

## VI. TESTING OF HYPOTHESIS – F AND CHI-SQUARE TESTING

### Aim

The aim of this lab manual is to introduce students to hypothesis testing using the F-test and Chi-Square test in statistics. Students will learn how to perform these tests, interpret results, and apply these skills using R.

### Exercises

#### 1. Exercise 1: F-Test

- o **Task:** Perform an F-test to compare the variances of two groups: Group A and Group B. Use the following data:

```
# Example data
groupA <- c(72, 75, 78, 71, 74, 77, 76, 73, 75, 78)
groupB <- c(68, 71, 73, 69, 72, 70, 72, 67, 71, 74)

# Conduct F-test for comparing variances
f_test <- var.test(groupA, groupB)

# Print test result
print(f_test)

# Interpretation
if (f_test$p.value < 0.05) {
  cat("Reject null hypothesis: Variances are significantly different \n")
} else {
  cat("Fail to reject null hypothesis: Variances are not significantly different \n")
}
```

The screenshot shows the RStudio interface with a script editor, console, and environment pane.

**Script Editor:**

```

1 groupA <- c(72, 75, 78, 71, 74, 77, 76, 73, 75, 78)
2 groupB <- c(68, 71, 73, 69, 72, 70, 72, 67, 71, 74)
3 # Conduct F-test for comparing variances
4 f_test <- var.test(groupA, groupB)
5 # Print test result
6 print(f_test)
7 # Interpretation
8 if (f_test$p.value < 0.05) {
9   cat("Reject null hypothesis: Variances are significantly different \n")
10 } else {
11   cat("Fail to reject null hypothesis: Variances are not significantly different \n")
12 }

```

**Console:**

```

R 4.4.2 ~ /
F test to compare two variances

data: groupA and groupB
F = 1.1995, num df = 9, denom df = 9, p-value = 0.7908
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.2979504 4.8293671
sample estimates:
ratio of variances
 1.199546

> # Interpretation
> if (f_test$p.value < 0.05) {
+   cat("Reject null hypothesis: Variances are significantly different \n")
+ } else {
+   cat("Fail to reject null hypothesis: Variances are not significantly different \n")
+ }
Fail to reject null hypothesis: Variances are not significantly different

```

**Environment Pane:**

Object	Class	Attributes
Global Environment	Environment	
steady_state	num [1, 1:3]	0.105 0.158 0.737
stock_market_...	Formal class markovchain	
stock_market_...	num [1:3, 1:3]	0.7 0.4 0.3 0.2 0.4 0...
t_test	List of 10	

**Values:**

a	-2
absorbing	"Jail"
alpha	0.05
area	40
b	2
cdf	num [1:401] 0 0.0025 0.005 0.0075 0.01...
cdf_values	0
counts	num [1:4] 10 15 7 5
data	int [1:1000] 4 6 5 7 7 2 5 7 5 5 ...
df	19
differences	num [1:15] 5 3 4 6 7 8 5 4 3 6 ...
evens	int [1:5] 2 4 6 8 10
exp_result	7.38905609893065
factorial	1
factorial_res...	720
fib	num [1:10] 0 1 1 2 3 5 8 13 21 34
found	TRUE
fruits	chr [1:4] "Apple" "Banana" "Cherry" "D...
groupA	num [1:10] 72 75 78 71 74 77 76 73 75 ...
groupB	num [1:10] 68 71 73 69 72 70 72 67 71 ...

## 2. Exercise 2: Chi-Square Test

- o **Task:** Perform a Chi-Square test to analyze the association between two categorical variables using the following contingency table:

```

# Example data (contingency table)
observed <- matrix(c(50, 30, 20, 25), nrow = 2, byrow = TRUE)

# Conduct Chi-Square test
chi_square_test <- chisq.test(observed)

# Print test result
print(chi_square_test)

# Interpretation
if (chi_square_test$p.value < 0.05) {
  cat("Reject null hypothesis: There is a significant association between variables \n")
} else {
  cat("Fail to reject null hypothesis: There is no significant association between variables \n")
}

```

The screenshot displays the RStudio environment with the following components:

- Source Editor:** Contains an R script for a Chi-square test.
 

```

1 observed <- matrix(c(50, 30, 20, 25), nrow = 2, byrow = TRUE)
2 # Conduct Chi-Square test
3 chi_square_test <- chisq.test(observed)
4 # Print test result
5 print(chi_square_test)
6 # Interpretation
7 if (chi_square_test$p.value < 0.05) {
8   cat("Reject null hypothesis: There is a significant association between variables\n")
9 } else {
10   cat("Fail to reject null hypothesis: There is no significant association between\n")
11   cat("variables\n")
12 }
13

```
- Console:** Shows the output of the script.
 

```

> print(chi_square_test)

Pearson's Chi-squared test with Yates' continuity correction

data:  observed
X-squared = 3.1129, df = 1, p-value = 0.07768

> # Interpretation
> if (chi_square_test$p.value < 0.05) {
+   cat("Reject null hypothesis: There is a significant association between variables\n")
+ } else {
+   cat("Fail to reject null hypothesis: There is no significant association between\n")
+   cat("variables\n")
+ }
Fail to reject null hypothesis: There is no significant association between
variables

```
- Environment Pane:** Lists objects in the Global Environment.
 

Object	Class	Value
observed	num [1:2, 1:2]	50 20 30 25
pagerank	num [1, 1:3]	0.278 0.389 0.333
pagerank_chain	Formal class markovchain	
pagerank_matr...	num [1:3, 1:3]	0.1 0.3 0.4 0.6 0.4 0...
prisoner_chain	Formal class markovchain	
prisoner_matr...	num [1:3, 1:3]	0.5 0.3 0 0.4 0.5 0 0...
res	List of 5	
six_step_matr...	Formal class markovchain	
squared	List of 5	
steady_state	num [1, 1:3]	0.105 0.158 0.737
stock_market_...	Formal class markovchain	
stock_market_...	num [1:3, 1:3]	0.7 0.4 0.3 0.2 0.4 0...
t_test	List of 10	
- Values Pane:** Shows attributes of the 't\_test' object.
 

Attribute	Value
a	-2
absorbing	"Jail"
alpha	0.05
area	40
b	2
cdf	num [1:401] 0 0.0025 0.005 0.0075 0.01...
cdf_values	0
counts	num [1:4] 10 15 7 5
data	int [1:1000] 4 6 5 7 7 2 5 7 5 5 ...
df	19
differences	num [1:15] 5 3 4 6 7 8 5 4 3 6 ...