Statistics Software Lab Report - 8 (Outputs file)

Name of the Student: Shatansh Patnaik
Roll No: 20MA20067

IIT Kharagpur
Statistics Software Lab

Problem-1

The lateral deviation in yards of a certain type of mortar shell is being investigated by the propellant manufacturer. The following data have been observed:

Round	Deviation
1	11.28
2	−10.42
3	−8.51
4	1.95
5	6.47
6	−9.48
7	6.25
8	10.11
9	−8.65
10	−0.68

Assuming that the lateral deviations are normally distributed, test the hypothesis

$$H_0 : \mu = 0 \quad \text{vs.} \quad H_1 : \mu \neq 0,$$

where μ is the mean lateral deviation of these mortar shells. Take $\alpha = 0.05$ and 0.1.

```
> ########################################################################
> # Exercise - 1
> print(t)
[1] -0.06203595
> print(critical_value)
[1] 2.262157

Accept the Null Hypothesis that mean is equal to 0 with alpha = 0.05
> ############################################################s############
```

Problem-2

Lengths of pins (in mm) produced by a machine follow a normal distribution. Using a measuring device on a random sample of 10 pins following lengths were observed: 7.12, 7.13, 7.01, 6.95, 6.89, 6.97, 6.99, 6.93, 7.05, 7.02. Test the hypothesis $H_0 : \sigma^2 \leq 0.005$ vs. $H_1 : \sigma^2 > 0.005$ at 5% level of significance.

```
> ########################################################################
> # Exercise - 2
> print(critical_value)
[1] 3.325113
> print(chi_square)
[1] 10.888

Reject the Null Hypothesis that variance is less than equal to 0.005 with
    alpha = 0.05
> ########################################################################
```

Problem-3

Breaking strength (in kg) of the front part of a new vehicle is normally distributed. In 10 trials, the breaking strengths were found to be 578, 572, 570, 568, 572, 570, 570, 572, 596, 584. Assuming the standard deviation $\sigma = 8.7$, test the hypothesis $H_0 : \mu \leq 570$ vs. $H_1 : \mu \geq 570$ at the 1% level of significance.

```
> ######################################################################
# Problem-3
> print(critical_value)
[1] -2.326348
> print(z)
[1] 1.879296

Reject the Null Hypothesis that mean = 570 with alpha = 0.1
> ######################################################################
```

Problem 4

The following measurements on time (in seconds) of an Olympic class athlete in completing ten 100 meters races are recorded:

$$9.85, 9.93, 9.75, 9.77, 9.67, 9.87, 9.67, 9.94, 9.85, 9.75$$

Can it be claimed that at the 5% level of significance, the average time for the athlete to complete the race is less than 10 seconds?

```
> ######################################################################
# Problem-4
> print(critical_value)
[1] 1.833113
> print(t)
[1] -6.313726

[1] "Accept the Null Hypothesis that that the average time for the athelete
    to complete the race is less than 10 seconds"
> ######################################################################
```

Problem 5

An experiment was conducted to compare the recovery time (in days) of patients from a serious disease using two different medications. The first medicine was given to a random sample of 15 patients and the sample mean and sample variance of the recovery time were observed to be 16 and 1.4 respectively. The second medicine was administered to a random sample of 19 patients and sample mean and sample variance of the recovery time were observed to be 20 and 2.0 respectively. Test the hypothesis that the average recovery time using the first medicine is significantly less than the one by using the second (at 5% level). Assume the two populations to be normal with equal variances.

```
> ######################################################################
> print(critical_value)
```

```
[1] 1.693889
> print(t)
[1] -8.785785

[1] "Accept the null hypothesis"
> ########################################################################
```

Problem 6

Two catalysts are being analyzed to determine how they affect the mean yield of a chemical process. Let μ_1 and μ_2 denote the mean yields by using catalyst 1 and 2 respectively. On the basis of random samples of size 8 from each process, the following data were recorded: $\bar{X} = 91.73$, $\bar{Y} = 93.75$, $S_{12} = 3.89$, $S_{22} = 4.02$. At the 5% level of significance, test the hypothesis $H_0 : \sigma_1^2 = \sigma_2^2$ vs. $H_1 : \sigma_1^2 \neq \sigma_2^2$. Further test the hypothesis $H_0 : \mu_1 = \mu_2$ vs. $H_1 : \mu_1 \neq \mu_2$ at the 5% level of significance.

```
> ########################################################################
# Problem 6
1] "Testing of variances"
[1] 0.9676617
[1] 4.994909
[1] 0.2002038
Accept the Null Hypothesis

[1] "Testing of means"
[1] -2.031459
[1] -2.144787
Accept the Null Hypothesis
> ########################################################################
```

Problem 7

Carbon emissions on 8 randomly selected vehicles of brand A were recorded as 150, 250, 240, 280, 290, 210, 220, 180, whereas those of 10 randomly selected vehicles of brand B were recorded as 140, 230, 270, 190, 270, 200, 150, 200, 190, 170. First test the hypothesis that the variances of the two populations are equal at the 10% level of significance. Based on the result of this test, conduct an appropriate test for the hypothesis that the average emission from vehicles of brand B is less than the average emission from vehicles of brand A at the 5% level of significance.

```
> ########################################################################
# Problem 7
[1] "Testing of variances"
[1] 1.146291
[1] 3.292746
[1] 0.2719849
Accept the Null Hypothesis

[1] "Testing of means"
[1] 1.214785
[1] 1.745884
```

```
[1] "Accept the null hypothesis"
> ########################################################################
```

Problem 8

It is claimed that an industrial safety program is effective in reducing the loss of working hours due to factory accidents. The following data are collected concerning the weekly loss of working hours due to accidents in 6 plants both before and after the safety program is initiated:

Plant	1	2	3	4	5	6
Before	12	29	16	37	28	15
After	10	28	17	35	25	16

Test the hypothesis if the data support the claim. (Take $\alpha = 0.05$.)

```
> ########################################################################
# Problem 8
[1] "Testing of variances"
[1] 1.171906
[1] 5.050329
[1] 0.1980069
Accept the Null Hypothesis

[1] "Testing of means"
[1] 0.1816015
[1] 1.812461
[1] "Accept the null hypothesis"
> ########################################################################
```

Problem 9

In an opinion survey regarding a certain political issue, there was some question as to whether or not the eligible voters under 25 years of age might view the issue differently from those over 25. Fifteen hundred individuals of those over 25 were interviewed, and 1000 of those under 25 were interviewed with the following results:

	Opposed	Undecided	Favor
Under 25	400	100	500
Over 25	600	400	500
Total	1000	500	1000

Test the hypothesis that there is no association between age and opinion. (Take $\alpha = 0.05$.)

```
> ########################################################################
# Problem 9
[1] "Reject the Null Hypothesis"
> ########################################################################
```