1. Exercise 1: One-Sample Z-Test

o Task: Perform a one-sample Z-test to determine if the mean weight of a sample of 50 individuals is significantly different from 65 kg. Use a significance level of 0.05.
o Expected Output:

```
# Example data
sample_data <- rnorm(50, mean = 68, sd = 5) # Simulated sample data
# Population parameters (if known)
mu <- 65 # Population mean
sigma <- 5 # Population standard deviation
# Calculate Z-statistic
z_stat <- (mean(sample_data) - mu) / (sigma / sqrt(length(sample_data)))
# Calculate p-value (two-tailed)
p_value <- 2 * (1 - pnorm(abs(z_stat)))
# Print results
cat("Z-statistic:", z_stat, "\n")
cat("P-value:", p_value, "\n")
# Interpretation
if (p_value < 0.05) {
cat("Reject null hypothesis: The sample mean is significantly different from",
mu, "\n")
} else {
cat("Fail to reject null hypothesis: There is not enough evidence to conclude that
the sample mean is different from", mu, "\n")
}
```

**OUTPUT:**

```
> sample<-rnorm(50, mean=68, sd=5)
> mu<-65
> sigma<-5
> z_stat<-(mean(sample)-mu)/(sigma/sqrt(length(sample_mean)))
> p<-2*(1-pnorm(abs(z_stat)))
> cat("Z-statistic:",z_stat,"\n")
Z-statistic: 0.4580299
> cat("P value:",p,"\n")
P value: 0.646931
> if(p<0.05){
+   cat("Reject null hypothesis: the sample mean is significantly differen
t from",mu,"\n")
+ }else{
+   cat("Fail to reject null hypothesis: There is not enough evidence to c
onclude that the sample mean is different from",mu,"\n")
+ }
Fail to reject null hypothesis: There is not enough evidence to conclude t
hat the sample mean is different from 65
```

**2. Exercise 2: Two-Sample Z-Test**

o Task: Perform a two-sample Z-test to compare the mean scores of two groups:

Group A and Group B. Use the following data:

```
# Example data

groupA <- c(85, 89, 92, 78, 86, 88, 90, 82, 87, 84)

groupB <- c(80, 81, 85, 79, 83, 81, 84, 78, 82, 80)

# Calculate Z-statistic for two-sample test

z_stat <- (mean(groupA) - mean(groupB)) / sqrt(var(groupA)/length(groupA) +

var(groupB)/length(groupB))

# Calculate p-value (two-tailed)

p_value <- 2 * (1 - pnorm(abs(z_stat)))

# Print results

cat("Z-statistic:", z_stat, "\n")

cat("P-value:", p_value, "\n")

# Interpretation

if (p_value < 0.05) {

cat("Reject null hypothesis: The means of two groups are significantly different

\n")

} else {

cat("Fail to reject null hypothesis: There is not enough evidence to conclude that

the means of two groups are different \n")

}
```

**OUTPUT:**

```
> A<-c(85,89,92,78,86,88,90,82,87,84)
> B<-c(80,81,85,79,83,81,84,78,82,80)
> z_stat<-(mean(A)-mean(B))/sqrt(var(A)/length(A)+var(B)/length(B))
> p<-2*(1-pnorm(abs(z_stat)))
> cat("Z statistic:",z_stat,"\n")
Z statistic: 3.260958
> cat("P value:",p,"\n")
P value: 0.001110365
> if(p<0.05){
+   cat("reject null hypothesis\n")
+ }else{
+   cat("fail to reject")
+ }
reject null hypothesis
```

Example 1: One-Sample t-Test

```
# Example data

sample_data <- c(12, 15, 18, 14, 16, 19, 17, 13, 15, 18, 16, 15, 17, 16, 14)

# Population parameters (if known)

mu <- 16 # Population mean (null hypothesis)

# Conduct one-sample t-test

t_test <- t.test(sample_data, mu = mu)

# Print test result

print(t_test)

# Interpretation

if (t_test$p.value < 0.05) {

cat("Reject null hypothesis: The sample mean is significantly different from",

mu, "\n")

} else {

cat("Fail to reject null hypothesis: There is not enough evidence to conclude that

the sample mean is different from", mu, "\n")

}
```

```
> sample<-c(12,15,18,14,16,19,17,13,15,18,16,15,17,16,14)
> mu<-16
> t_test<-t.test(sample,mu=mu)
> print(t_test)

        One Sample t-test

data:  sample
t = -0.66144, df = 14, p-value = 0.5191
alternative hypothesis: true mean is not equal to 16
95 percent confidence interval:
 14.58580 16.74754
sample estimates:
mean of x
 15.66667

> if(t_test$p.value<0.05){
+   cat("reject null hypothesis",mu,"\n")
+ }else{
+   cat("fail to reject null hypothesis",mu,"\n")
+ }
fail to reject null hypothesis 16
```

Example 2: Two-Sample t-Test

```
# Example data

group1 <- c(72, 75, 78, 71, 74, 77, 76, 73, 75, 78)

group2 <- c(68, 71, 73, 69, 72, 70, 72, 67, 71, 74)

# Conduct two-sample t-test

t_test <- t.test(group1, group2)

# Print test result

print(t_test)

# Interpretation

if (t_test$p.value < 0.05) {

cat("Reject null hypothesis: The means of two groups are significantly different

\n")

} else {

cat("Fail to reject null hypothesis: There is not enough evidence to conclude that

the means of two groups are different \n")

}
```

```
> grp1<-c(72,75,78,71,74,77,76,73,75,78)
> grp2<-c(68,71,73,69,72,70,72,67,71,74)
> t_test<-t.test(grp1,grp2)
> print(t.test)
function (x, ...)
UseMethod("t.test")
<bytecode: 0x000001c407b2a3d0>
<environment: namespace:stats>
> if(t_test$p.value<0.05){
+   cat("reject null hypothesis")
+ }else{
+   cat("fail to reject null hypothesis")
+ }
reject null hypothesis


>
```

```
# Example data

sample_data <- rnorm(50, mean = 68, sd = 5) # Simulated sample data

# Population parameters (if known)

mu <- 65 # Population mean (null hypothesis)

# Conduct one-sample t-test

t_test <- t.test(sample_data, mu = mu)

# Print test result

print(t_test)

# Interpretation

if (t_test$p.value < 0.05) {

cat("Reject null hypothesis: The sample mean is significantly different from",

mu, "\n")

} else {

cat("Fail to reject null hypothesis: There is not enough evidence to conclude that

the sample mean is different from", mu, "\n")

}
```

```
> # Example data
> sample_data <- rnorm(50, mean = 68, sd = 5) # Simulated sample data
> # Population parameters (if known)
> mu <- 65 # Population mean (null hypothesis)
> # Conduct one-sample t-test
> t_test <- t.test(sample_data, mu = mu)
> # Print test result
> print(t_test)

        One Sample t-test

data:  sample_data
t = 4.5989, df = 49, p-value = 3.014e-05
alternative hypothesis: true mean is not equal to 65
95 percent confidence interval:
 66.82854 69.66679
sample estimates:
mean of x
 68.24767

> # Interpretation
> if (t_test$p.value < 0.05) {
+   cat("Reject null hypothesis: The sample mean is significantly different from",
+       mu, "\n")
+ } else {
+   cat("Fail to reject null hypothesis: There is not enough evidence to conclude that
+ the sample mean is different from", mu, "\n")
+ }
Reject null hypothesis: The sample mean is significantly different from 65
```

Exercise 2: Two-Sample t-Test

o Task: Perform a two-sample t-test to compare the mean scores of two groups:

Group A and Group B. Use the following data:

```
# Example data

groupA <- c(85, 89, 92, 78, 86, 88, 90, 82, 87, 84)

groupB <- c(80, 81, 85, 79, 83, 81, 84, 78, 82, 80)

# Conduct two-sample t-test

t_test <- t.test(groupA, groupB)

# Print test result

print(t_test)

# Interpretation

if (t_test$p.value < 0.05) {

cat("Reject null hypothesis: The means of two groups are significantly different

\n")

} else {

cat("Fail to reject null hypothesis: There is not enough evidence to conclude that

the means of two groups are different \n")

}
```

```
> # Example data
> groupA <- c(85, 89, 92, 78, 86, 88, 90, 82, 87, 84)
> groupB <- c(80, 81, 85, 79, 83, 81, 84, 78, 82, 80)
> # Conduct two-sample t-test
> t_test <- t.test(groupA, groupB)
> # Print test result
> print(t_test)

        Welch Two Sample t-test

data:  groupA and groupB
t = 3.261, df = 13.847, p-value = 0.005759
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 1.639673 7.960327
sample estimates:
mean of x mean of y
     86.1      81.3

> # Interpretation
> if (t_test$p.value < 0.05) {
+   cat("Reject null hypothesis: The means of two groups are significantly differen
t
+ \n")
+ } else {
+   cat("Fail to reject null hypothesis: There is not enough evidence to conclude t
hat
+ the means of two groups are different \n")
+ }
Reject null hypothesis: The means of two groups are significantly different
```