and sample standard deviation of 7.3. Does this constitute sufficient evidence to conclude that the population means differ at the $\alpha = 0.10$ level of significance?

(a) What type of test should be used?

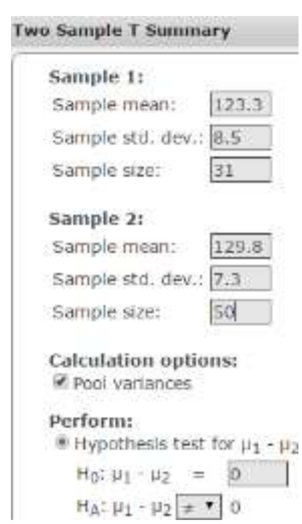
STAT – T-STATS – TWO SAMPLE – WITH SUMMARY

- A. A hypothesis test regarding the difference of two means using a matched-pairs design.
- B. A hypothesis test regarding the difference between two population proportions from independent samples.
- ✔ C. A hypothesis test regarding the difference of two means using Welch's approximate t.
- D. A hypothesis test regarding two population standard deviations.

(b) Determine the null and alternative hypotheses. Choose the correct answer below.

- ✔ A. $H_0: \mu_1 = \mu_2$; $H_1: \mu_1 \neq \mu_2$
- B. $H_0: \mu_1 = \mu_2$; $H_1: \mu_1 \leq \mu_2$
- C. $H_0: \mu_1 = \mu_2$; $H_1: \mu_1 > \mu_2$
- D. $H_0: \mu_1 \leq \mu_2$; $H_1: \mu_1 \neq \mu_2$

Using the mean with independent samples and large sample sizes.



(c) Use technology to calculate the P-value.

.001 (Round to three decimal places as needed.)

(d) Draw a conclusion based on the hypothesis test. Choose the correct answer below.

- A. There is sufficient evidence to reject the null hypothesis because the P-value $> \alpha$.
- B. There is not sufficient evidence to reject the null hypothesis because the P-value $< \alpha$.
- C. There is not sufficient evidence to reject the null hypothesis because the P-value $> \alpha$.
- ✔ D. There is sufficient evidence to reject the null hypothesis because the P-value $< \alpha$.

A random sample of size n = 15 obtained from a population that is normally distributed results in a sample mean of 44.3 and sample standard deviation 12.9. An independent sample of size n = 16 obtained from a population that is normally distributed results in a sample mean of 52.8 and sample standard deviation 14.7. Doe this constitute sufficient evidence to conclude that the population means differ at the $\alpha = 0.05$ level of significance?

Click here to view the standard normal distribution table (page 1).
Click here to view the standard normal distribution table (page 2).
Click here to view the table of critical t-values.
Click here to view the chi-square critical values table.

The given situation is about a mean, μ.

Write the hypotheses for the test.

T-STATS TWO SAMPLE WITH SUMMARY

H_0: $\mu_1 = \mu_2$

H_1: $\mu_1 \neq \mu_2$

Hypothesis test results:

Difference	Sample Diff.	Std. Err.	DF	T-Stat	P-value
$\mu_1 - \mu_2$	-8.5	4.9813415	29	-1.7063677	0.0986

Calculate the test statistic.

t_0 = −1.71 (Round to two decimal places as needed.)

Identify the critical region. Select the correct choice below and fill in all answer boxes within your choice.
(Type an integer or decimal rounded to two decimal places as needed.)

$\alpha = \frac{.05}{2} = .025$ USE Critical table df = (15+16)−2=29

A. test statistic <

B. test statistic < −2.05 or test statistic > 2.05

C. test statistic >

TWO TAILED therefore: -2.05,2.05

What is the conclusion?

Do not reject the null hypothesis and conclude there is not sufficient evidence that the parameter of interest of population 1 is different from the parameter of interest of population 2 at the $\alpha = 0.05$ level of significance.

Two Sample T Summary

Sample 1:
Sample mean: 44.3
Sample std. dev.: 12.9
Sample size: 15

Sample 2:
Sample mean: 52.8
Sample std. dev.: 14.7
Sample size: 16

Calculation options:
Pool variances (NOTE: the default was recently changed to "off")

Perform:
Hypothesis test for $\mu_1 - \mu_2$
H_0: $\mu_1 - \mu_2$ = 0
H_A: $\mu_1 - \mu_2$ ≠ 0
Confidence interval for $\mu_1 - \mu_2$

P > .05 SO DO NOT REJECT

	Area in Righ					
Degrees of Freedom	0.25	0.20	0.15	0.10	0.05	0.025
1	1.000	1.376	1.963	3.078	6.314	12.706
2	0.816	1.061	1.386	1.886	2.920	4.303
3	0.765	0.978	1.250	1.638	2.353	3.182
4	0.741	0.941	1.190	1.533	2.132	2.776
5	0.727	0.920	1.156	1.476	2.015	2.571
6	0.718	0.906	1.134	1.440	1.943	2.447
7	0.711	0.896	1.119	1.415	1.895	2.365
8	0.706	0.889	1.108	1.397	1.860	2.306
9	0.703	0.883	1.100	1.383	1.833	2.262
10	0.700	0.879	1.093	1.372	1.812	2.228
11	0.697	0.876	1.088	1.363	1.796	2.201
12	0.695	0.873	1.083	1.356	1.782	2.179
13	0.694	0.870	1.079	1.350	1.771	2.160
14	0.692	0.868	1.076	1.345	1.761	2.145
15	0.691	0.866	1.074	1.341	1.753	2.131
16	0.690	0.865	1.071	1.337	1.746	2.120
17	0.689	0.863	1.069	1.333	1.740	2.110
18	0.688	0.862	1.067	1.330	1.734	2.101
19	0.688	0.861	1.066	1.328	1.729	2.093
20	0.687	0.860	1.064	1.325	1.725	2.086
21	0.686	0.859	1.063	1.323	1.721	2.080
22	0.686	0.858	1.061	1.321	1.717	2.074
23	0.685	0.858	1.060	1.319	1.714	2.069
24	0.685	0.857	1.059	1.318	1.711	2.064
25	0.684	0.856	1.058	1.316	1.708	2.060
26	0.684	0.856	1.058	1.315	1.706	2.056
27	0.684	0.855	1.057	1.314	1.703	2.052
28	0.683	0.855	1.056	1.313	1.701	2.048
29	0.683	0.854	1.055	1.311	1.699	2.045

In a survey, adult Americans were asked if they were happy or unhappy, and they were asked whether they were healthy or unhealthy. The accompanying table shows the results of the survey. Are healthy people also happy people? Use the $\alpha = 0.10$ level of significance. Complete parts **(a)** through **(e)** below.

	Healthy (success)	Not healthy (failure)
Happy (success)	2,499	120
Not happy (failure)	90	59

(a) What type of test should be used?

- ✔ A. A hypothesis test regarding the difference between two population proportions from dependent samples.
- B. A hypothesis test regarding two population standard deviations.
- C. A hypothesis test regarding the difference between two population proportions from independent samples.
- D. A hypothesis test regarding the difference of two means using a matched-pairs design.

(b) Determine the null and alternative hypotheses. Choose the correct answer below.

- A. $H_0: p_1 = p_2$; $H_1: p_1 \le p_2$
- B. $H_0: p_1 < p_2$; $H_1: p_1 \ne p_2$
- C. $H_0: p_1 = p_2$; $H_1: p_1 > p_2$
- ✔ D. $H_0: p_1 = p_2$; $H_1: p_1 \ne p_2$

To test hypotheses regarding two population proportions, p_1 and p_2, where the samples are dependent, the data should be arranged in a contingency table as shown below.

		Treatment A	
		Success	Failure
Treatment B	Success	f_{11}	f_{12}
	Failure	f_{21}	f_{22}

Use McNemar's Test to compare the proportions, provided the samples are dependent and obtained randomly and the total number of observations where the outcomes differ is greater than or equal to 10. That is, $f_{12} + f_{21} \ge 10$. The formula for the test statistic is as follows.

$$z_0 = \frac{|f_{12} - f_{21}| - 1}{\sqrt{f_{12} + f_{21}}}$$

(c) Calculate the test statistic.

$z_0 =$ 2.00 (Round to two decimal places as needed.)

(d) Calculate the P-value.

.044 (Round to three decimal places as needed.)

Use proportion two sample summary to get p then Divide it by 2.

Two Sample Prop. Summary

Sample 1:
# of successes: 2619
# of observations: 2768

Sample 2:
# of successes: 2589
# of observations: 2768

Perform:
(•) Hypothesis test for $p_1 - p_2$
$H_0: p_1 - p_2 = 0$
$H_A: p_1 - p_2 \ne 0$
( ) Confidence interval for $p_1 - p_2$
Level: 0.95

(e) Draw a conclusion based on the hypothesis test. Choose the correct answer below.

- A. There is not sufficient evidence to reject the null hypothesis because the P-value > α.
- ✔ B. There is sufficient evidence to reject the null hypothesis because the P-value < α.