Probability and Statistics - IT2120

IT24101484 – Mayadunna.S.W.S.P

Lab sheet 09

Exercise:

i)

```
# Exercise
setwd("D:\\SLIIT\\Y2S1\\PS\\Lab09")

# i)
# Generate a random sample of size 25 for the baking time.
sample_times <- rnorm(25, mean = 45, sd = 2)
print(sample_times)

```

Output

```
> sample_times <- rnorm(25, mean = 45, sd = 2)
> print(sample_times)
 [1] 43.54708 49.06274 46.77022 42.88613 45.03377
 [6] 42.00585 44.90646 43.84984 48.28850 45.84482
[11] 43.85816 45.95842 45.30095 45.08475 48.35474
[16] 47.50149 45.08696 42.59687 45.31034 44.25147
[21] 47.03731 44.90141 48.23523 44.26465 42.57832
>
```

ii)

```
# ii)
# Test whether the average baking time is less than 46 minutes at a 5% level of significance

# t-test (use when population sd is unknown)
print("--- One-sample t-test (H0: mu = 46, H1: mu < 46) ---")
t_test_result <- t.test(sample_times, alternative = "less", mu = 46)
print(t_test_result)
```

Output

```
> print(t_test_result)

        One Sample t-test

data:  sample_times
t = -1.7755, df = 24, p-value = 0.04425
alternative hypothesis: true mean is less than 46
95 percent confidence interval:
     -Inf 45.97455
sample estimates:
mean of x
 45.30066
```

```
17  # z-test (use when population sd is known)
18  print("--- Z-test using known population sd = 2 (H0: mu = 46, H1: mu < 46) ---")
19  sample_mean <- mean(sample_times)
20  z_stat <- (sample_mean - 46) / (2 / sqrt(25))
21
22  # one-sided p-value (lower tail)
23  p_value_z <- pnorm(z_stat)
24  print(paste("Sample mean =", sample_mean))
25  print(paste("Z statistic =", z_stat))
26  print(paste("One-sided p-value =", p_value_z))
```

Output

```
> print(paste("Sample mean =", sample_mean))
[1] "Sample mean = 45.3006599488525"
> print(paste("Z statistic =", z_stat))
[1] "Z statistic = -1.74835012786868"
> print(paste("One-sided p-value =", p_value_z))
[1] "One-sided p-value = 0.0402017090378086"
```

```r
# Decision at alpha = 0.05
alpha <- 0.05
if (p_value_z < alpha) {
  print("Decision (z-test): Reject H0 at alpha = 0.05. Evidence that mean < 46 minutes.")
} else {
  print("Decision (z-test): Fail to reject H0 at alpha = 0.05. Not enough evidence mean < 46 minutes.")
}
```

Output

```
[1] "Decision (z-test): Reject H0 at alpha = 0.05. Evidence that mean < 46 minutes."
```

```r
# Also show the equivalent t-test decision using t_test_result
if (t_test_result$p.value < alpha) {
  print("Decision (t-test): Reject H0 at alpha = 0.05. Evidence that mean < 46 minutes.")
} else {
  print("Decision (t-test): Fail to reject H0 at alpha = 0.05. Not enough evidence mean < 46 minutes.")
}
```

Output

```
[1] "Decision (t-test): Reject H0 at alpha = 0.05. Evidence that mean < 46 minutes."
```