AP Statistics
Unit 06 – HW #6
Significance Tests: Means

Name Key
Period

1. An inventor has developed a new, energy-efficient lawn mower engine. He claims that the engine will run continuously for 5 hours (300 minutes) on a single gallon of regular gasoline. Suppose a simple random sample of 50 engines is tested. The engines run for an average of 295 minutes, with a standard deviation of 20 minutes. Test the null hypothesis that the mean run time is 300 minutes against the alternative hypothesis that the mean run time is not 300 minutes. Assume that run times for the population of engines are Normally distributed.

State: $H_0: \mu = 300$ minutes
$H_A: \mu \neq 300$ minutes
$\bar{x} = 295$ minutes $\quad \alpha = 0.05$

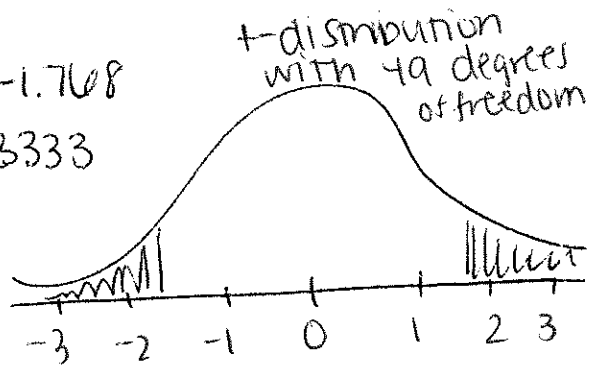
where μ = the true mean run time of a lawnmower engine on a single gallon of regular gasoline, in minutes.

Plan: Random: simple random sample ✓
10% condition: 500 < all lawnmower engines
Normal/Large: $n \geq 30$
$50 \geq 30$ ✓ and the population dist. is approx. Normal.

Because our conditions are met, we will perform a 1-sample t-test for the population mean μ.

DO: T-Test:
$\mu_0: 300$
$\bar{x}: 295$
$S_x: 20$
$n: 50$
$\mu \neq \mu_0$

$df = 49$
test statistic: -1.768
p-value: 0.08333



Conclude: Because our p-value 0.08333 is greater than our significance level $\alpha = 0.05$, we fail to reject the null. There is not convincing evidence that the true mean run time of a lawnmower engine on a single gallon of regular gasoline differs from 300 minutes.

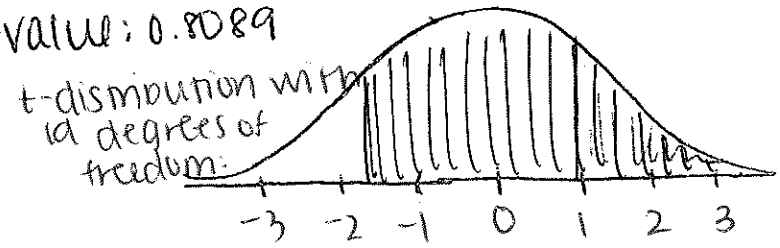
2. Bon Air Elementary School has 300 students. The principal of the school thinks that the average IQ of students at Bon Air is ~~at least~~ over 110. To prove her point, she administers an IQ test to 20 randomly selected students. Among the sampled students, the average IQ is 108 with a standard deviation of 10. Based on these results, should the principal accept or reject her original hypothesis? Assume pop. dist. is approx. Normal

State: $H_0: \mu = 110$ points
$H_A: \mu > 110$ points
where μ = the true mean IQ score of students at Bon Air Elementary School.
$\bar{x} = 108$ points $\alpha = 0.05$

Plan: Random: randomly selected students ✓
10% condition: 200 < 300 students at the school ✓
Normal/Large: population distribution is approximately Normal. ✓
(even though n = 20 ~~>30~~)
because our conditions are met, we will perform a 1-sample t-test for the population mean μ.

Do: T-Test:
μ_0: 110
$\bar{x}$: 108
S_x: 10
n: 20
$\mu > \mu_0$

df: 19
test statistic: -0.8944
p-value: 0.8089



Conclude: Because our p-value 0.8089 is greater than our significance level $\alpha = 0.05$, we fail to reject the null. There is not convincing evidence that the true mean IQ score of students at Bon Air elementary is greater than 110.

3. A bus company advertised a mean time of 150 minutes for a trip between two cities. A consumer group had reason to believe that the mean time was more than 150 minutes. A random sample of 40 trips showed a mean $\bar{x}$= 153 minutes and a standard deviation s=7.5 minutes. Determine if the consumer group's hypothesis is correct.

State: $H_0: \mu = 150$ minutes where μ = the true mean time of a bus trip between 2 cities, in minutes.

$H_A: \mu > 150$ minutes

$\bar{x} = 153$ minutes $\quad \alpha = 0.05$

Plan: Random: random sample ✓

10% Condition: 400 < all bus trips between these two cities ✓

Normal/Large: $n = 40 > 30$ ✓

because our condition are met, we will perform a 1-sample t-test for the population mean μ.

Do:

T-Test:

μ_0: 150

$\bar{x}$: 153

S_x: 7.5

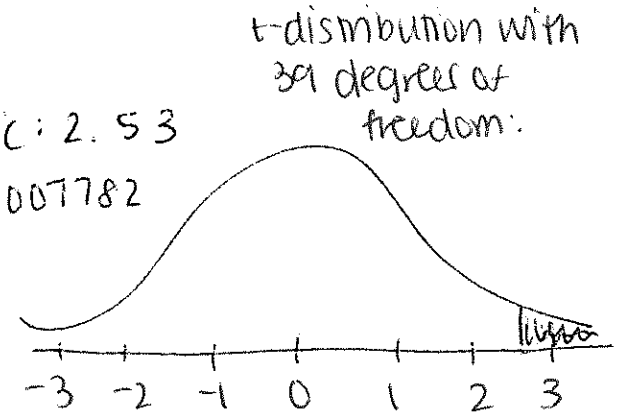
n: 40

$\mu > \mu_0$

df = 39

test statistic: 2.53

p-value: 0.007782



Conclude: Because our p-value 0.007782 is less than our significance level $\alpha = 0.05$, we reject the null. There is convincing evidence that the true mean time of a bus trip between 2 cities is greater than 150 minutes.

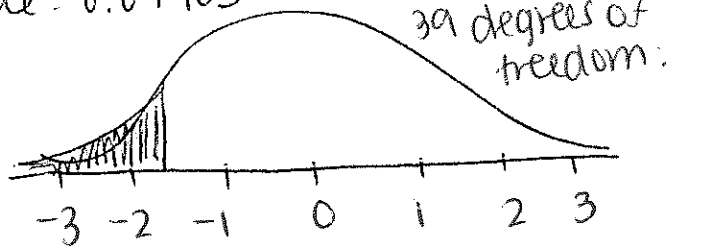
4. According to the Centers for Disease Control, the mean number of cigarettes smoked per day by individuals who are daily smokers is 18.1. Do retired adults who are daily smokers smoke less than the general population of daily smokers? To answer this question, we obtain a random sample of 40 retired adults who are current daily smokers and record the number of cigarettes smoked on a randomly selected day. The data result in a sample mean of (16.8) cigarettes and a standard deviation of (4.7) cigarettes.

State: $H_0: \mu = 18.1$ cigarettes
$H_A: \mu < 18.1$ cigarettes
$\bar{x} = 16.8$ cigarettes $\quad \alpha = 0.05$
where μ = the true mean # of cigarettes that a retired adult smokes daily.

Plan: Random: random sample ✓
10% condition: 400 < all retired adults ✓
Normal/Large: $n = 40 \geq 30$ ✓
Because our conditions are met, we will perform a 1-sample t-test for the population mean μ.

Do: T-Test:
μ_0: 18.1
$\bar{x}$: 16.8
S_x: 4.7
n: 40
$\mu < \mu_0$

df: 39
test-statistic: -1.749
p-value: 0.04405



Conclude: Because our p-value 0.04405 is less than our significance level $\alpha = 0.05$, we reject the null. There is convincing evidence that the true mean # of cigarettes that a retired adult smokes daily is less than 18.1 cigarettes.

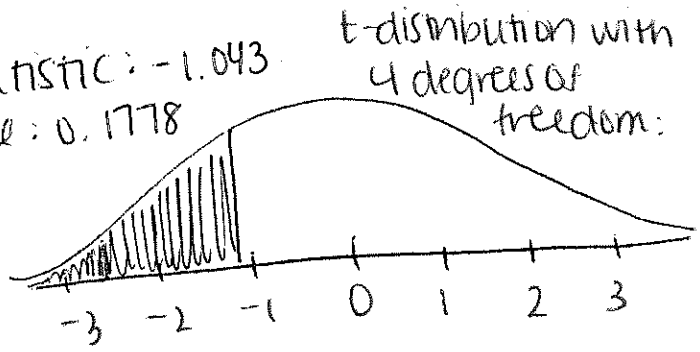
5. A recent report indicated that waiters and waitresses at casual dining restaurants make an average of $100 per night in tips with a standard deviation of $15. Maureen works in a casual dining restaurant and doesn't think this is correct. She feels she makes much less than this in an average night. Over the next five work nights, she computes her tips and the average is $93. Determine if the average on tips is really $100. Assume the population dist. for tip amount in $ is approx. Normal.

State: $H_0: \mu = \$100$ where μ = the true mean amount of tips made by individual servers casual restaurants, in dollars, per night.
$H_A: \mu < \$100$
$\bar{x}: \$93$ $\alpha = 0.05$

Plan: Random: Every night in a work week ✓
10% Condition: 50 < all nights the waitress works ✓
Normal/Large: $n = 5$ ~~≥ 30~~ but the distribution is approx. Normal with no outliers and no strong skewness ✓
because our conditions are met, we will perform a 1-sample t-test for the population mean μ.

DO: T-Test:
$\mu_0: 100$
$\bar{x}: 93$
$S_x: 15$
$n: 5$
$\mu < \mu_0$

df: 4
test-statistic: -1.043
p-value: 0.1778



Conclude: Because our p-value 0.1778 is greater than our significance level $\alpha = 0.05$, we fail to reject the null. There is not convincing evidence that the true mean amount of tips made by a server in a casual restaurant per night is less than $100.