TIME SERIES ANALYSIS
PRESENTATION

PROBLEM 1 : SALES

Data Description:

- Data name: **Souvenir Sales**
- About: **sales for a souvenir shop at a beach resort town in Queensland, Australia**
- Duration: **From 1995 to 2001 August, Monthly Data**
- Objective:
  - To plot time plot
  - Converting into log scale
  - Comparing time plot
  - Computing ACF and PACF

GLIMPSE OF THE SALES DATA...

Date	Sales
Jan-95	1664.81
Feb-95	2397.53
Mar-95	2840.71
Apr-95	3547.29
May-95	3752.96

Time plot

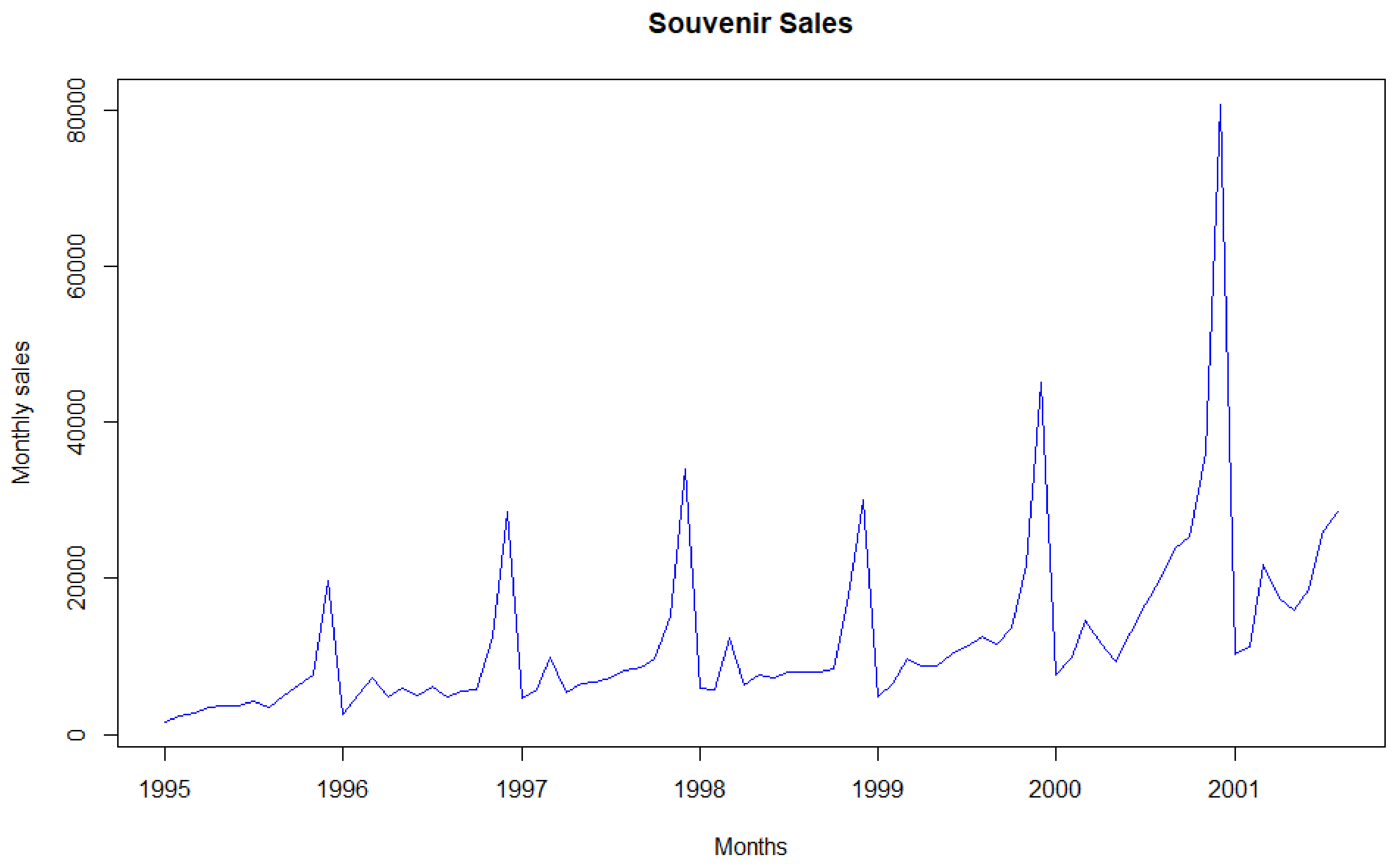

FIGURE 1: TIME PLOT OF SOUVENIR SALES

Description of the graph:

- x axis: Time line
- y axis: The Souvenir monthly sale

The graph displays the monthly sale of Souvenir shop from **Jan 1995** to **August 2001**

Insights:

- The sales over the years has gradually increased.
- There is an unexpected increase in sales at the end of the year 2000
- **Presence of seasonality**: Within a year at particular month their is a increase in sales, and this pattern continues over the years.
- **Presence of trend**: There is a presence of trend but the rate of increment is low .There is a growth of sales but its not significant over the given years.

Time plot comparison

Time plot of Souvenir sales

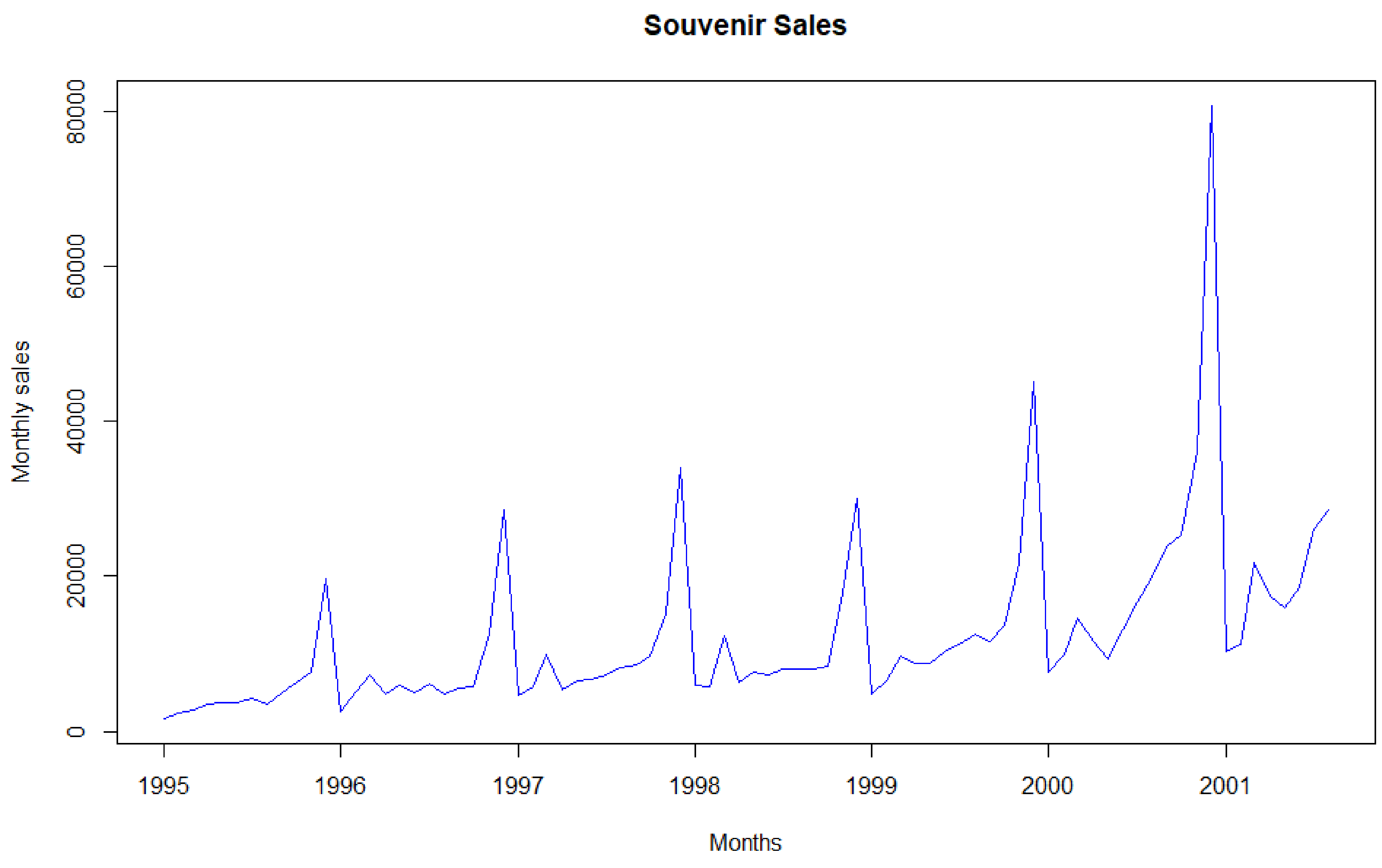

FIGURE 2

Time plot of log scale of Souvenir sales

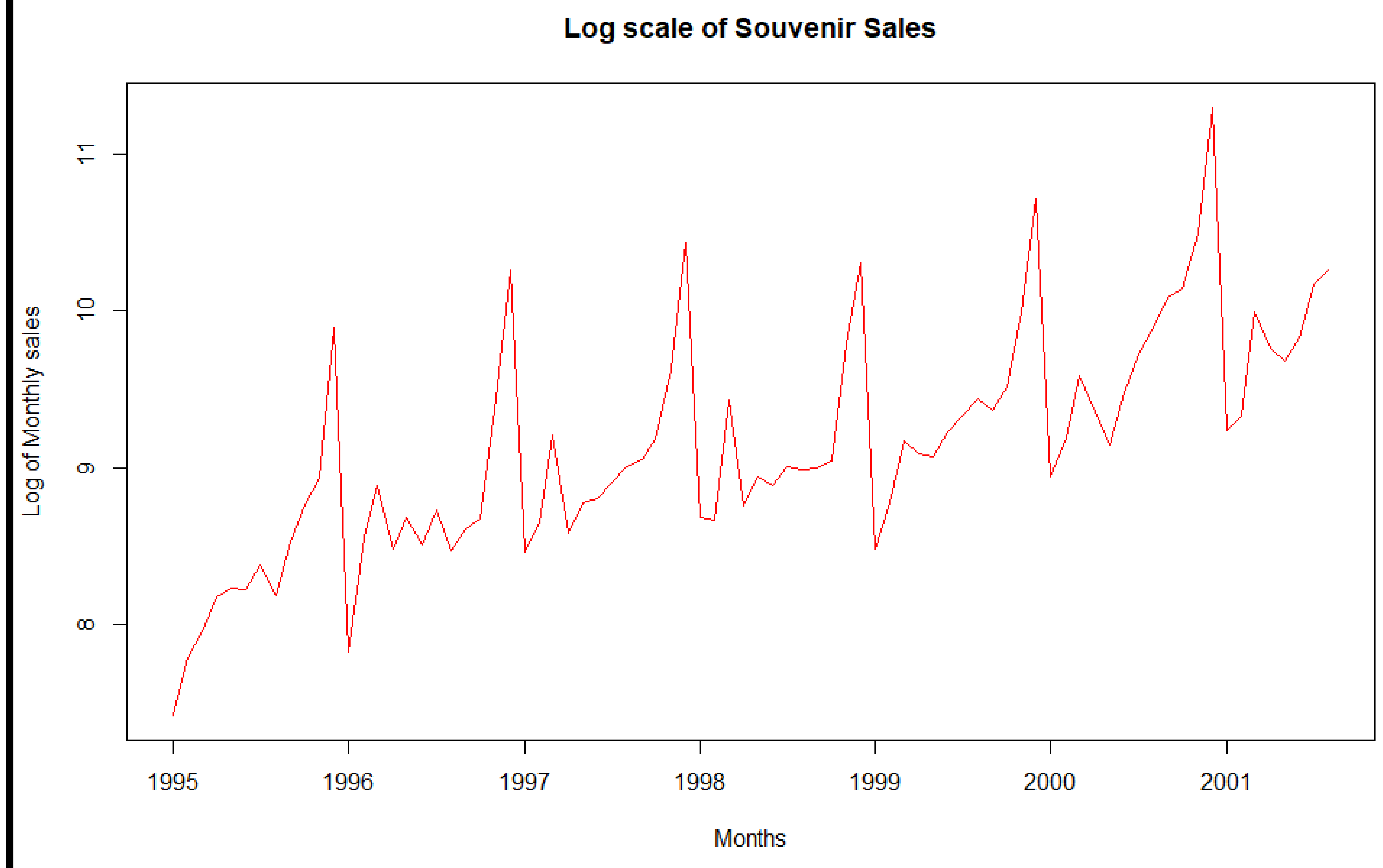

FIGURE 3

Time plot comparison

- **Figure 2** represents the time plot of Souvenir sales.\

- **Figure 3** represents the time plot of Souvenir sales where the sales of the shop is converted into log scale.

- **Trend**: Both the graph shows upward growth of sales over the years but **figure 2** shows the presence of **trend** but the **rate of increment is low,** where as **figure 3** shows the presence **strong trend** that is the **rate of increment of sales over the period is high** .

- **Seasonality :** Both the figures show presence of seasonality. From both graph it can be seen that their is high sales during particular month within a year and the pattern continues throughout the data.

- In **figure 2** there is an **unexpected increase in the sales** at the the end of year 2000 where as in **figure 3** there are **no sudden increase in sales**.

Comparison of decomposition plots

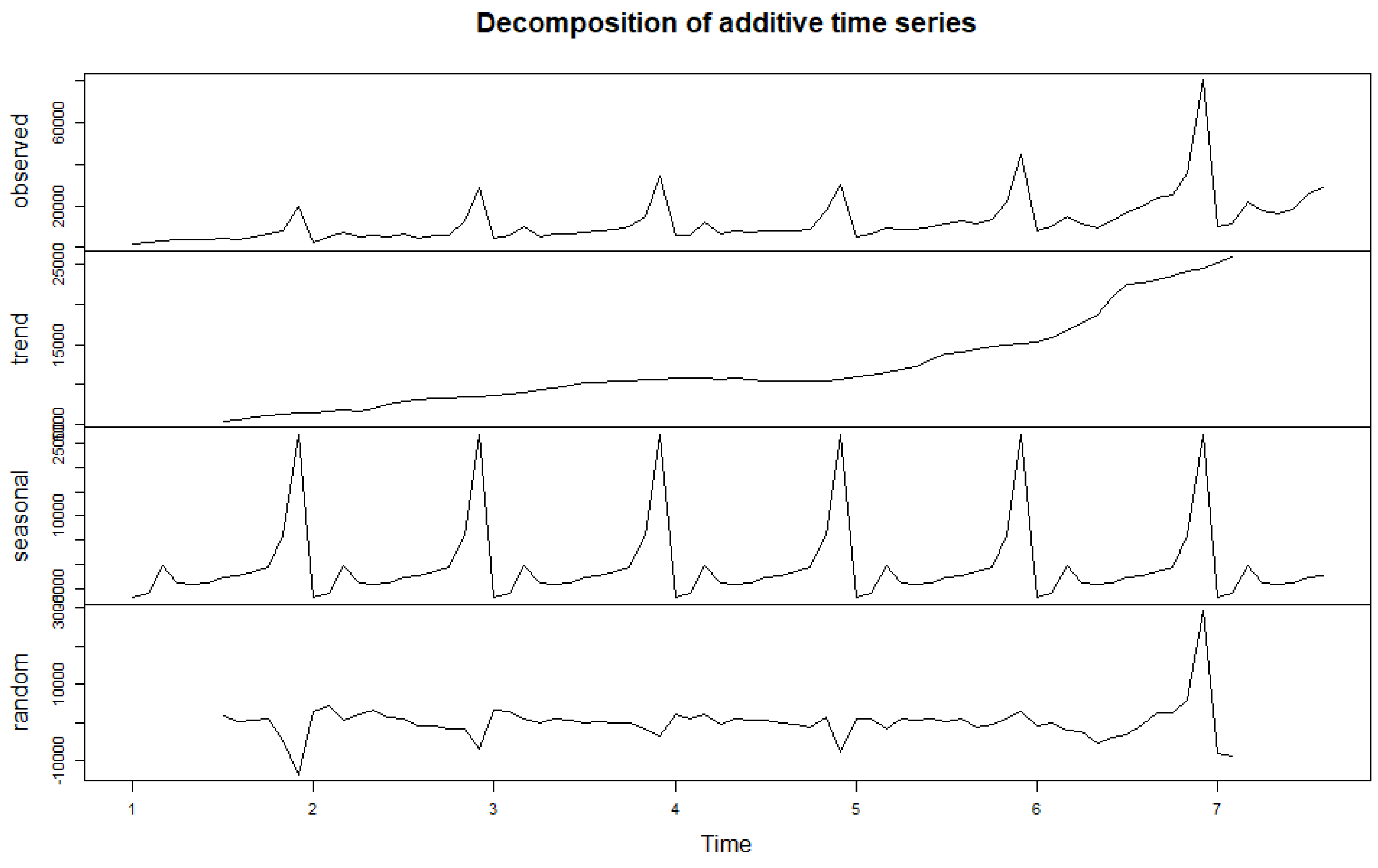

FIGURE 4 :DECOMPOSITION PLOT OF SOUVENIR SALES

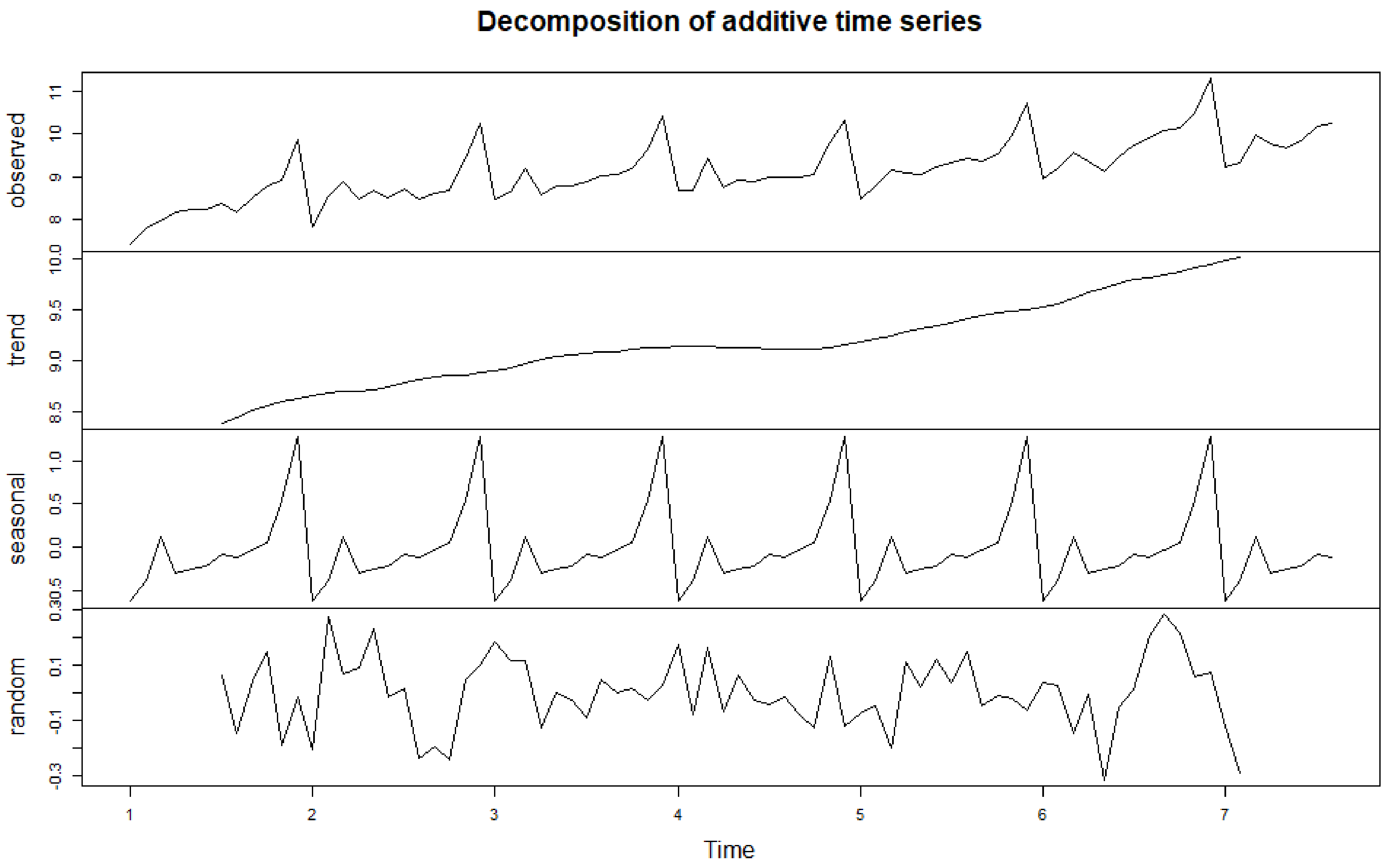

FIGURE 5 :DECOMPOSITION PLOT FOR LOG SCALE OF SOUVENIR SALES

Comparison of decomposition plots

- By Comparing the Decomposition plot of both the time series data, following conclusion are made about the trend of both thee data
    - Both has presence of positive trend
    - Rate of increment in trend is high in Log scale of Souvenir sales.
    - The trend in Log scale of Souvenir sales is linear , where as the trend of Souvenir sales is not linear
- Error component : The error of Souvenir sales data is not random, it shows a weak pattern where as the error of Log scale of Souvenir sales data is completely random

Autocorrelation Function Graph

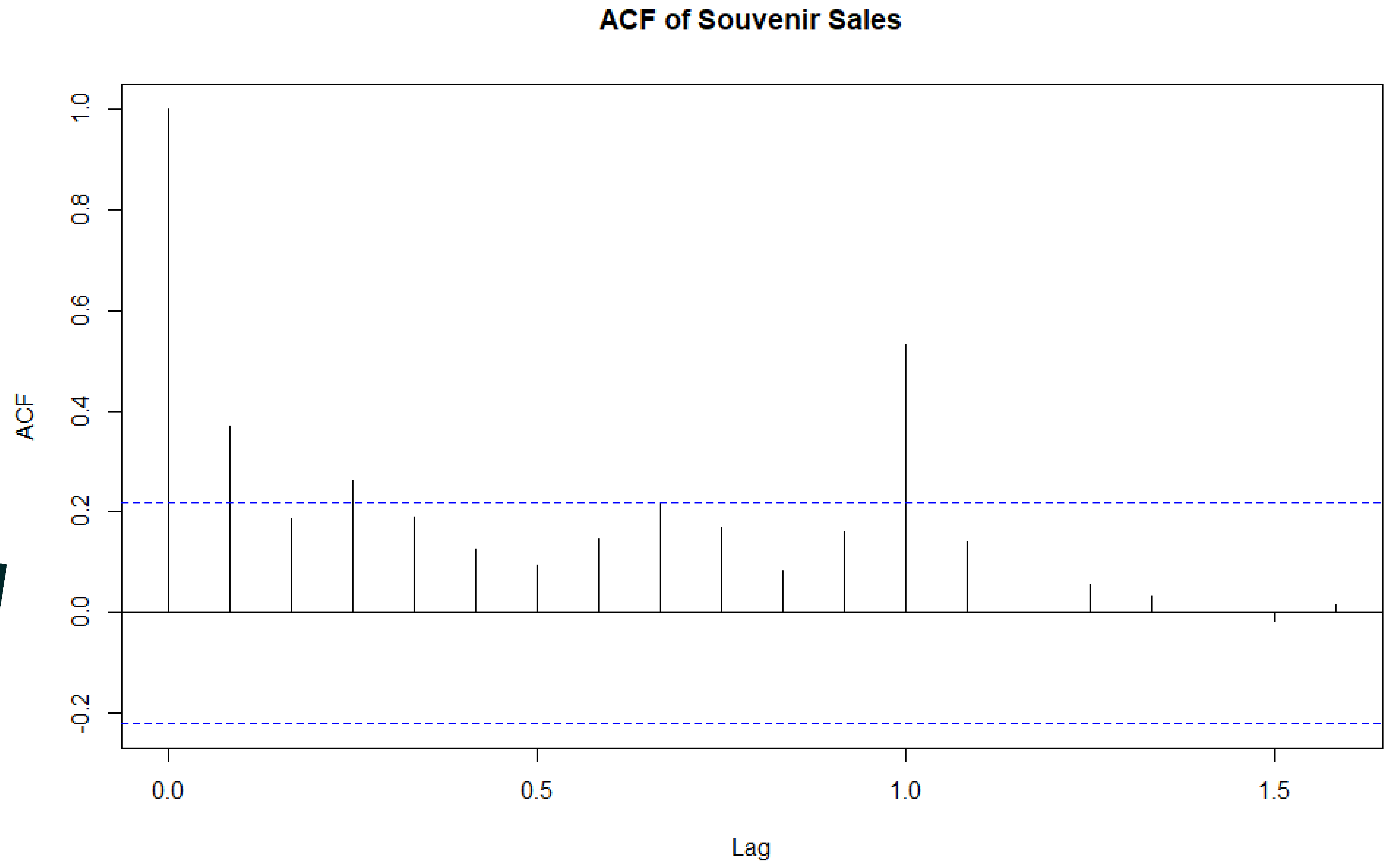

FIGURE 6 : ACF PLOT OF SOUVENIR SALES

- **Figure 6** shows the autocorrelation graph of Souvenir sales.
- In the most of the spikes are within the confidence interval. so, there is no significant correlation between the present and past sales.
- According to the business language the sales of the present day does not depend much on the sales of the previous day.
- Taking important decision based only on the previous sales data is not advisable.

Autocorrelation Function Graph

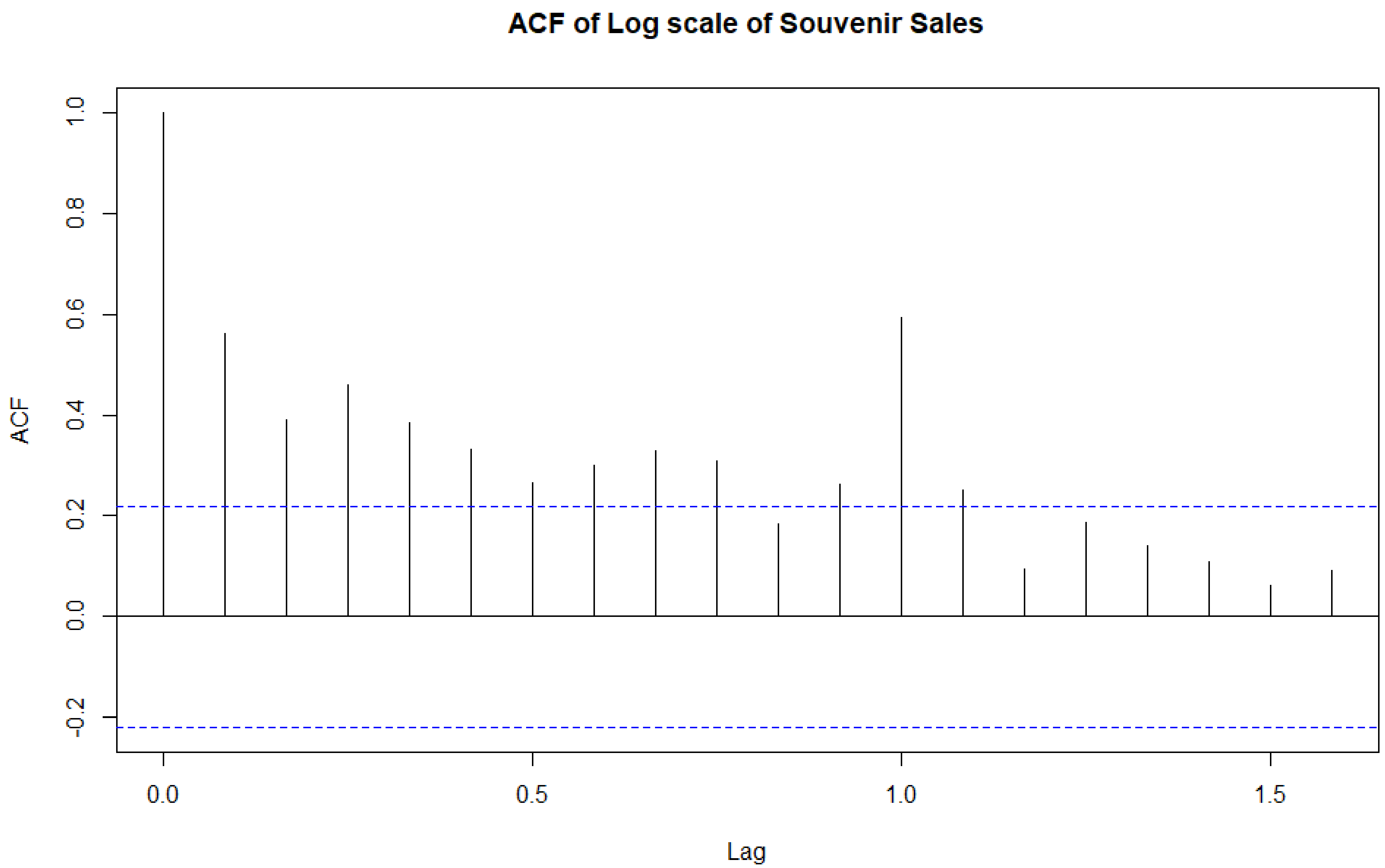

FIGURE 7: ACF PLOT FOR LOG SCALE OF SOUVENIR SALES

- **Figure 7** shows the autocorrelation graph of Log scale of Souvenir sales.
- In the most of the spikes are out of the confidence interval. so, there is significant correlation between the present and past sales.
- According to the business language the sales of the present day does depends on the sales of the past days.

Partial Auto Correlation Function Plots

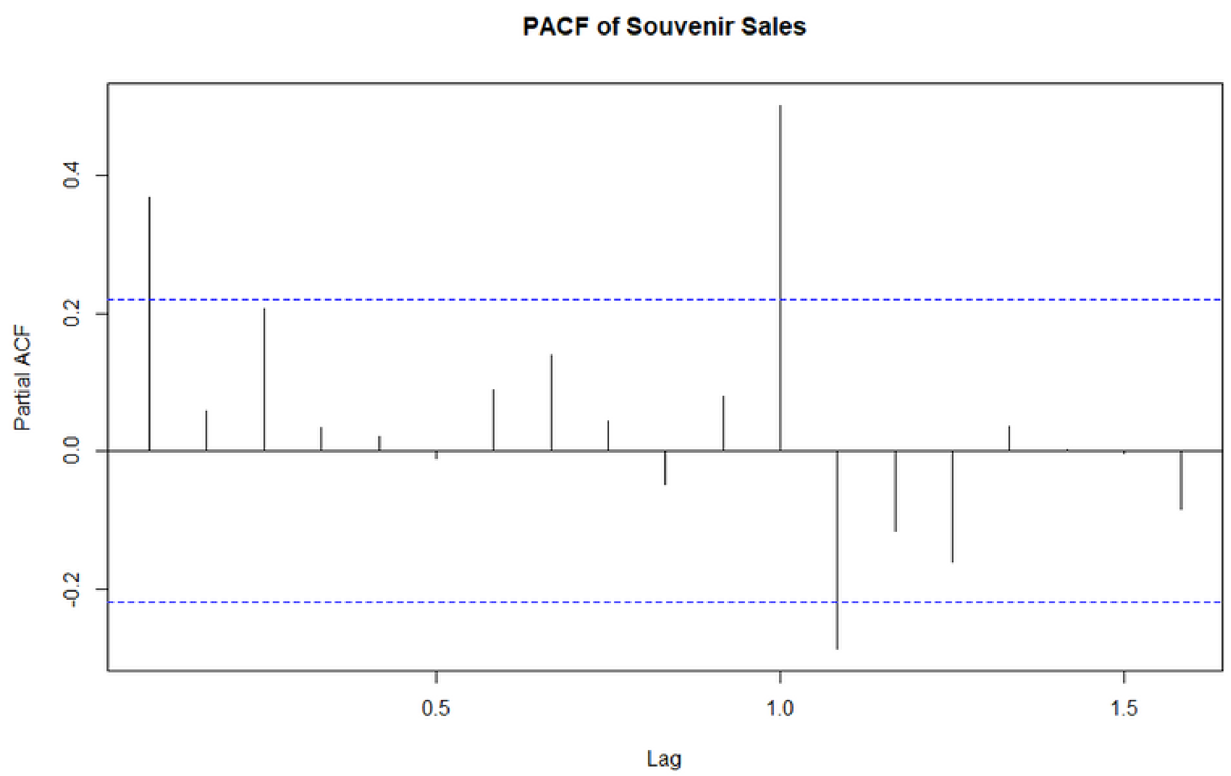

FIGURE 8: PACF PLOT OF SOUVENIR SALES

- Based on PACF graph of Souvenir sales shown in Figure 8, still there is no Correlation between the Sales of the present and past data

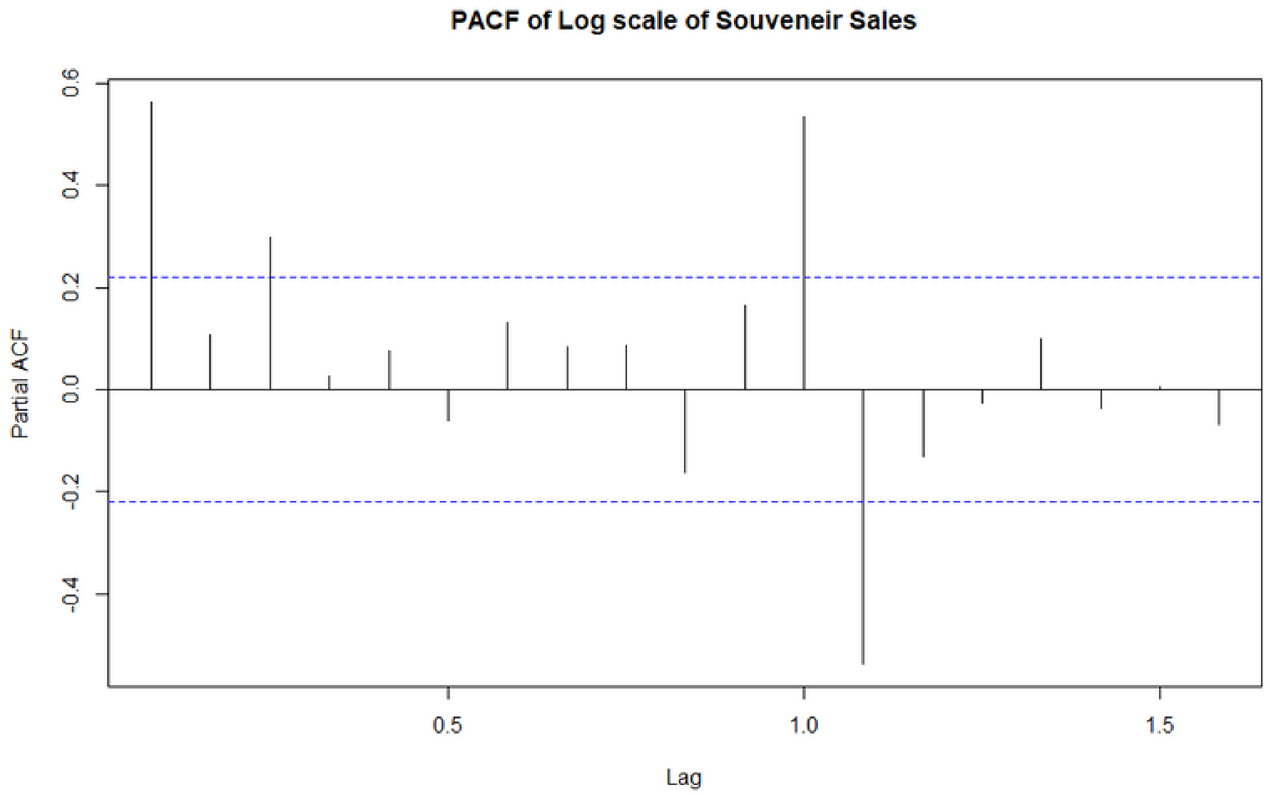

FIGURE 9: PACF PLOT FOR LOG SCALE OF SOUVENIR SALES

- Based on PACF graph of Log scale of Souvenir sales shown in Figure 9, there is no Correlation between the Sales of the present and past data. PACF helped in better deduction of relationship than ACF

Problem 2 : Simulation

Understanding the problem:

- To generate: **Two chi-square completely random process each of size 48 and degrees of freedom 2 and 8 respectively**
- Objective**:**
  - **To plot time plot**
  - **Checking whether the time series is stationary**
  - **Decomposing the series and commenting about it.**
  - **Computing ACF and PACF**

Time plot

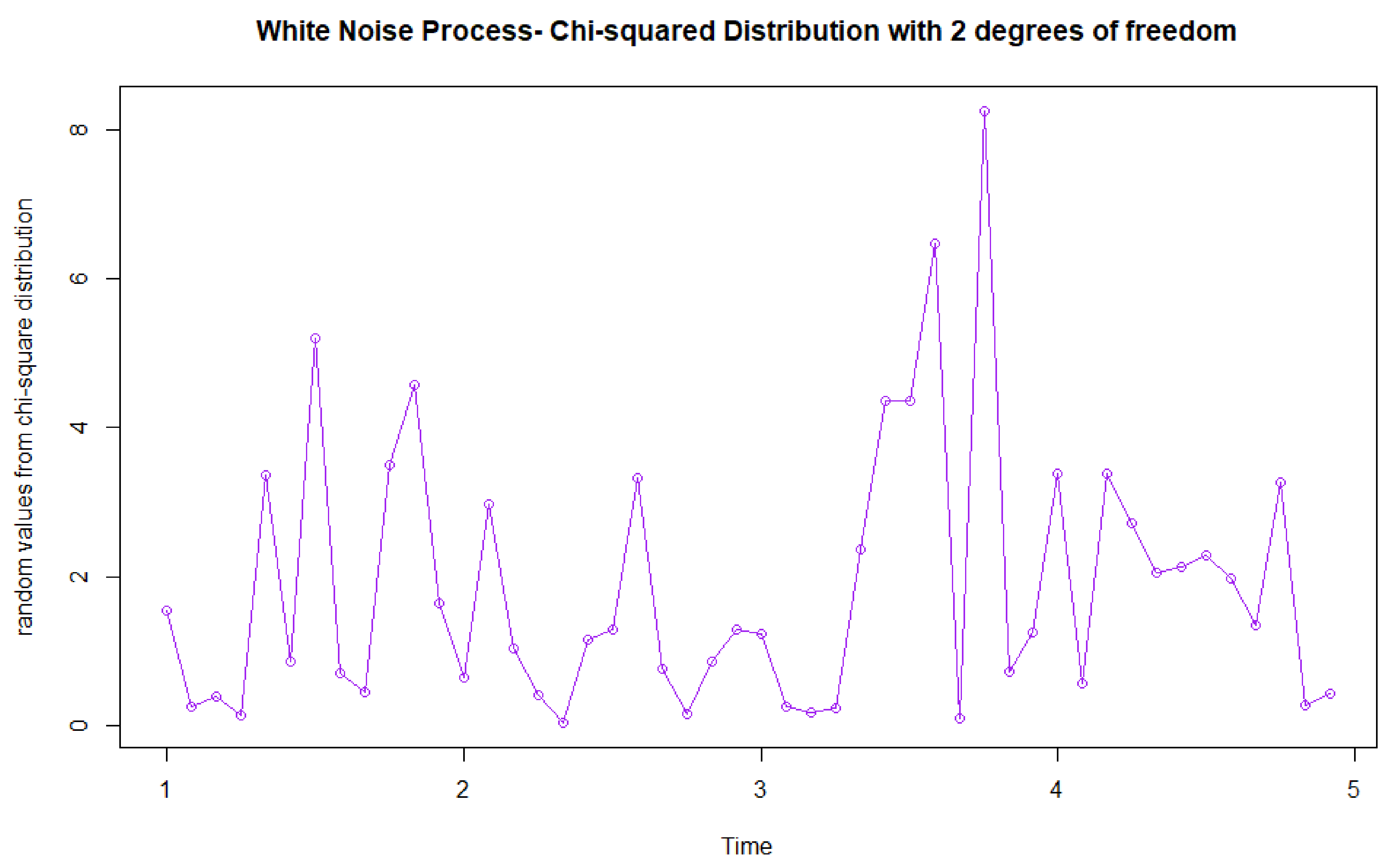

FIGURE 10: TIME PLOT OF TIME SERIES FROM CHI-SQUARE DISTRIBUTION WITH 2 DEGREES OF FREEDOM

- Figure 10 Shows the time plot of time series from chi-square distribution with 2 degrees of freedom.
- The frequency is taken as 12.
- From the graph it can be seen that there is no presence of trend.
- There might be a presence of seasonality.
- The curve reaches its highest peak between the period 3 and 4

Time plot

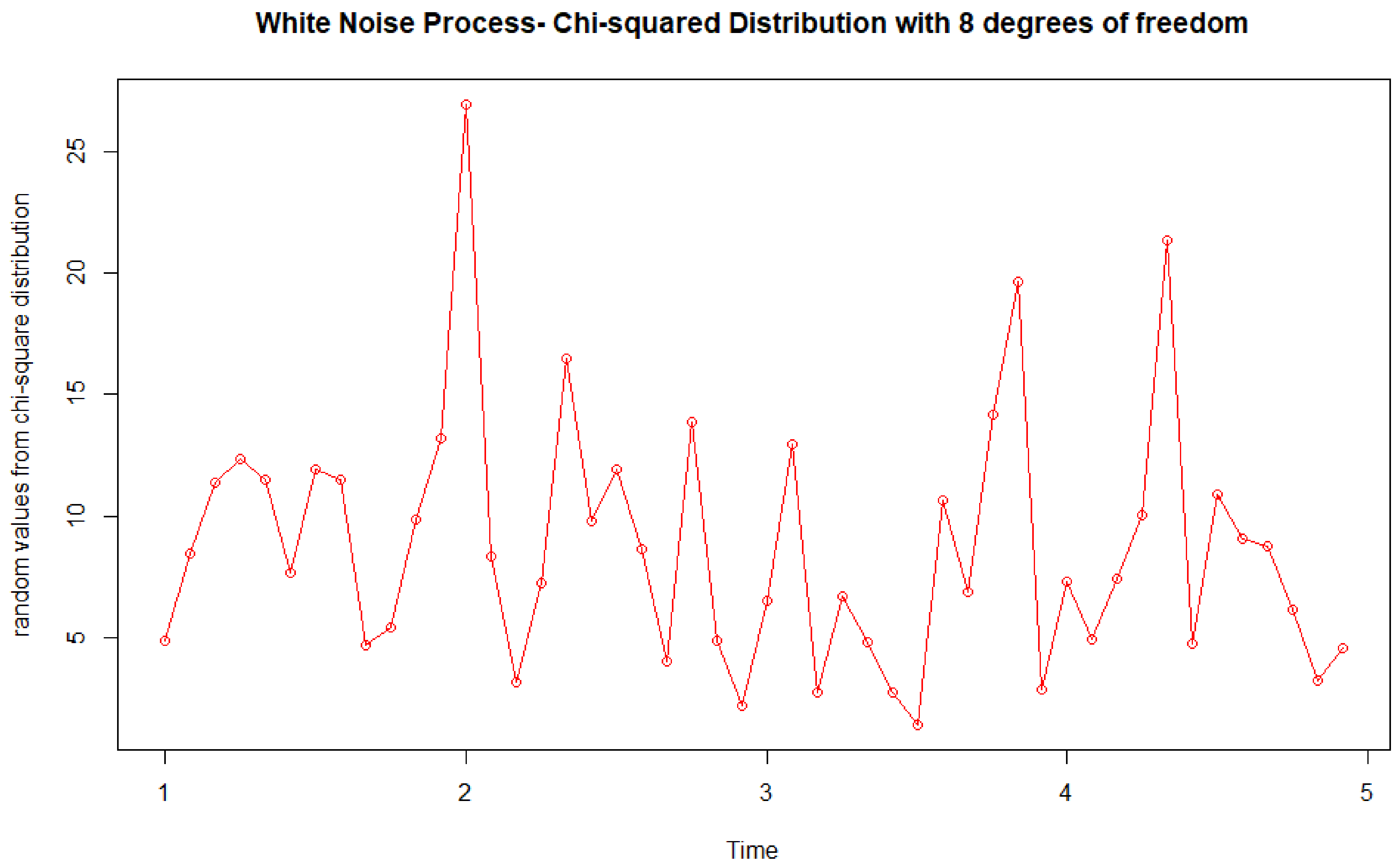

FIGURE 11: TIME PLOT OF TIME SERIES FROM CHI-SQUARE DISTRIBUTION WITH 8 DEGREES OF FREEDOM

- Figure 11 Shows the time plot of time series from chi-square distribution with 8 degrees of freedom.
- The frequency is taken as 12.
- From the graph it can be seen that there might be a presence of trend but it would be for short period of time.
- There might be a presence of seasonality.
- The curve reaches its highest peak at 2nd time period

Checking Stationarity …

Checking whether the time series generated using chi-square distribution with 2 degrees of freedom is stationary or not

Dividing the time series into two equal halves	Mean	Variance
First 50 percentage of Data	1.522511	2.179764
Next 50 percentage of Data	2.230504	4.314505

TABLE 1 : MEAN AND VARIANCE OF THE SPLITS OF THE SERIES

Test statistic value	Lag order	p value	Result
-2.7504	3	0.2744	The time series is stationary

TABLE 2: AUGUMENTED DICKEY-FULLER TEST

- To check stationarity the series was split up and the mean and variance of the splits are checked
- As the mean of the splits are almost close to each other ,therefore the series is weakly stationary
- The variance of the splits are not the same.
- The ADF test for checking stationarity also shows that the series is stationary

Checking Stationarity …

Checking whether the time series generated using chi-square distribution with 2 degrees of freedom is stationary or not

Dividing the time series into two equal halves	Mean	Variance
First 50 percentage of Data	1.522511	27.78962
Next 50 percentage of Data	7.927898	26.07071

TABLE 3: MEAN AND VARIANCE OF THE SPLITS OF THE SERIES

Test statistic value	Lag order	p value	Result
-3.6893	3	0.03551	The time series is not stationary

TABLE 4: AUGUMENTED DICKEY-FULLER TEST

- To check stationarity the series was split up and the mean and variance of the splits are checked
- As the mean of the splits are very different from each other, therefore the series is not stationary
- The variance of the splits are not the same.
- The ADF test for checking stationarity also shows that the series is not stationary

Decomposition plot …

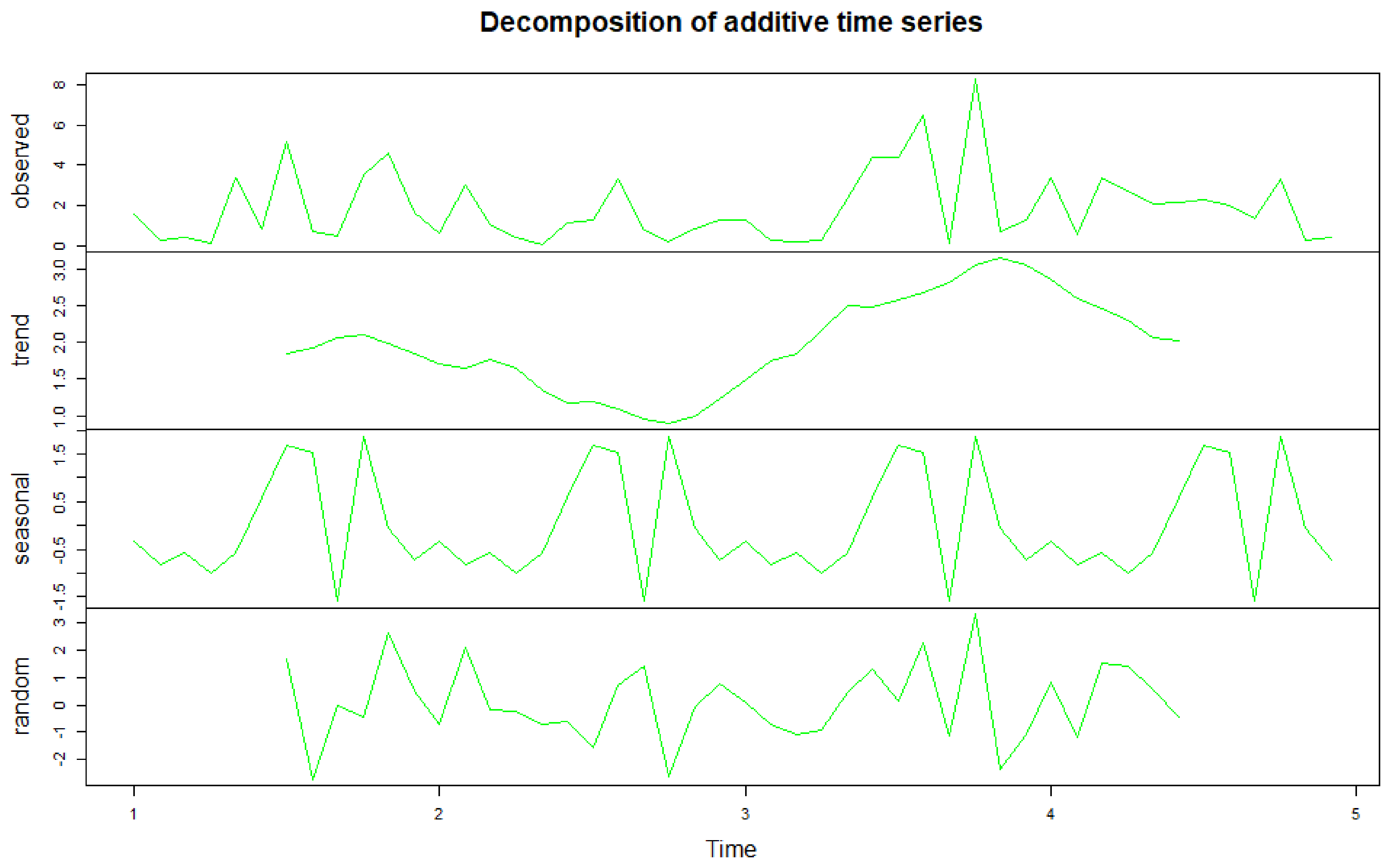

FIGURE 12 : Decomposition Plot of Chi-squared Distribution with 2 degrees of freedom

- The decomposition plot of the time series from chi-square distribution with 2 degrees of freedom shows that there is presence of positive trend but its for short time period
- There is a presence of seasonality.
- The error of the series does not follow any pattern. So, it is randomly distributed.

Decomposition plot …

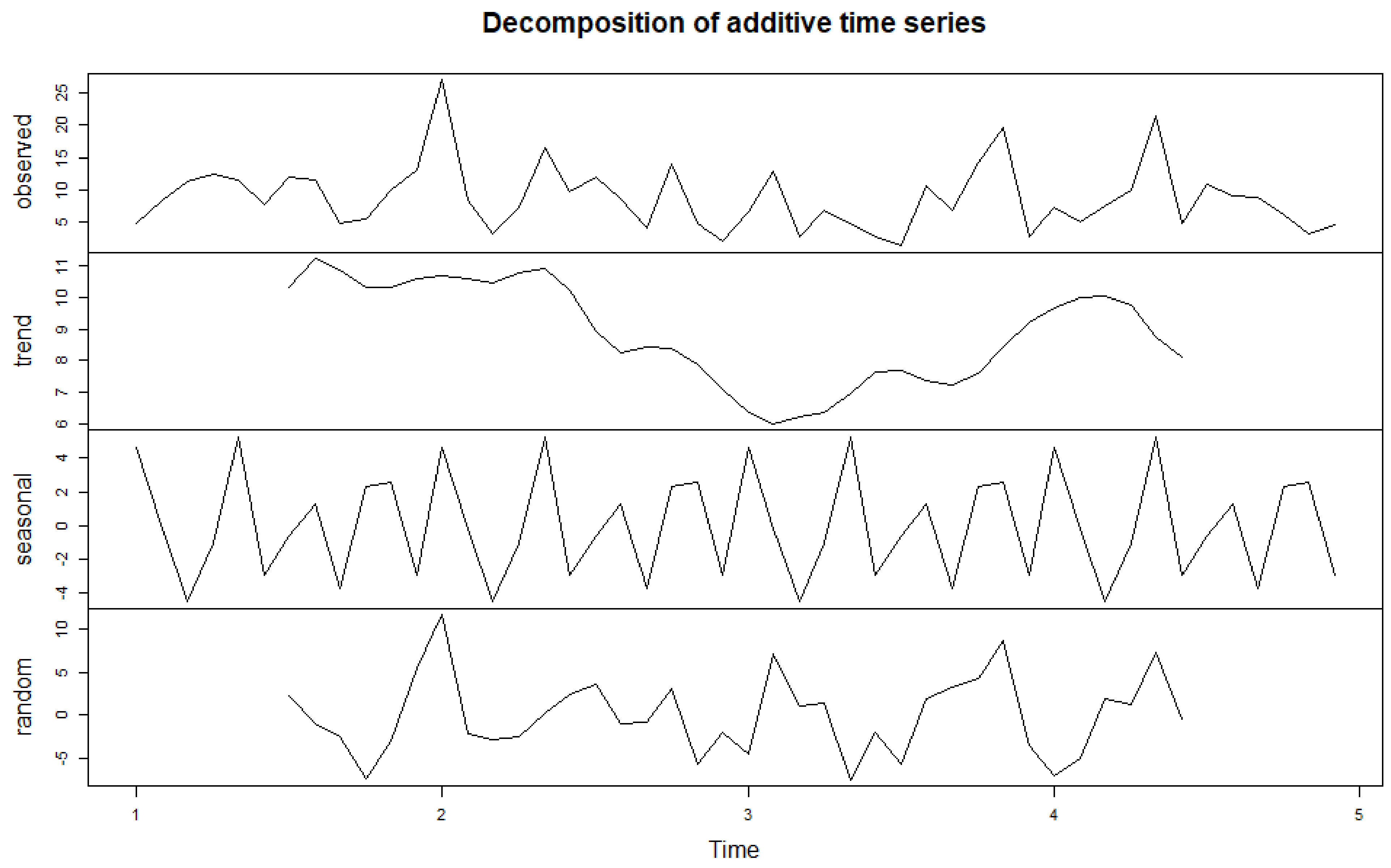

FIGURE 13 : Decomposition Plot of Chi-squared Distribution with 8 degrees of freedom

- The decomposition plot of the time series from chi-square distribution with 8 degrees of freedom shows that there is presence of positive and as well as negative trend but its for short time period and the trend is also nnot linear

- There is a presence of seasonality.

- The error of the series does not follow any pattern.so, it is randomly distributed.

Autocorrelation Function Graph

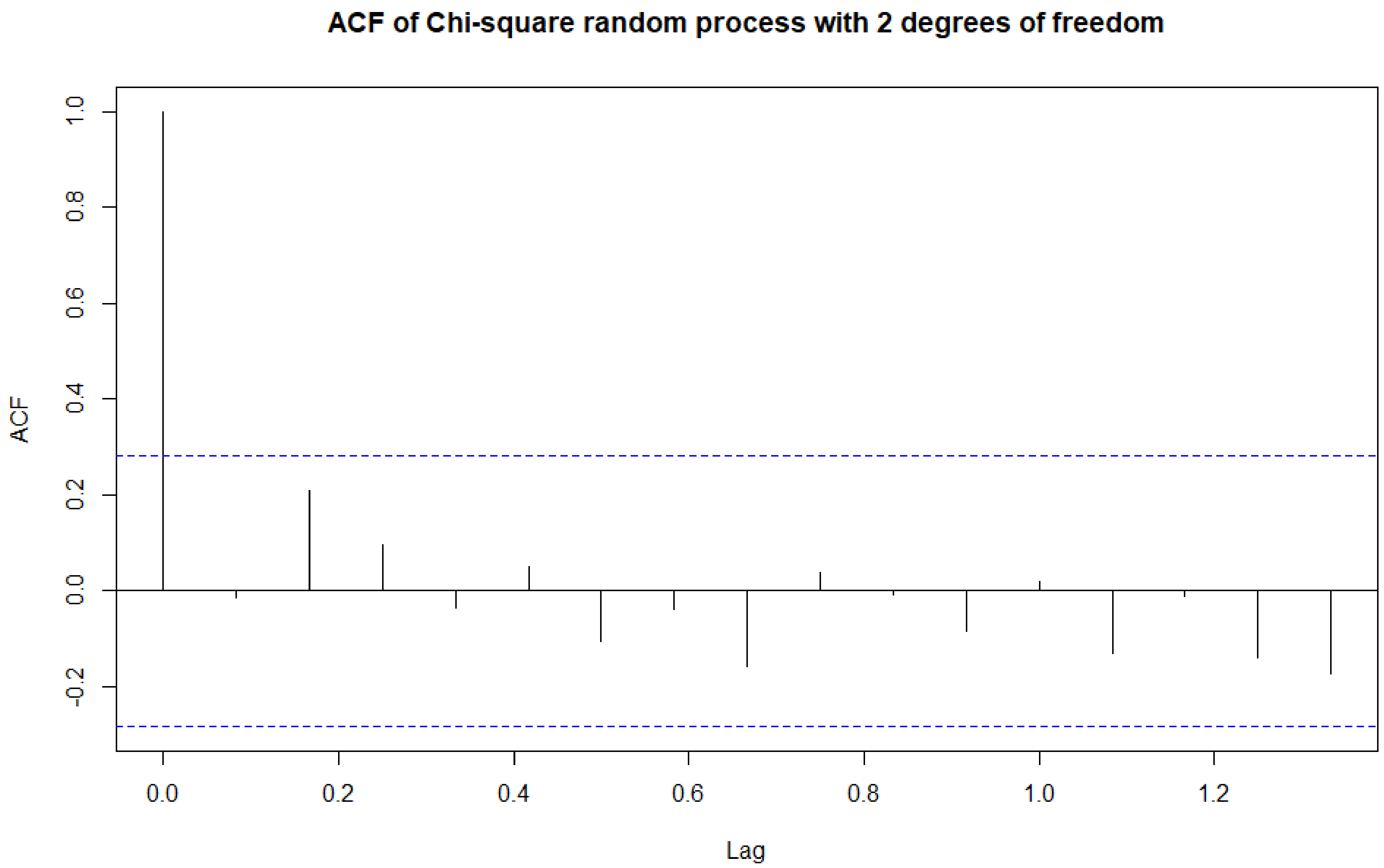

FIGURE 14 : Autocorrelation Plot of Chi-squared Distribution with 2 degrees of freedom

- The Autocorrelation plot of the time series from chi-square distribution with 2 degrees of freedom shows that there is no presence of correlation between present value and the past value with respect to time
- All the values lie within the confidence interval. So, observations over time are independent of each other.
- The autocorrelation of the first lag is always 1.

Autocorrelation Function Graph

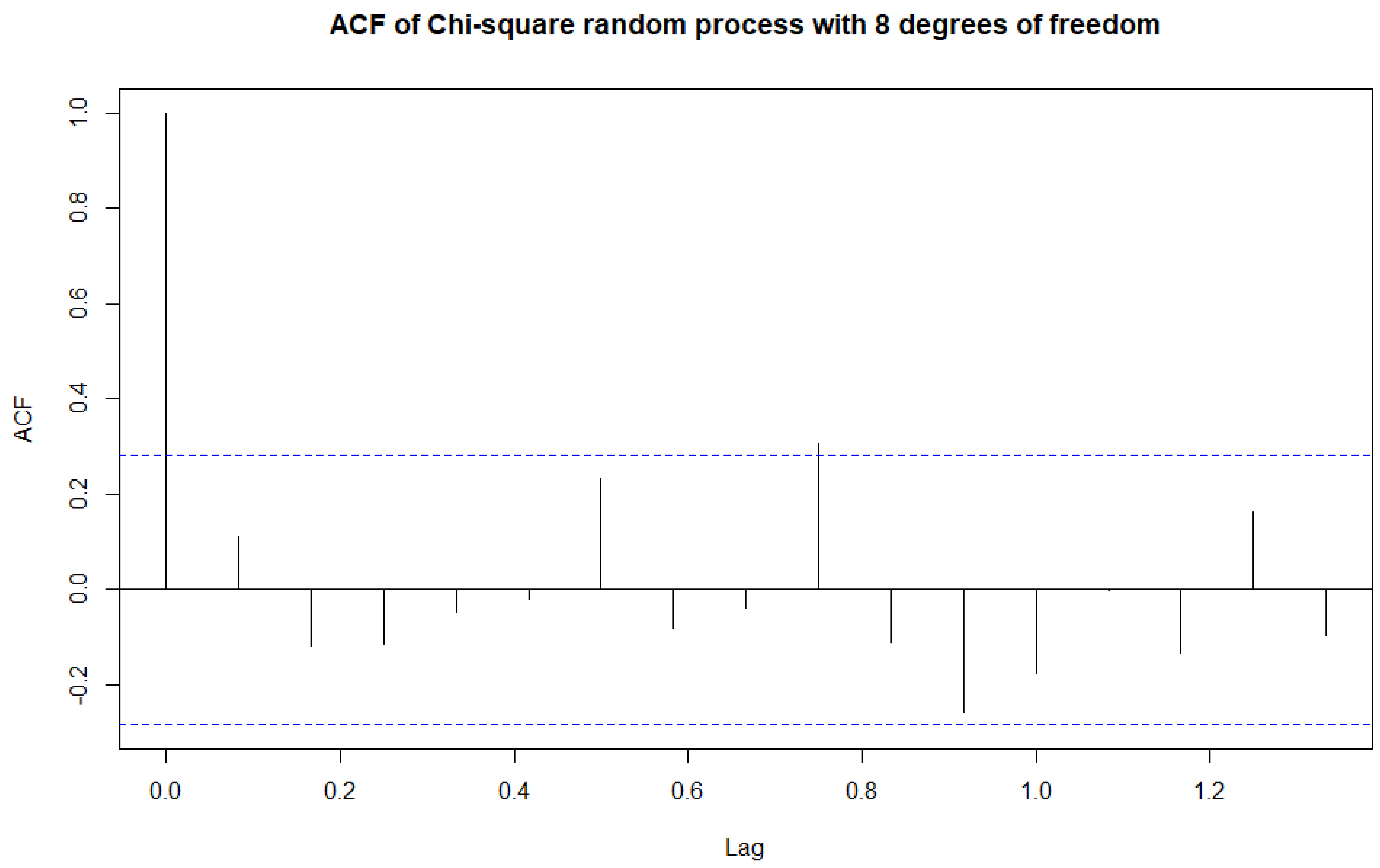

FIGURE 15 : Autocorrelation Plot of Chi-squared Distribution with 8 degrees of freedom

- The Autocorrelation plot of the time series from chi-square distribution with 8 degrees of freedom shows that there is no presence of correlation between present value and the past value with respect to time
- All the values lie within the confidence interval. So, observations over time are independent of each other.
- The autocorrelation of the first lag is always 1.
- Although 1 of the spike go outside confidence interval, it doe not mean significant correlation between the values over time.

Partial Auto Correlation Function Plots

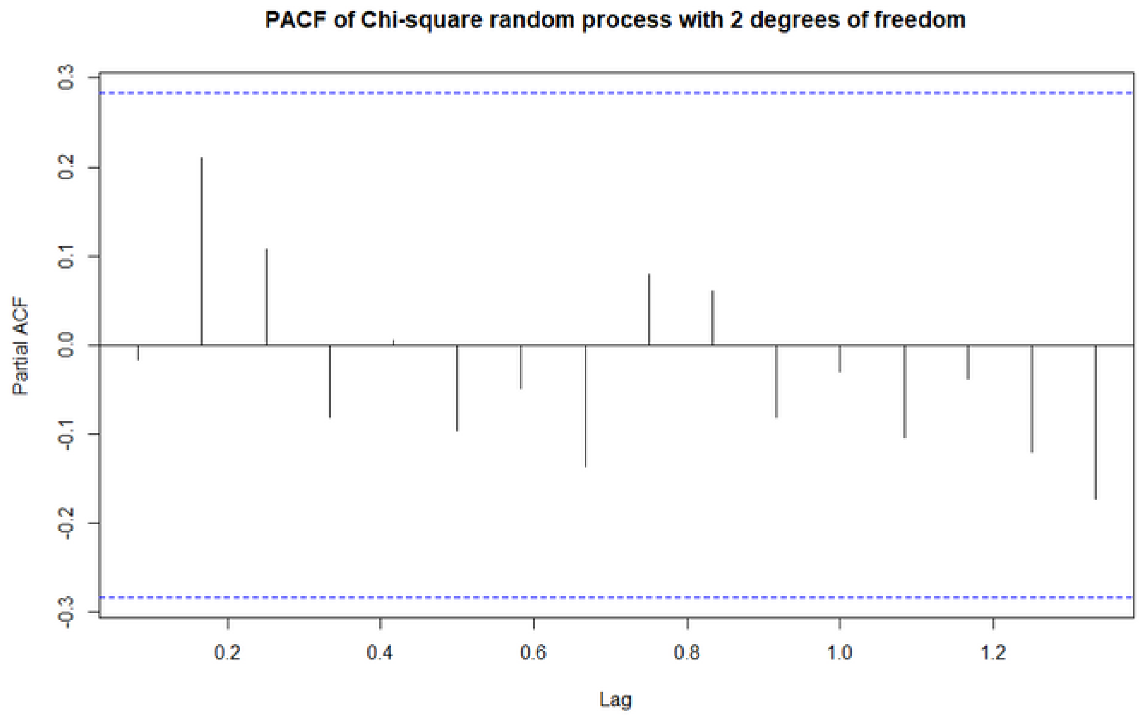

FIGURE 16 : PACF Plot of Chi-squared Distribution with 2 degrees of freedom

- Based on PACF graph of the time series from chi-square distribution with 2 degrees of freedom shown in Figure 16, still there is no Correlation between the present and past values

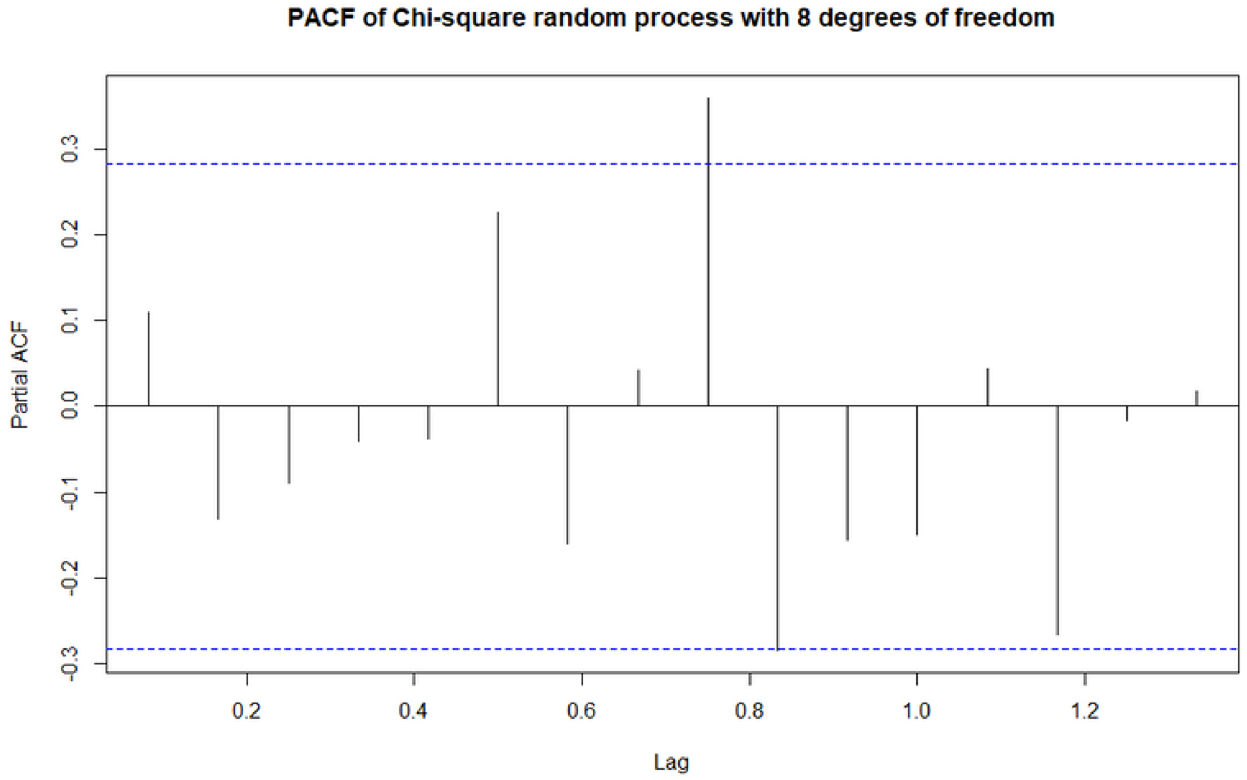

FIGURE 17 : PACF Plot of Chi-squared Distribution with 8 degrees of freedom

- Based on PACF graph of the time series from chi-square distribution with 8 degrees of freedom shown in Figure 17, still there is no Correlation between the present and past values

Appendix

R code

```
#Time series
# Assignment 1
#2nd question
library(readxl)
SouvenirSales <- read_excel("C:/Users/GOD/Downloads/SouvenirSales.xlsx")
View(SouvenirSales)
t.data<-SouvenirSales
date<-t.data$Date
date<-as.Date(date,format="%Y-%m-%d")#converting the type of the variable into date
sales<-ts(t.data$Sales,frequency=12)
decompose1=decompose(sales,type=c("additive"))
#plot
plot(date,sales,main="Souvenir Sales",ylab="Monthly sales",xlab="Months",type="l",col="blue")
plot(decompose1)
#converting y axis into logrithmic
log_sales<-log(sales)
decompose2=decompose(log_sales,type=c("additive"))
plot(date,log_sales,main="Log scale of Souvenir Sales",ylab="Log of Monthly sales",xlab="Months",type="l",col="red")
plot(decompose2)
#acf
acf_sales<-acf(log_sales,main="ACF of Log scale of Souvenir Sales")
acf_2<-acf(sales,main="ACF of Souvenir Sales")
#Pacf
pacf_sales<-pacf(log_sales,main="PACF of Log scale of Souvenir Sales")
pacf_2<-pacf(sales,main="PACF of Souvenir Sales")
```

Appendix

R code

```
#########4th Question########
set.seed(45)#to reproduce thhe result
random_1<-rchisq(48,2)#chi-square with 2 degrees of freedom
random_2<-rchisq(48,8)#Chi-square with 8 degrees of freedom
library(tseries)
#converting into time series
r_1<-ts(random_1,frequency=12)
r_2<-ts(random_2,frequency=12)
#plot the data
plot(r_1,main="White Noise Process- Chi-squared Distribution with 2 degrees of freedom",xlab="Time",ylab="random values from chi-square distribution",type="o",col="purple")
plot(r_2,main="White Noise Process- Chi-squared Distribution with 8 degrees of freedom",xlab="Time",ylab="random values from chi-square distribution",type="o",col="red")
#Checking Stationarity
#chi-square degrees of freedom 2
e1<-r_1[1:24]
e2<-r_1[25:48]
mean(e1)
mean(e2)
var(e1)
var(e2)
adf.test(r_1)

#chi-square degrees of freedom 8
f1<-r_2[1:24]
f2<-r_2[25:48]
mean(f1)
mean(f2)
var(f1)
var(f2)
adf.test(r_2)
```

Appendix

R code

```
#decomposing the series
d_1<-decompose(r_1,type=c('additive'))
d_2<-decompose(r_2,type=c('additive'))
plot(d_1,col="green")
plot(d_2,col="black")

#ACF
acf_1<-acf(r_1,main="ACF of Chi-square random process with 2 degrees of freedom")
acf_2<-acf(r_2,main="ACF of Chi-square random process with 8 degrees of freedom")

#PACF
pacf_1<-pacf(r_1,main="PACF of Chi-square random process with 2 degrees of freedom")
pacf_2<-pacf(r_2,main="PACF of Chi-square random process with 8 degrees of freedom")
```