Practical No: 04

Q1. Write R command for the following data to test the hypothesis (i) H0: µ = 3400 against H1: µ ≠

3400 (ii) H0: µ = 3400 against H1: µ &lt; 3400 (iii) H0: µ = 3400 against H1: µ &gt; 3400 at 5% L.O.S. 3366, 3337, 3361, 3410, 3316, 3357, 3348, 3356, 3376,

3382, 3377, 3355, 3408, 3401, 3390, 3424, 3383, 3374, 3384, 3390

Ans-

* # Student t-Test
* # Left Tailed Problem
* # H0: mu=3400 vs H1: mu<3400
* x<- c (3366,3337,3361,3410,3316,3357,3348,3356,3376,

+ 3382,3377,3355,3408,3401,3390,3424,3383,3374,3484,3390)

* y<-NULL
* mu<-3400

>

* tTest<-t.test(x,y,mu,alt="less")
* tTest

One Sample t-test

data: x

t = -2.5268, df = 19, p-value = 0.01027

alternative hypothesis: true mean is less than 3400 95 percent confidence interval:

-Inf 3393.607

sample estimates:

mean of x 3379.75

* names(tTest)

[1] "statistic" "parameter" "p.value" "conf.int" "estimate"

[6] "null.value" "alternative" "method" "data.name"

* tTest$statistic t

-2.526799

* tTest$parameter df

19

* tTest$p.value [1] 0.01027214
* tTest$conf.int [1] -Inf 3393.607

attr(,"conf.level") [1] 0.95

* tTest$estimate mean of x

3379.75

* tTest$null.value mean

3400

* tTest$alternative

[1] "less"

* tTest$method

[1] "One Sample t-test"

* tTest$data.name

[1] "x"

* if(tTest$p.value<0.05)

+ {

+ print ('Reject H0 i.e., population mean is less than 3400.')

+} else

+ {

+ print ('Accept H0 i.e., population mean is 3400.')

+ }

[1] "Reject H0 i.e., population mean is less than 3400."

Q2. Below are given the gain in weights (in lbs.) of pigs fed on two diets A and B. Diet A: 25,32,30,43,24,14,32,24,31,31,35,25 Diet B:

44,34,22,10,47,31,40,30,32,35,18,21,35,29,22 Test, if the two diets differ significantly as regards their effect on increase in weight. Use LOS 5%.

Ans-

* #student t-Test for double mean
* #Two Tailed Problem
* H0: NO significant difference between means of x and y vs
* H1: significant difference between means of x and y

>x<-c (25, 32, 30, 34, 24, 14, 32, 24, 30, 31, 35, 25)

>y<-c (44, 34, 22, 10, 47, 31, 40, 30, 32, 35, 18, 21, 35, 29, 22)

>

>tTest<- t. test (x, y, var. equal=T)

* TTest

TWO sample t-test data: x and y

T= -0.61028, df = 25, p-value = 0.5472

alternative hypothesis: true difference in means is not equal to 0 95 percent confidence interval:

-8.749507 4.749507

sample estimates:

mean of x mean of y 28 30

* if (tTest$p.va1ue<0.05)

+ {

+ print ('Reject H0 i.e., there is significant difference b/ n means. ')

+} else

+ {

+ print ('Accept H0 i.e., there is no significant difference b/n means. ')

+ }

[1] "Accept HO i.e., there is no significant difference b/ n means. "

Q3. Eleven school boys were given a test in mathematics. They were given a month’s tuition and a second test was held at the end of it. Do the marks give evidence that the students have benefited by the extra coaching? Use LOS 5%. Marks in test-1: 23, 20, 19, 21, 18, 20, 18, 17, 23, 16, 19 Marks in test-2: 24, 19,

22, 18, 20, 22, 20, 20, 23, 20, 17

Ans-

* # Paired t-Test
* # Two Tailed Problem
* # HO: No significant difference between x and y vs
* # Hl: Significant difference between x and y >
* x<-c (23,20,19,21,18,20,18,17,23,16,19)
* y<-c (24,19,22,18,20,22,20,20,23,20,17)
* tTest<-t.test(x,y,paired-T)
* tTest

Paired t-test data: x and y

t = -1.4832, df = 10, p-value = 0.1688

alternative hypothesis: true difference in means is not equal to 0 95 percent confidence interval:

-2.5022109 0.5022109

sample estimates: mean of the differences

-1

* if(tTest$p.value<0.05)

+ {

+ print ('Reject HO i.e., there is significant difference b/n x s y.')

+} else

+ {

+ print ('Accept HO i.e., there is no significant difference b/n x & y.')

+ }

[1] "Accept HO i.e., there is no significant difference b/n x & y."

Q4. Twelve cars were equipped with radial tires and driven over a test course.

Then the same 12 cars

(with the same drivers) were equipped with regular belted tires and driven over the same course.

After each run, the cars’ gas economy (in km/l) was measured. Is there evidence that radial tires

produce better fuel economy? (Assume normality of data, and use = .05.) gas 1 2 3 4 5 6 7 8 9 10 11 12

radial 4.2 4.7 6.6 7 6.7 4.5 5.7 6 7.4 4.9 6.1 5.2

belted 4.1 4.9 6.2 6.9 6.8 4.4 5.7 5.8 6.9 4.7 6 4.9 ANSWER:

𝑑*̅ = 0.1417 ,* 𝑆𝑑 *= 0.1975*

* 𝐻***0: = 0 against*** 𝐻***1: > 0***



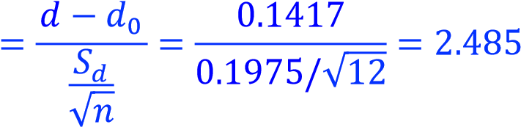
𝜇𝑑



𝜇𝑑

* ***Test statistic :***



𝑇

***3. Decision:***

***Rejection Region(***𝑇 ***>*** 𝑇𝑛***1−1,***𝛼***)***

𝑇𝑛***1−1,***𝛼 ***=*** 𝑇***11,0.05 = 1.796***

***Reject*** 𝐻***0 = 2.485 > 1.796*** ⟹ 𝑤𝑒 𝑅𝑒𝑗𝑒𝑐𝑡 𝐻***0 at*** 𝛼 ***= 0.05.***



𝑖𝑓 𝑇



***i.e the cars equipped with radial tires give better fuel economy than those equipped with belted tires***

Q5. To test the hypothesis that eating fish makes one smarter, a random sample of 12 persons take a

fish oil supplement for one year and then are given an IQ test. Here are the results: 116 111 101 120

99 94 106 115 107 101 110 92

Solution:-

One-sample t-test. To test the hypothesis that eating fish makes one smarter, a random sample of 12

persons take a fish oil supplement for one year and then are given an IQ test. Here are the results:

116 111 101 120 99 94 106 115 107 101 110 92

Test using the following hypotheses, report the test statistic with the P-value, then summarize your

conclusion. H0: μ = 100 Ha: μ > 100

Answer:

Hypotheses:

H0: μ = 100 (no effect -- eating fish does not help increase the mean IQ) Ha: μ > 100 (effect -- eating fish helps increase the mean IQ)

Test statistic:

From the data, we obtain 𝒙𝒙� = 𝟏𝟏𝟏𝟏𝟏𝟏 and 𝐬𝐬𝒙𝒙 = 𝟖𝟖. 𝟖𝟖𝟖𝟖. Then we get

𝒕𝒕 = 𝒙𝒙� − 𝝁𝝁𝟎𝟎

𝒔𝒔𝒙𝒙

√𝒏𝒏

= 𝟏𝟏𝟏𝟏𝟏𝟏 − 𝟏𝟏𝟏𝟏𝟏𝟏

𝟖𝟖. 𝟖𝟖𝟖𝟖

√𝟏𝟏𝟏𝟏

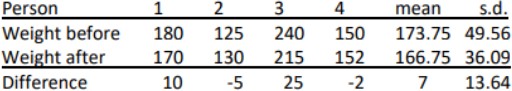
= 𝟔𝟔

𝟐𝟐. 𝟓𝟓𝟓𝟓 = 𝟐𝟐. 𝟑𝟑𝟑𝟑.

Q6. The water diet requires you to drink 2 cups of water every half hour from when you get up until

you go to bed but eat anything you want. Four adult volunteers agreed to test this diet. They are

weighed prior to beginning the diet and 6 weeks after. Their weights in pounds are



**Solution:-**

Matched one-sample t-test. The water diet requires you to drink 2 cups of water every half hour from

when you get up until you go to bed but eat anything you want. Four adult volunteers agreed to test this

diet. They are weighed prior to beginning the diet and 6 weeks after. Their weights in pounds are

Person 1 2 3 4 mean \_ s.d.

Weight before 180 125 240 150 173.75 49.56

Weight after 170 130 215 152 166.75 36.09

Difference 10 -5 25 -2 7 13.64

Conduct a one-sample t-test using the difference with the following hypotheses: H0: Diff = 0

Ha: Diff ≠ 0

Report the test statistic with the P-value, then summarize your conclusion. Answer:

Hypotheses:

H0: Diff = 0 (no difference -- there is no difference in the mean of the weight difference)

Ha: Diff ≠ 0 (difference – diet made difference in the mean of the weight difference)

Test statistic:

From the data, we know 𝑫𝑫𝑫𝑫𝑫𝑫𝑫𝑫 ������� = 𝟕𝟕 and

𝐬𝐬𝑫𝑫𝑫𝑫𝑫𝑫𝑫𝑫 = 𝟏𝟏𝟏𝟏. 𝟔𝟔𝟔𝟔. Then we get

𝒕𝒕 = 𝑫𝑫𝑫𝑫𝑫𝑫𝑫𝑫 ������� − 𝝁𝝁𝟎𝟎

𝒔𝒔𝑫𝑫𝑫𝑫𝑫𝑫𝑫𝑫

√𝒏𝒏

= 𝟕𝟕 − 𝟎𝟎

𝟏𝟏𝟏𝟏. 𝟔𝟔𝟔𝟔

√𝟒𝟒

= 𝟕𝟕

𝟔𝟔. 𝟖𝟖𝟖𝟖 = 𝟏𝟏. 𝟎𝟎𝟎𝟎𝟎𝟎.

Q7. Two different alloys are being considered for making lead-free solder used in the wave soldering

process for printed circuit boards. A crucial characteristic of solder is its melting point, which is

known to follow a Normal distribution. A study was conducted using a random sample of 21 pieces

of solder made from each of the two alloys. In each sample, the temperature at which each of the 21

pieces melted was determined. The mean and standard deviation of the sample for Alloy 1 were x1 =

218.9ºC and s1 = 2.7ºC; for Alloy 2 the results were x2 = 215.5ºC and s2 = 3.6ºC. If we were to test

H0: µ1 = µ2 against Ha: µ1 ≠ µ2 , what would be the value of the test statistic??

Answer:

***The two-sample test statistic (for the hypothesis*** 𝜇𝜇***1 −*** 𝜇𝜇***2 = 0) is***

***(***𝑥𝑥***1 −*** 𝑥𝑥***2) 218.9 − 215.5 3.4 3.4 3.4***

𝑡𝑡

***21 21***



𝑛𝑛𝑠𝑠***121 +*** 𝑛𝑛𝑠𝑠***222***

***And the degrees of freedom is 21 – 1 = 20.***

Q8. A U.S. magazine, Consumer Reports, carried out a survey of the calorie and sodium content of a

number of different brands of hotdog. There were two types of hotdog: beef, ’meat‘ (mainly pork

and beef but can contain up to 15% poultry) and poultry. The results below are the calorie content

of the different brands of beef and poultry hotdogs.

Beef hotdogs: 186, 181, 176, 149, 184, 190, 158, 139, 175, 148, 152, 111,

141, 153, 190, 157, 131,

149, 135, 132

Poultry hotdogs: 129, 132, 102, 106, 94, 102, 87, 99, 170, 113, 135, 142,

86, 143, 152, 146, 144.

Is , there is strong evidence that the calorie content of poultry hotdogs is lower than the calorie

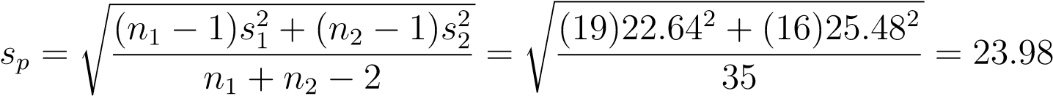
ANSWER:

***content of beef hotdog Before carrying out a t-test you should check whether the two samples are roughly normally distributed. This can be done by looking at histograms of the data. In this case there are no outliers and the data look reasonably close to a normal distribution; the t-test is therefore appropriate. So, first we need to calculate the sample mean and standard deviation in each group:***

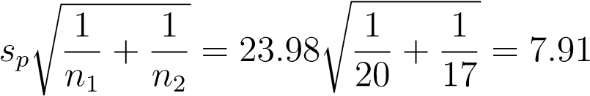
|  |  |  |  |
| --- | --- | --- | --- |
| ***Group*** | ***Sample size*** | ***Sample mean*** | ***Sample standard deviation*** |
| ***Beef*** | ***20*** | ***156.85*** | ***22.64*** |
| ***Poultry*** | ***17*** | ***122.47*** | ***25.48*** |

***So, we have ¯x1 − x¯2 = 156.85 − 122.47 = 34.38***

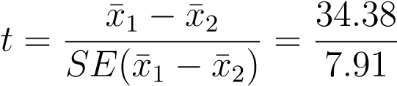
***The standard deviations are approximately equal, so we can calculate the pooled standard deviation:***



***We can now calculate SE(¯x1 − x¯2):***



***And now the value for T:***



***If we look this up in tables of the t-distribution with 35 degrees of freedom, we find p < 0.001. Therefore, there is strong evidence that the calorie content of poultry hotdogs is lower than the calorie content of beef hotdogs.***