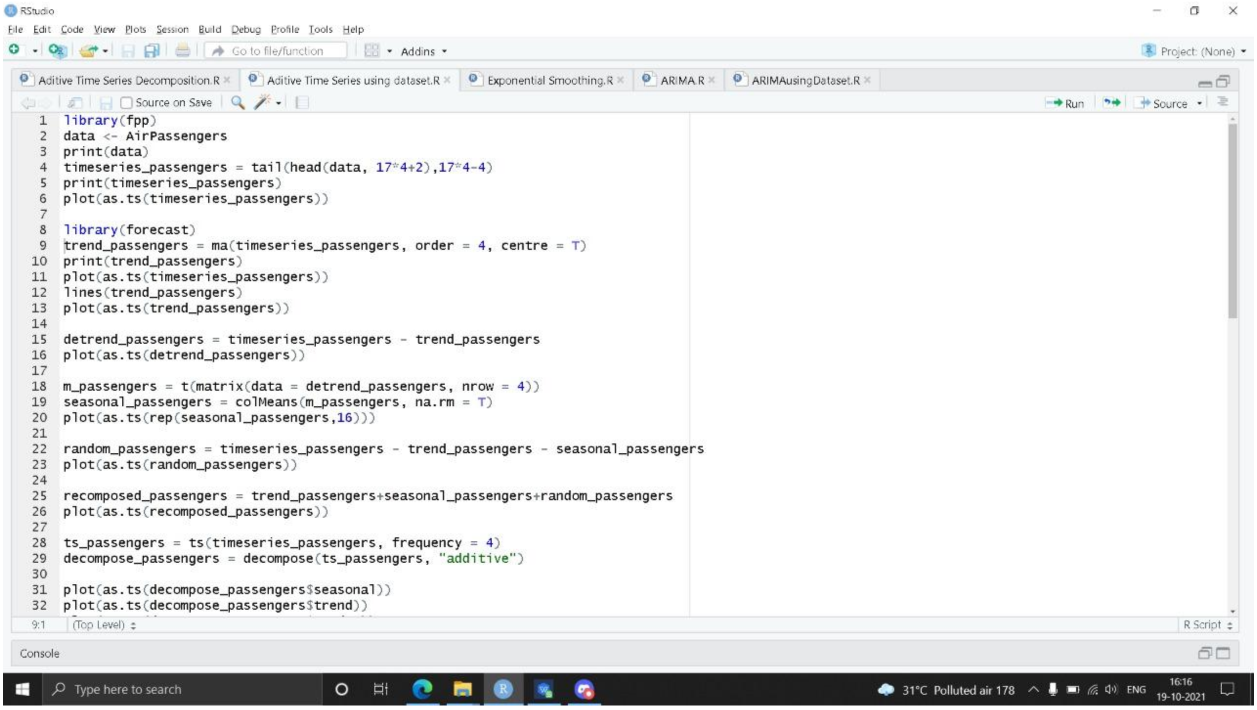
Assignment
Time Series Decomposition

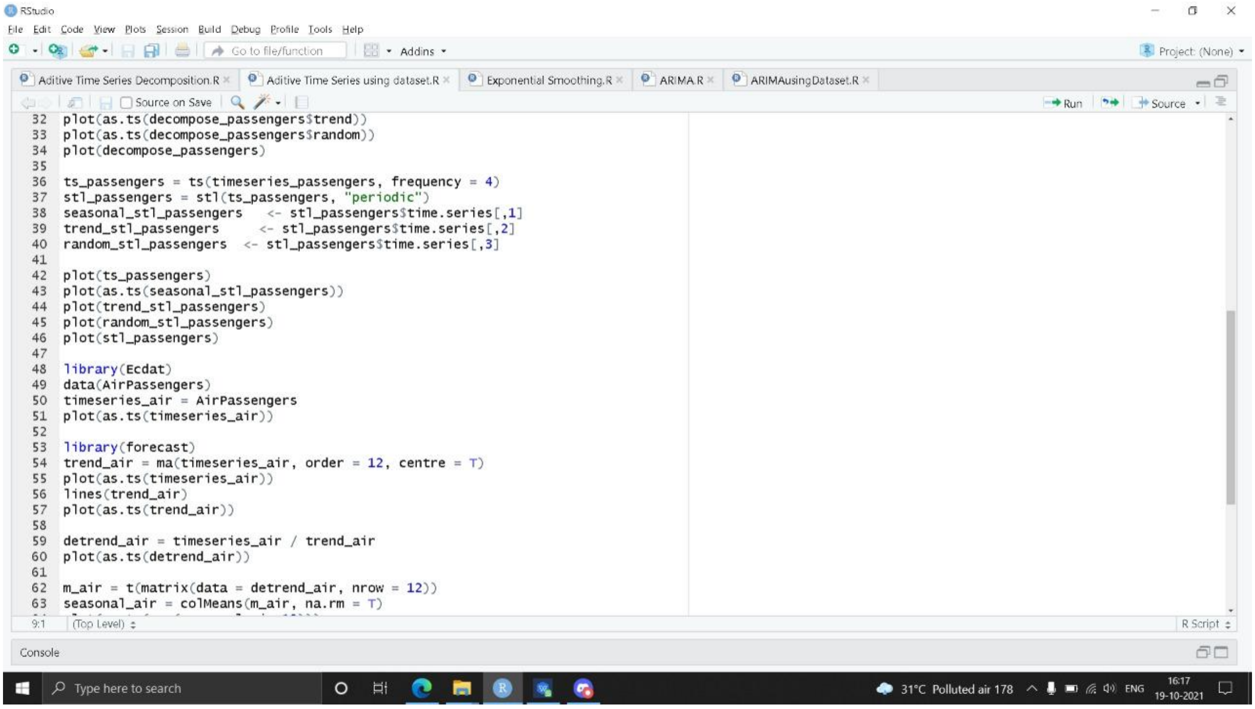
-- Jay Rathod

We are using Air Passengers Data Set
Which is inbuilt in R

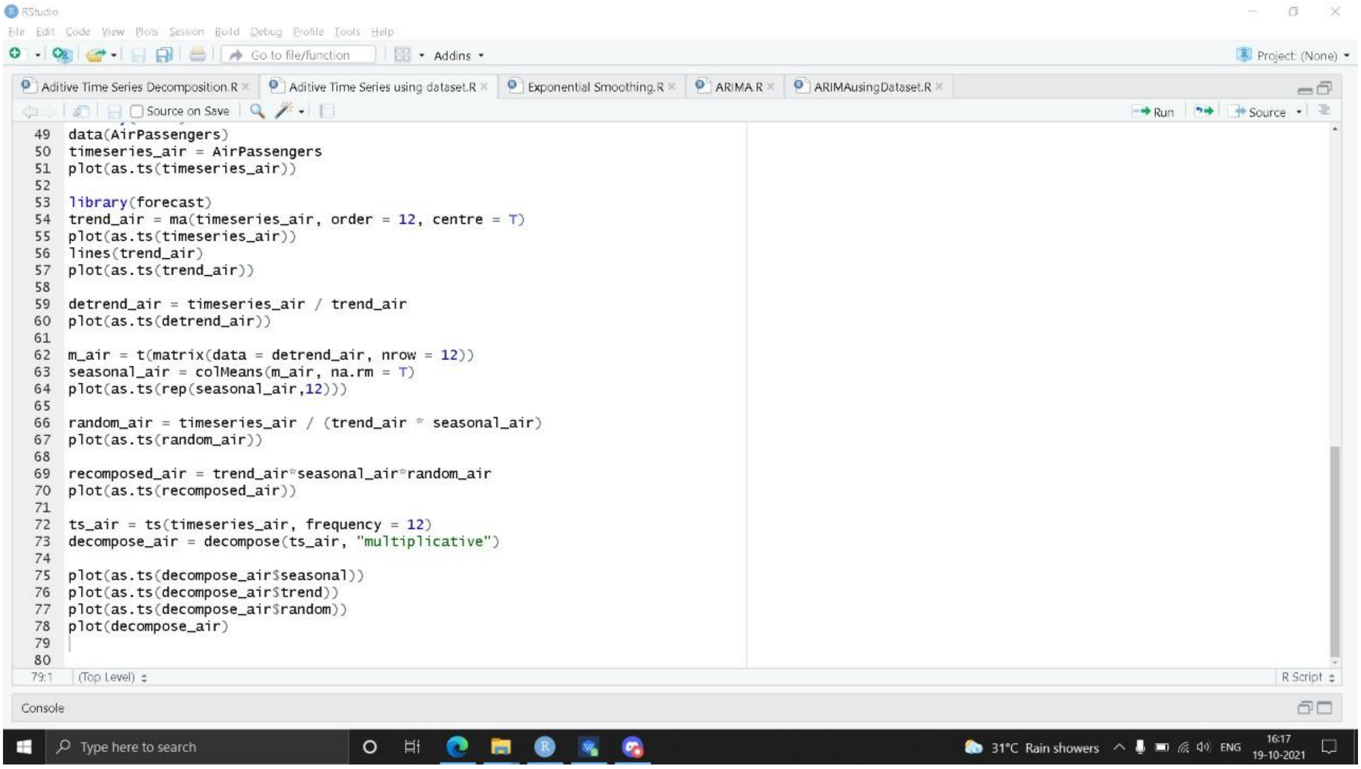
Code:



```r
library(fpp)
data <- AirPassengers
print(data)
timeseries_passengers = tail(head(data, 17*4+2),17*4-4)
print(timeseries_passengers)
plot(as.ts(timeseries_passengers))

library(forecast)
trend_passengers = ma(timeseries_passengers, order = 4, centre = T)
print(trend_passengers)
plot(as.ts(timeseries_passengers))
lines(trend_passengers)
plot(as.ts(trend_passengers))

detrend_passengers = timeseries_passengers - trend_passengers
plot(as.ts(detrend_passengers))

m_passengers = t(matrix(data = detrend_passengers, nrow = 4))
seasonal_passengers = colMeans(m_passengers, na.rm = T)
plot(as.ts(rep(seasonal_passengers,16)))

random_passengers = timeseries_passengers - trend_passengers - seasonal_passengers
plot(as.ts(random_passengers))

recomposed_passengers = trend_passengers+seasonal_passengers+random_passengers
plot(as.ts(recomposed_passengers))

ts_passengers = ts(timeseries_passengers, frequency = 4)
decompose_passengers = decompose(ts_passengers, "additive")

plot(as.ts(decompose_passengers$seasonal))
plot(as.ts(decompose_passengers$trend))
```

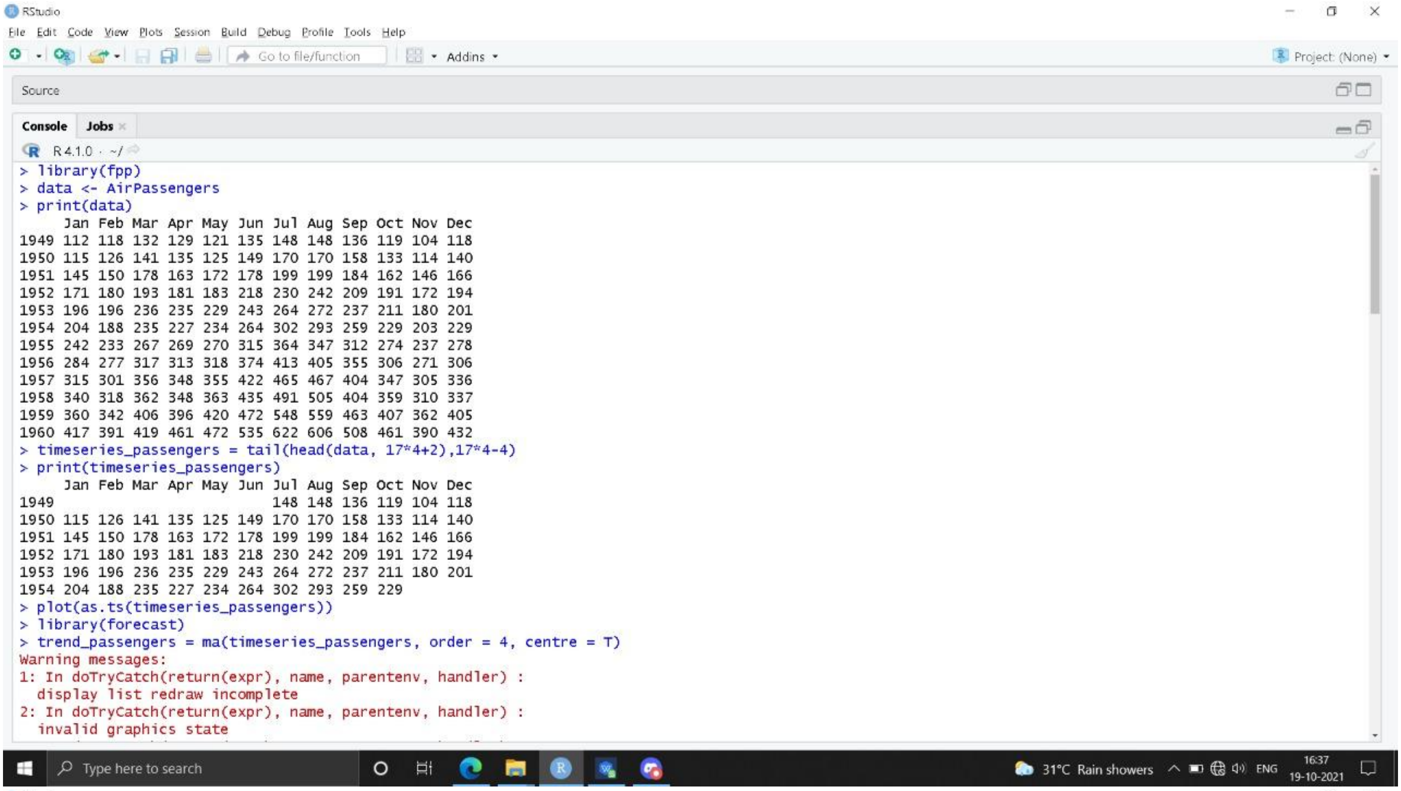


```r
plot(as.ts(decompose_passengers$trend))
plot(as.ts(decompose_passengers$random))
plot(decompose_passengers)

ts_passengers = ts(timeseries_passengers, frequency = 4)
stl_passengers = stl(ts_passengers, "periodic")
seasonal_stl_passengers   <- stl_passengers$time.series[,1]
trend_stl_passengers     <- stl_passengers$time.series[,2]
random_stl_passengers  <- stl_passengers$time.series[,3]

plot(ts_passengers)
plot(as.ts(seasonal_stl_passengers))
plot(trend_stl_passengers)
plot(random_stl_passengers)
plot(stl_passengers)

library(Ecdat)
data(AirPassengers)
timeseries_air = AirPassengers
plot(as.ts(timeseries_air))

library(forecast)
trend_air = ma(timeseries_air, order = 12, centre = T)
plot(as.ts(timeseries_air))
lines(trend_air)
plot(as.ts(trend_air))

detrend_air = timeseries_air / trend_air
plot(as.ts(detrend_air))

m_air = t(matrix(data = detrend_air, nrow = 12))
seasonal_air = colMeans(m_air, na.rm = T)
```

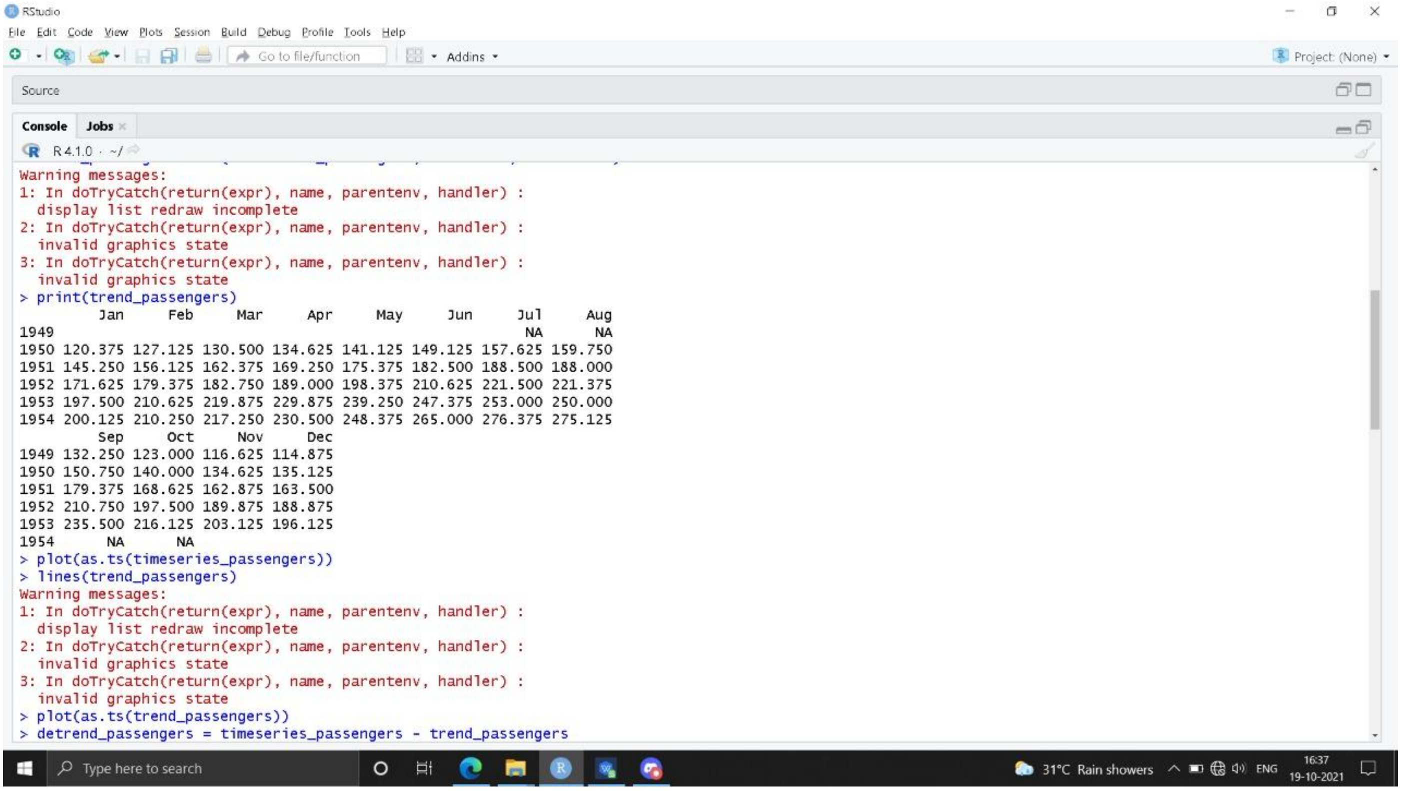


```
data(AirPassengers)
timeseries_air = AirPassengers
plot(as.ts(timeseries_air))

library(forecast)
trend_air = ma(timeseries_air, order = 12, centre = T)
plot(as.ts(timeseries_air))
lines(trend_air)
plot(as.ts(trend_air))

detrend_air = timeseries_air / trend_air
plot(as.ts(detrend_air))

m_air = t(matrix(data = detrend_air, nrow = 12))
seasonal_air = colMeans(m_air, na.rm = T)
plot(as.ts(rep(seasonal_air,12)))

random_air = timeseries_air / (trend_air * seasonal_air)
plot(as.ts(random_air))

recomposed_air = trend_air*seasonal_air*random_air
plot(as.ts(recomposed_air))

ts_air = ts(timeseries_air, frequency = 12)
decompose_air = decompose(ts_air, "multiplicative")

plot(as.ts(decompose_air$seasonal))
plot(as.ts(decompose_air$trend))
plot(as.ts(decompose_air$random))
plot(decompose_air)
```

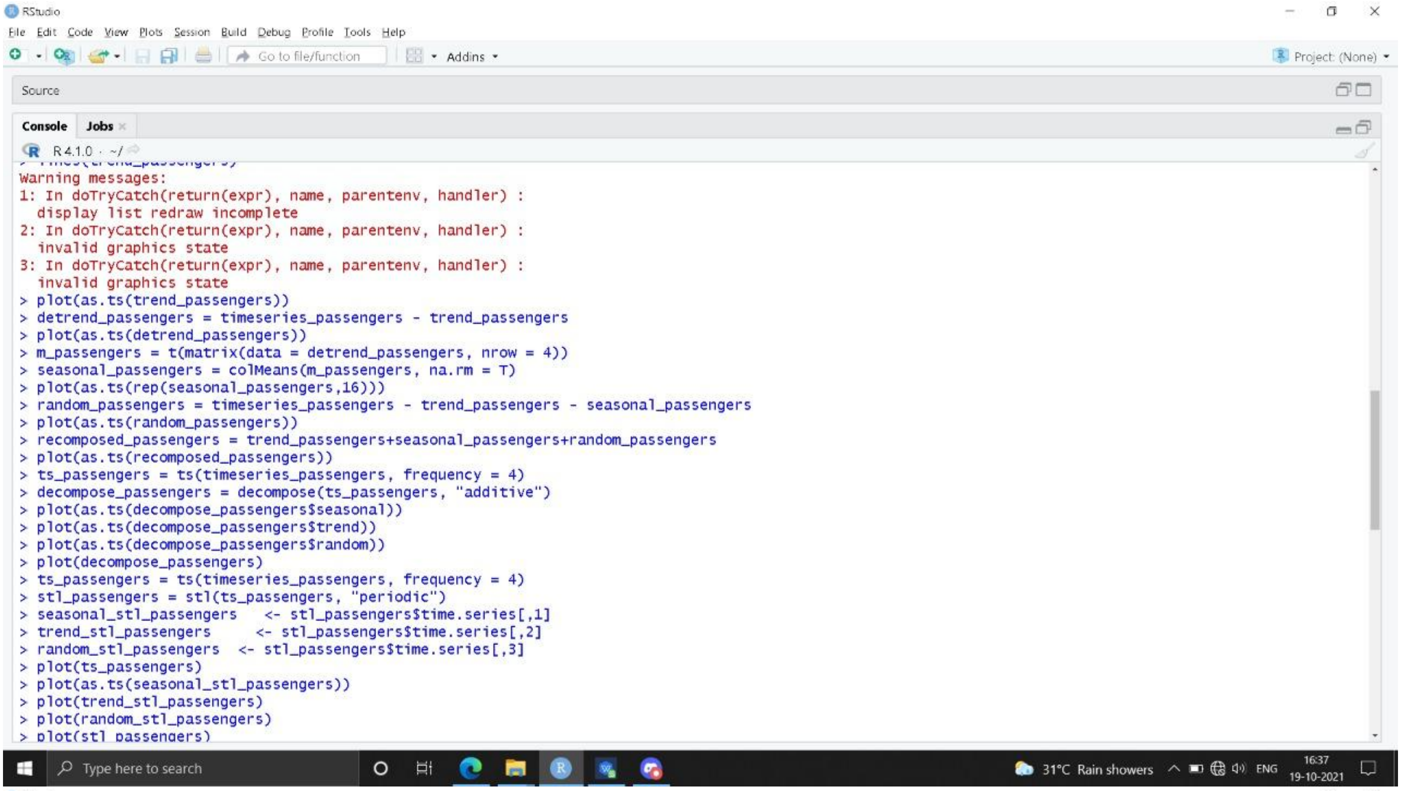
Output:



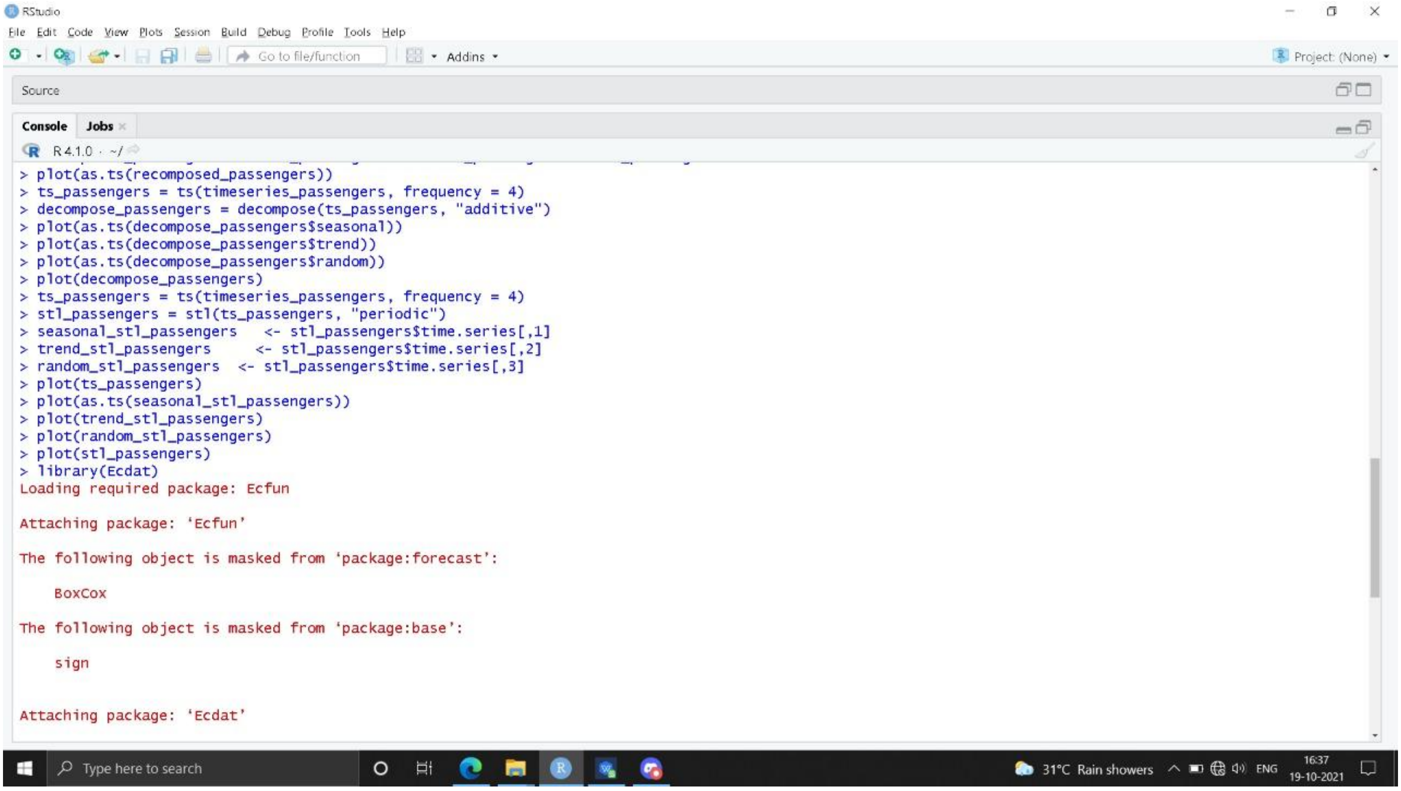
```
> library(fpp)
> data <- AirPassengers
> print(data)
     Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1949 112 118 132 129 121 135 148 148 136 119 104 118
1950 115 126 141 135 125 149 170 170 158 133 114 140
1951 145 150 178 163 172 178 199 199 184 162 146 166
1952 171 180 193 181 183 218 230 242 209 191 172 194
1953 196 196 236 235 229 243 264 272 237 211 180 201
1954 204 188 235 227 234 264 302 293 259 229 203 229
1955 242 233 267 269 270 315 364 347 312 274 237 278
1956 284 277 317 313 318 374 413 405 355 306 271 306
1957 315 301 356 348 355 422 465 467 404 347 305 336
1958 340 318 362 348 363 435 491 505 404 359 310 337
1959 360 342 406 396 420 472 548 559 463 407 362 405
1960 417 391 419 461 472 535 622 606 508 461 390 432
> timeseries_passengers = tail(head(data, 17*4+2),17*4-4)
> print(timeseries_passengers)
     Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1949                         148 148 136 119 104 118
1950 115 126 141 135 125 149 170 170 158 133 114 140
1951 145 150 178 163 172 178 199 199 184 162 146 166
1952 171 180 193 181 183 218 230 242 209 191 172 194
1953 196 196 236 235 229 243 264 272 237 211 180 201
1954 204 188 235 227 234 264 302 293 259 229
> plot(as.ts(timeseries_passengers))
> library(forecast)
> trend_passengers = ma(timeseries_passengers, order = 4, centre = T)
Warning messages:
1: In doTryCatch(return(expr), name, parentenv, handler) :
  display list redraw incomplete
2: In doTryCatch(return(expr), name, parentenv, handler) :
  invalid graphics state
```



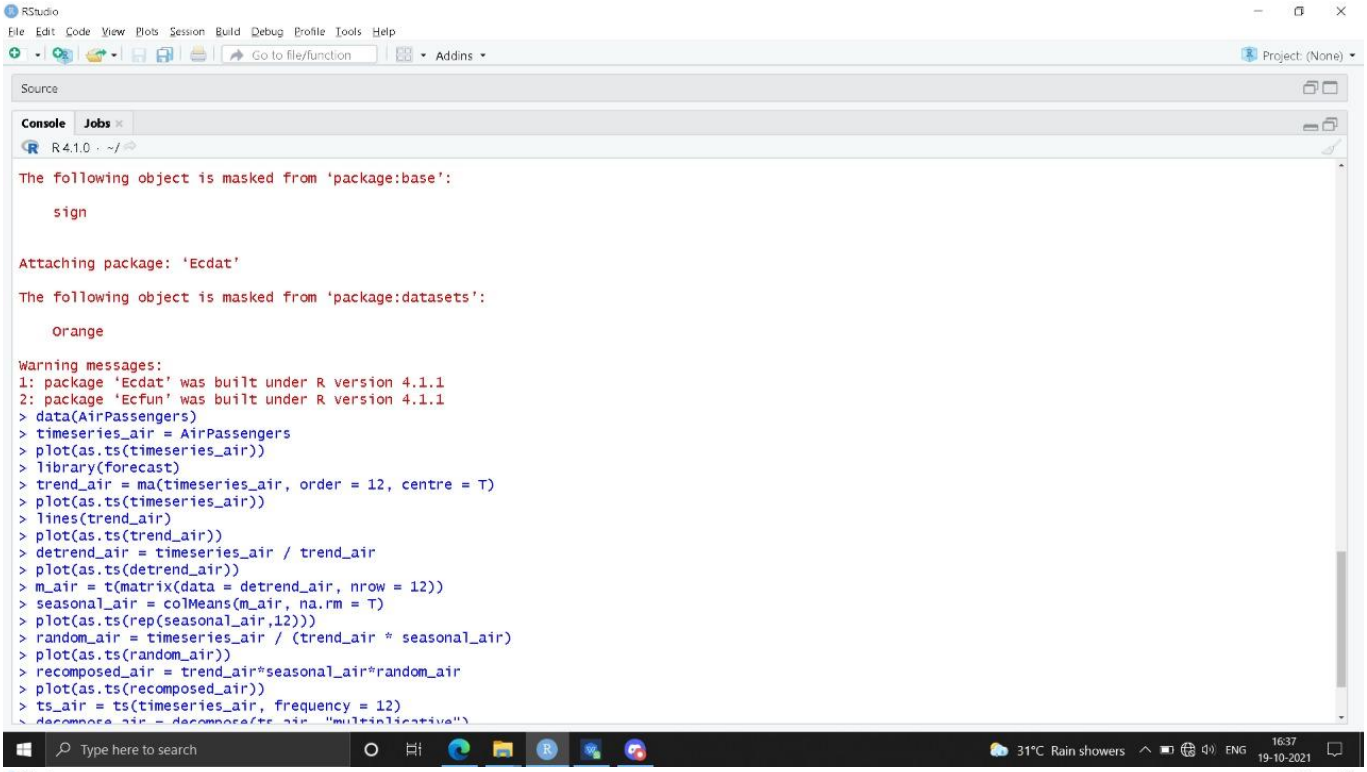
```
Warning messages:
1: In doTryCatch(return(expr), name, parentenv, handler) :
  display list redraw incomplete
2: In doTryCatch(return(expr), name, parentenv, handler) :
  invalid graphics state
3: In doTryCatch(return(expr), name, parentenv, handler) :
  invalid graphics state
> print(trend_passengers)
         Jan     Feb     Mar     Apr     May     Jun     Jul     Aug
1949                                                      NA      NA
1950 120.375 127.125 130.500 134.625 141.125 149.125 157.625 159.750
1951 145.250 156.125 162.375 169.250 175.375 182.500 188.500 188.000
1952 171.625 179.375 182.750 189.000 198.375 210.625 221.500 221.375
1953 197.500 210.625 219.875 229.875 239.250 247.375 253.000 250.000
1954 200.125 210.250 217.250 230.500 248.375 265.000 276.375 275.125
         Sep     Oct     Nov     Dec
1949 132.250 123.000 116.625 114.875
1950 150.750 140.000 134.625 135.125
1951 179.375 168.625 162.875 163.500
1952 210.750 197.500 189.875 188.875
1953 235.500 216.125 203.125 196.125
1954      NA      NA
> plot(as.ts(timeseries_passengers))
> lines(trend_passengers)
Warning messages:
1: In doTryCatch(return(expr), name, parentenv, handler) :
  display list redraw incomplete
2: In doTryCatch(return(expr), name, parentenv, handler) :
  invalid graphics state
3: In doTryCatch(return(expr), name, parentenv, handler) :
  invalid graphics state
> plot(as.ts(trend_passengers))
> detrend_passengers = timeseries_passengers - trend_passengers
```



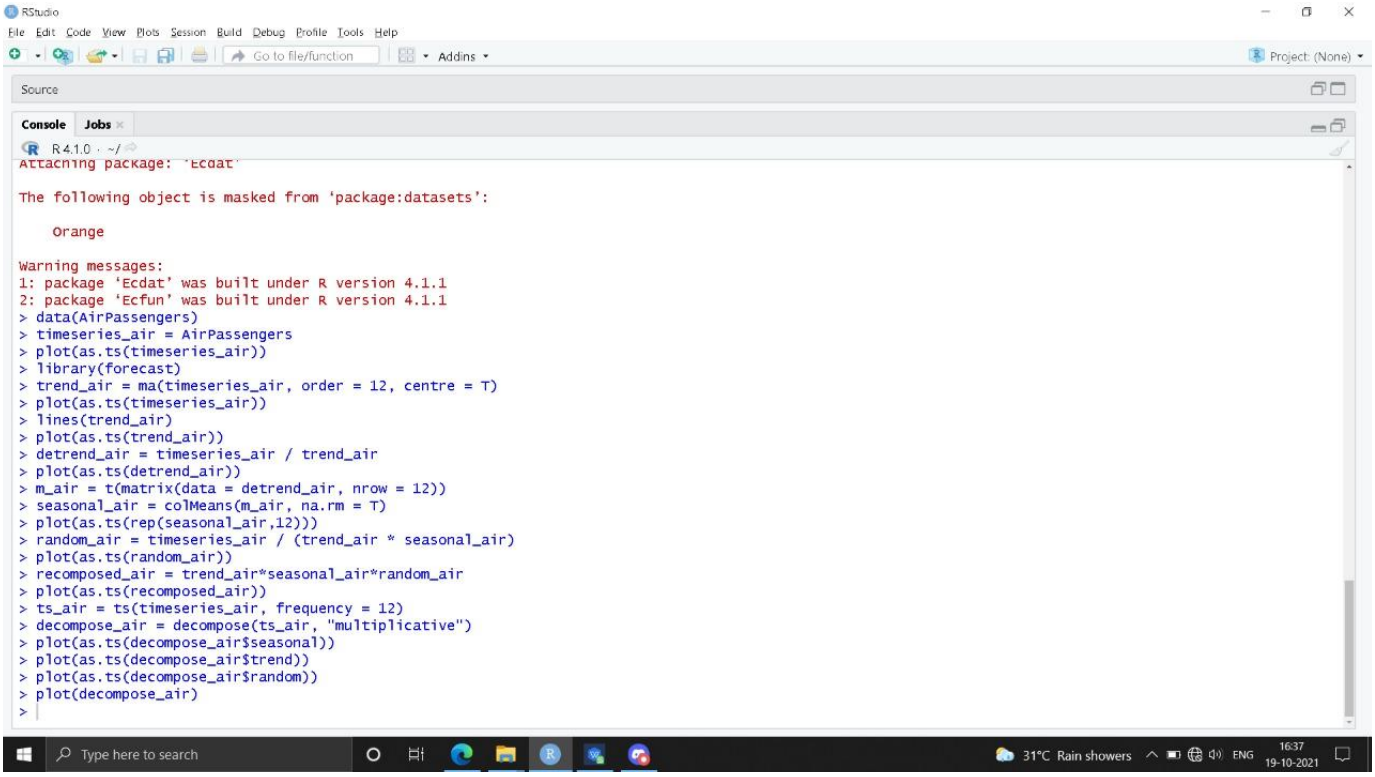
```
Warning messages:
1: In doTryCatch(return(expr), name, parentenv, handler) :
  display list redraw incomplete
2: In doTryCatch(return(expr), name, parentenv, handler) :
  invalid graphics state
3: In doTryCatch(return(expr), name, parentenv, handler) :
  invalid graphics state
> plot(as.ts(trend_passengers))
> detrend_passengers = timeseries_passengers - trend_passengers
> plot(as.ts(detrend_passengers))
> m_passengers = t(matrix(data = detrend_passengers, nrow = 4))
> seasonal_passengers = colMeans(m_passengers, na.rm = T)
> plot(as.ts(rep(seasonal_passengers,16)))
> random_passengers = timeseries_passengers - trend_passengers - seasonal_passengers
> plot(as.ts(random_passengers))
> recomposed_passengers = trend_passengers+seasonal_passengers+random_passengers
> plot(as.ts(recomposed_passengers))
> ts_passengers = ts(timeseries_passengers, frequency = 4)
> decompose_passengers = decompose(ts_passengers, "additive")
> plot(as.ts(decompose_passengers$seasonal))
> plot(as.ts(decompose_passengers$trend))
> plot(as.ts(decompose_passengers$random))
> plot(decompose_passengers)
> ts_passengers = ts(timeseries_passengers, frequency = 4)
> stl_passengers = stl(ts_passengers, "periodic")
> seasonal_stl_passengers   <- stl_passengers$time.series[,1]
> trend_stl_passengers     <- stl_passengers$time.series[,2]
> random_stl_passengers  <- stl_passengers$time.series[,3]
> plot(ts_passengers)
> plot(as.ts(seasonal_stl_passengers))
> plot(trend_stl_passengers)
> plot(random_stl_passengers)
> plot(stl_passengers)
```



```
> plot(as.ts(recomposed_passengers))
> ts_passengers = ts(timeseries_passengers, frequency = 4)
> decompose_passengers = decompose(ts_passengers, "additive")
> plot(as.ts(decompose_passengers$seasonal))
> plot(as.ts(decompose_passengers$trend))
> plot(as.ts(decompose_passengers$random))
> plot(decompose_passengers)
> ts_passengers = ts(timeseries_passengers, frequency = 4)
> stl_passengers = stl(ts_passengers, "periodic")
> seasonal_stl_passengers   <- stl_passengers$time.series[,1]
> trend_stl_passengers     <- stl_passengers$time.series[,2]
> random_stl_passengers  <- stl_passengers$time.series[,3]
> plot(ts_passengers)
> plot(as.ts(seasonal_stl_passengers))
> plot(trend_stl_passengers)
> plot(random_stl_passengers)
> plot(stl_passengers)
> library(Ecdat)
Loading required package: Ecfun

Attaching package: ‘Ecfun’

The following object is masked from ‘package:forecast’:

    BoxCox

The following object is masked from ‘package:base’:

    sign


Attaching package: ‘Ecdat’
```

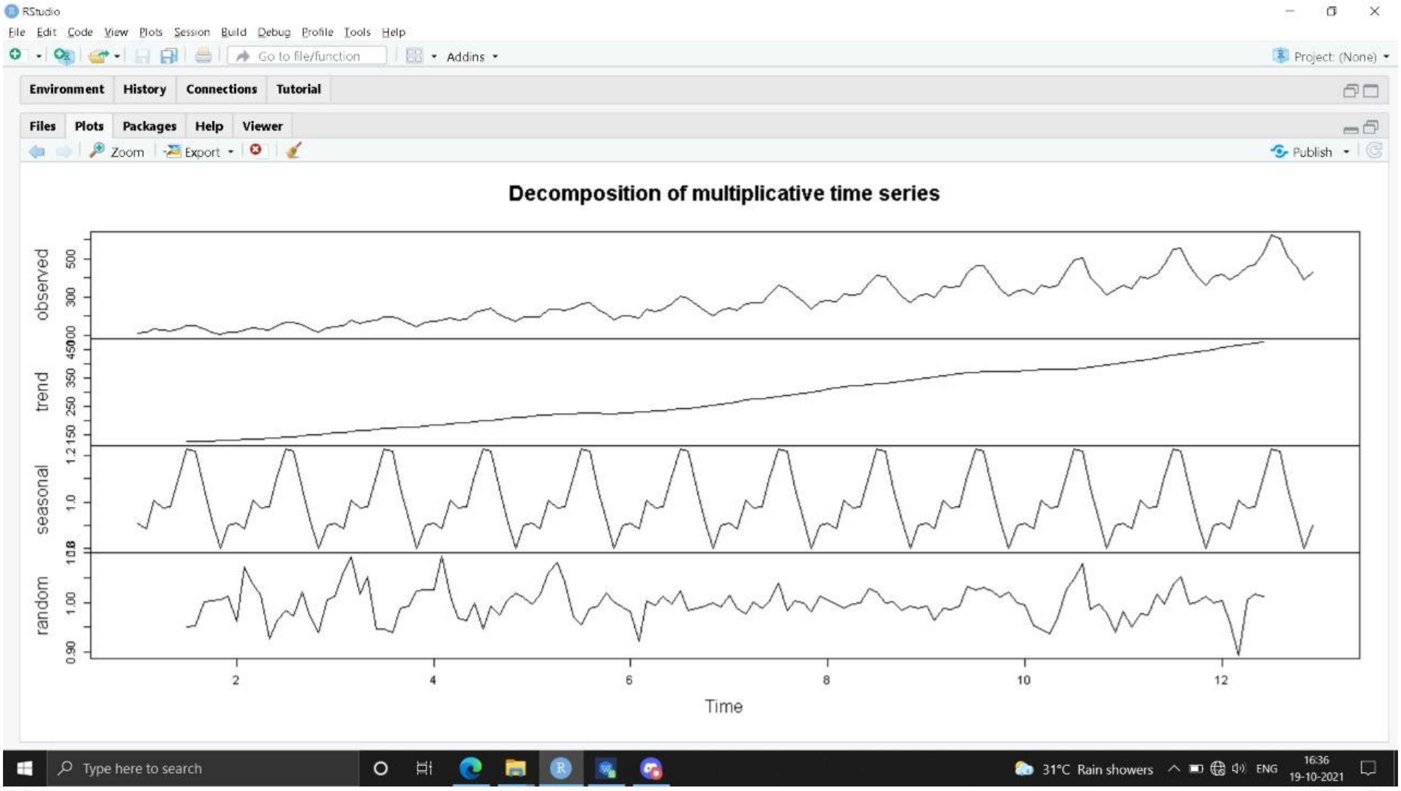


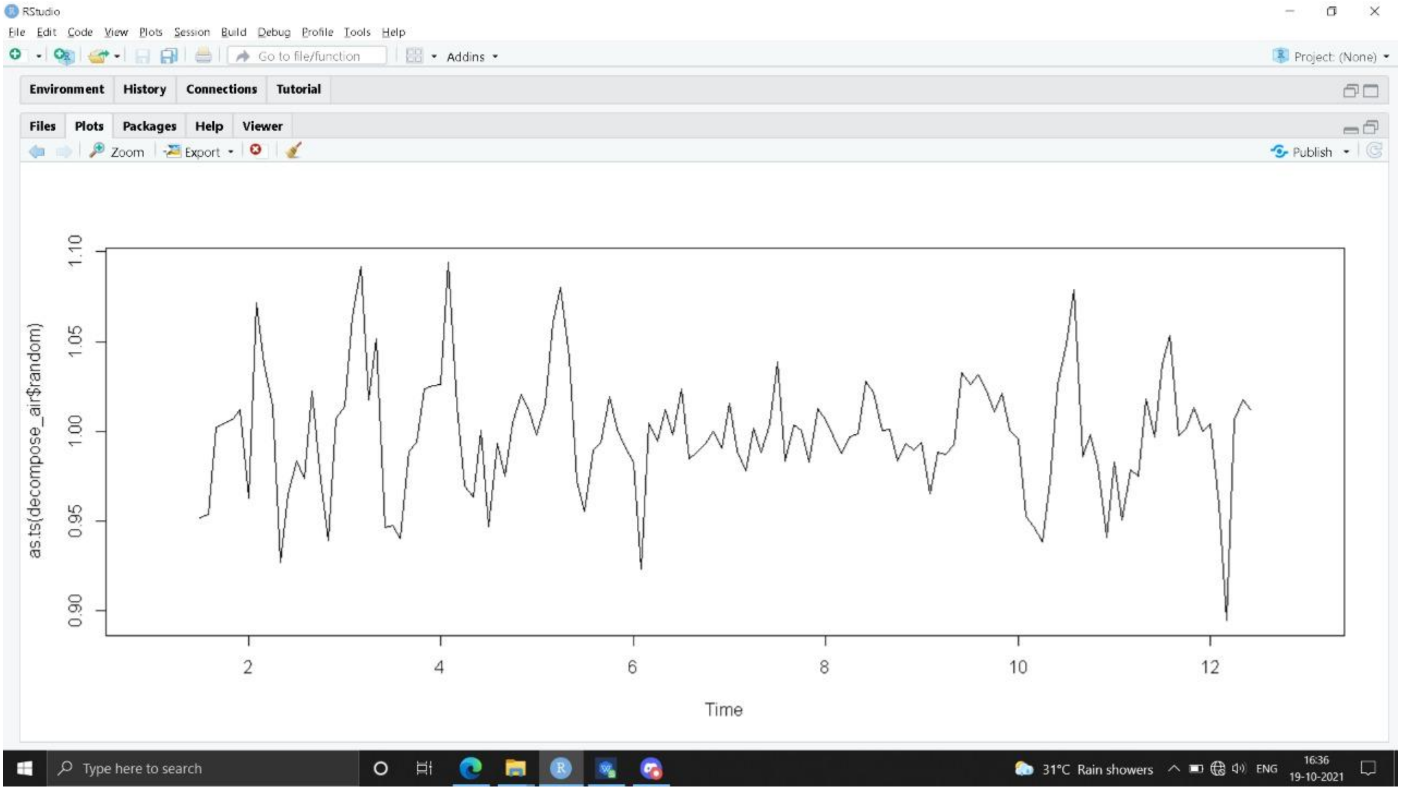
```
The following object is masked from ‘package:base’:

    sign


Attaching package: ‘Ecdat’

The following object is masked from ‘package:datasets’:

    Orange

Warning messages:
1: package ‘Ecdat’ was built under R version 4.1.1
2: package ‘Ecfun’ was built under R version 4.1.1
> data(AirPassengers)
> timeseries_air = AirPassengers
> plot(as.ts(timeseries_air))
> library(forecast)
> trend_air = ma(timeseries_air, order = 12, centre = T)
> plot(as.ts(timeseries_air))
> lines(trend_air)
> plot(as.ts(trend_air))
> detrend_air = timeseries_air / trend_air
> plot(as.ts(detrend_air))
> m_air = t(matrix(data = detrend_air, nrow = 12))
> seasonal_air = colMeans(m_air, na.rm = T)
> plot(as.ts(rep(seasonal_air,12)))
> random_air = timeseries_air / (trend_air * seasonal_air)
> plot(as.ts(random_air))
> recomposed_air = trend_air*seasonal_air*random_air
> plot(as.ts(recomposed_air))
> ts_air = ts(timeseries_air, frequency = 12)
> decompose_air = decompose(ts_air, "multiplicative")
```

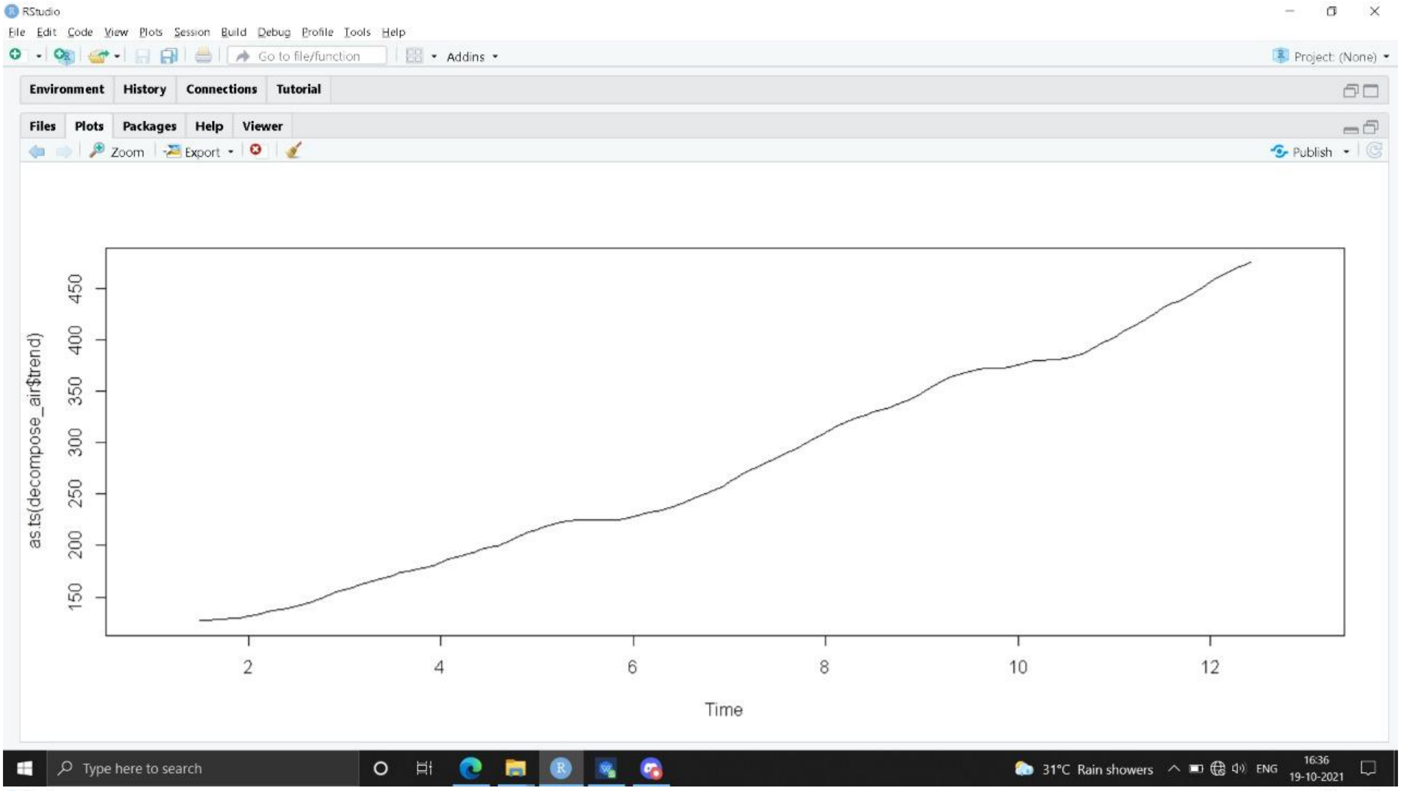


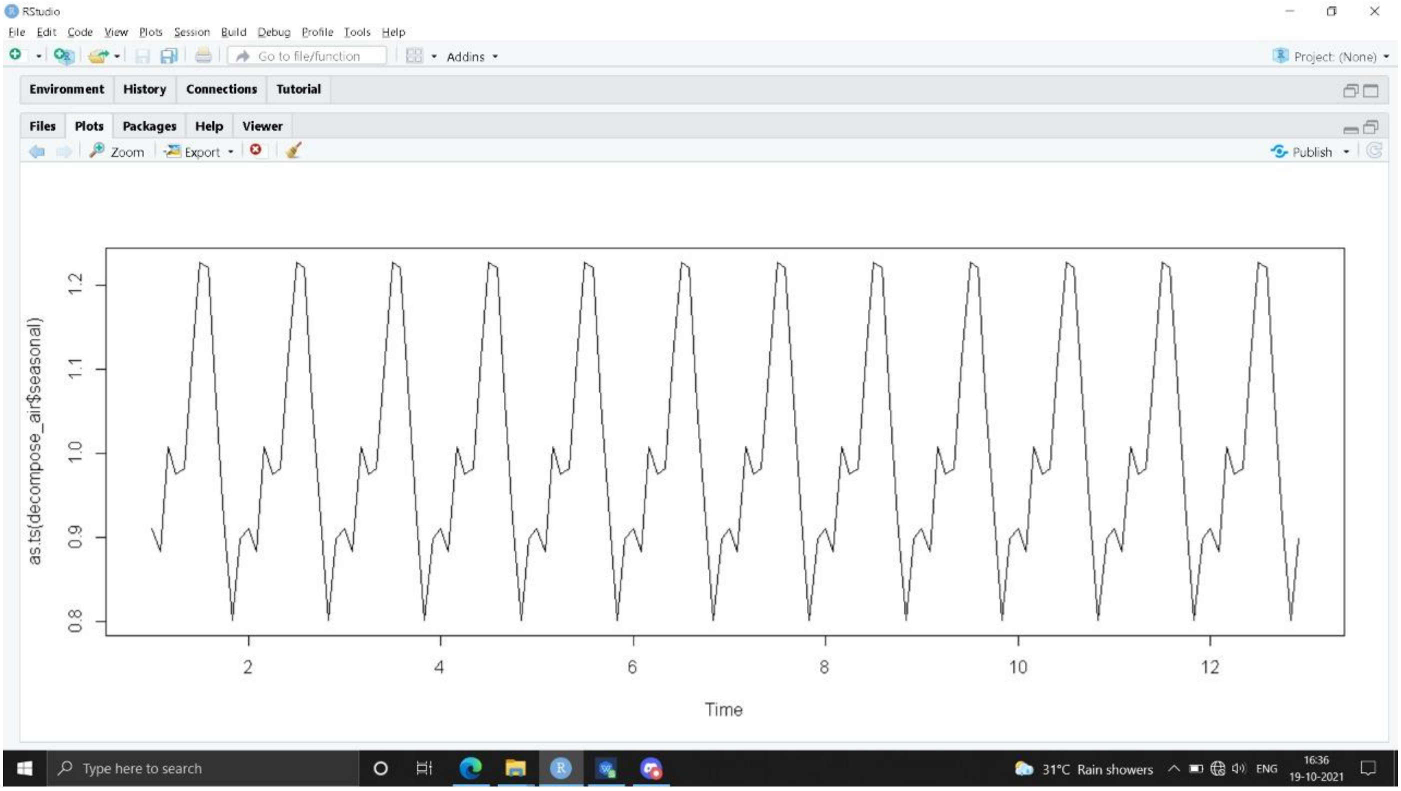
```
Attaching package: ‘Ecdat’

The following object is masked from ‘package:datasets’:

    Orange

Warning messages:
1: package ‘Ecdat’ was built under R version 4.1.1
2: package ‘Ecfun’ was built under R version 4.1.1
> data(AirPassengers)
> timeseries_air = AirPassengers
> plot(as.ts(timeseries_air))
> library(forecast)
> trend_air = ma(timeseries_air, order = 12, centre = T)
> plot(as.ts(timeseries_air))
> lines(trend_air)
> plot(as.ts(trend_air))
> detrend_air = timeseries_air / trend_air
> plot(as.ts(detrend_air))
> m_air = t(matrix(data = detrend_air, nrow = 12))
> seasonal_air = colMeans(m_air, na.rm = T)
> plot(as.ts(rep(seasonal_air,12)))
> random_air = timeseries_air / (trend_air * seasonal_air)
> plot(as.ts(random_air))
> recomposed_air = trend_air*seasonal_air*random_air
> plot(as.ts(recomposed_air))
> ts_air = ts(timeseries_air, frequency = 12)
> decompose_air = decompose(ts_air, "multiplicative")
> plot(as.ts(decompose_air$seasonal))
> plot(as.ts(decompose_air$trend))
> plot(as.ts(decompose_air$random))
> plot(decompose_air)
> 
```

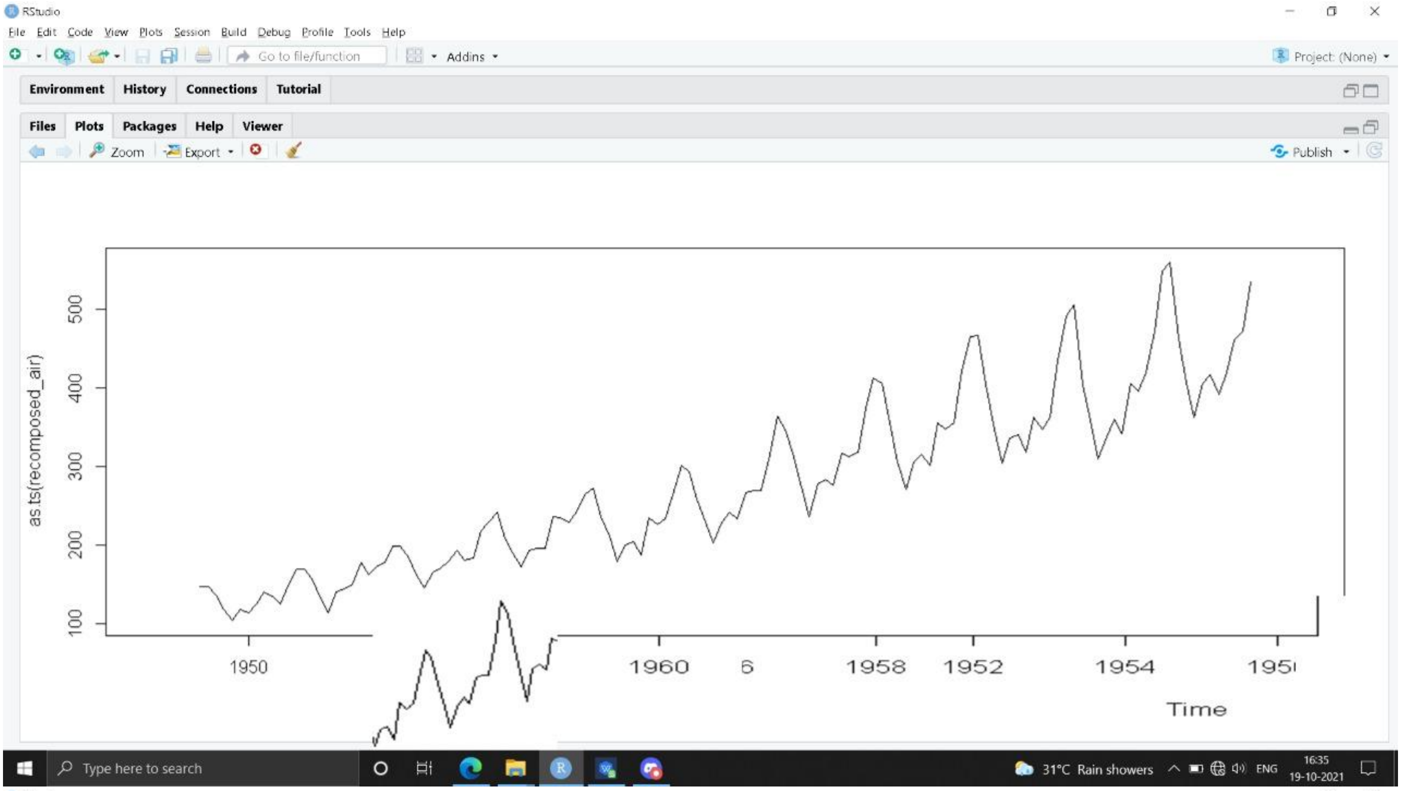
Graphs:

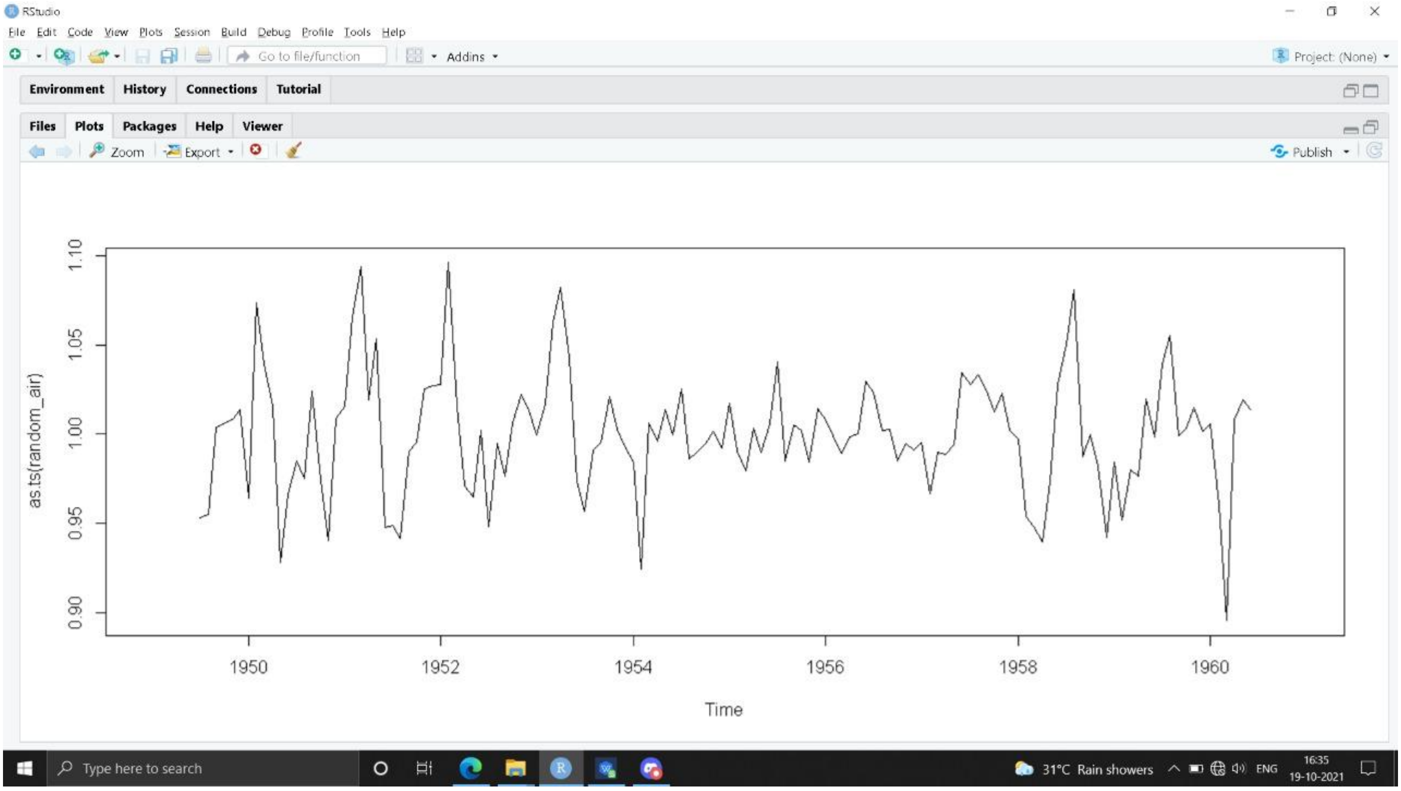

RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom Export
Publish
Decomposition of multiplicative time series
observed
100 300 500
trend
150 250 350 450
seasonal
0.8 1.0 1.2
random
0.90 1.00 1.10
2 4 6 8 10 12
Time
Type here to search
31°C Rain showers
ENG
16:36
19-10-2021

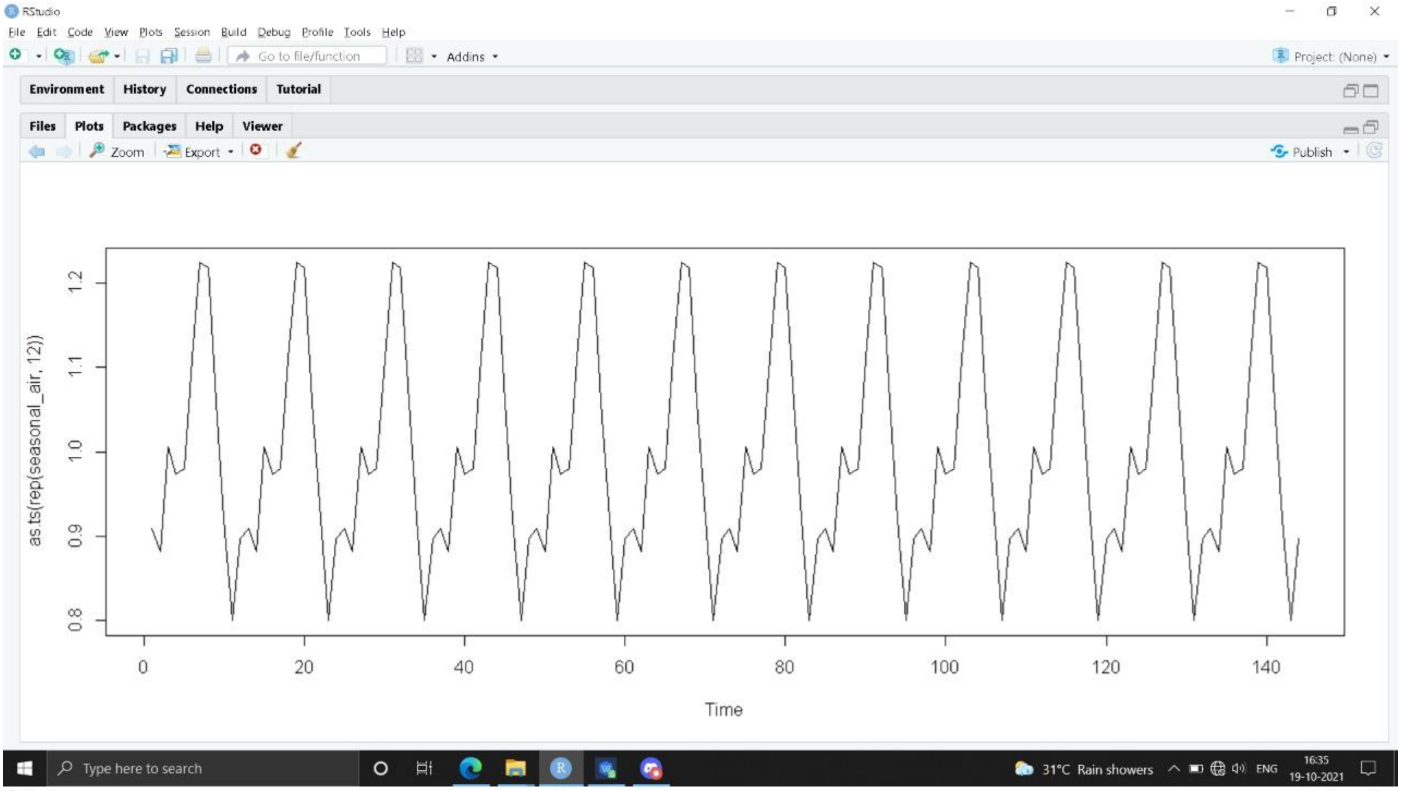

RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom Export
Publish
as.ts(decompose_air$random)
0.90 0.95 1.00 1.05 1.10
2 4 6 8 10 12
Time
Type here to search
31°C Rain showers
ENG
16:36
19-10-2021

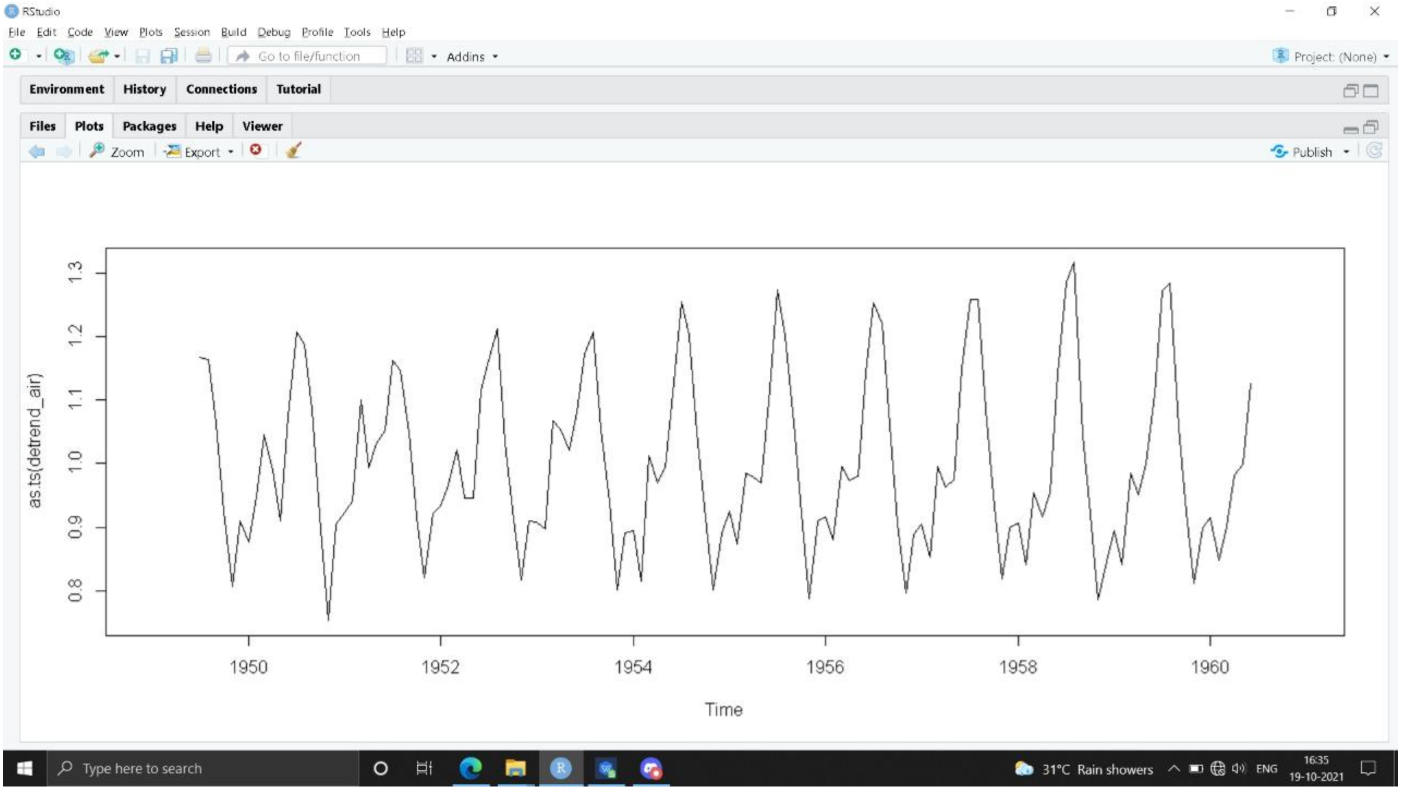

RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom
Export
Publish
as.ts(decompose_air$trend)
150
200
250
300
350
400
450
2
4
6
8
10
12
Time
Type here to search
31°C Rain showers
ENG
16:36
19-10-2021

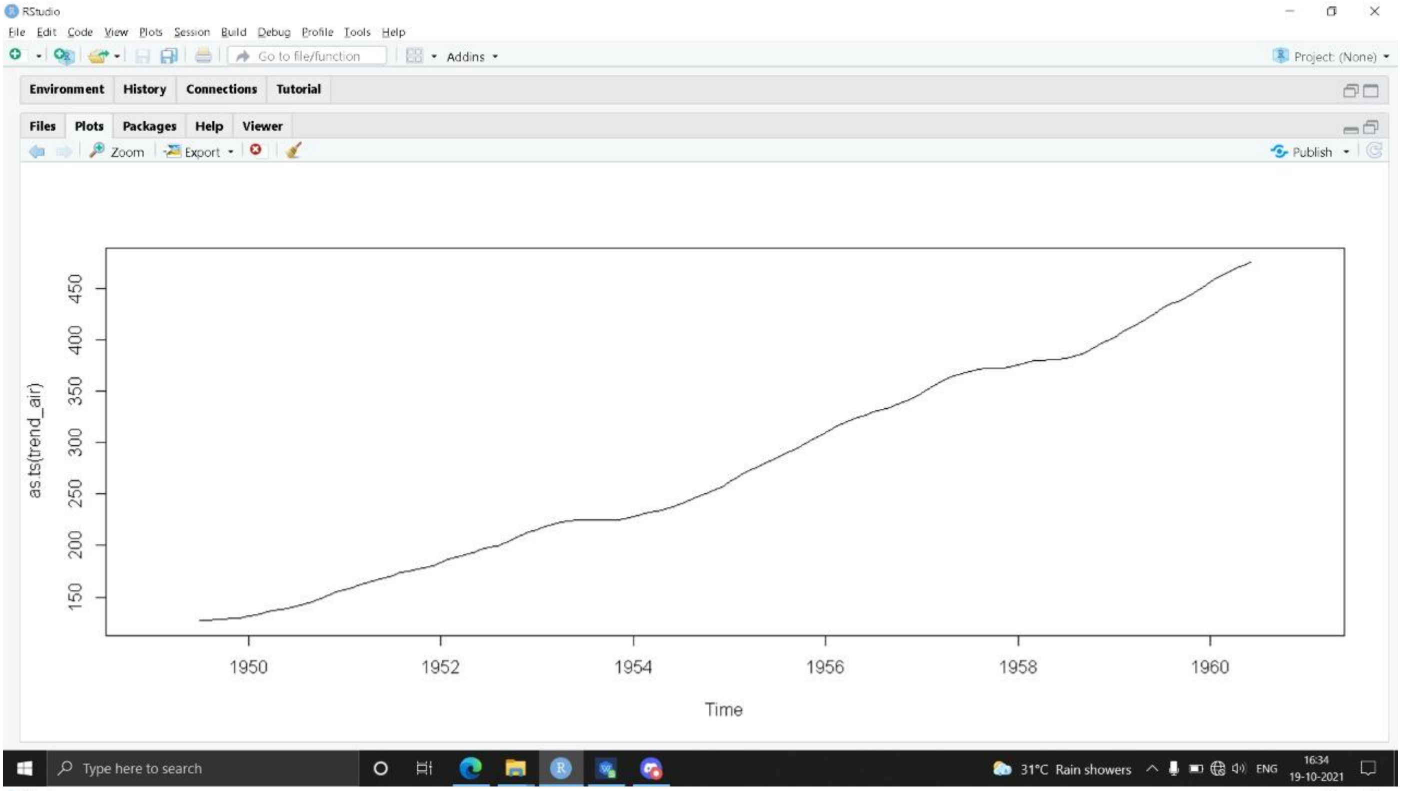

RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom
Export
Publish
as.ts(decompose_air$seasonal)
0.8
0.9
1.0
1.1
1.2
2
4
6
8
10
12
Time
Type here to search
31°C Rain showers
ENG
16:36
19-10-2021

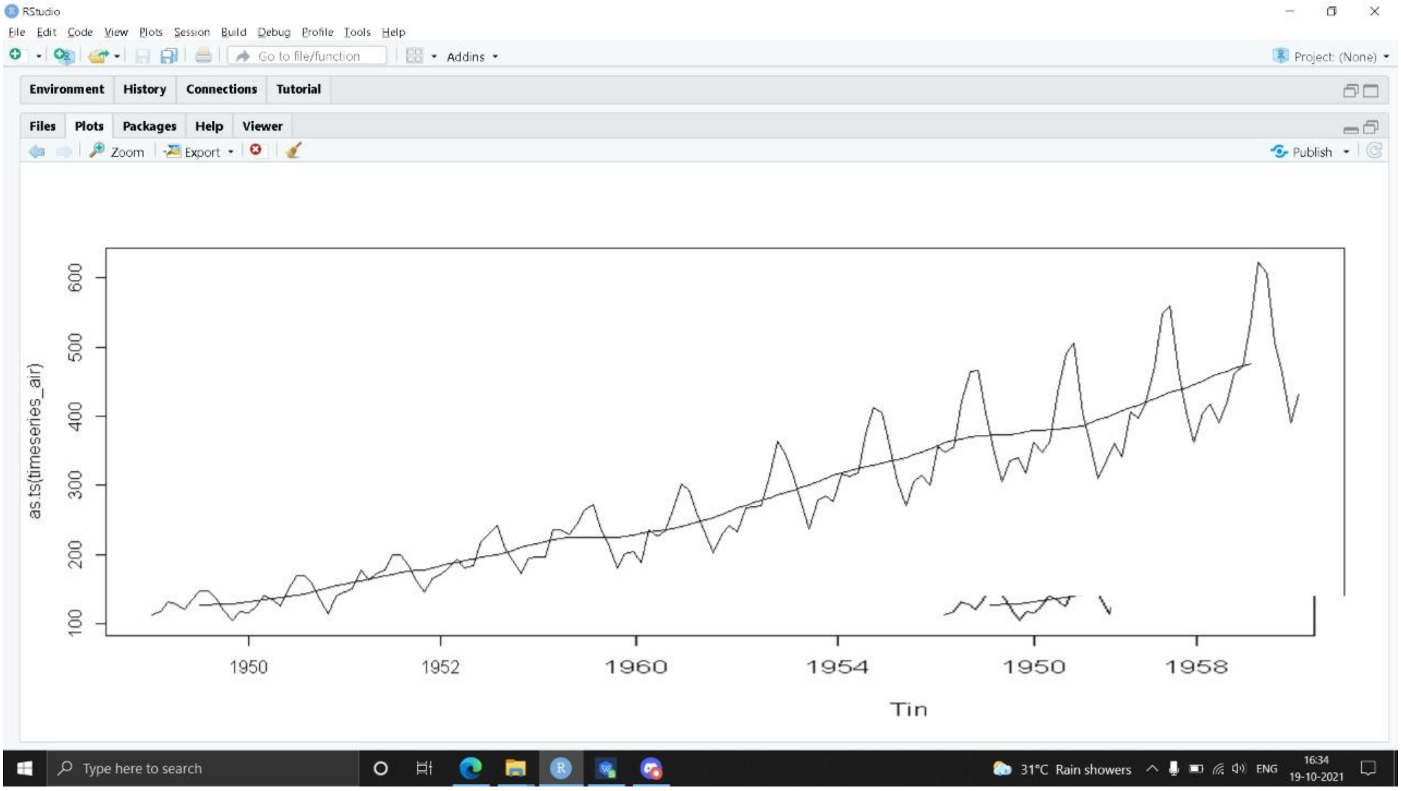

RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom
Export
Publish
as.ts(recomposed_air)
100
200
300
400
500
1950
1960
6
1958
1952
1954
195
Time
Type here to search
31°C Rain showers
ENG
16:35
19-10-2021

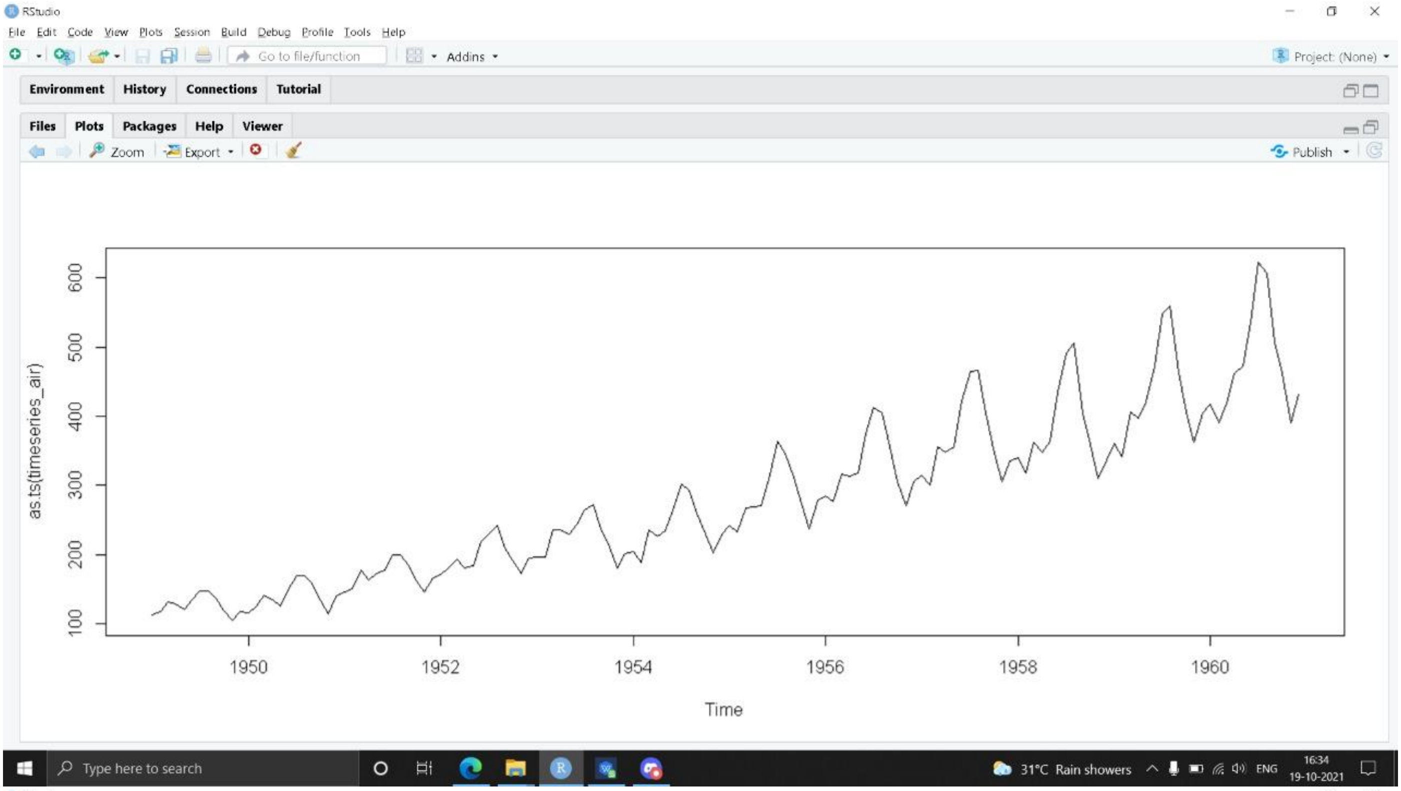

RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom
Export
Publish
as.ts(random_air)
0.90
0.95
1.00
1.05
1.10
1950
1952
1954
1956
1958
1960
Time
Type here to search
31°C Rain showers
ENG
16:35
19-10-2021

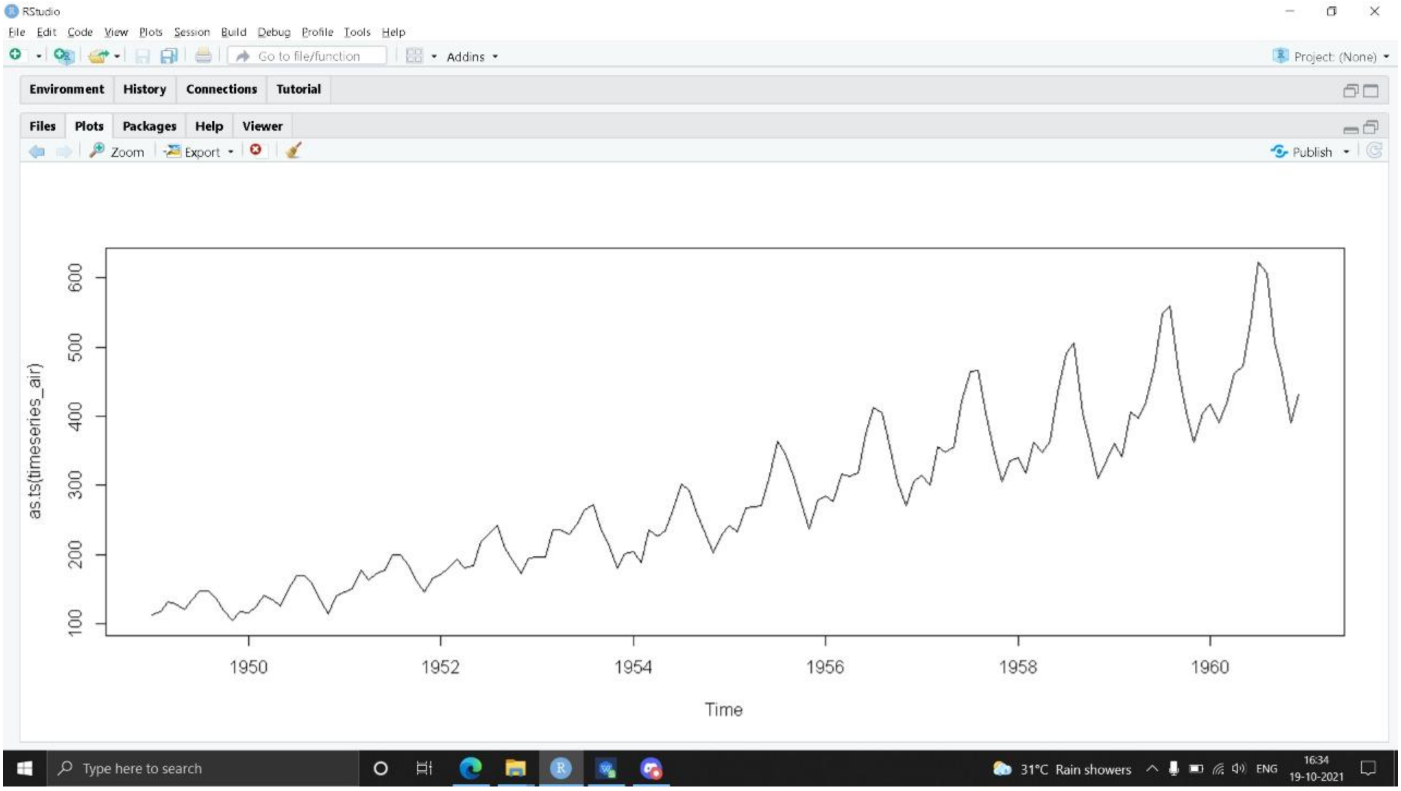

RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom
Export
Publish
as.ts(rep(seasonal_air, 12))
0.8
0.9
1.0
1.1
1.2
0
20
40
60
80
100
120
140
Time
Type here to search
31°C Rain showers
ENG
16:35
19-10-2021

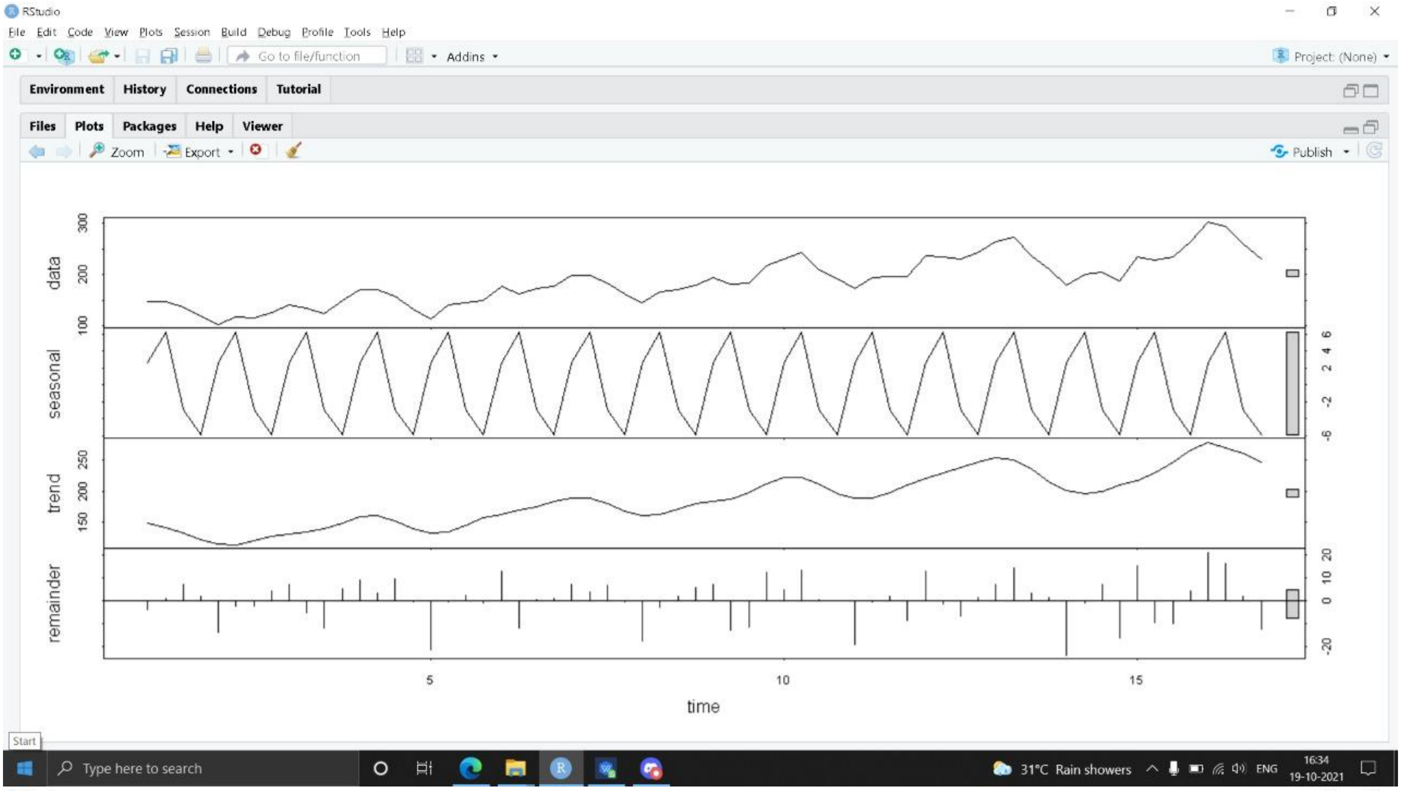

RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom
Export
Publish
as.ts(detrend_air)
0.8
0.9
1.0
1.1
1.2
1.3
1950
1952
1954
1956
1958
1960
Time
Type here to search
31°C Rain showers
ENG
16:35
19-10-2021

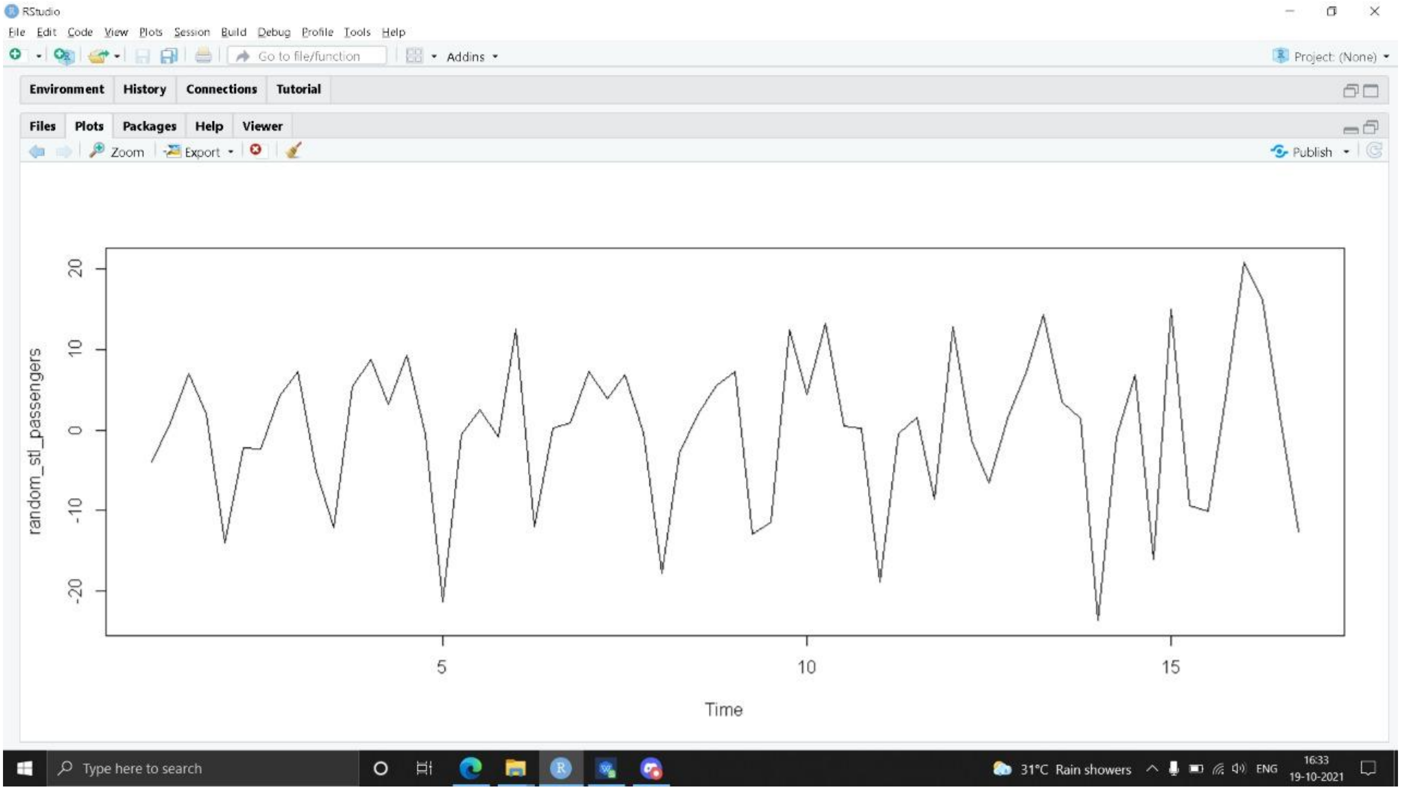

RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom Export
Publish
as.ts(trend_air)
150
200
250
300
350
400
450
1950
1952
1954
1956
1958
1960
Time
Type here to search
31°C Rain showers
ENG
16:34
19-10-2021


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom Export
Publish
as.ts(timeseries_air)
100
200
300
400
500
600
1950
1952
1960
1954
1950
1958
Tin
Type here to search
31°C Rain showers
ENG
16:34
19-10-2021


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom
Export
Publish
as.ts(timeseries_air)
100
200
300
400
500
600
1950
1952
1954
1956
1958
1960
Time
Type here to search
31°C Rain showers
ENG
16:34
19-10-2021


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom
Export
Publish
as.ts(timeseries_air)
100
200
300
400
500
600
1950
1952
1954
1956
1958
1960
Time
Type here to search
31°C Rain showers
ENG
16:34
19-10-2021


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom
Export
Publish
data
100
200
300
seasonal
-6
-2
2
4
6
trend
150
200
250
remainder
-20
0
10
20
5
10
15
time
Start
Type here to search
31°C Rain showers
ENG
16:34
19-10-2021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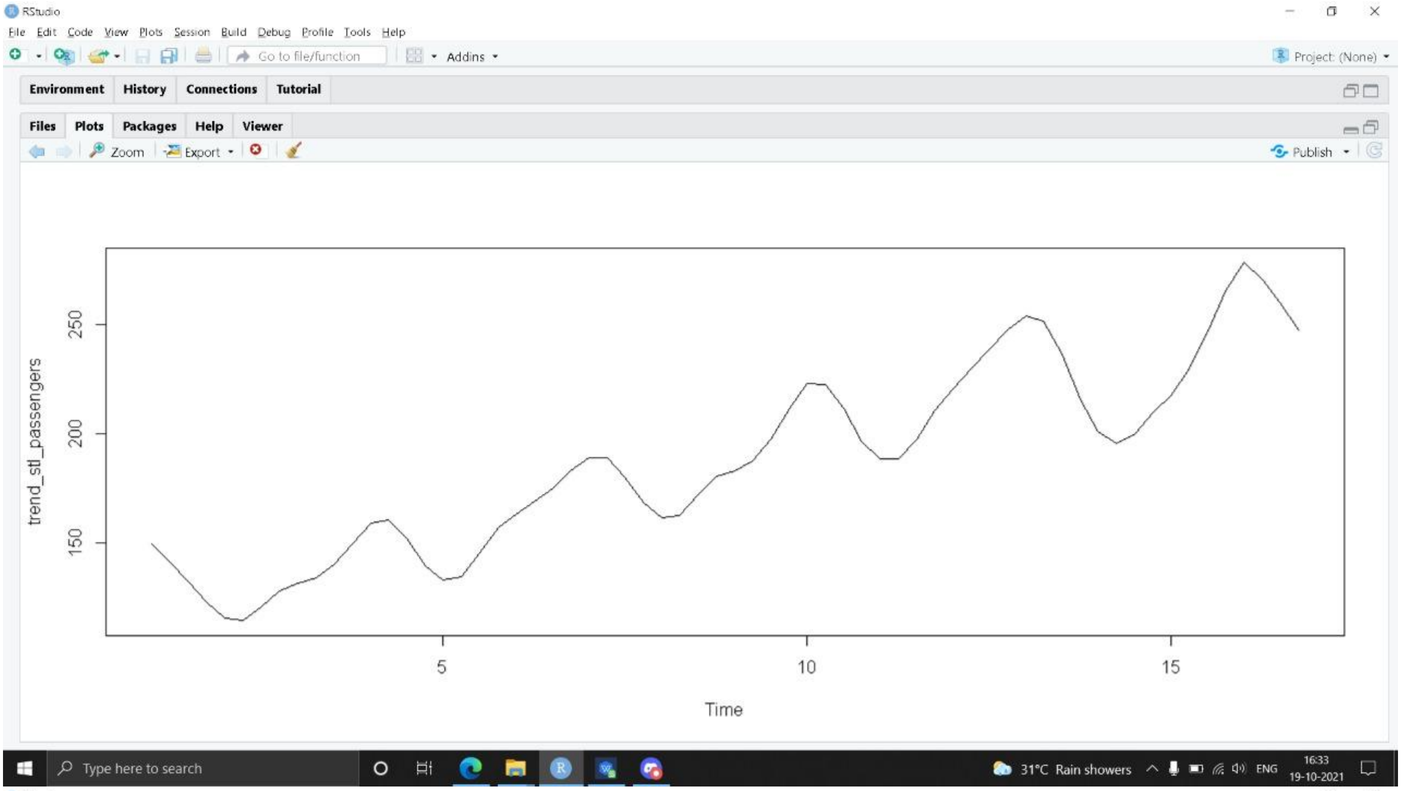
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom
Export
Publish
random_stl_passengers
-20
-10
0
10
20
5
10
15
Time
Type here to search
31°C Rain showers
ENG
16:33
19-10-2021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Zoom
Export
Publish
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150
200
250
5
10
15
Time
Type here to search
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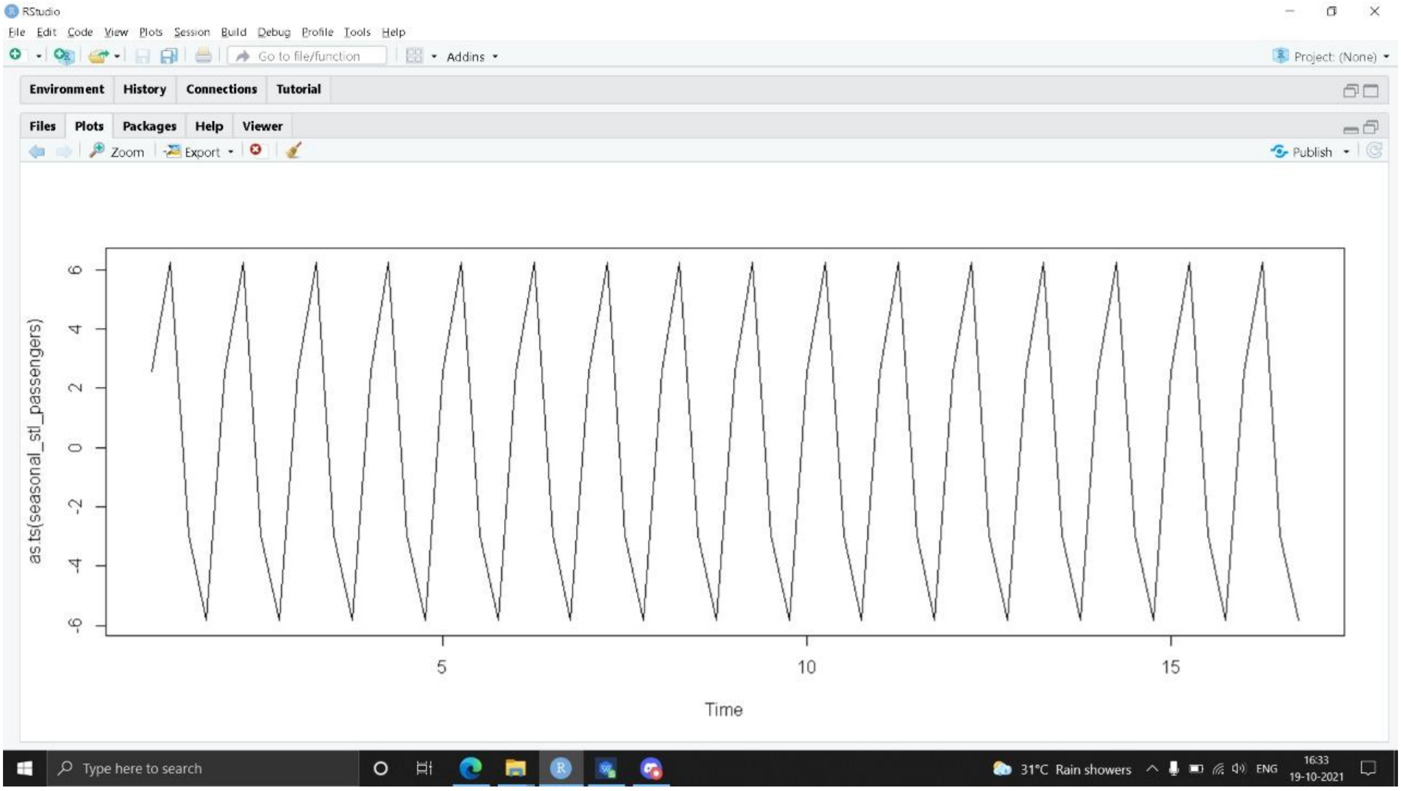
ENG
16:33
19-10-2021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Go to file/function
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Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom
Export
Publish
as.ts(seasonal_stl_passengers)
-6
-4
-2
0
2
4
6
5
10
15
Time
Type here to search
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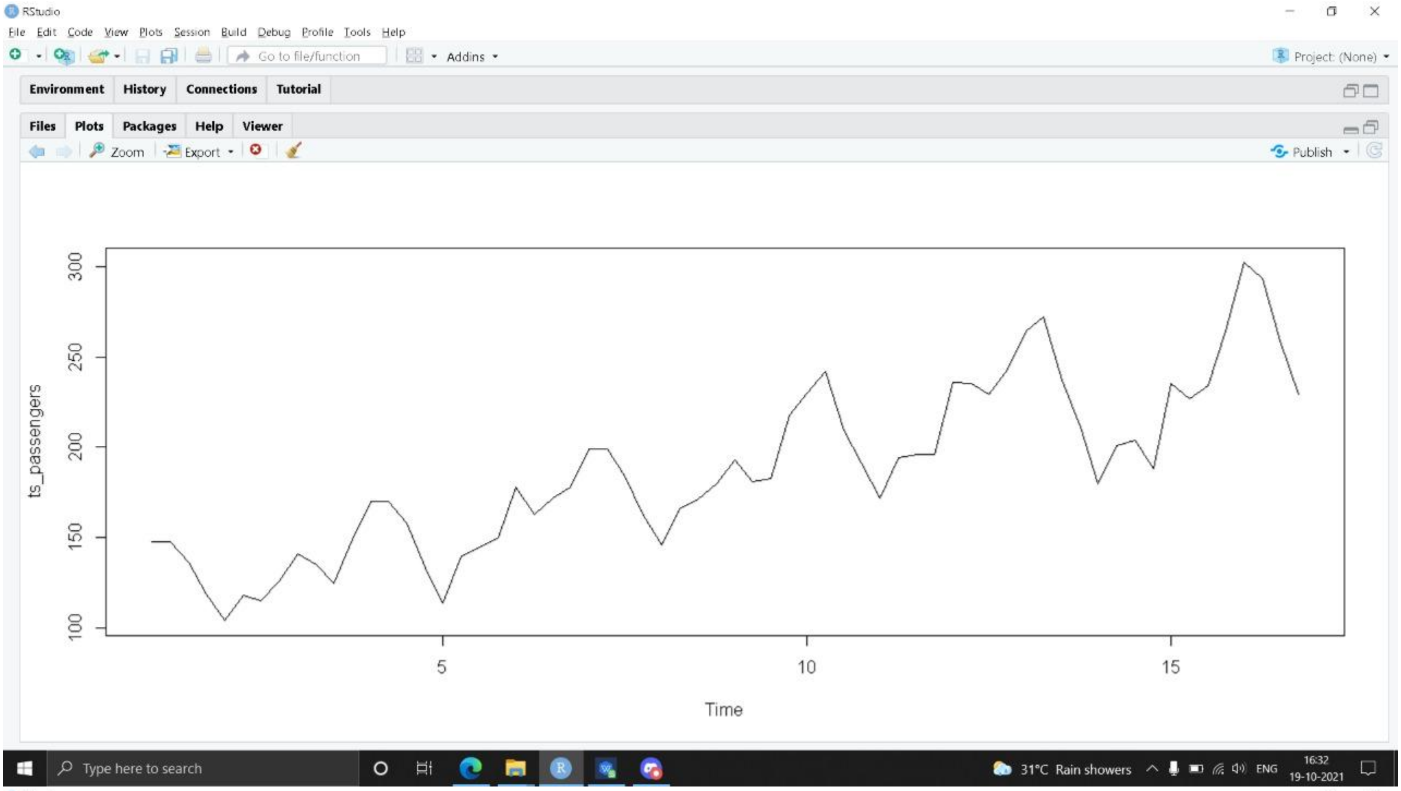
ENG
16:33
19-10-2021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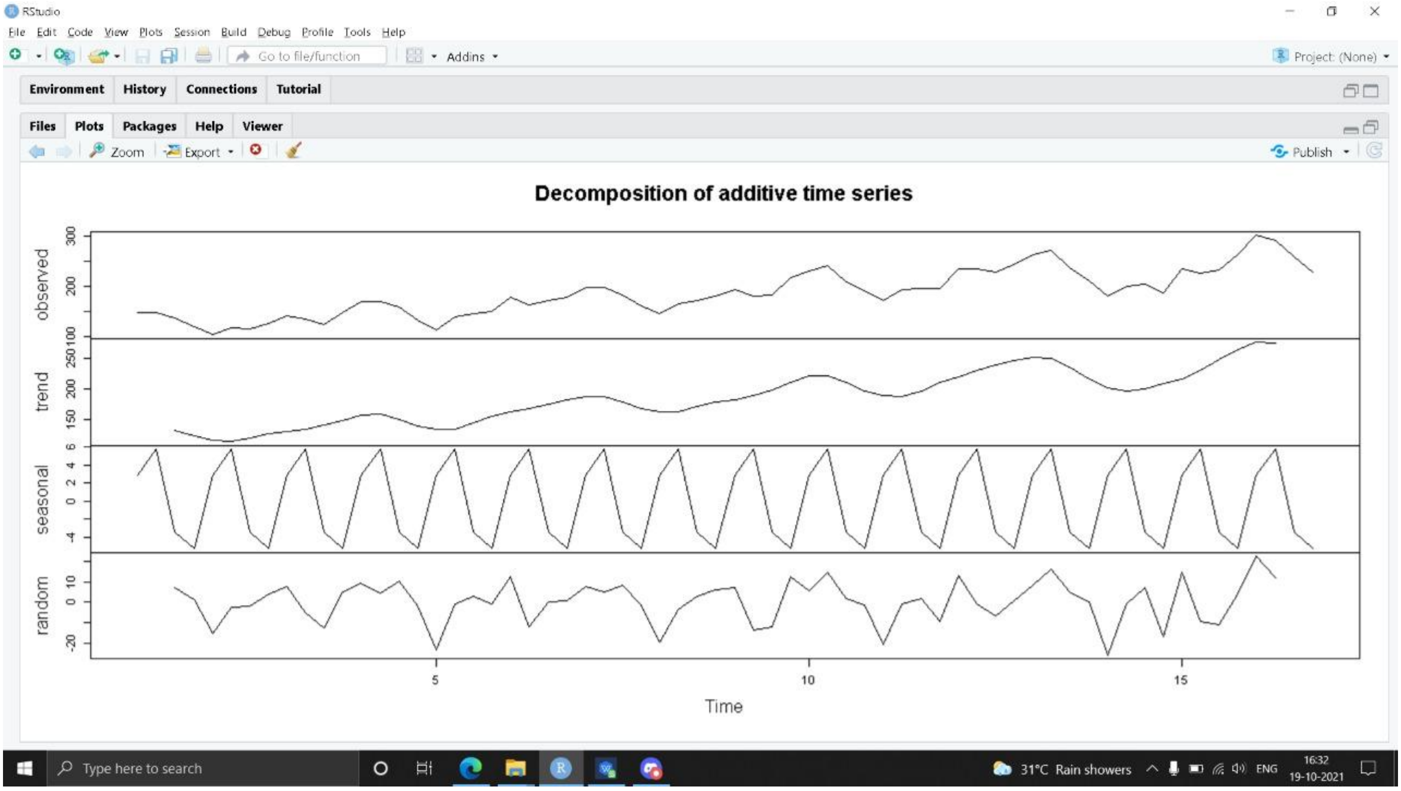
Files Plots Packages Help Viewer
Zoom Export
Publish
ts_passengers
100
150
200
250
300
5
10
15
Time
Type here to search
31°C Rain showers
ENG
16:32
19-10-2021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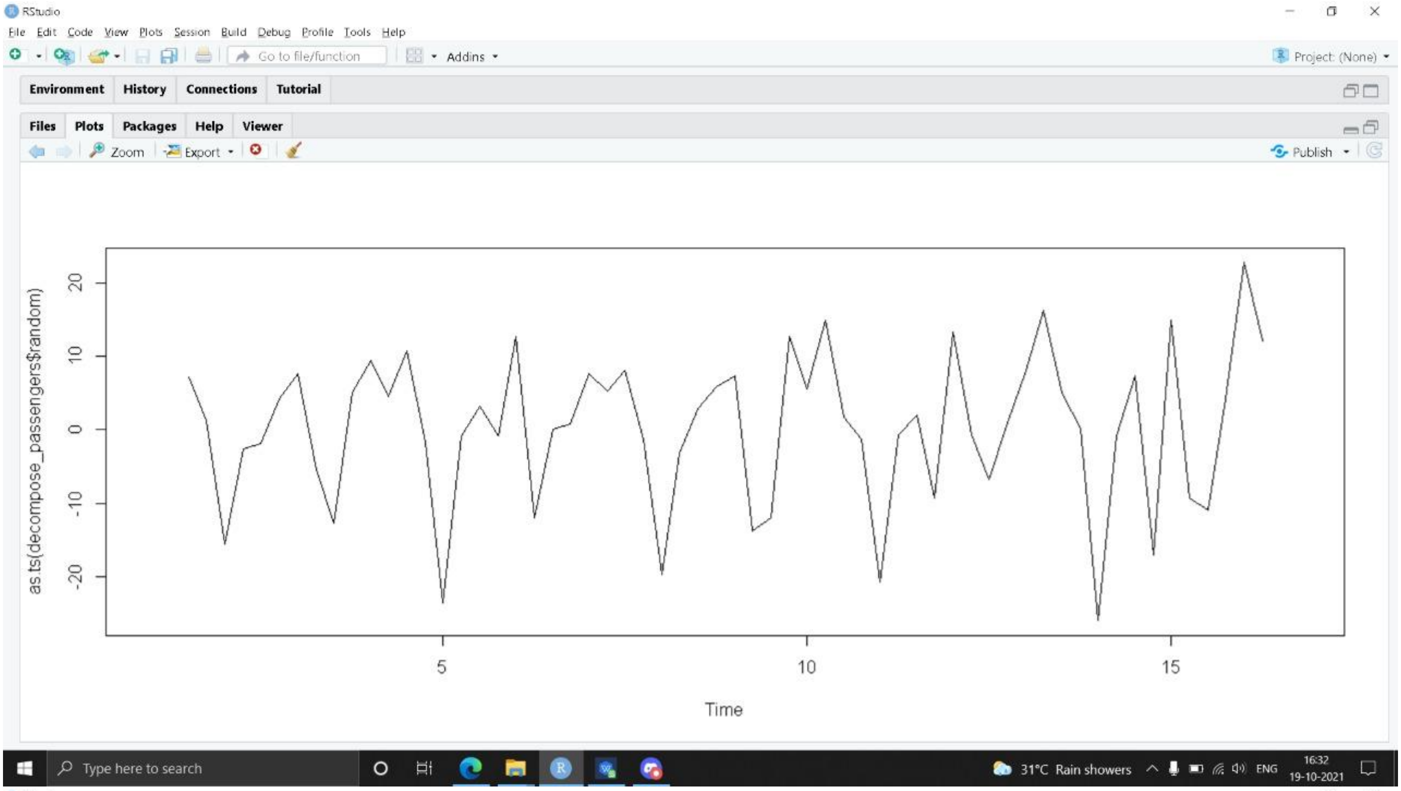
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom Export
Publish
Decomposition of additive time series
observed
100
200
300
trend
150
200
250
seasonal
-4
0
2
4
6
random
-20
0
10
5
10
15
Time
Type here to search
31°C Rain showers
ENG
16:32
19-10-2021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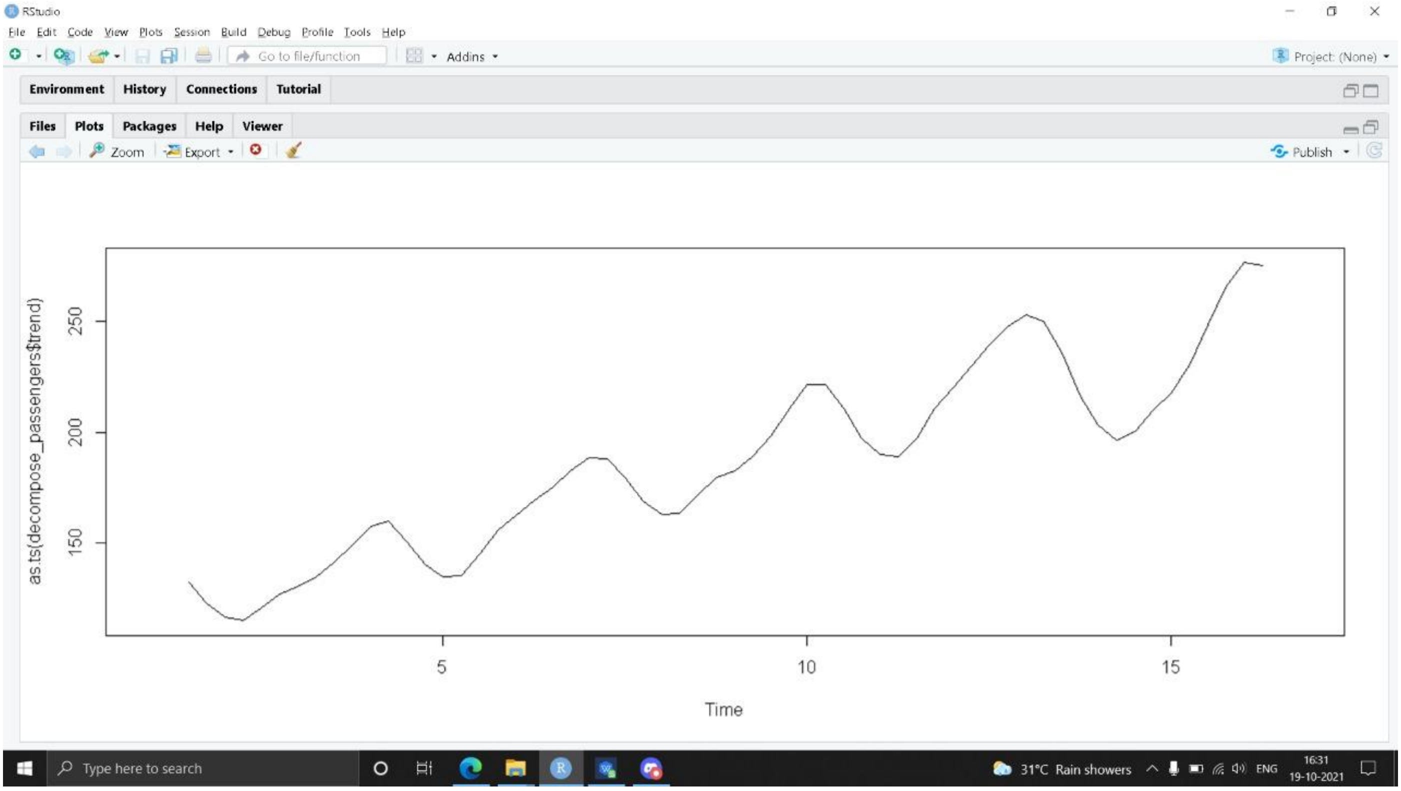
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom Export
Publish
as.ts(decompose_passengers$random)
-20
-10
0
10
20
5
10
15
Time
Type here to search
31°C Rain showers
ENG
16:32
19-10-2021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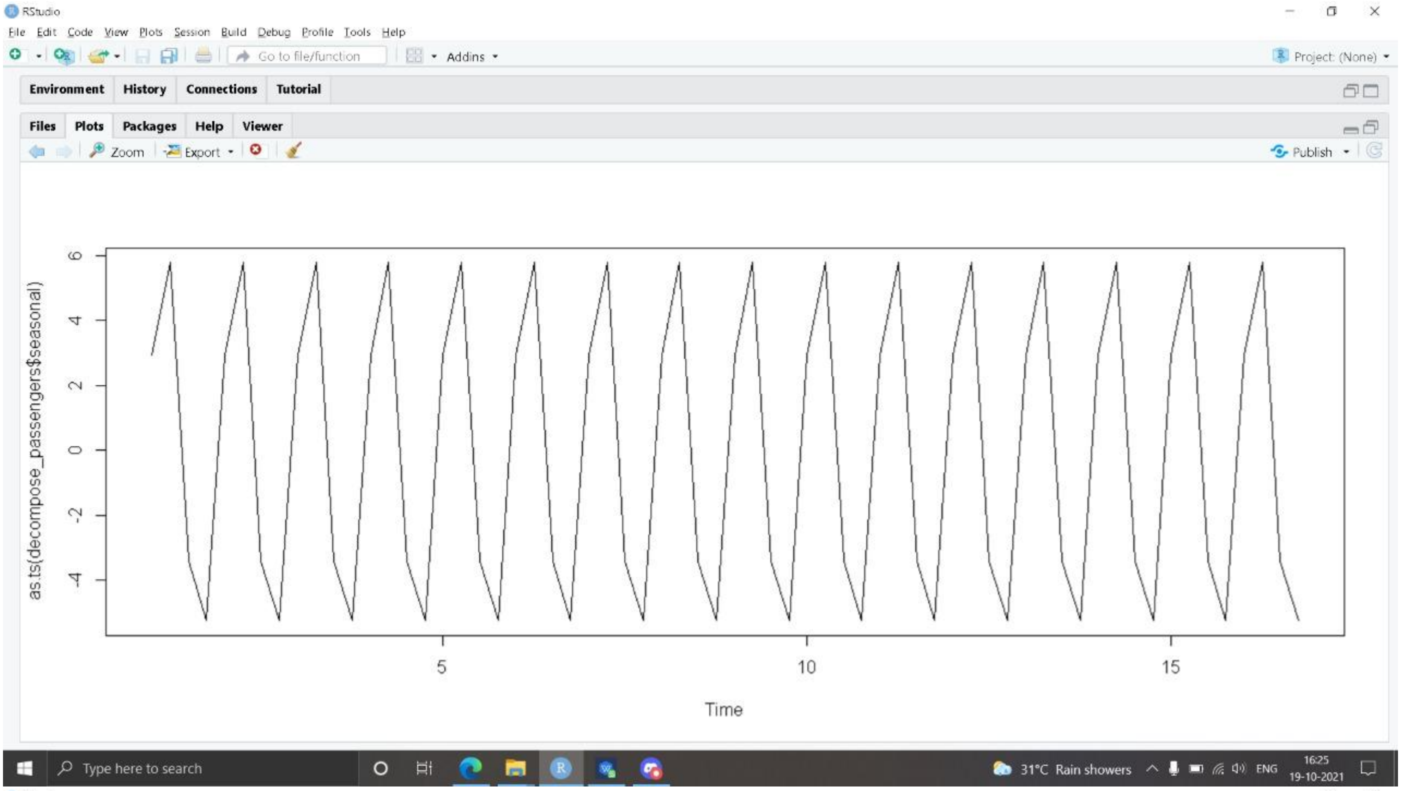
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom Export
Publish
as.ts(decompose_passengers$trend)
150
200
250
5
10
15
Time
Type here to search
31°C Rain showers
ENG
16:31
19-10-2021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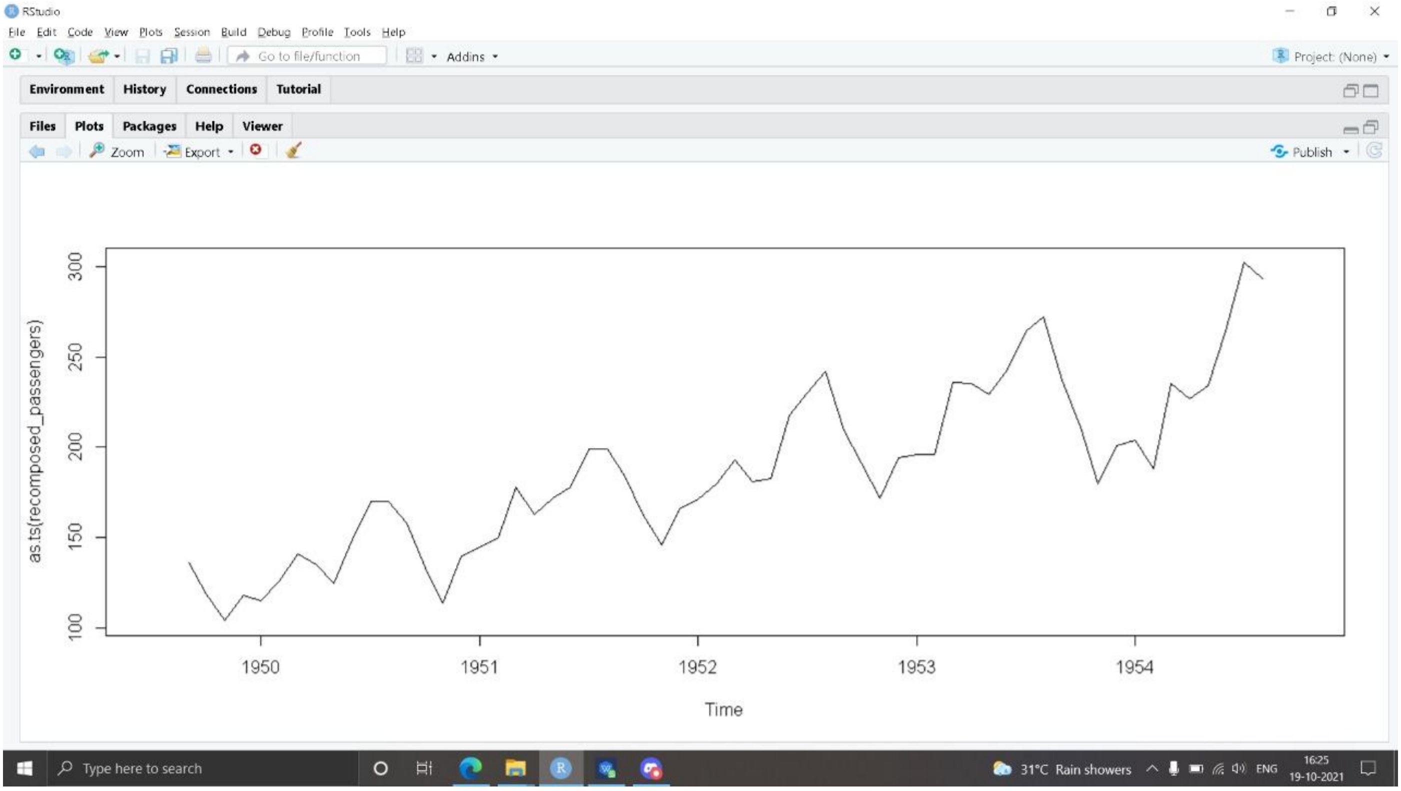
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom
Export
Publish
as.ts(decompose_passengers$seasonal)
6
4
2
0
-2
-4
5
10
15
Time
Type here to search
31°C Rain showers
ENG
16:25
19-10-2021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Go to file/function
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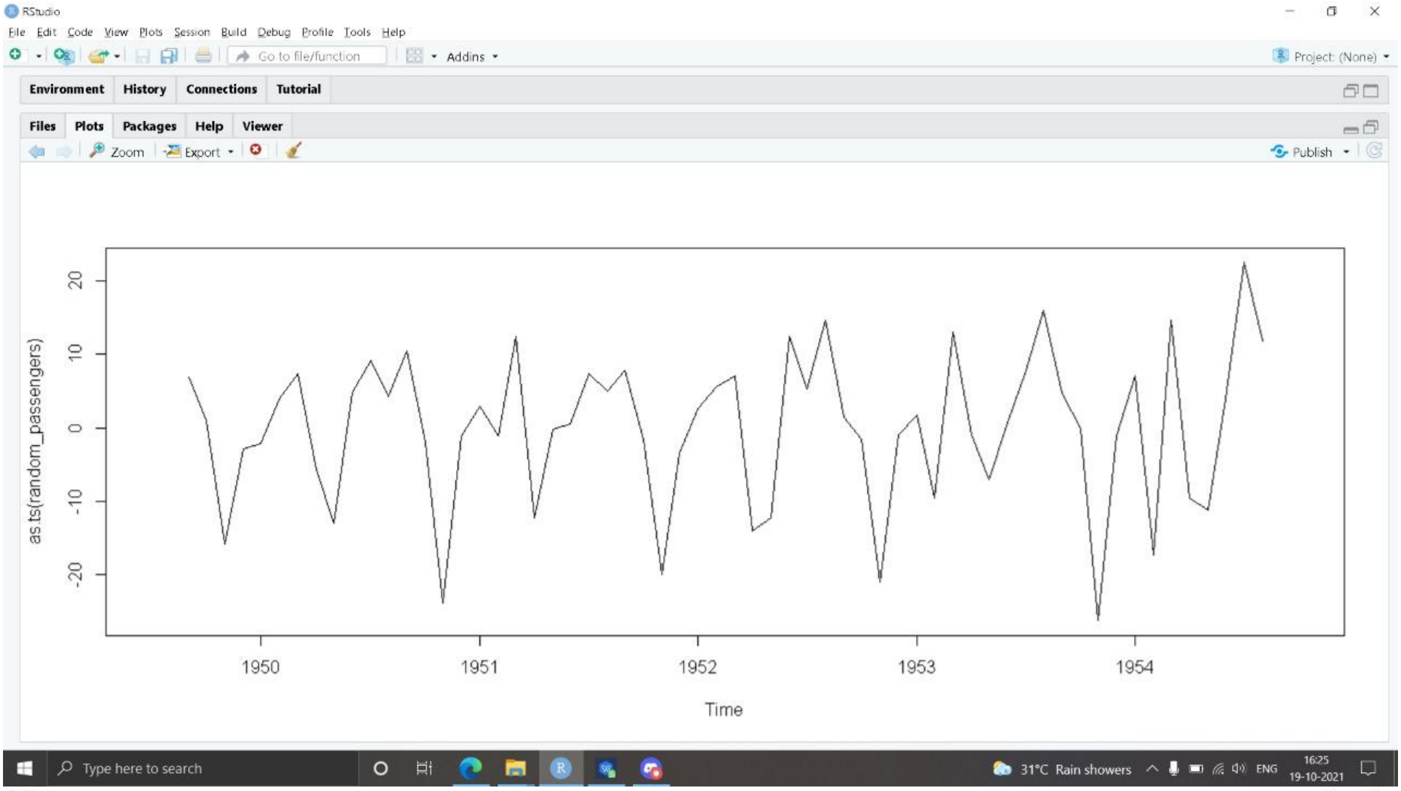
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom
Export
Publish
as.ts(recomposed_passengers)
300
250
200
150
100
1950
1951
1952
1953
1954
Time
Type here to search
31°C Rain showers
ENG
16:25
19-10-2021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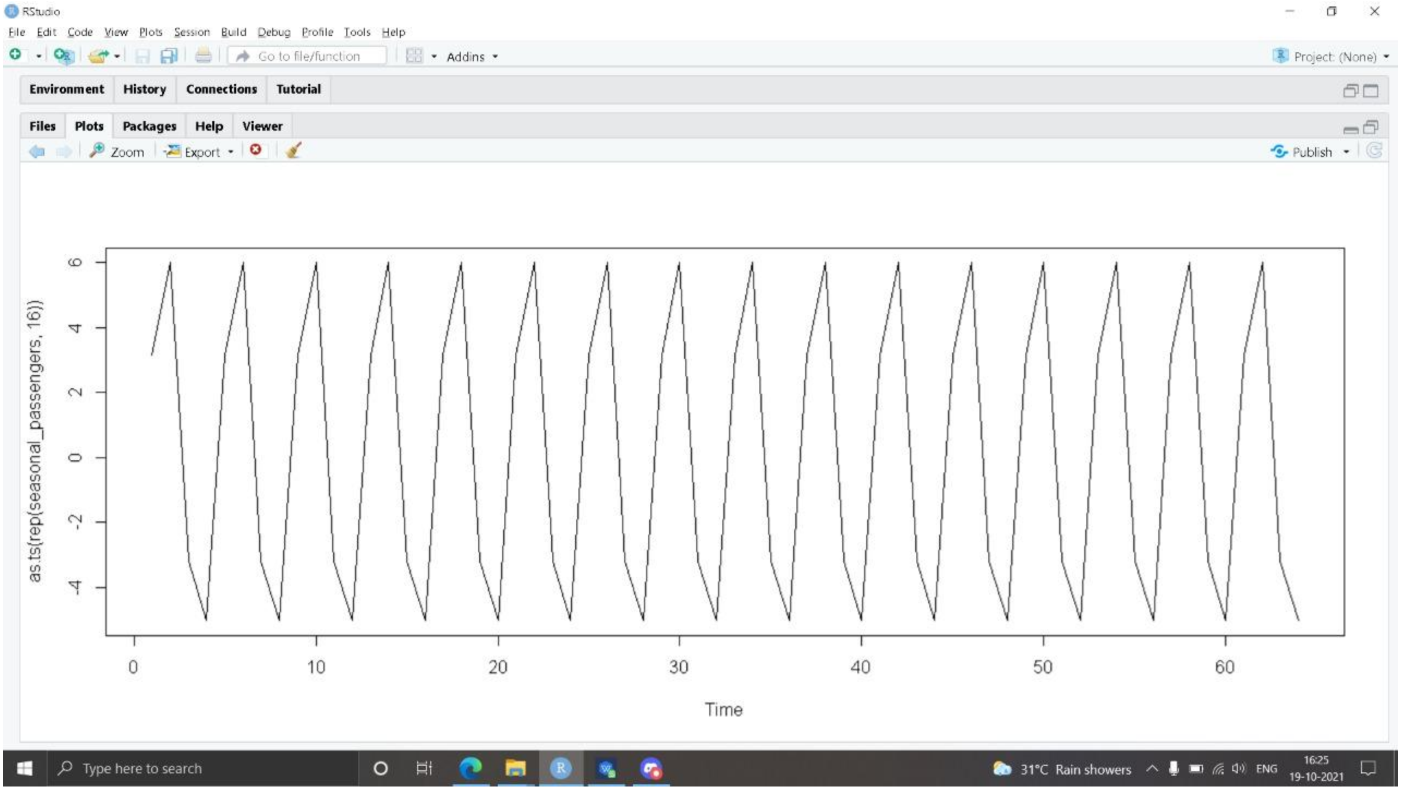
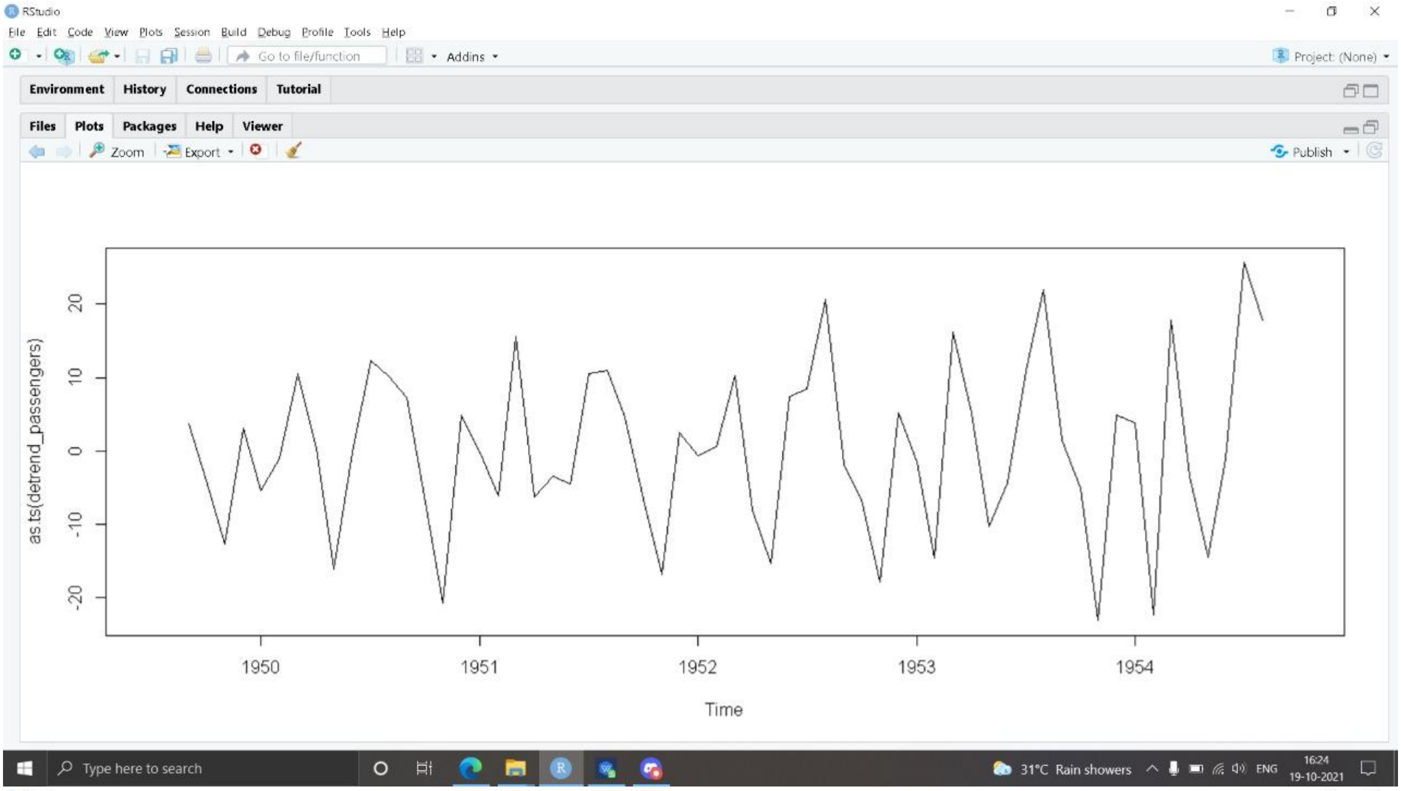
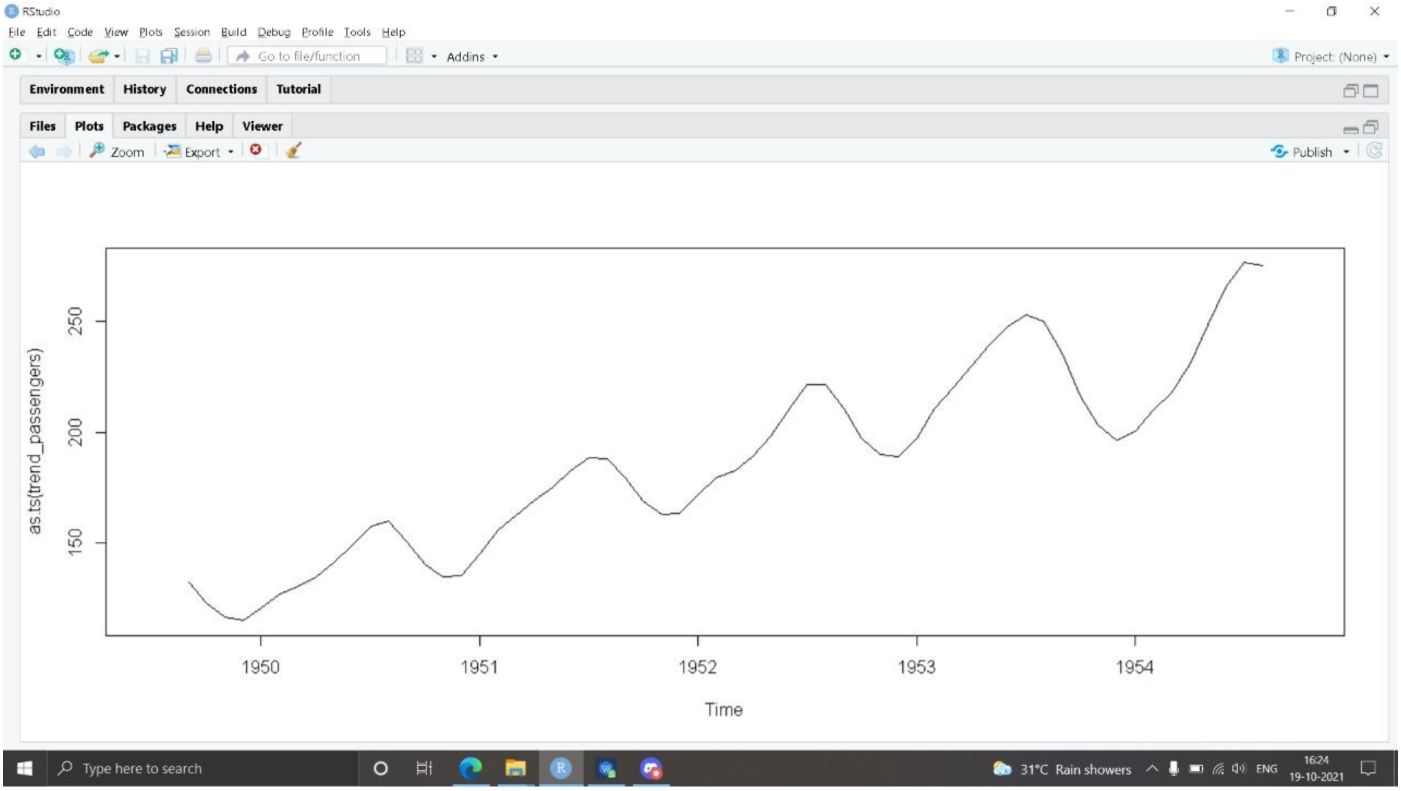
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom
Export
Publish
as.ts(random_passengers)
-20
-10
0
10
20
1950
1951
1952
1953
1954
Time
Type here to search
31°C Rain showers
ENG
16:25
19-10-2021

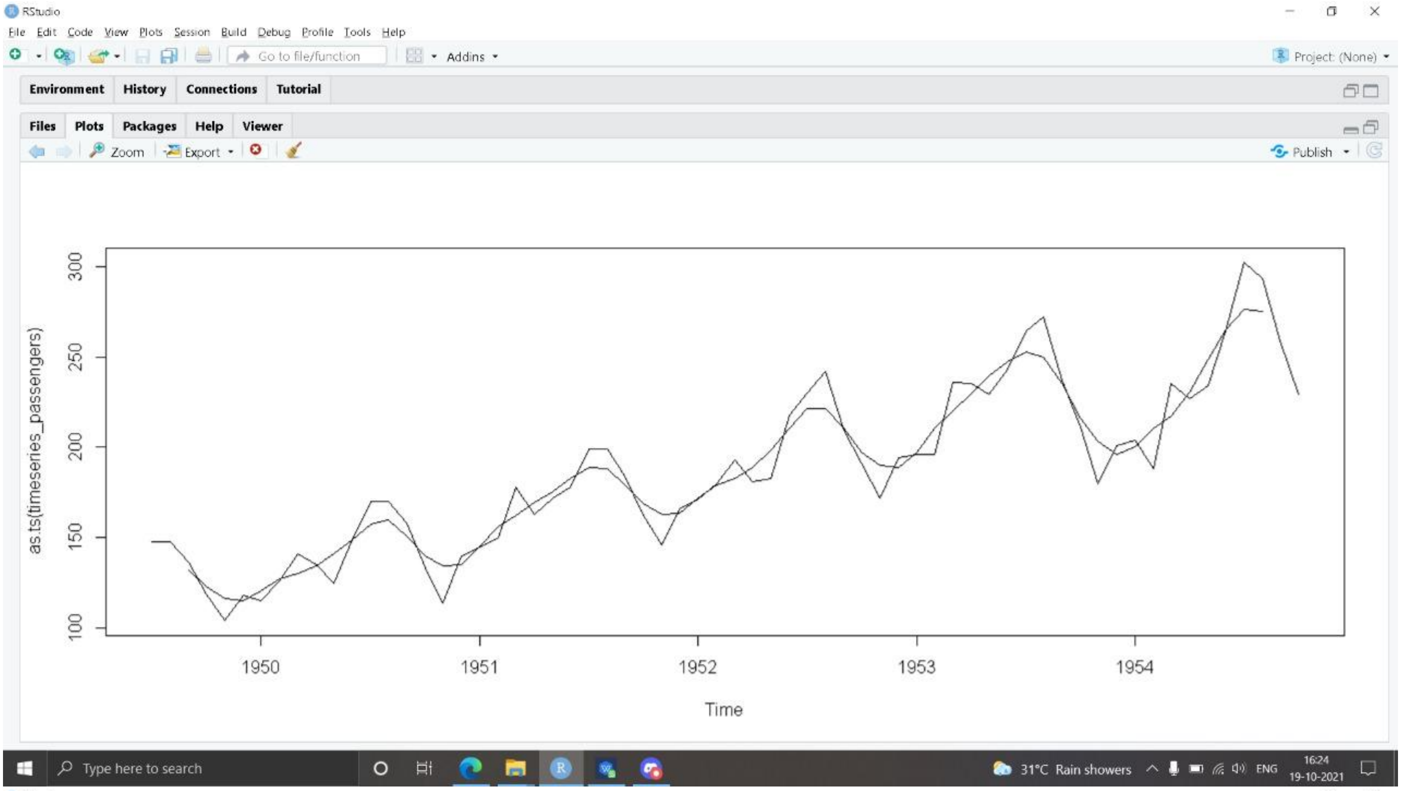

RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom
Export
Publish
as.ts(rep(seasonal_passengers, 16))
-4
-2
0
2
4
6
0
10
20
30
40
50
60
Time
Type here to search
31°C Rain showers
ENG
16:25
19-10-2021

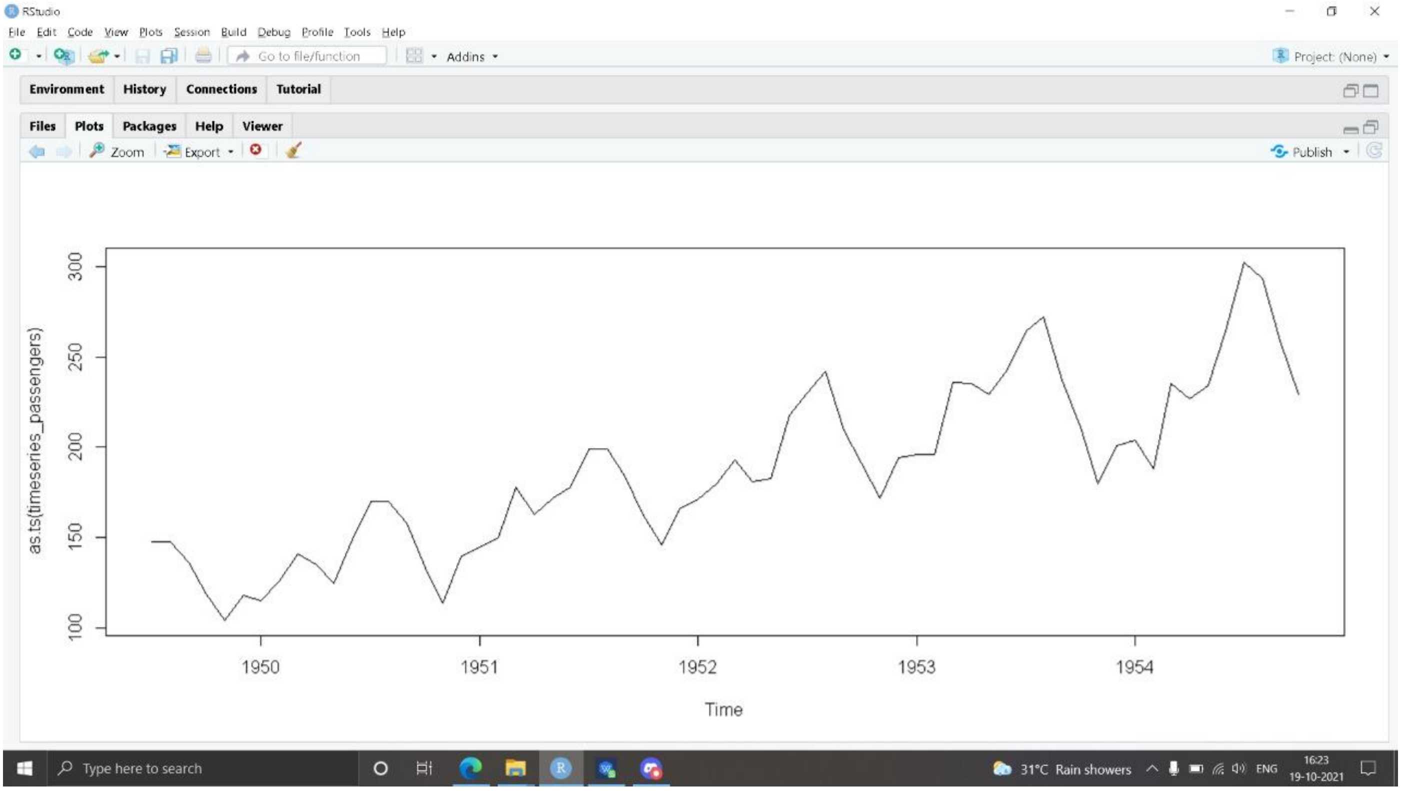


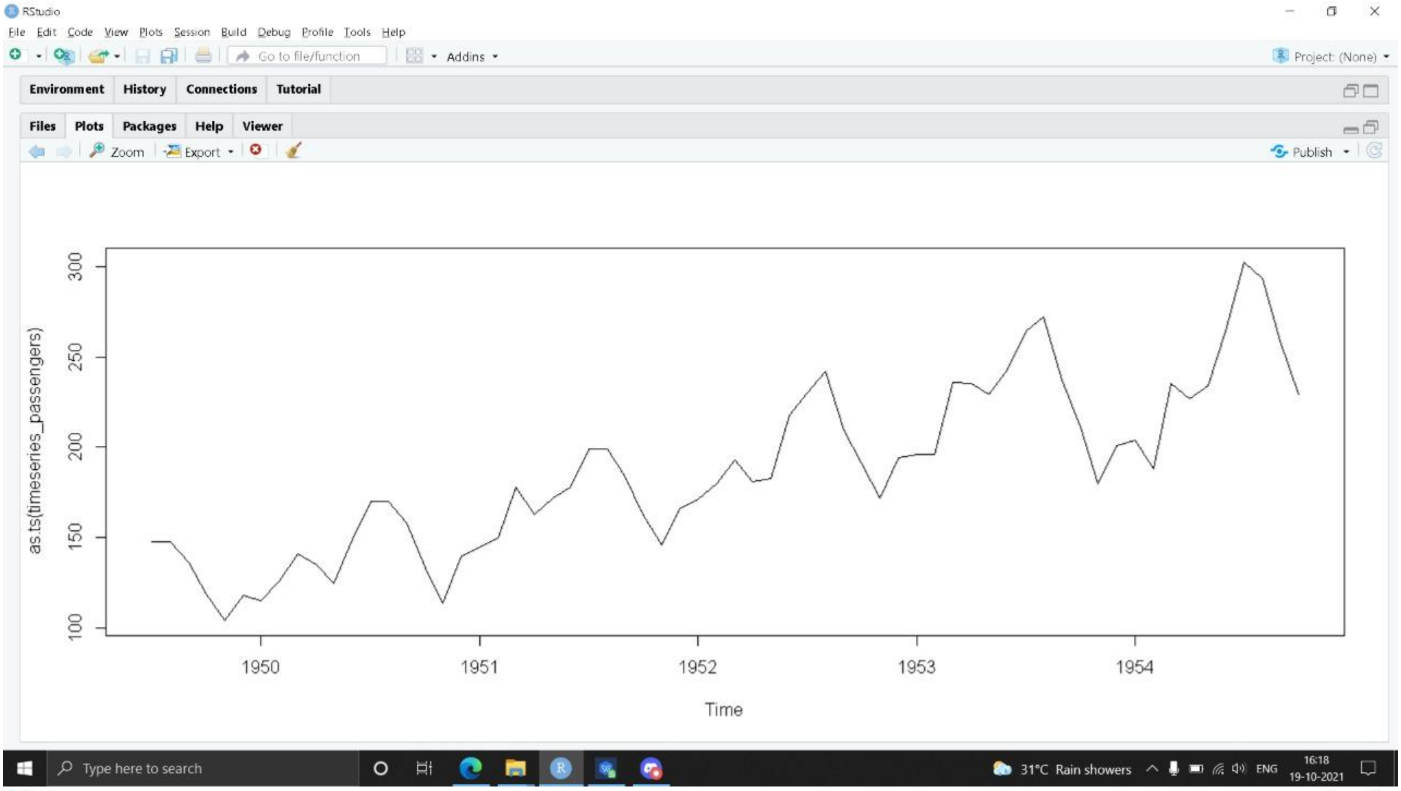
RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom Export
Publish
as.ts(detrend_passengers)
-20
-10
0
10
20
1950
1951
1952
1953
1954
Time
Type here to search
31°C Rain showers
ENG
16:24
19-10-2021

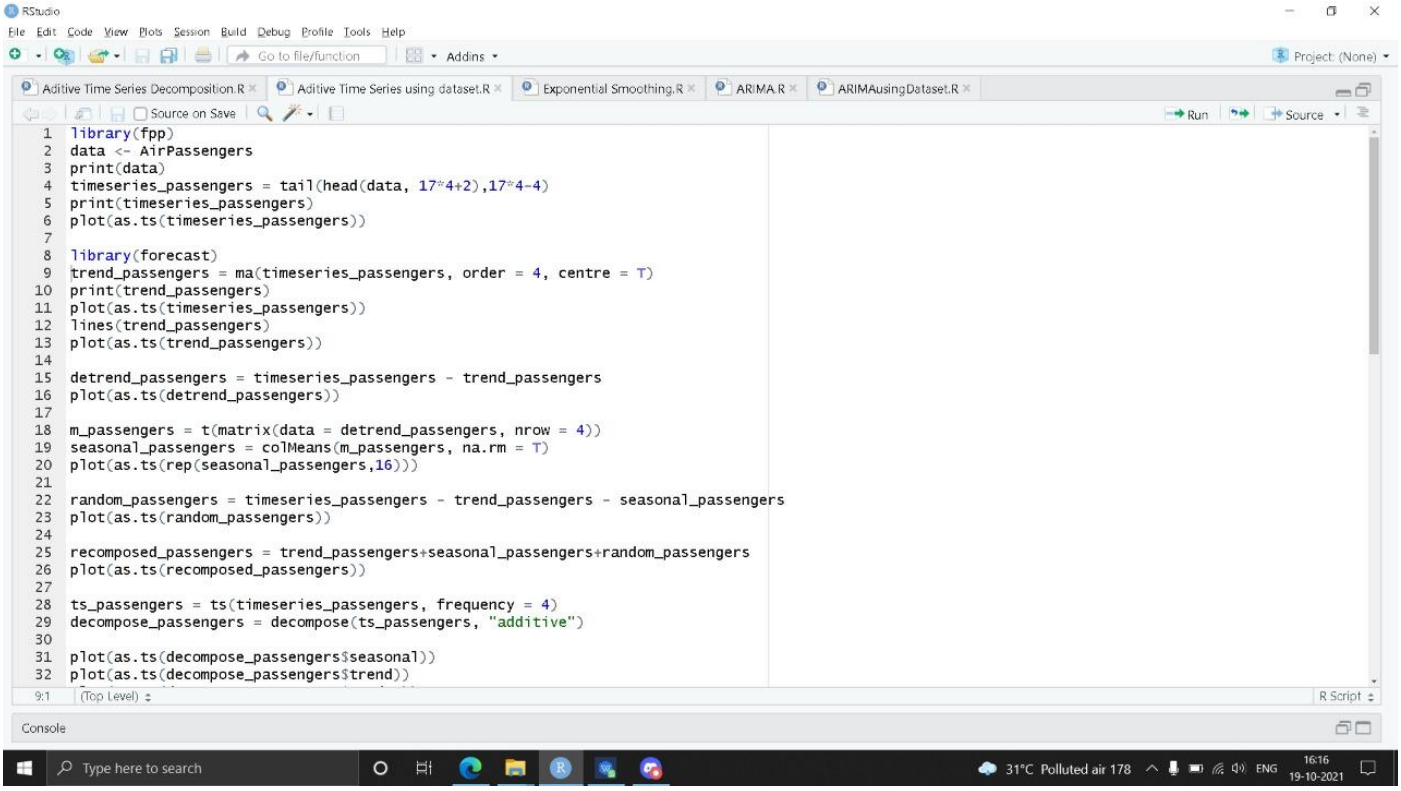


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom Export
Publish
as.ts(trend_passengers)
150
200
250
1950
1951
1952
1953
1954
Time
Type here to search
31°C Rain showers
ENG
16:24
19-10-2021


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom Export
Publish
as.ts(timeseries_passengers)
100
150
200
250
300
1950
1951
1952
1953
1954
Time
Type here to search
31°C Rain showers
ENG
16:24
19-10-2021


RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
Go to file/function
Addins
Project: (None)
Environment History Connections Tutorial
Files Plots Packages Help Viewer
Zoom Export
Publish
as.ts(timeseries_passengers)
100
150
200
250
300
1950
1951
1952
1953
1954
Time
Type here to search
31°C Rain showers
ENG
16:23
19-10-2021





```
library(fpp)
data <- AirPassengers
print(data)
timeseries_passengers = tail(head(data, 17*4+2),17*4-4)
print(timeseries_passengers)
plot(as.ts(timeseries_passengers))

library(forecast)
trend_passengers = ma(timeseries_passengers, order = 4, centre = T)
print(trend_passengers)
plot(as.ts(timeseries_passengers))
lines(trend_passengers)
plot(as.ts(trend_passengers))

detrend_passengers = timeseries_passengers - trend_passengers
plot(as.ts(detrend_passengers))

m_passengers = t(matrix(data = detrend_passengers, nrow = 4))
seasonal_passengers = colMeans(m_passengers, na.rm = T)
plot(as.ts(rep(seasonal_passengers,16)))

random_passengers = timeseries_passengers - trend_passengers - seasonal_passengers
plot(as.ts(random_passengers))

recomposed_passengers = trend_passengers+seasonal_passengers+random_passengers
plot(as.ts(recomposed_passengers))

ts_passengers = ts(timeseries_passengers, frequency = 4)
decompose_passengers = decompose(ts_passengers, "additive")

plot(as.ts(decompose_passengers$seasonal))
plot(as.ts(decompose_passengers$trend))
```