IE 306.02 Spring 2019 Assignment 2

Group 33 Members Who Have Contributed

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Introduction

In this project we were asked to fit a distribution to the interarrival times of customers if possible, in order to build a simulation model to analyze the service adequacy of a service system. The service system is subject to customer arrivals with random interarrival times. Customers arrive one by one. The interarrival times were observed in seconds for two days and the data is given in the excel file that was provided to us separately.

1 – Kolmogorov Smirnov Test

In this part of the assignment, we have tested the validity of the assumption that interarrival times are distributed uniformly between 0 and 400 seconds using the Kolmogorov-Smirnov test with a significance level of 0.05.

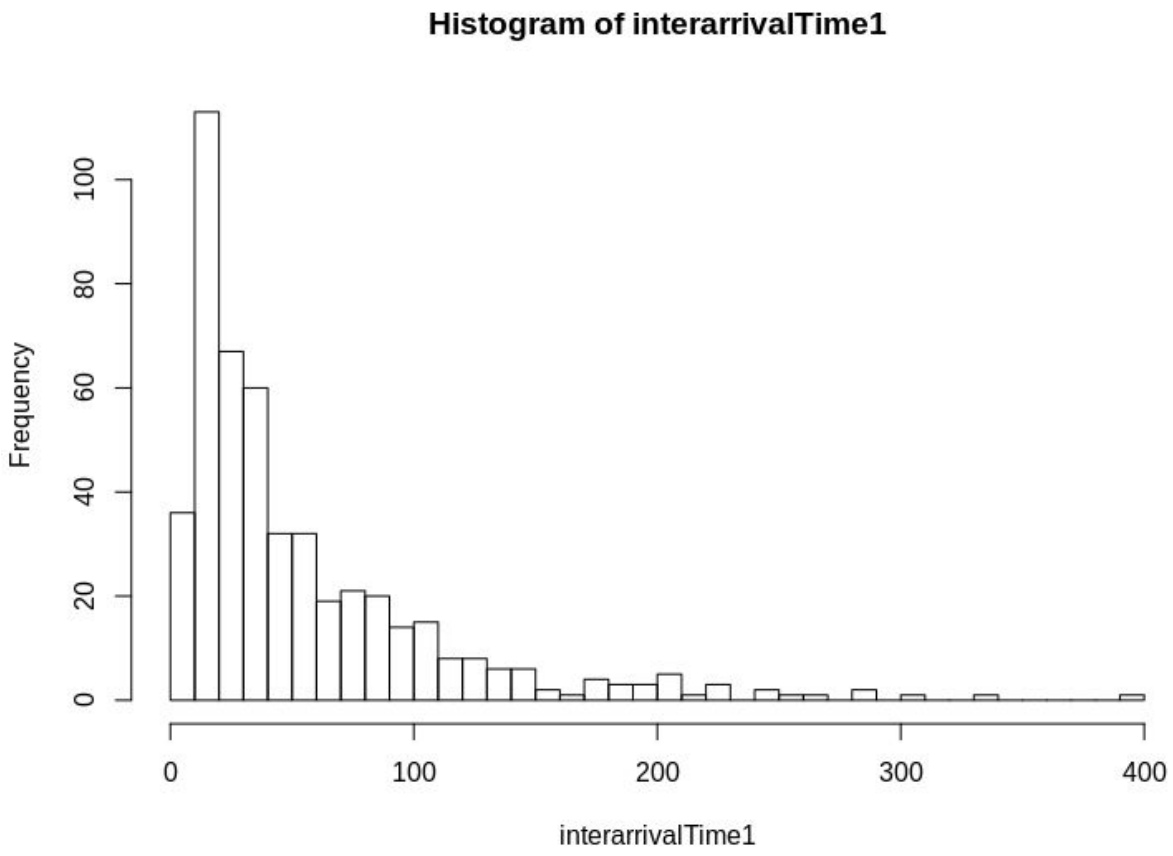
We have calculated D = 0.59016 and the critical value 0.0615 for day 1, and D = 0.5775 and the critical value 0.0616 for day 2. Since both D values are greater than the critical values, the assumption is rejected.

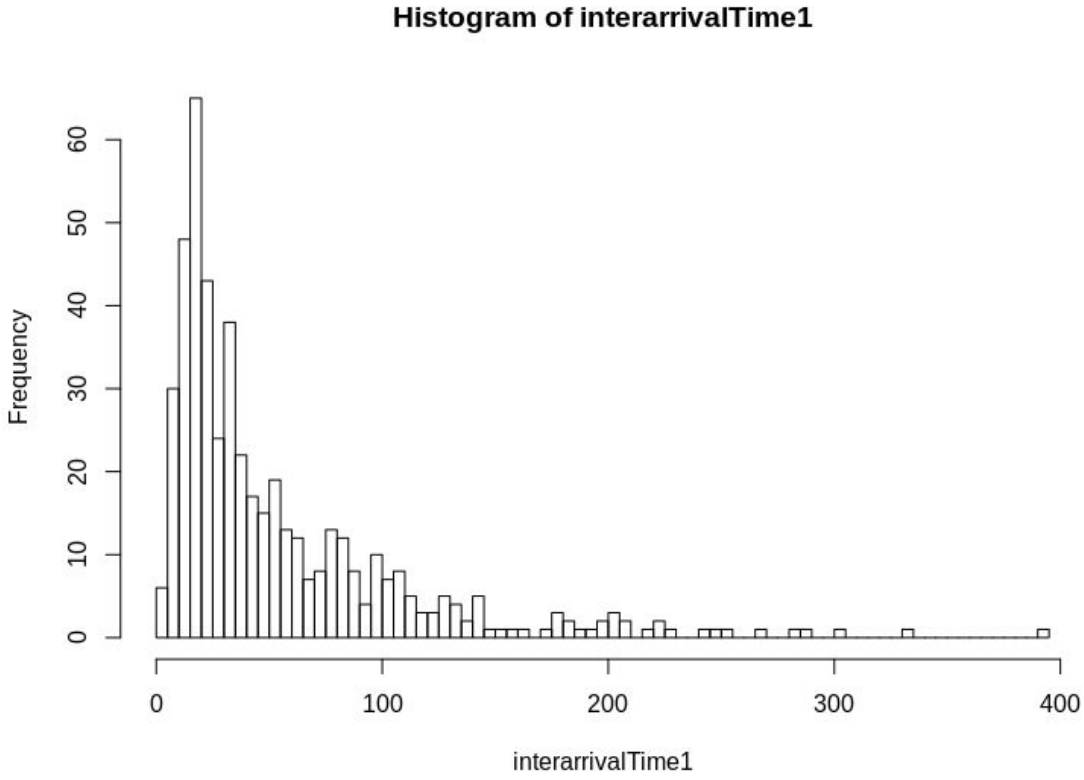
2 – Descriptive Statistics

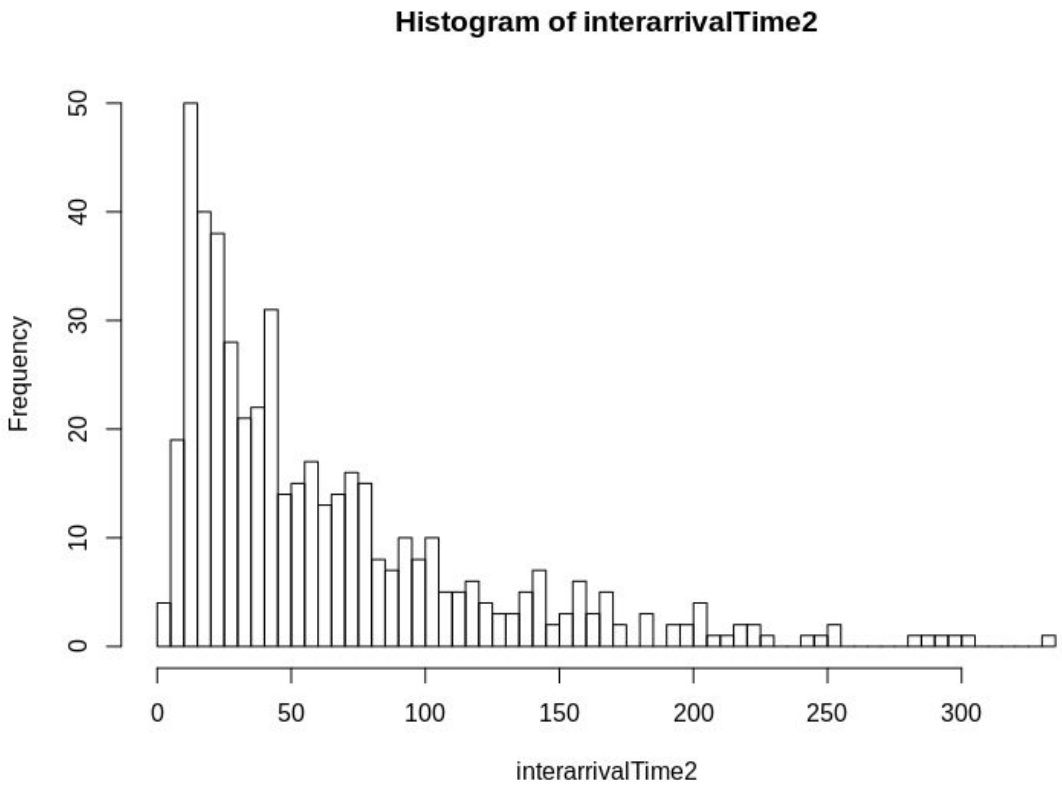
In this part we have calculated the sample mean, standard deviation and maximum values.

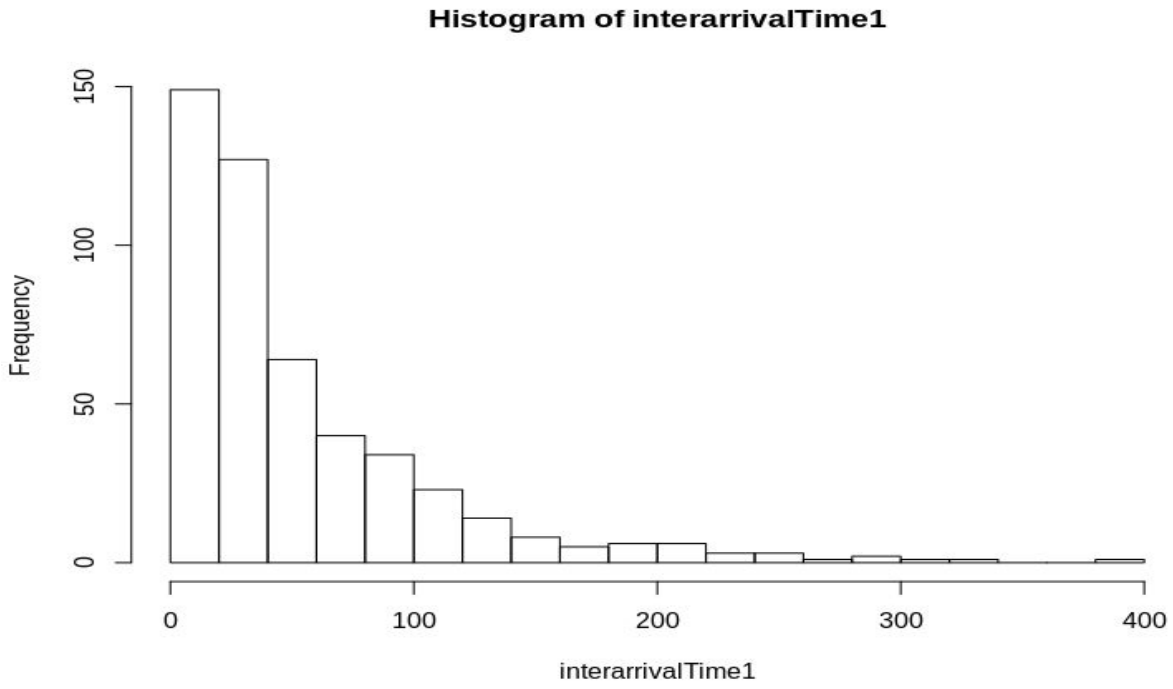
3 – Frequency Histograms

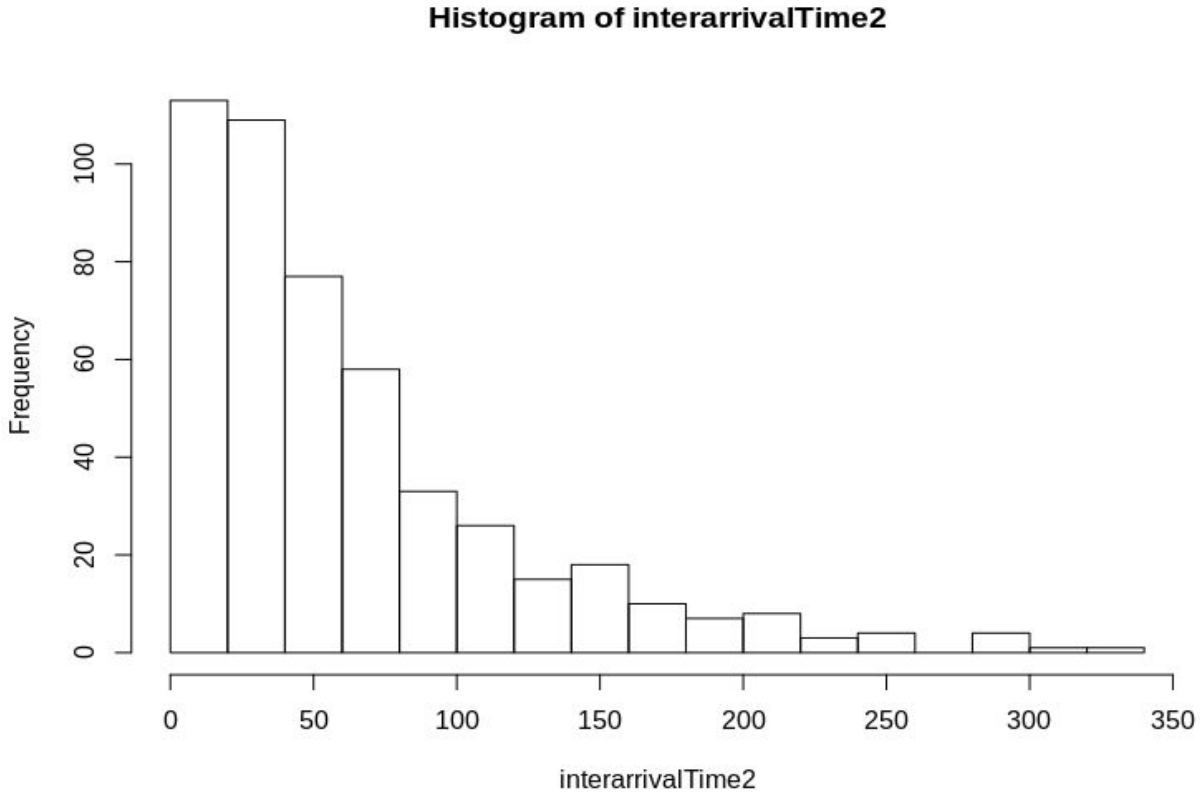
We have plotted the frequency histograms of the data for 5, 10 and 20 second intervals. The shape of these histograms reminds us of the shape of exponential distributions. This makes us suspect whether the data comes from an exponential distribution.


Histogram of interarrivalTime1
Frequency
0
20
40
60
80
100
0
100
200
300
400
interarrivalTime1


Histogram of interarrivalTime1
Frequency
0
10
20
30
40
50
60
0
100
200
300
400
interarrivalTime1


Histogram of interarrivalTime2
Frequency
0
10
20
30
40
50
0
50
100
150
200
250
300
interarrivalTime2


Histogram of interarrivalTime1
Frequency
0
50
100
150
0
100
200
300
400
interarrivalTime1


Histogram of interarrivalTime2
Frequency
0
20
40
60
80
100
0
50
100
150
200
250
300
350
interarrivalTime2

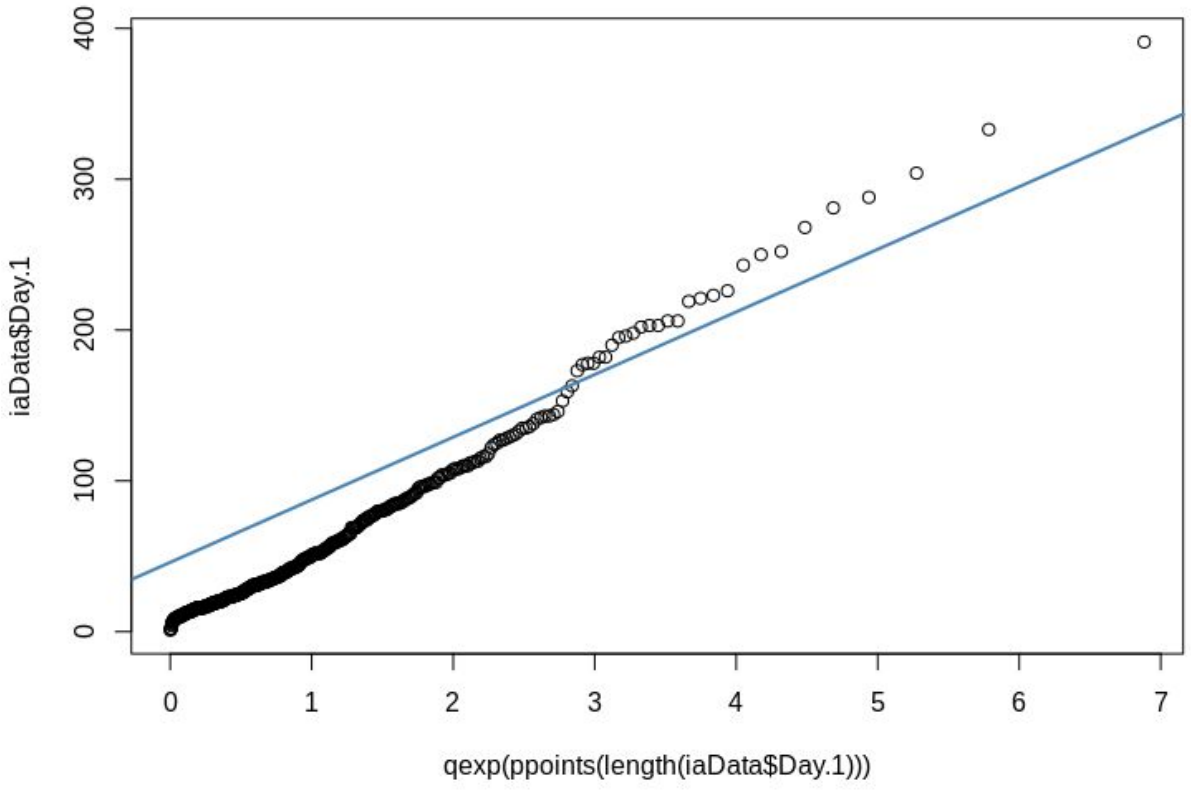
4 – Chi-square Test

In this part we perform a chi-square test at a significance level of 0.05 with 10 second intervals to test whether the data comes from an exponential distribution where the mean is as found in step 2.

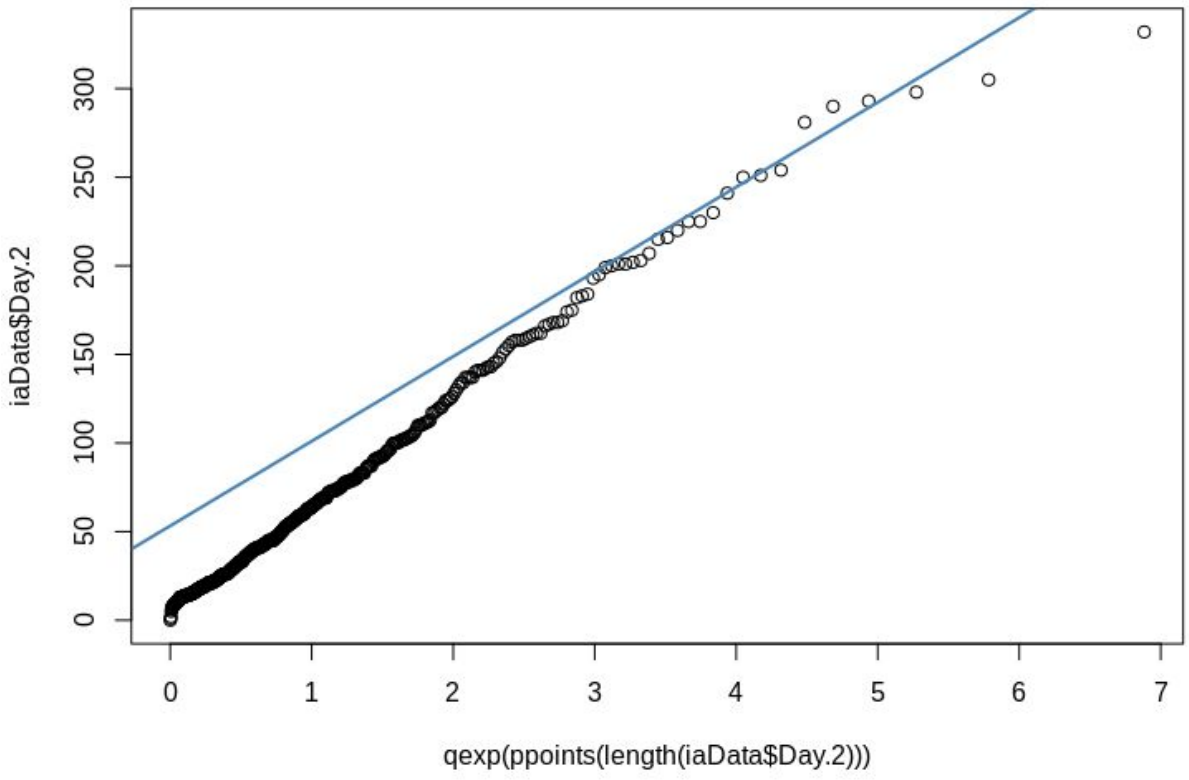
We have calculated the chi-square value 120 for the day 1 and 85 for day 2. Since these values are above the expected values for the significance level of 0.05, the assumption is rejected.

5 – QQ-plot

For the day 1 QQ plot case, as you can see our data for the interarrival times approximately fits exponential distribution figured as blue line.

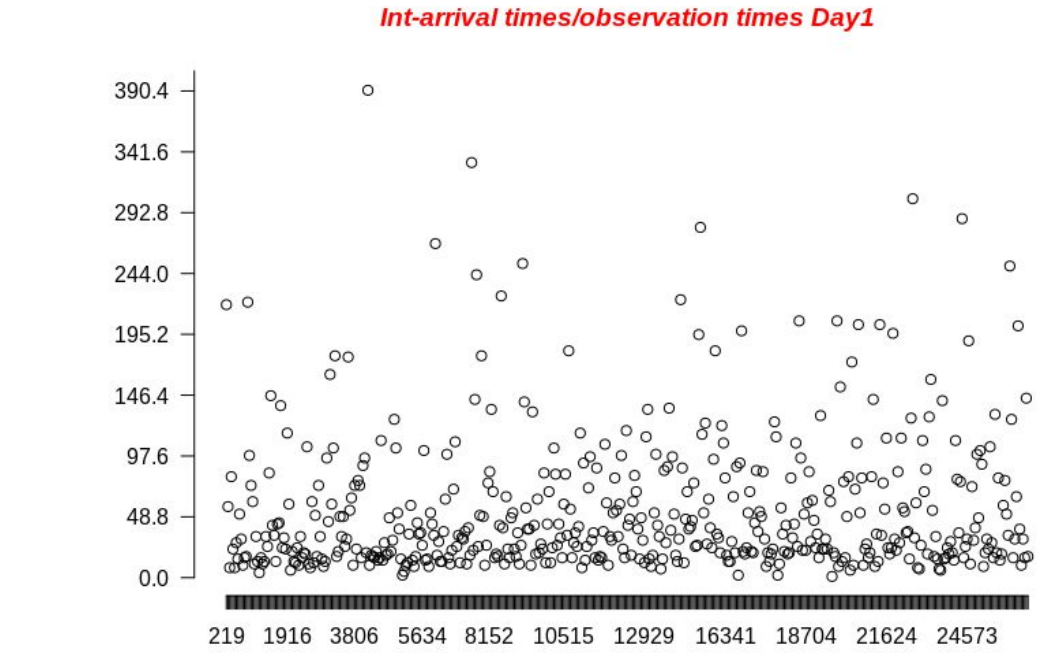


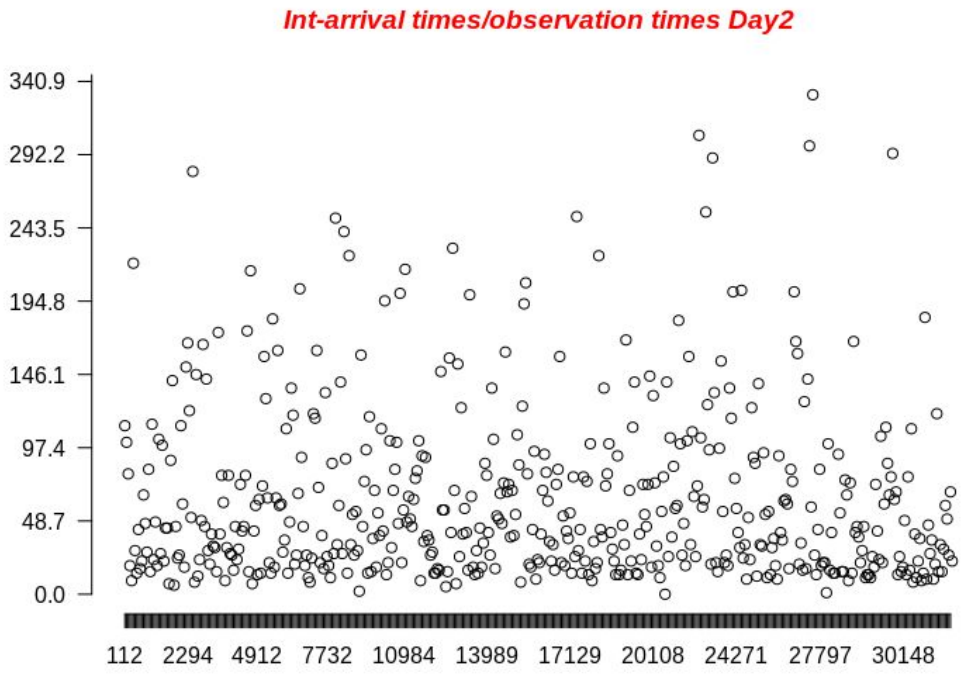
For the day 2 QQ plot case, it is similar to day 1 as you can see our data for the interarrival times approximately fits exponential distribution figured as blue line.



6 – Interarrival Times with respect to Observation Times

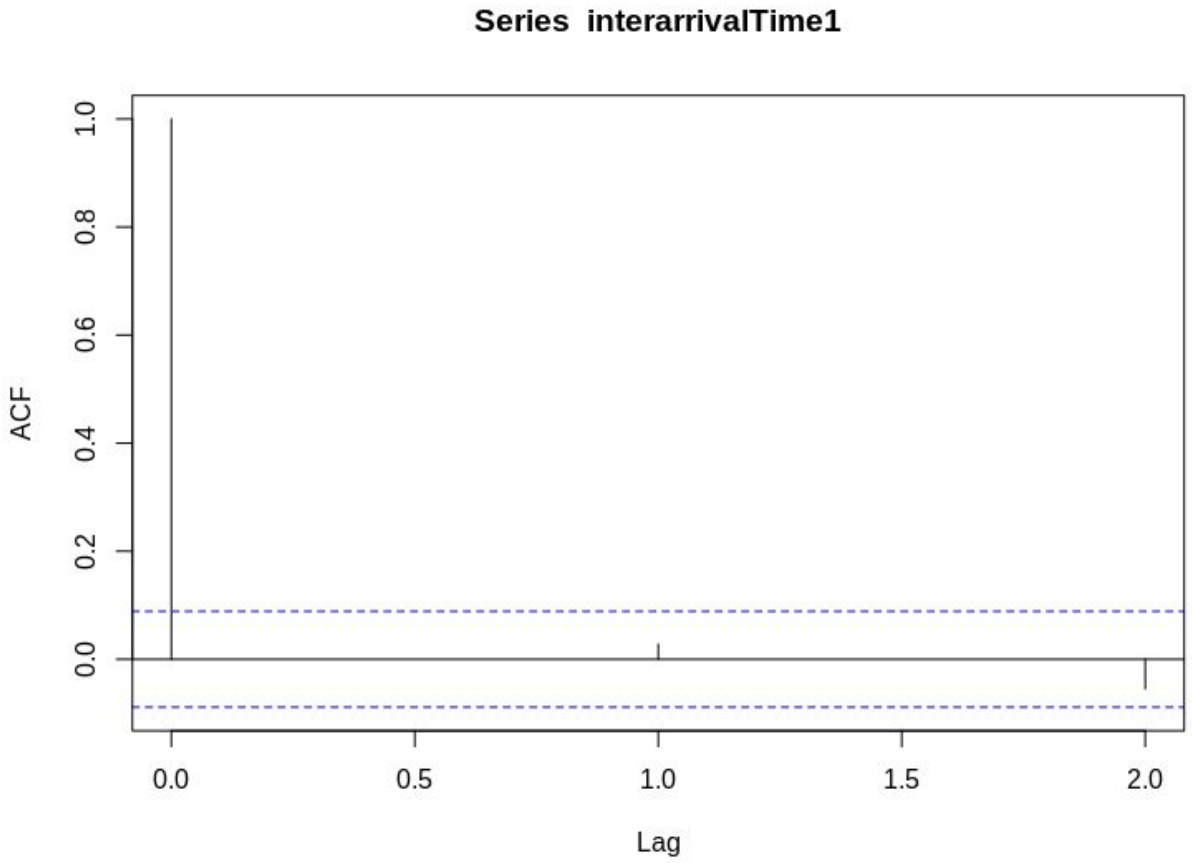
We have plotted the interarrival times with respect to observation times. We could observe no obvious pattern. The frequency is significantly higher in the range 0-50. Analysing the data visually, the data doesn't seem stationary.


Int-arrival times/observation times Day1
390.4
341.6
292.8
244.0
195.2
146.4
97.6
48.8
0.0
219 1916 3806 5634 8152 10515 12929 16341 18704 21624 24573


Int-arrival times/observation times Day2
340.9
292.2
243.5
194.8
146.1
97.4
48.7
0.0
112 2294 4912 7732 10984 13989 17129 20108 24271 27797 30148

7 – Autocorrelation Test

For day 1, observation for lag 1 and lag2 difference lines do not exceed the critical values figured as blue lines.You could observe difference values at above the lag 1.0 and lag 2.0.



For day 2, observation for lag 1 lag 2 difference lines do not exceed the critical values figured as blue lines.You could observe difference values at above the lag 1.0 and lag

2.0.But not like the previous day for day 2 lag 2 difference is very close to the critical value.