Midterm 3 - STAT 301
Fall 2016

Solutions

Name:

UIN:

Signature:

Version A:

1. Do not open this test until told to do so.
2. This is a closed book examination, However you may use the cheat sheet provided and the tables you have brought with you. You should have no other printed or written material with you on the exam. But scrap paper is allowed.
3. You have 60 minutes to work on this exam. There are **17** multiple choice questions.
4. On the scantron please state the version of exam that you have.
5. You may use a calculator in the exam.
6. If there is no correct answer or if multiple answers are correct, select the **best** answer.
7. If you are unsure of what a question is asking for, do not hesitate to ask the instructor or course assistant for clarification.
8. Do all tests at the **5%** level unless specified otherwise.
9. Some questions are very easy (don't make them more complicated than they are), make sure you get these correct.
10. Please only give one answer per question (the one that is closest to the solution).
11. Good Luck!!!

(1-6) There was a sales promotion in Kroger for Italian cheese. Prior to the sales promotion the mean number of Italian cheeses sold each day was **40**. **After** the sales promotion, over a 14 day period the average number of Italian cheese sold was 48. The output is summarized below. Let μ denote the mean daily sales of Italian cheese.

One sample T hypothesis test:
μ : Mean of population
$H_0 : \mu = 40$
$H_A : \mu > 40$

Hypothesis test results:

Mean	Sample Mean	Std. Err.	DF	T-Stat	P-value
μ	48	2.6726124	13	2.9933259	0.0052

(1) Using the output above determine whether there is evidence to suggest the sales promotion **increased** sales? State the hypothesis of interest and the results of the test at the 5% level.

(A) $H_0 : \mu \leq 40$ vs. $H_A : \mu > 40$, the p-value is 99.48%, there is **no** evidence to suggest the promotion **increased** sales.

(B) $H_0 : \mu \leq 40$ vs. $H_A : \mu > 40$, the p-value is 0.52%, there **is** evidence to suggest the promotion **increased** sales.

(C) $H_0 : \mu \leq 48$ vs. $H_A : \mu > 48$, the p-value is 0.52%, there **is** evidence to suggest the promotion **increased** sales.

(D) $H_0 : \mu \geq 40$ vs. $H_A : \mu < 40$, the p-value is 99.48%, there **is** evidence to suggest the promotion **decreased** sales.

(E) $H_0 : \mu \leq 40$ vs. $H_A : \mu > 40$, the p-value is 0.52%, there is **no** evidence to suggest the promotion **increased** sales.

(2) Using the output above is there any evidence to suggest that the sales promotion resulted in a **drop** in sales?

100 - 0.52 = 99.48%

(A) $H_0 : \mu \geq 40$ vs. $H_A : \mu < 40$, the p-value is 99.48%, there is **no** evidence to suggest the promotion **decreased** sales.

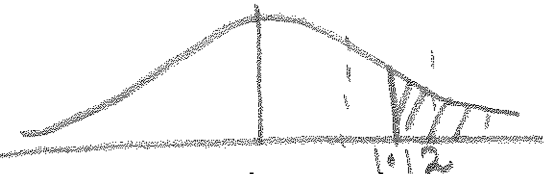
(B) $H_0 : \mu \geq 40$ vs. $H_A : \mu < 40$, the p-value is 99.48%, there **is** evidence to suggest the promotion **decreased** sales.

(C) $H_0 : \mu \geq 40$ vs. $H_A : \mu < 40$, the p-value is 0.52%, there **is** evidence to suggest the promotion **decreased** sales.

(D) $H_0 : \mu \geq 48$ vs. $H_A : \mu < 48$, the p-value is 0.52%, there **is** evidence to suggest the promotion **decreased** sales.

(E) $H_0 : \mu \geq 48$ vs. $H_A : \mu < 48$, the p-value is 99.48%, there is **no** evidence to suggest the promotion **decreased** sales.

$$t = \frac{48-45}{2.67} = 1.12$$



(3) Suppose you want to test the hypothesis that the promotion increased mean sales to more than 45 cheeses a day. You test the hypothesis $H_0 : \mu \leq 45$ vs $H_A : \mu > 45$. What is the p-value and the result of the test (at the 5% level)?

(A) The p-value is between **20-30%**, there **is** evidence to suggest mean sales have increased to over 45.

(B) The p-value is between **98-99%**, there is **no** evidence to suggest mean sales have increased to **over 45**.

(C) The p-value is between **1-2%**, there **is** evidence to suggest mean sales have increased to **over 45**.

(D) The p-value is between **10-15%**, there is **no** evidence to suggest mean sales have increased to **over 45**. Look at t-tables.

(E) The p-value is between **85-90%** there is **no** evidence to suggest the mean sales have increased to over 45.

(4) Using the output above construct a 95% confidence interval for the mean number of dail sales after the promotion.

(A) $[48 \pm 1.77 \times 2.67] = [43.27, 52.7]$ [B] $[48 \pm 2.16 \times 2.67] = [42.23, 53.76]$

(C) $[40 \pm 2.16 \times 2.67] = [34.23, 45.76]$ [D] $[40 \pm 1.77 \times 2.67] = [35.27, 44.72]$

(E) $[0, 48 + 2.16 \times 2.67] = [0, 53.76]$.

(5) Suppose in the construction of the 95% confidence interval, above, you had used the normal distribution **instead** of the t-distribution. Which statement(s) is correct?

(A) The confidence interval would be narrower and you would have **more** than 95% confidence in the interval.

(B) The confidence interval would be narrower and you would have **less** than 95% confidence in the interval.

(C) The confidence interval would be wider and you would have **more** than 95% confidence in the interval.

(D) By using the t-distribution you correct the for lack of normality of the data

(E) [C] and [D].

→ If a normal distribution is used the interval is $[48 \pm 1.96 \times 2.67]$ this is narrower than $[42.23, 53.76]$. So less confidence.

(6) Using the output above is there **any evidence** in the data (think testing) to suggest that the sales promotion has increased mean sales to over 49 cheeses per day.

(A) **Yes**, it is likely, since 49 is contained within the 95% confidence interval [42.23, 53.76].

(B) **Yes**, it is likely, since the 49 is not contained within the interval [35.27, 44.72].

(C) As the average number of cheeses bought over a 14 day period is only 48, there is **no** evidence the true mean is over 49.

(D) By doing a formal test, we would reject the null and determine there **is** evidence in the data to suggest the mean number of sales has increased to **over 49**.

(E) (A) and (D).

(7) On a tomato box it states that mean weight of tomatoes is $227g$. To ensure that the machine is packing the tomatoes correctly, in a tomato packing plant, **every hour** quality control sample 20 boxes of tomatoes and test the hypothesis $H_0 : \mu = 227g$ vs $H_A : \mu \neq 227g$, each test is done at the **5%** level.

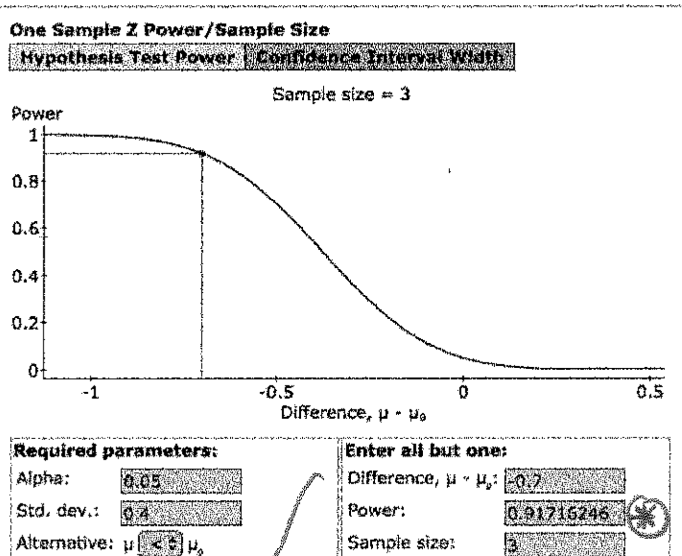
Suppose the machine is **functioning correctly**. Over a 1000 hour period on average how many times will the **null not be rejected**?

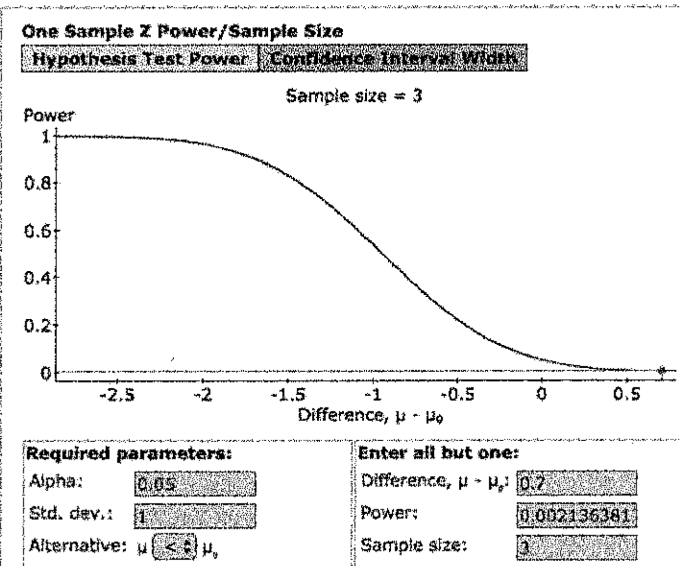
(A) 950 (B) 50 (C) 980 (D) 20 (E) 500.

(8) Low potassium is diagnosed if the mean amount of potassium in blood is **less than** 3.5mg/ml.

To determine whether someone has low potassium **three** blood samples are taken. The standard deviation for each blood sample is known to be $\sigma = 0.4mg/ml$. We test the hypothesis $H_0 : \mu \geq 3.5$ vs $H_A : \mu < 3.5$, the test is done at the 5% level.

A person has critically **critically low potassium** if their mean level is $2.8mg/ml$ or below. A power analysis is given below. Which statement(s) is correct?





$2.8 - 3.5 = -0.7$

(A) We see that there is a **0.2%** chance of diagnosing low potassium when a person has critically low potassium.

(B) We see that there is a **91.7%** chance of diagnosing low potassium when a person has critically low potassium.

(C) We see that there is a **8.3%** chance of the diagnosing low potassium when a person has critically low potassium.

(D) The p-value is **0.2%**, thus there is evidence that the person has critically low potassium.

(E) [A] and [D]

(9) Based on how the data was collected, choose the correct testing procedure.

1. To see whether more accidents happen on Friday 13th compared with other dates, the number of accidents in a hospital was recorded on Friday the 13th and the previous Friday the 6th.
2. The viewing habits of students from Texas A&M in College Station and Galveson were compared by randomly sampling 100 students from both towns.
3. To compare running times at high and low altitudes, the same sample of athletes were asked to run 5 miles at a high altitude and 5 miles at a low altitude.

		[1]	[2]	[3]
1/2	(A)	Independent two sample t-test	Independent two sample t-test	Matched t-test
	(B)	Independent two sample t-test	Matched t-test	One sample t-test
	(C)	Independent two sample t-test	Matched t-test	One sample t-test
	(D)	Matched t-test	One sample t-test	Independent two sample t-test
1	(E)	Matched t-test	Independent two sample t-test	Matched t-test

(10) A health group is concerned that the mean number of calories in Luxury Chocolate bar is **more** than the 200 calories that is advertised. Let μ_B denote the mean number of calories in a Luxury Chocolate bar. They collect a sample of 40 Luxury Chocolate bars and measure the number of calories in each bar and find that the sample mean $\bar{X} = 260$. Identify the hypothesis of interest:

(A) $H_0 : \mu_B \leq 200$ against $H_A : \mu_B > 200$.

(B) $H_0 : \mu_B > 200$ against $H_A : \mu_B \leq 200$.

(C) $H_0 : \mu_B = 200$ against $H_A : \mu_B > 260$.

(D) $H_0 : \bar{X} \geq 260$ against $H_A : \bar{X} < 260$.

(E) $H_0 : \bar{X} \leq 200$ against $H_A : \bar{X} > 260$.

(11-12) The weights of three types of geese/ducks are compared. Namely, canadian geese, muscovy ducks and snow geese, 10 of each animal is sampled. The dot plot of the weights in each group is given below.

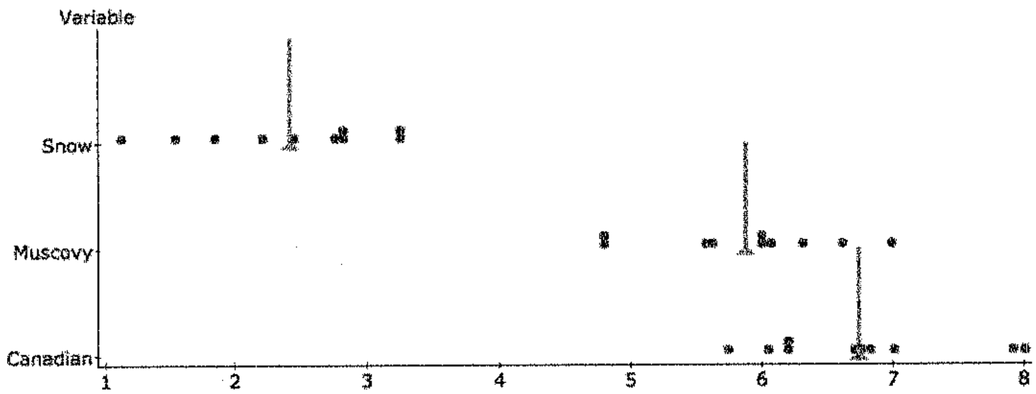


Figure 1: Average Snow = 2.4, Average Muscovy = 5.8, Average Canadian = 6.7.

(11) Use the plot in Figure 1 to identify the correct p-value for each hypothesis. Read each hypothesis **carefully**.

	$H_0 : \mu_{\text{Canadian}} - \mu_{\text{Muscovy}} \leq 0$ $H_A : \mu_{\text{Canadian}} - \mu_{\text{Muscovy}} > 0$	$H_0 : \mu_{\text{Canadian}} - \mu_{\text{Snow}} \leq 0$ $H_A : \mu_{\text{Canadian}} - \mu_{\text{Snow}} > 0$	$H_0 : \mu_{\text{Muscovy}} - \mu_{\text{Snow}} \leq 0$ $H_A : \mu_{\text{Muscovy}} - \mu_{\text{Snow}} > 0$
A	90-99%	more than 99.9%	more than 99.9%
B	1-10%	less than 0.1%	less than 0.1%
C	greater than 50%	10-20%	less than 5%
D	less than 0.1%	10-20%	10-20%
E	30-40%	greater than 50%	40-50%

(12) Use the plot in Figure 1 to identify the correct p-value for each hypothesis. Read each hypothesis **carefully**.

	$H_A : \mu_{\text{Canadian}} - \mu_{\text{Muscovy}} \geq 0$ $H_A : \mu_{\text{Canadian}} - \mu_{\text{Muscovy}} < 0$	$H_A : \mu_{\text{Canadian}} - \mu_{\text{Snow}} \geq 0$ $H_A : \mu_{\text{Canadian}} - \mu_{\text{Snow}} < 0$	$H_A : \mu_{\text{Muscovy}} - \mu_{\text{Snow}} \geq 0$ $H_A : \mu_{\text{Muscovy}} - \mu_{\text{Snow}} < 0$
A	90-99%	more than 99.9%	more than 99.9%
B	1-10%	less than 0.1%	less than 0.1%
C	less than 50%	10-70%	10-20%
D	more than 99.9%	80-90%	80-90%
E	less than 0.1%	10-20%	10-20%

(13-14) A study was conducted to understand if people are **more** restless during the full moon than other times of the month. A sample of 30 volunteers were recruited. It was found that the volunteers woke, on average, 0.766 **more** times during the full moon compared with the new moon (no moon in sky)[1]. The results of a matched t-test is given below. $= 0.04\%$

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

Difference	Mean	Std. Err.	DF	T-Stat	P-value
FullMoon - NewMoon	0.76666667	0.20724428	29	3.6993381	0.9996

$\rightarrow 1 - 0.9996 = 0.0004$

(13) Let μ_{fullmoon} denote the mean number of wake times during full moon and μ_{fullmoon} denote the mean number of wake times during half moon. Based on what the researchers want to study identify the hypothesis of interest and the results of the test (at the 5% level).

(A) $H_0 : \mu_{\text{fullmoon}} - \mu_{\text{newmoon}} \leq 0$ vs $H_A : \mu_{\text{fullmoon}} - \mu_{\text{newmoon}} > 0$. The p-value is 0.08% we reject the null, there is **no** evidence to suggest a person is **more** restless during the full moon.

(B) $H_0 : \mu_{\text{fullmoon}} - \mu_{\text{newmoon}} \leq 0$ vs $H_A : \mu_{\text{fullmoon}} - \mu_{\text{newmoon}} > 0$. The p-value is 99.96% we reject the null, there is evidence that a persons is **less** restless during the full moon.

(C) $H_0 : \mu_{\text{fullmoon}} - \mu_{\text{newmoon}} = 0$ vs $H_A : \mu_{\text{fullmoon}} - \mu_{\text{newmoon}} \neq 0$. The p-value is 99.96% we reject the null, there is **no** evidence that a persons sleep behavior is different over the full moon.

(D) $H_0 : \mu_{\text{fullmoon}} - \mu_{\text{newmoon}} \geq 0$ vs $H_A : \mu_{\text{fullmoon}} - \mu_{\text{newmoon}} < 0$. The p-value is 99.96% we reject the null, there is **no** evidence to suggest a person is **more** restless during the full moon.

(E) $H_0 : \mu_{\text{fullmoon}} - \mu_{\text{newmoon}} \leq 0$ vs $H_A : \mu_{\text{fullmoon}} - \mu_{\text{newmoon}} > 0$. The p-value is 0.04% we reject the null, there **is** evidence to suggest a person is **more** restless during the full moon.

(14) To assess the reliability of the above data analysis a histogram of the data and sample mean over 30 observations is plotted in Figure 2 (next page).

Which statement(s) are correct?

1/2 (A) The data is numerical discrete.

1/2 (B) The sample mean is close to normally distributed, so the p-value in (13) is reliable.

(C) The sample mean is right skewed, so the p-value in (13) is unreliable.

(D) (A) and (B)   [E] (A) and (C).

[1]Look at the moon tonight!

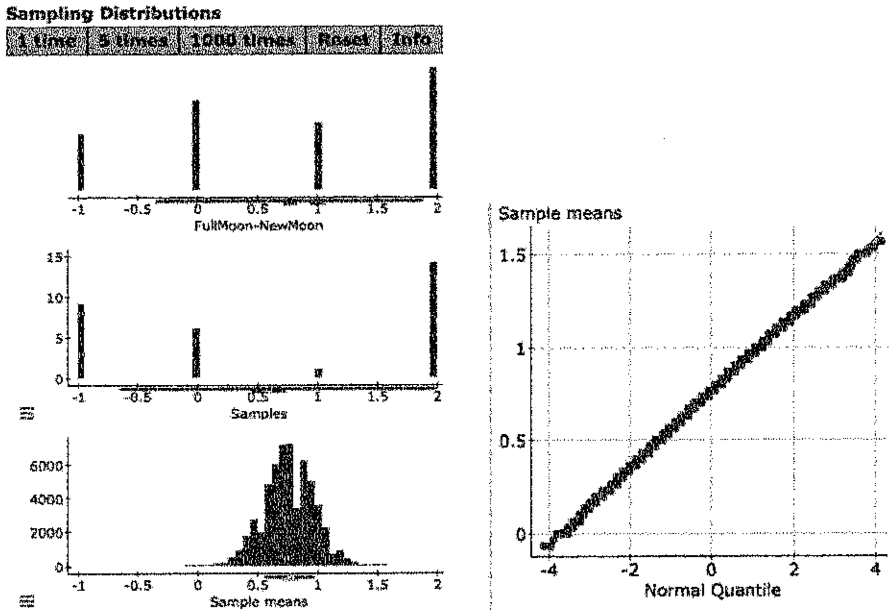


Figure 2: Left: Histogram of the differences in the moon data and the sample mean, Right: QQplot of the sample mean

(15) Which statement(s) correctly identify the general behaviour of (sample) standard deviations and standard errors.

1/2 (A) The standard error measures the reliability of the sample mean. As the sample size grows the standard error gets smaller.

(B) The standard deviation measures the spread of the population. Usually it is unknown and it has to be estimated from the data. As the sample size grows the sample standard deviation gets smaller.

1/2 (C) The standard deviation measures the spread of the population. Usually it is unknown and it has to be estimated from the data. As the sample size grows the sample standard deviation tends to get closer to the population standard deviation.

(D) (A) and (B) [E] (A) and (C).

1

(16) Blue bell ice cream made a sales promotion to **increase** sales of their ice cream. The sales for each month in 2014 (before the promotion) are compared with the corresponding monthly sales in 2015 (after the promotion). There are 12 observations from 2014 and 12 observations from 2015. The output of both a matched, paired t-test and and an independent two sample t-test are given below (since they did not know which test to use), together with the scatterplot of the sales. Each point on the plot corresponds to one month (2014 against 2015).

Options

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

Difference	Mean	Std. Err.	DF	T-Stat	P-value
AfterPromo - BeforePromo	19.583333	4.994631	11	3.9208769	0.0012

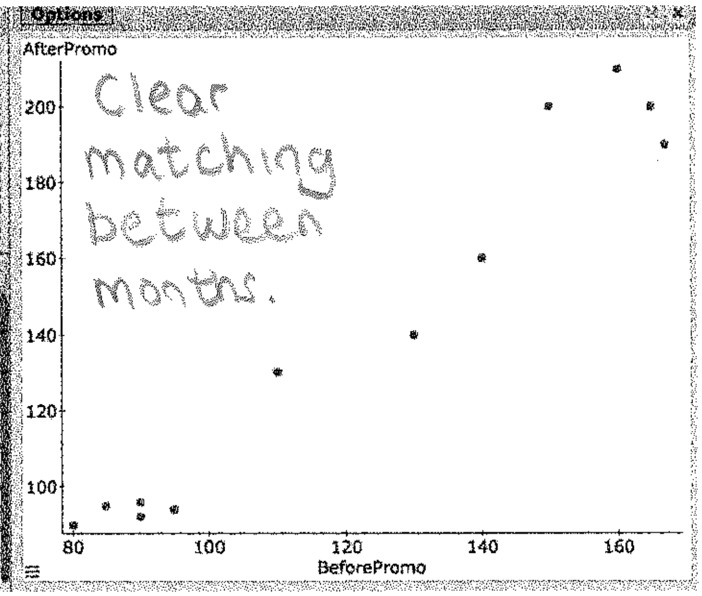
(*)

Options

Two sample T hypothesis test:
μ_1 : Mean of AfterPromo
μ_2 : Mean of BeforePromo
$\mu_1 - \mu_2$: 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
$\mu_1 - \mu_2$	19.583333	17.078381	19.618751	1.1466739	0.1327



Identify the hypothesis of interest and the correct output to use. State the results of the test at the 5% level.

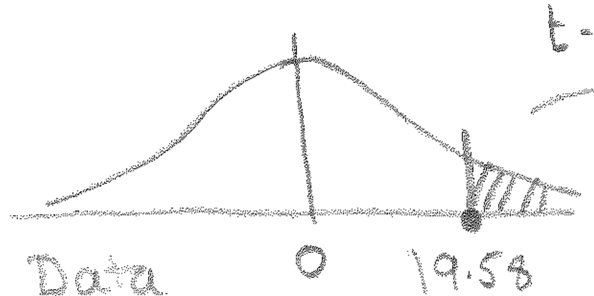
(A) $H_0 : \mu_{\text{after}} - \mu_{\text{before}} > 0$ vs $H_A : \mu_{\text{after}} - \mu_{\text{before}} \leq 0$ the p-value is 0.12%, there is **no** evidence the promotion worked.

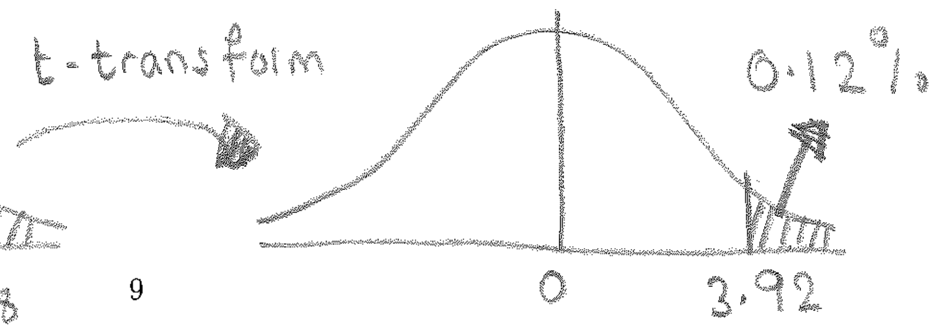
(B) $H_0 : \mu_{\text{after}} - \mu_{\text{before}} \leq 0$ vs $H_A : \mu_{\text{after}} - \mu_{\text{before}} > 0$ the p-value is 0.12%, there **is** evidence the promotion worked.

(C) $H_0 : \mu_{\text{after}} - \mu_{\text{before}} \leq 0$ vs $H_A : \mu_{\text{after}} - \mu_{\text{before}} > 0$ the p-value is 13.27%, there is **no** evidence the promotion worked.

(D) $H_0 : \mu_{\text{after}} - \mu_{\text{before}} \leq 0$ vs $H_A : \mu_{\text{after}} - \mu_{\text{before}} > 0$ the p-value is 86.73%, there is **no** evidence the promotion worked.

(E) $H_0 : \mu_{\text{after}} - \mu_{\text{before}} \geq 0$ vs $H_A : \mu_{\text{after}} - \mu_{\text{before}} < 0$ the p-value is 99.88%, there is **is** evidence the promotion worked.





(17) It is believed that a calcium low diet **increases** iron observation compared with a calcium high diet.

20 volunteers were randomly split into two groups (each of size 10). One group was placed on a calcium low diet, while the the other group was placed on a calcium high diet. The change in iron absorption is measured in both groups. In the Calcium Low group the iron absorption **increased** by 1.6, whereas in the Calcium High group iron absorption **decreased** by 0.43. The data summarized below.

Two sample T confidence interval:
μ_1 : Mean of CalciumHigh
μ_2 : Mean of CalciumLow
$\mu_1 - \mu_2$: Difference between two means
(without pooled variances)

95% confidence interval results:

Difference	Sample Diff.	Std. Err.	DF
$\mu_1 - \mu_2$	-1.991	0.62343894	17.623898

$$t = \frac{-1.991 - 0}{0.623} = -3.19$$

probability	0.3	0.15	0.10	0.05	0.025	0.01	0.005
t^*	0.52	1.04	1.29	1.695	1.98	2.37	2.63

Table 1: Critical values for t-distribution with 17.62 df

Identify the hypothesis of interest and the results of the test at the 5% level.

(A) $H_0 : \mu_1 - \mu_2 \leq 0$ vs $H_A : \mu_1 - \mu_2 > 0$, the p-value is close to 100%, there is **no** evidence that a calcium low diet **increases** iron absorption.

(B) $H_0 : \mu_1 - \mu_2 \geq 0$ vs $H_A : \mu_1 - \mu_2 < 0$, the p-value less than 0.5%, there **is** evidence that a calcium low diet **increases** iron absorption.

(C) $H_0 : \mu_1 - \mu_2 \geq 0$ vs $H_A : \mu_1 - \mu_2 < 0$, the p-value less than 0.5%, there **is** evidence that a calcium low diet **reduces** iron absorption.

(D) $H_0 : \mu_1 - \mu_2 \leq 0$ vs $H_A : \mu_1 - \mu_2 > 0$, the p-value is close to 100%, there **is** evidence that a calcium low diet **reduces** iron absorption.

(E) $H_0 : \mu_1 - \mu_2 = 0$ vs $H_A : \mu_1 - \mu_2 \neq 0$, the p-value less than 1%, there is **no** evidence of a change.

$H_0: \mu_{CaHig} - \mu_{CaLow} \geq 0$ $H_A: \mu_{CaHigh} - \mu_{CaLow} < 0$

less than 0.5%