Prob1_MA568

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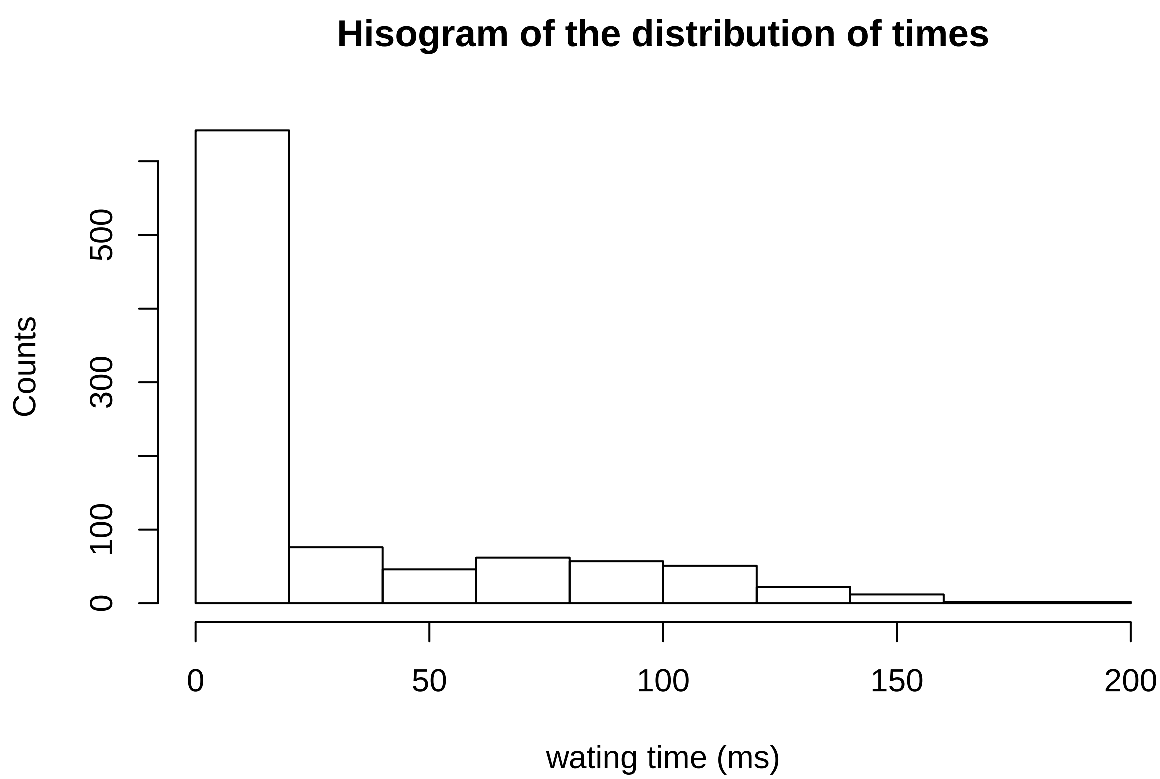
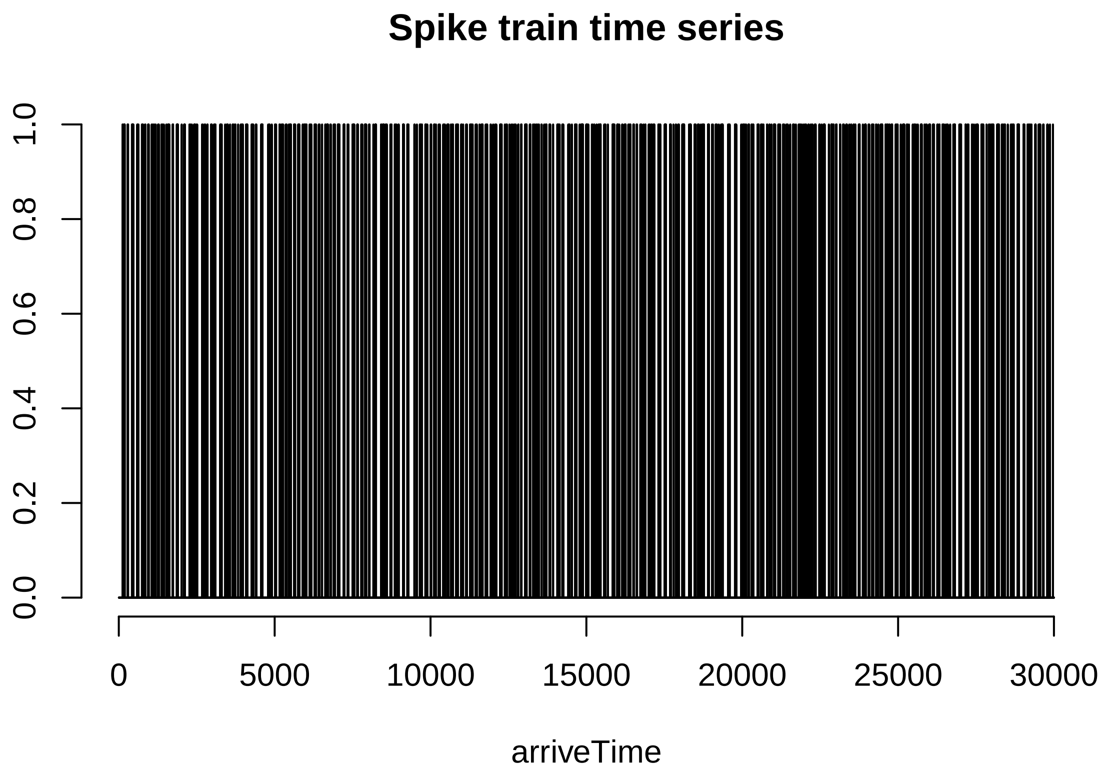
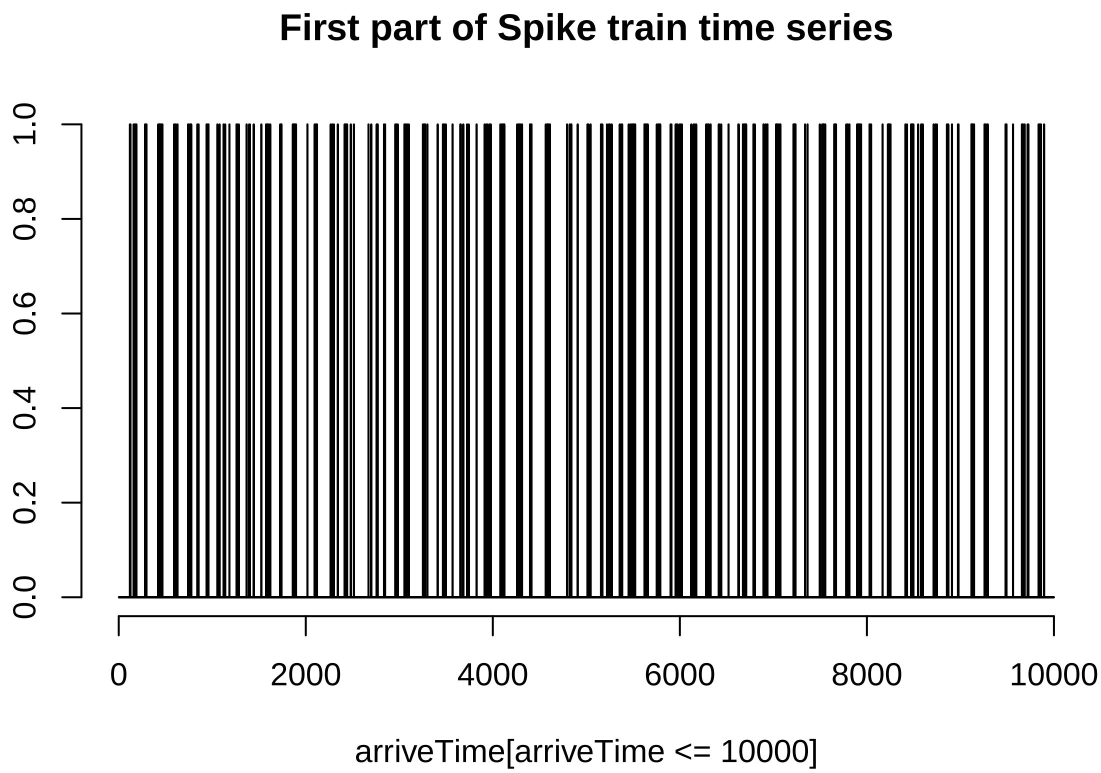
9/29/18

1.Download data file Retinal_ISIs.txt which contains wating times in milliseconds & Plot spiking activity as a histogram of the distribution of the times and as a spike train time series & Describe the spiking properties .

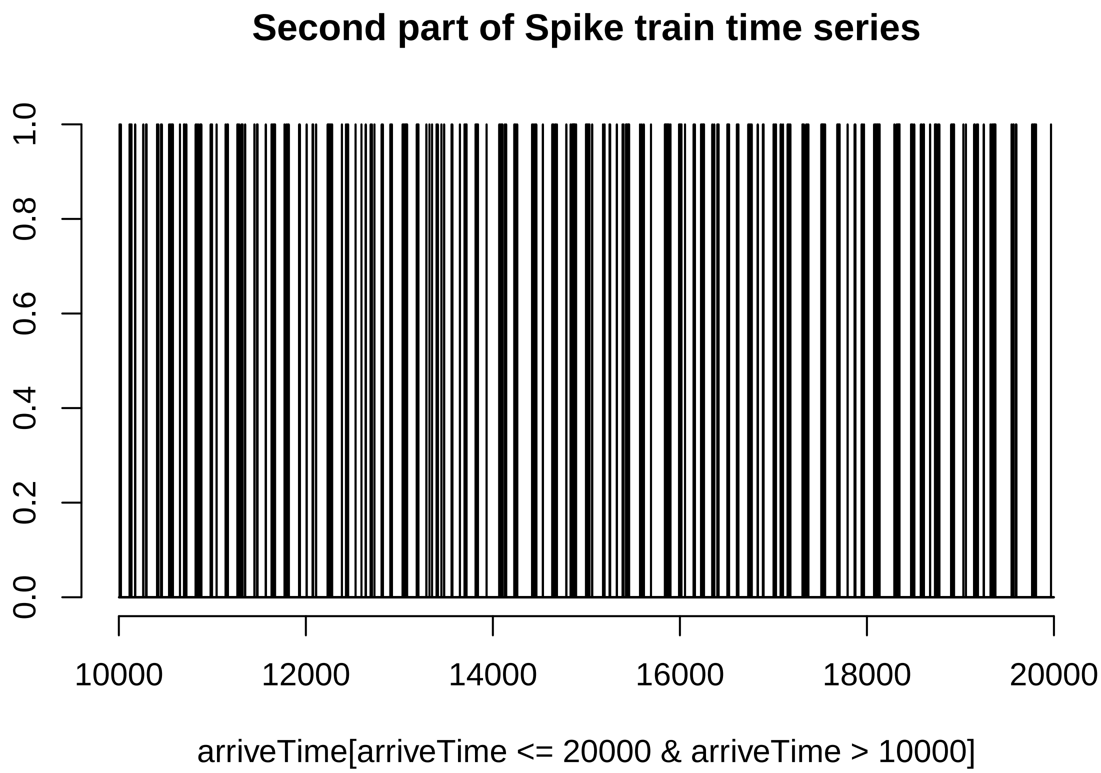


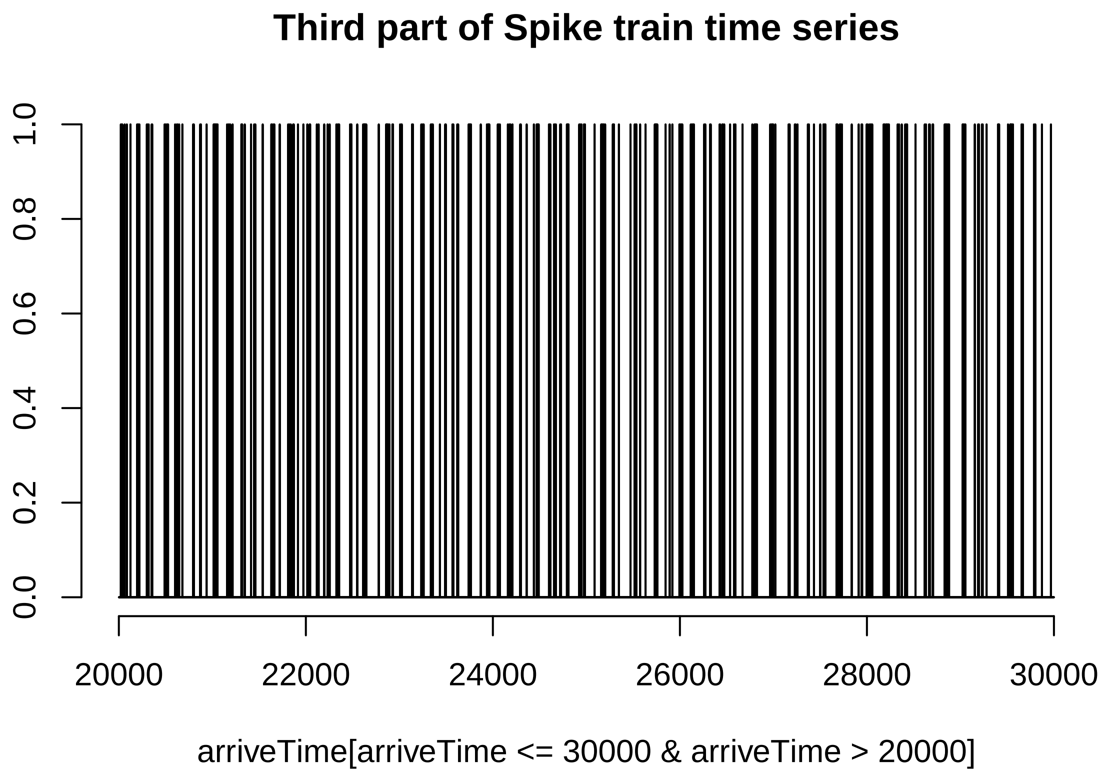


Since the plot is too narrow, I split this dataset into 3 equal parts



First part of Spike train time series
1.0
0.8
0.6
0.4
0.2
0.0
0
2000
4000
6000
8000
10000
arriveTime[arriveTime <= 10000]


Second part of Spike train time series
0.0
0.2
0.4
0.6
0.8
1.0
10000
12000
14000
16000
18000
20000
arriveTime[arriveTime <= 20000 & arriveTime > 10000]

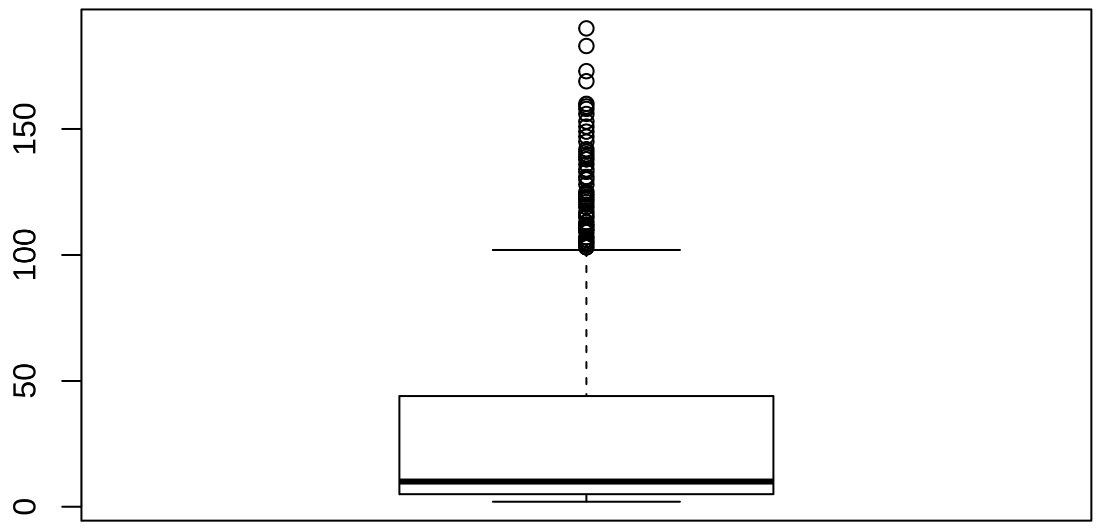


My Point of View is that : This point process is well fitted in Homogeneous Poisson Point Process because of :

- 1.The histogram of distribution of times between spiking events looks like exponential distribution;
- 2.Through the pictures of spike train time series, we can tell that the arrive time are kind of evenly distributed in the whole period.

2.Compute a 5-number summary & box plot for ISI distribution

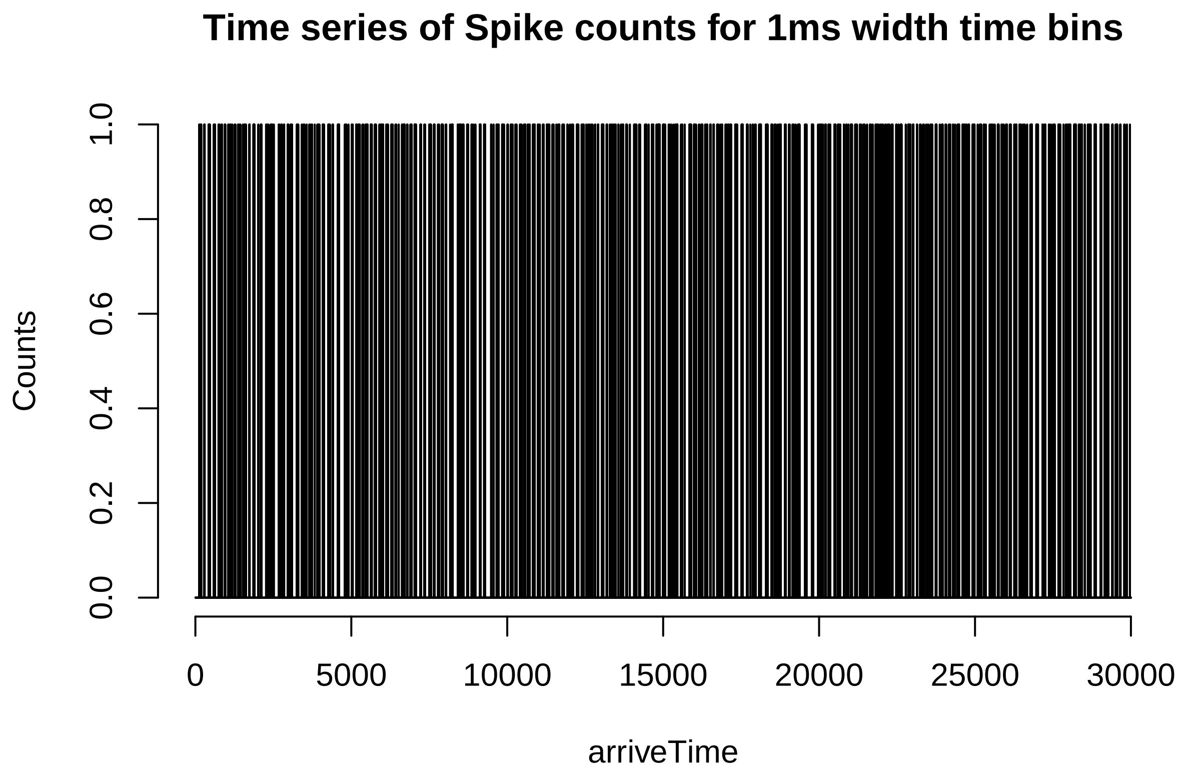
```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    2.00    5.00   10.00   30.83   44.00  190.00
```

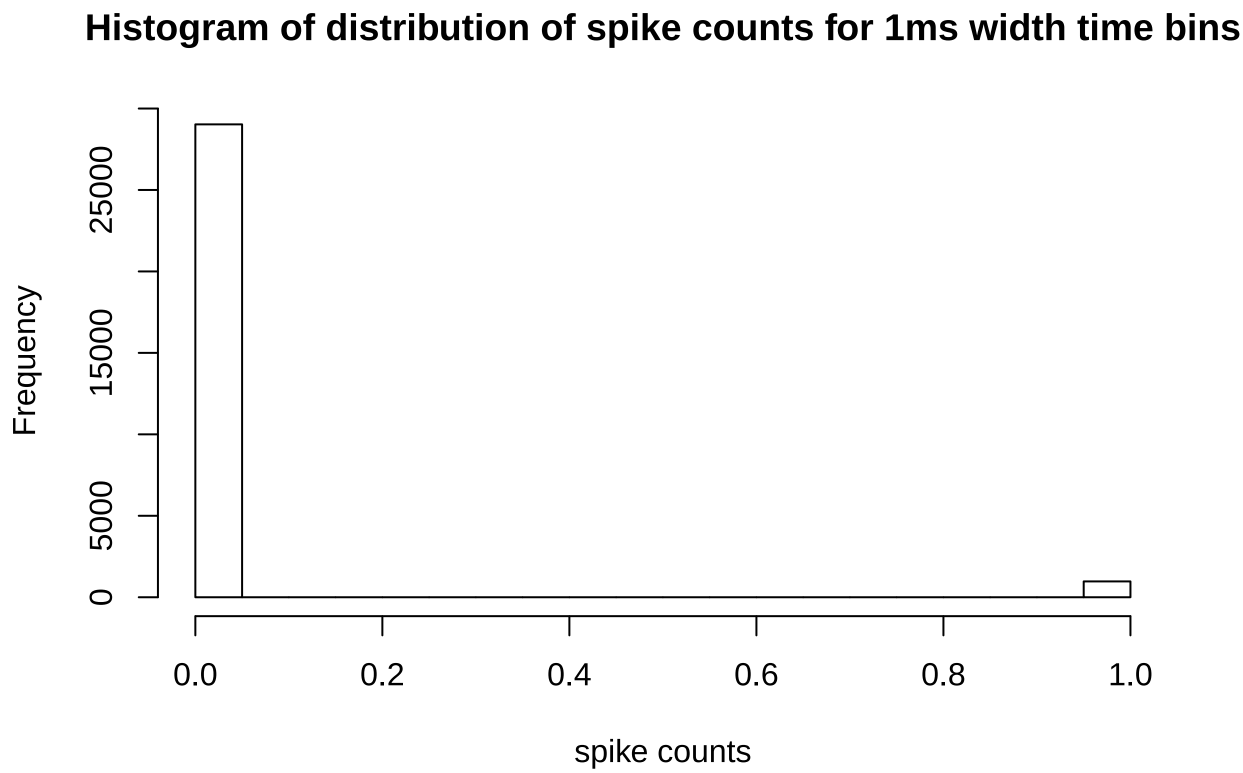


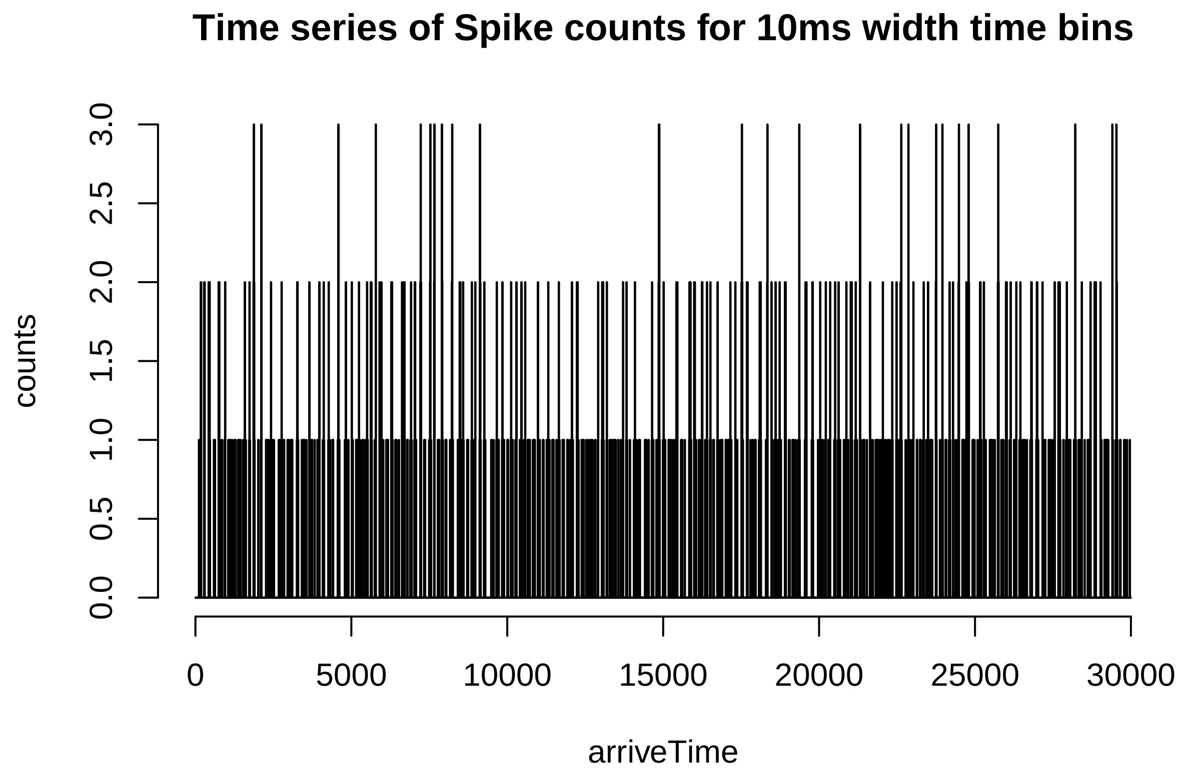
5-number summary of this data is (2, 5, 10, 44, 190) corresponding to (min, .25 quantile, median, .75 quantile, max).

- 1.The speed going down from max value to .75 quantile value is much faster than speed going down from .75 quantile to median. That is also a feature of exponential function.
- 2.Box plot shows that many data goes beyond the Whisker upper bound (.75 quantile + 1.5(.75 quantile - .25 quantile)). This is very common in box plot of exponential function.

3.Bin the spike train data from Retinal_ISIs.txt into time bins of width 1ms., 10ms., 100ms & Plot time series of spike counts and distribution of spike counts as histogram for each bin width

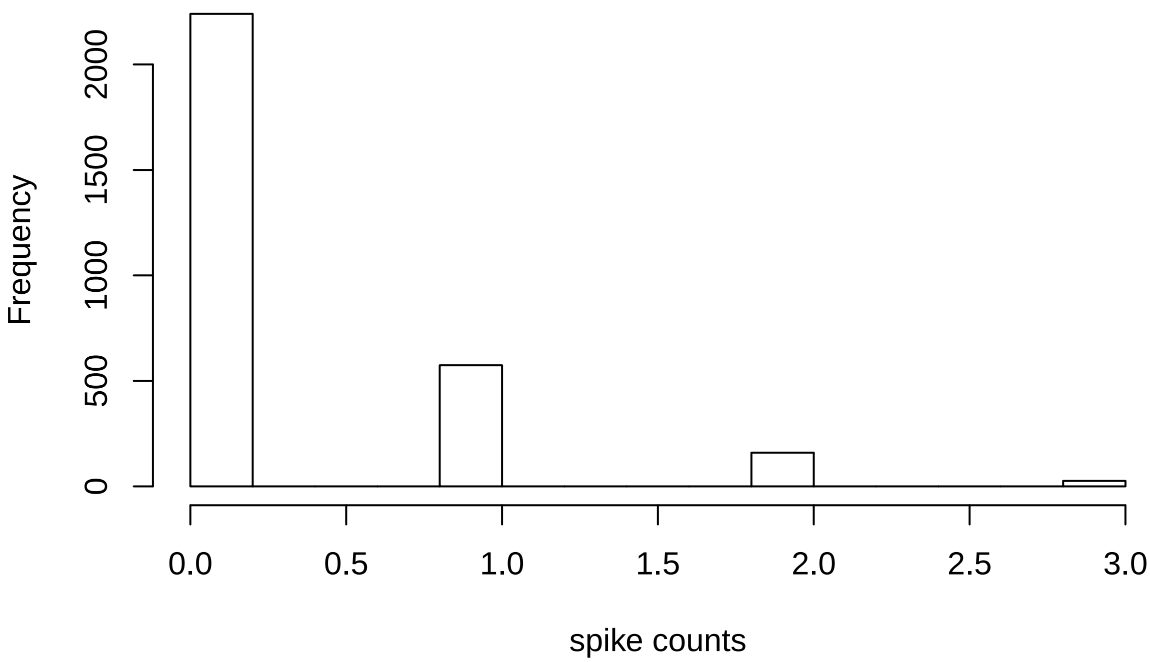

Time series of Spike counts for 1ms width time bins
Counts
0.0
0.2
0.4
0.6
0.8
1.0
0
5000
10000
15000
20000
25000
30000
arriveTime

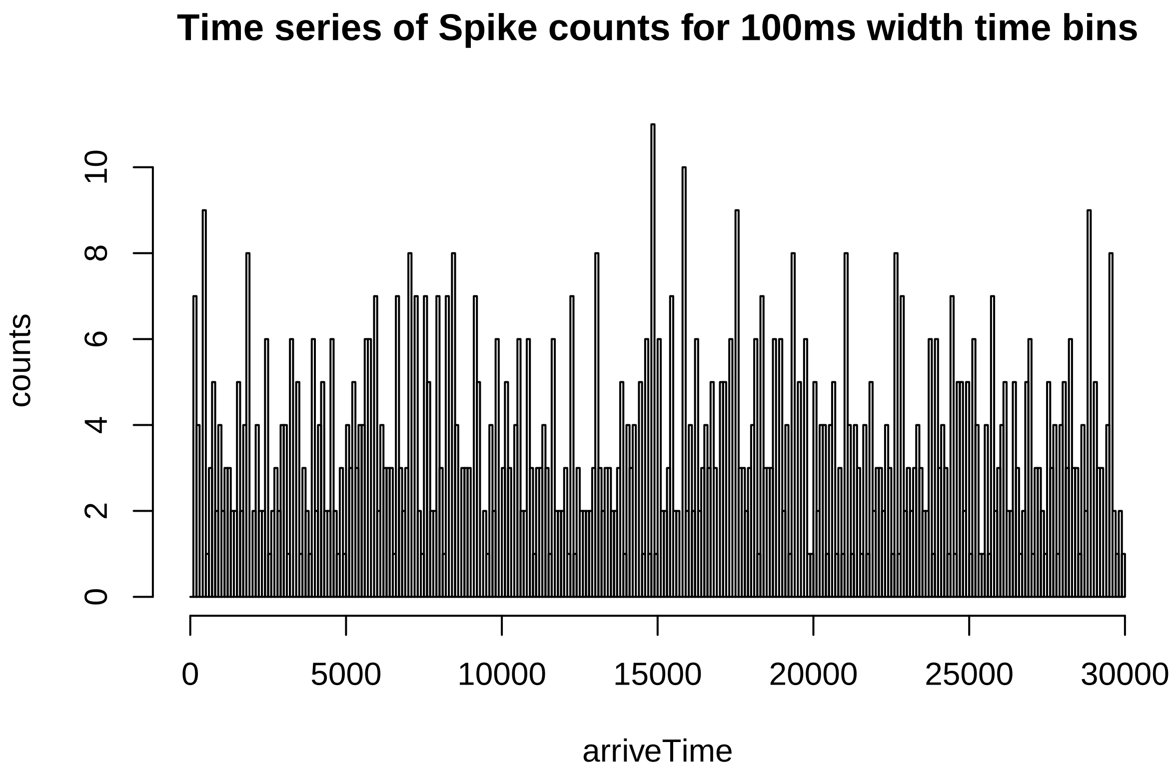

Histogram of distribution of spike counts for 1ms width time bins
Frequency
0
5000
15000
25000
0.0
0.2
0.4
0.6
0.8
1.0
spike counts

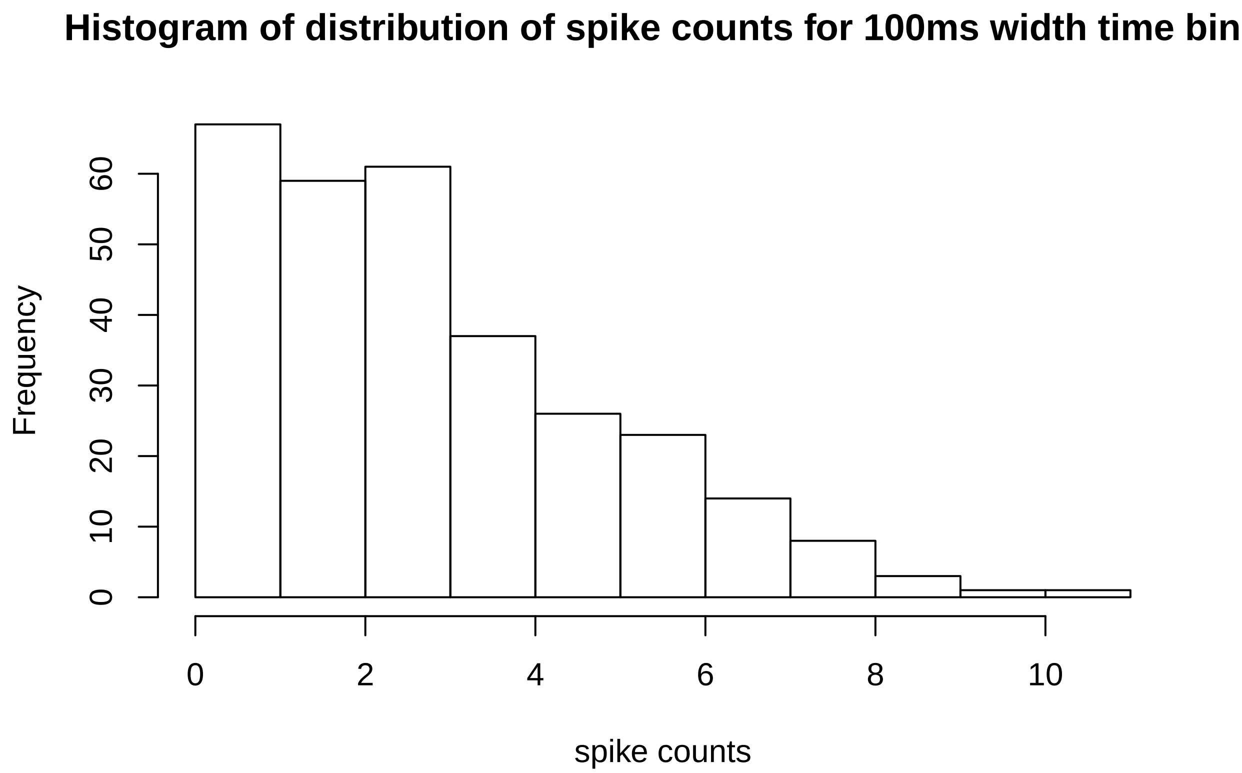


Time series of Spike counts for 10ms width time bins
counts
0.0
0.5
1.0
1.5
2.0
2.5
3.0
0
5000
10000
15000
20000
25000
30000
arriveTime

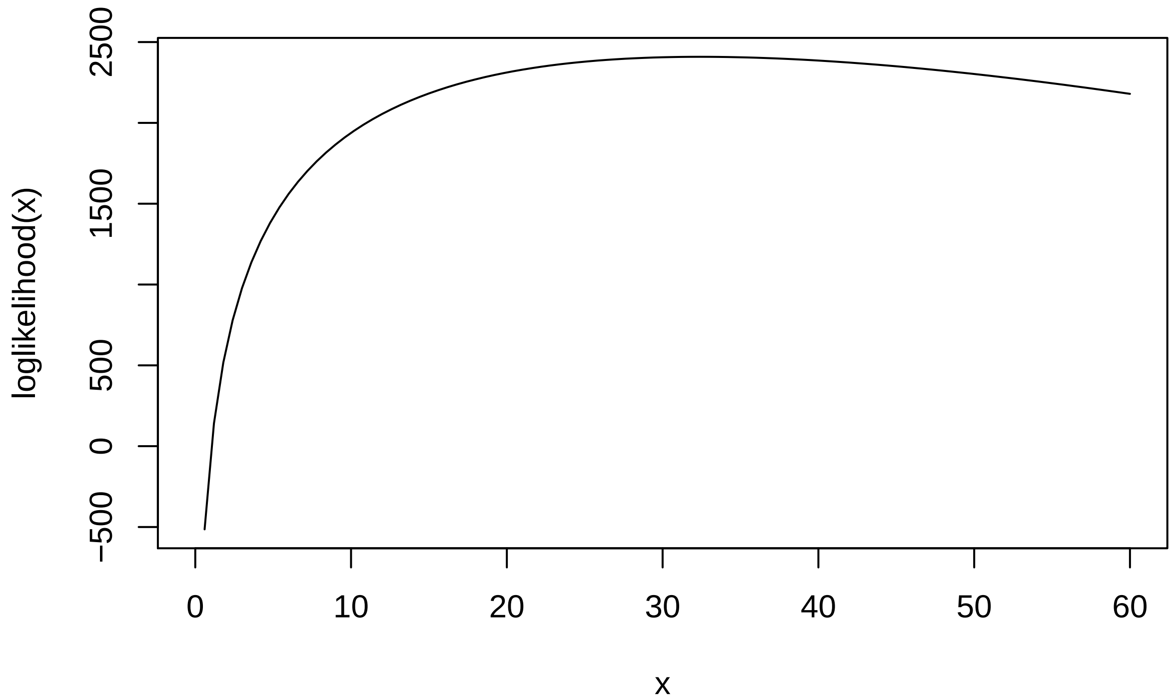
Histogram of distribution of spike counts for 10ms width time bins




Time series of Spike counts for 100ms width time bins
counts
0
2
4
6
8
10
0
5000
10000
15000
20000
25000
30000
arriveTime

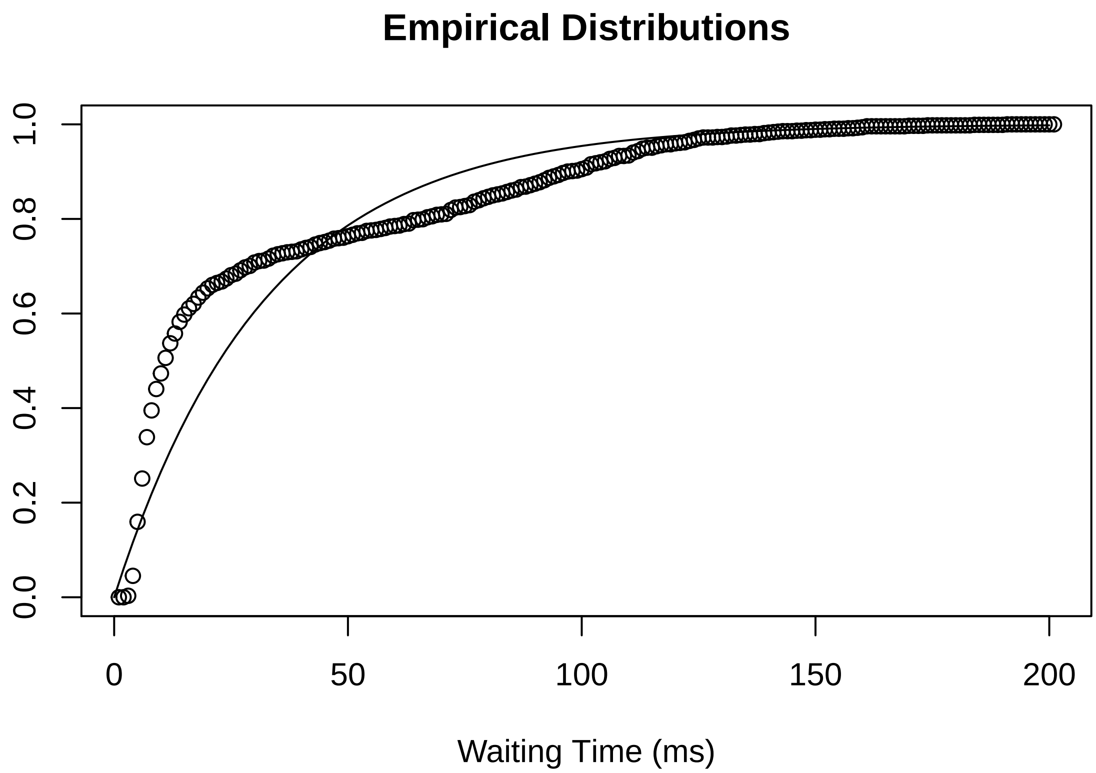


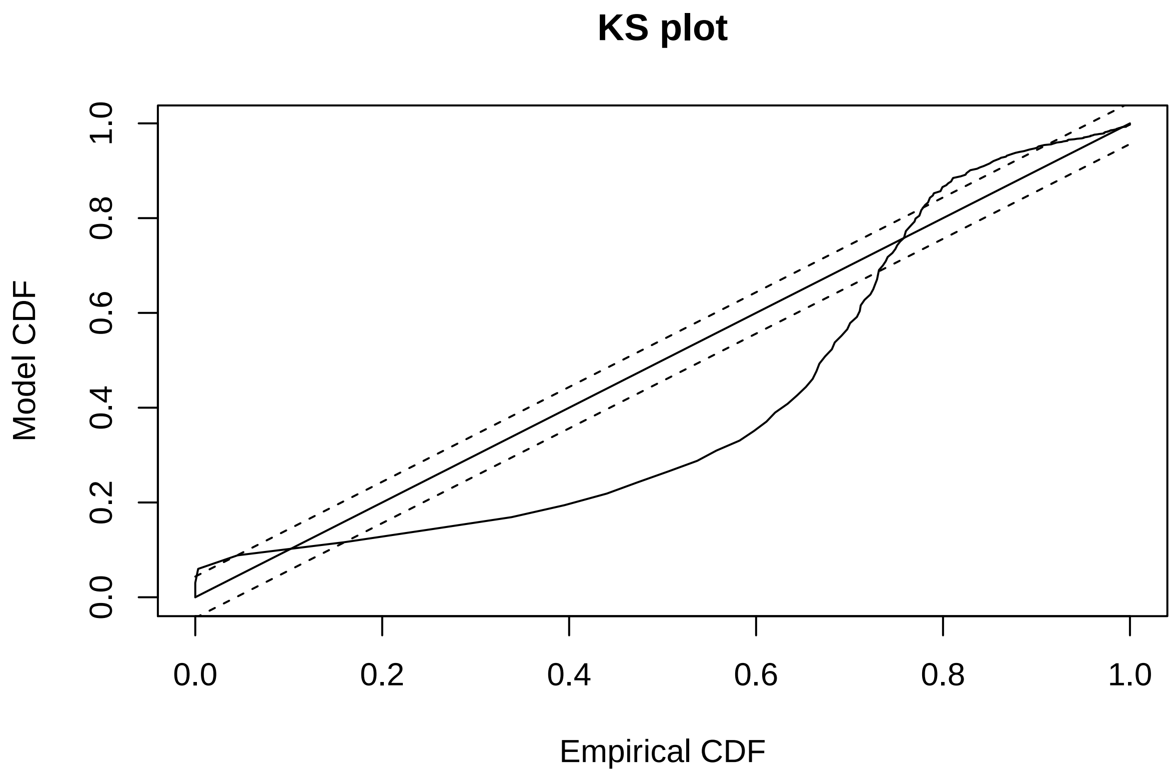
4.Plot the likelihood as a function of λ for values of λ between 0 Hz to 60 Hz & Find value $\hat{\lambda}_{ML}$ that maximize the likelihood & Provide an approximate 95% confidence interval for $\hat{\lambda}_{ML}$.




```
## $maximum
## [1] 32.4
##
## $objective
## [1] 2408.77
```

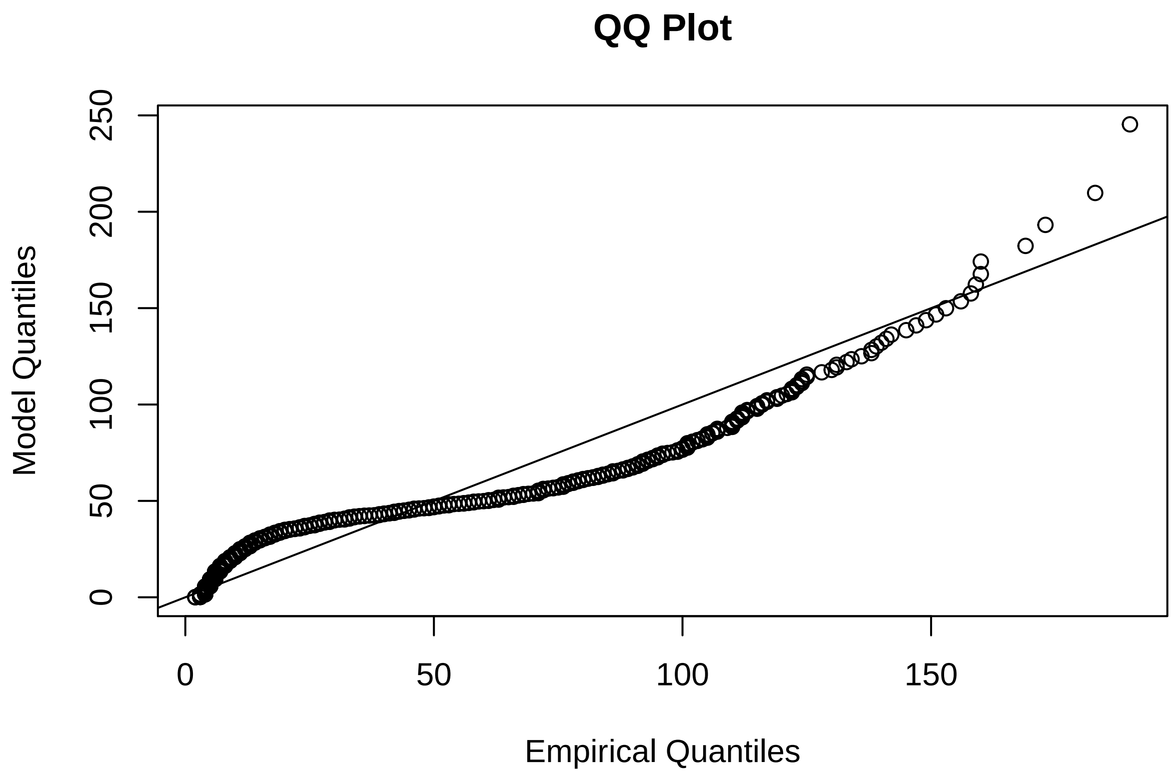
5.Plot an empirical CDF of the interspike intervals for the data & Plot the exponential CDF on the same plot as your empirical CDF & Construct a KS plot of the empirical CDF on the x-axis against the model CDF on the y-axis


Empirical Distributions
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
Waiting Time (ms)




```
## [1] "KS statistics is 0.251797527798863"
```

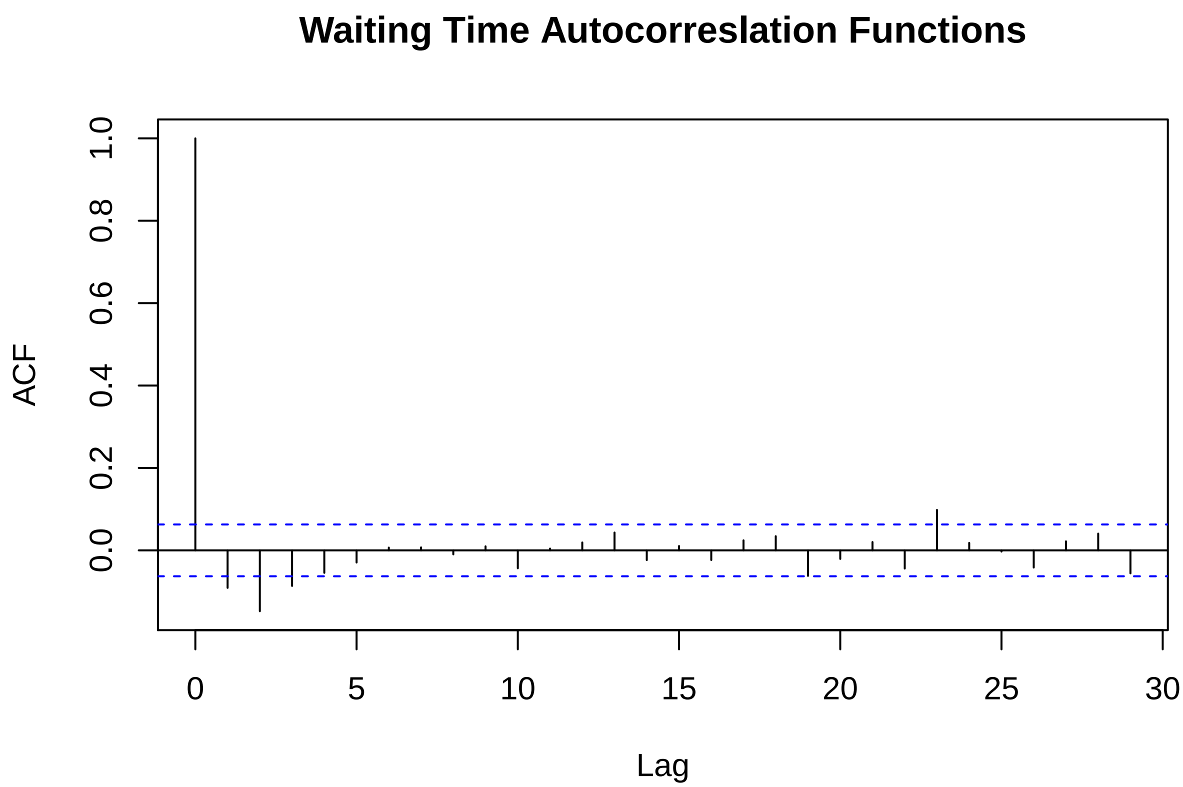
6.Construct a QQ plot of the empirical vs model quantiles



7.Compute the Fano Factor for increments process binned at 1ms, 10ms, 100ms

```
## [1] "The sample Fano Factor for the increments process binned at 1ms is  0.96763225440848"
## [1] "The 95% confidence interval of sample Fano Factor for a Poisson Process at 1ms bin length is [ 0
## [1] "The sample Fano Factor for the increments process binned at 10ms is  1.16610063436783"
## [1] "The 95% confidence interval of sample Fano Factor for a Poisson Process at 10ms bin length is [
## [1] "The sample Fano Factor for the increments process binned at 100ms is  1.45827655972584"
## [1] "The 95% confidence interval of sample Fano Factor for a Poisson Process at 100ms bin length is
```

8.Plot the autocorrelation function of the observed interspike intervals with 95% confidence bounds



Waiting Time Autocorreslation Functions
ACF
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
25
30
Lag