# Prob1_MA568

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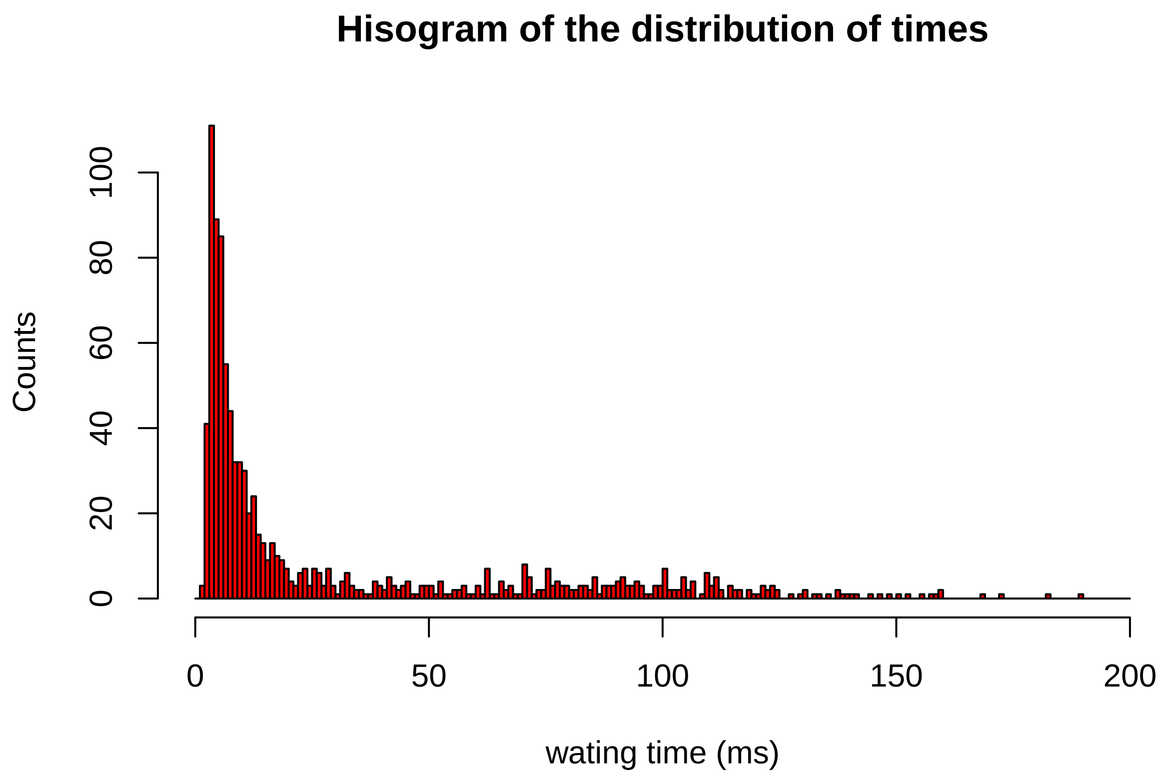
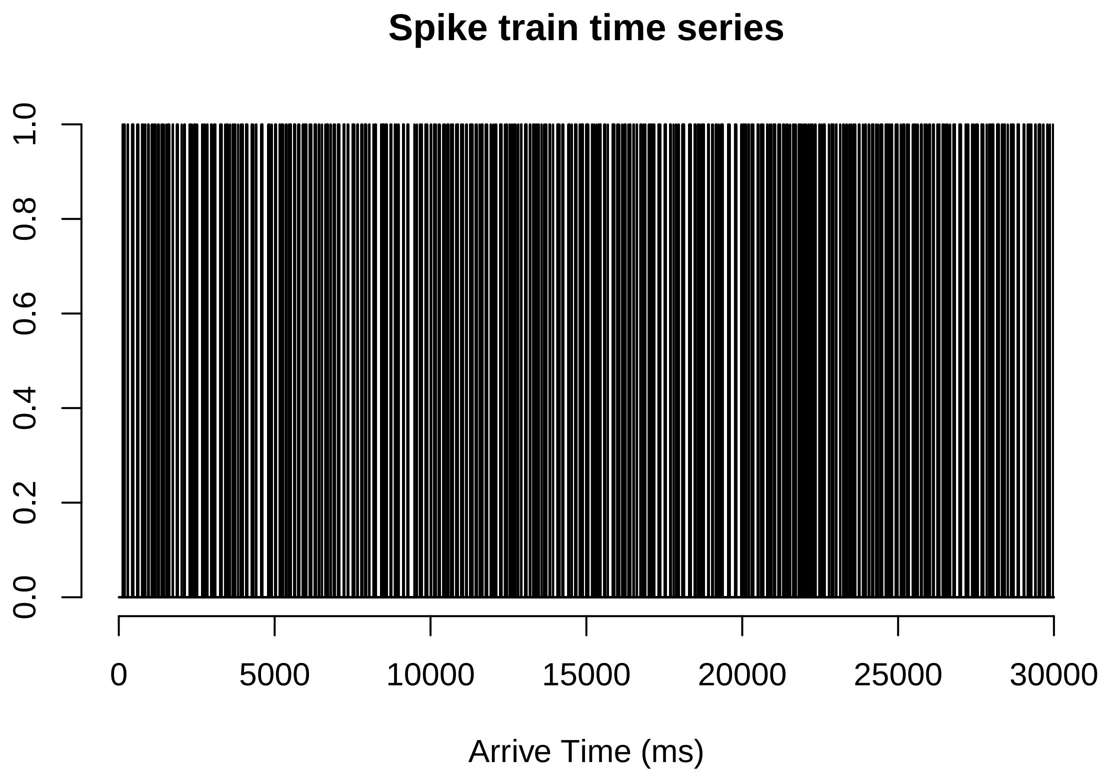
**1.Download data file Retinal_ISIs.txt which contains wating times in milliseconds & Plot spiking activity as a histogram of the distribution of the times and as a spike train time series & Describe the spiking properties .**






**My Point of View : The histogram shows that most of the waiting times are 3-30 ms, and the waiting times between 3-11 ms consists of more than 50 % of observed data. So a homogeneous Poisson Process may not well fitted in this data.**

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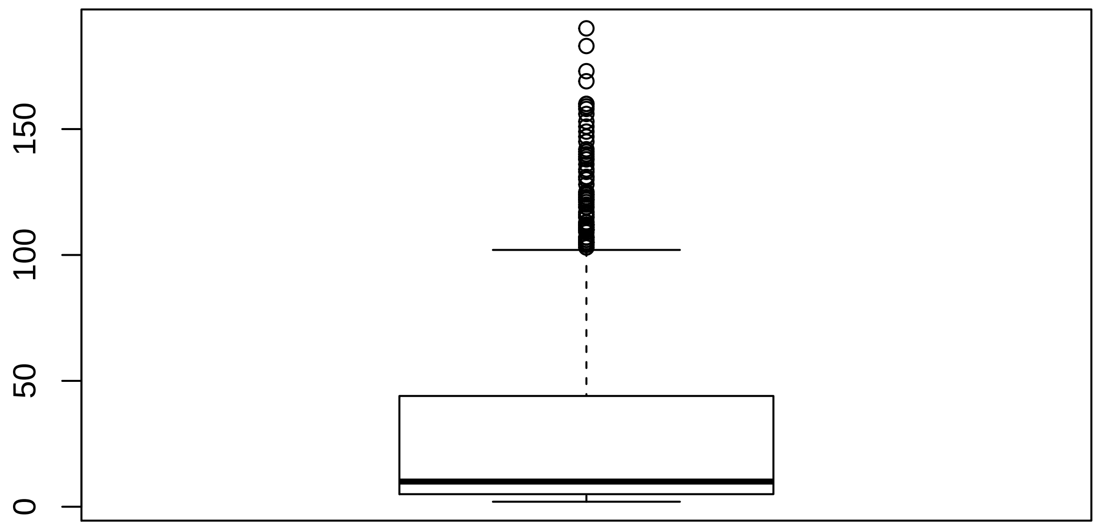
**2.Compute a 5-number summary & box plot for ISI distribution**

```
##    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).**

- From the 5-number summary, we can see that most of waiting time data are concentrated in 5-44 ms.
- From the boxplot, we can tell that this is a long-tailed distribution because there are lots of big data over 100 ms although most of data are concentrated in 5-44 ms.

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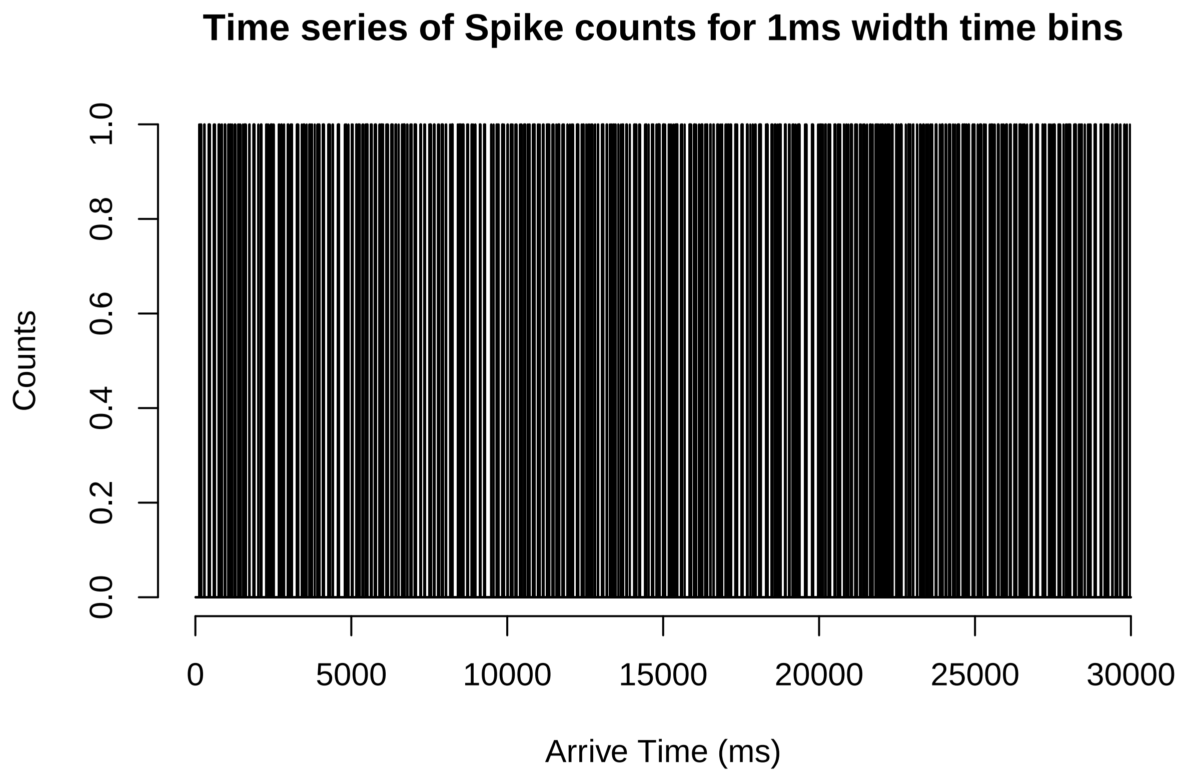
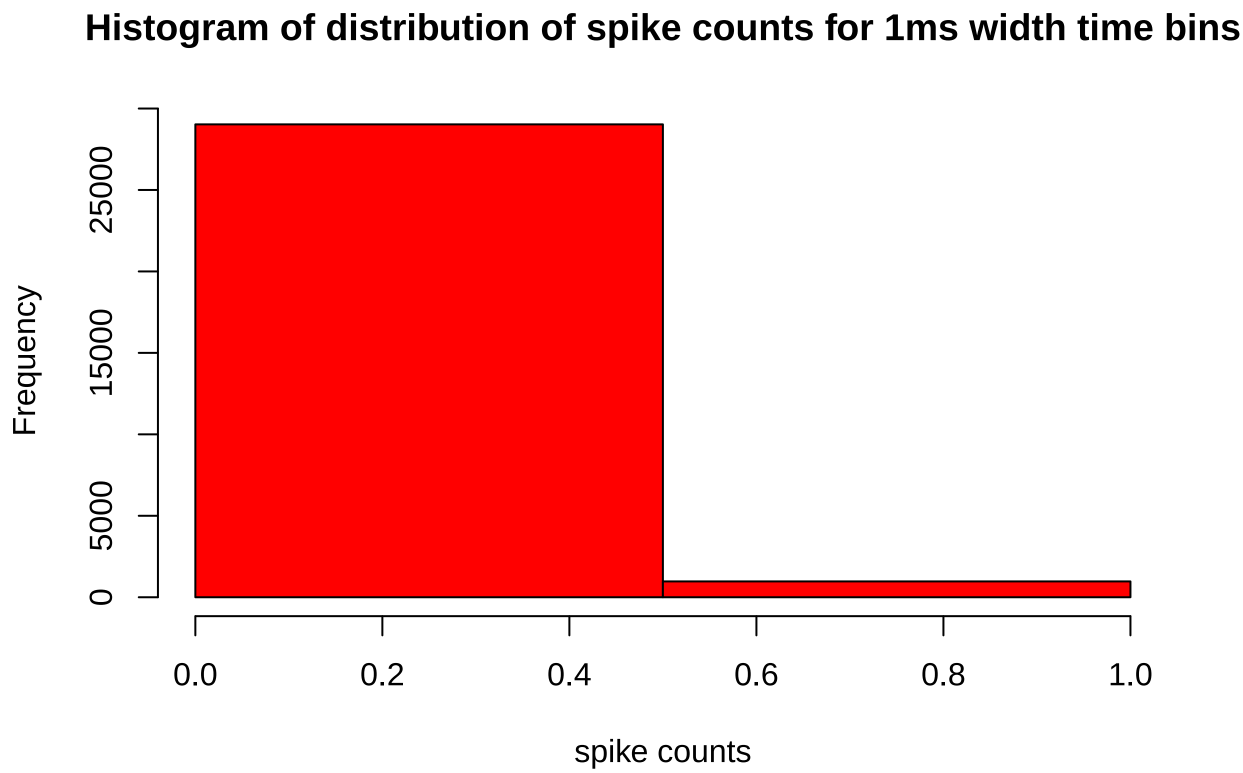
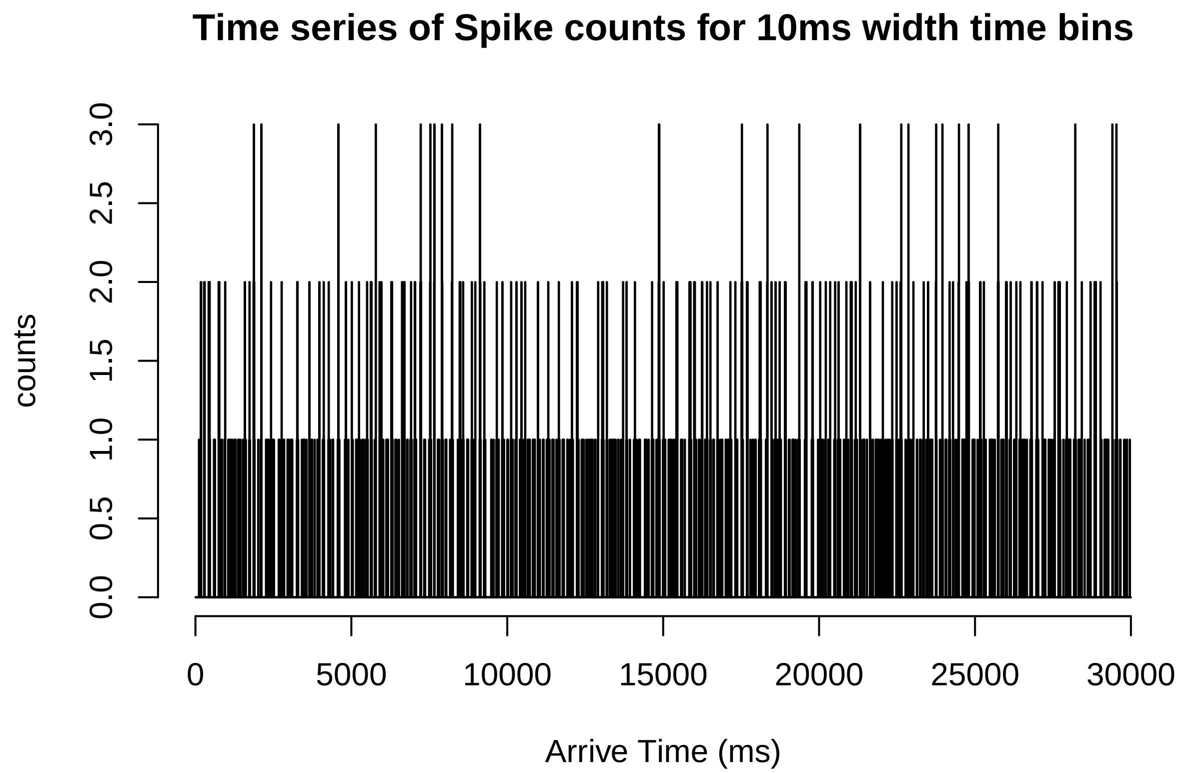
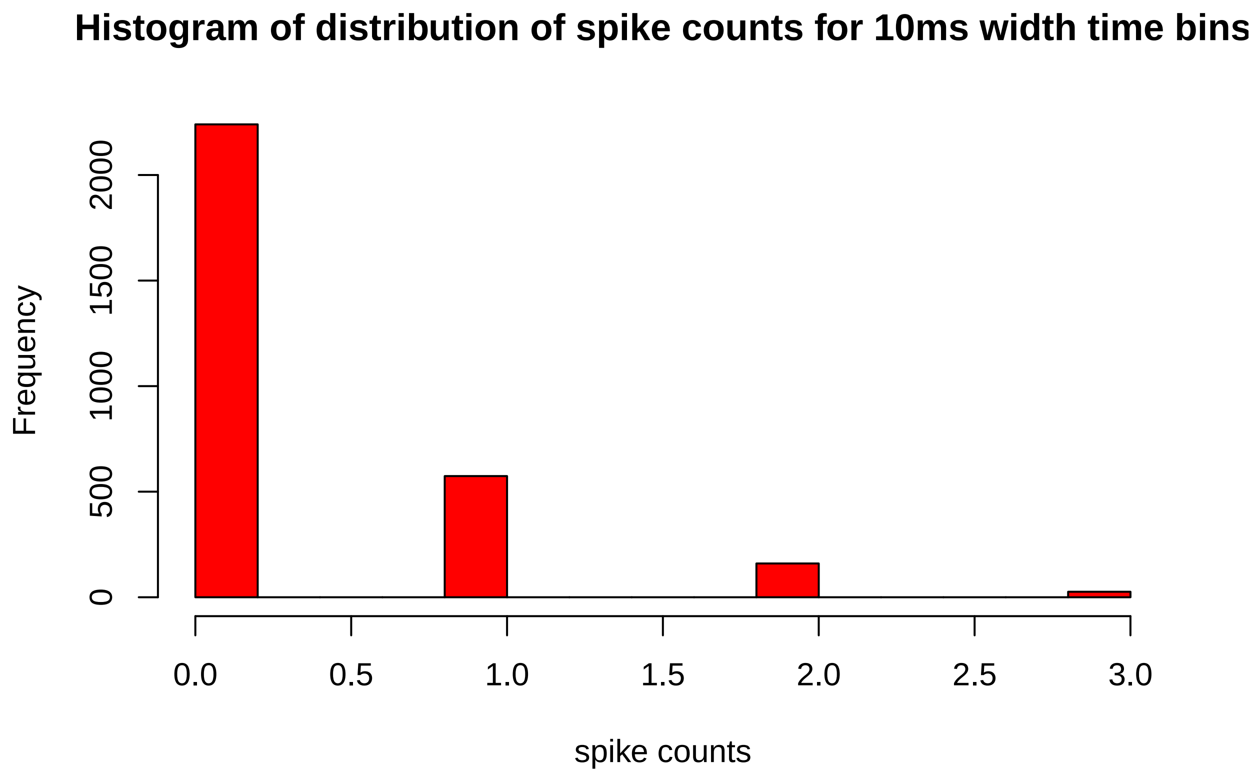
**3.Bin the spike train data from Retinal_ISIs.txt into time bins of width 1ms., 10ms., 100ms & Plot time series of spike counts and distribution of spike counts as histogram for each bin width**

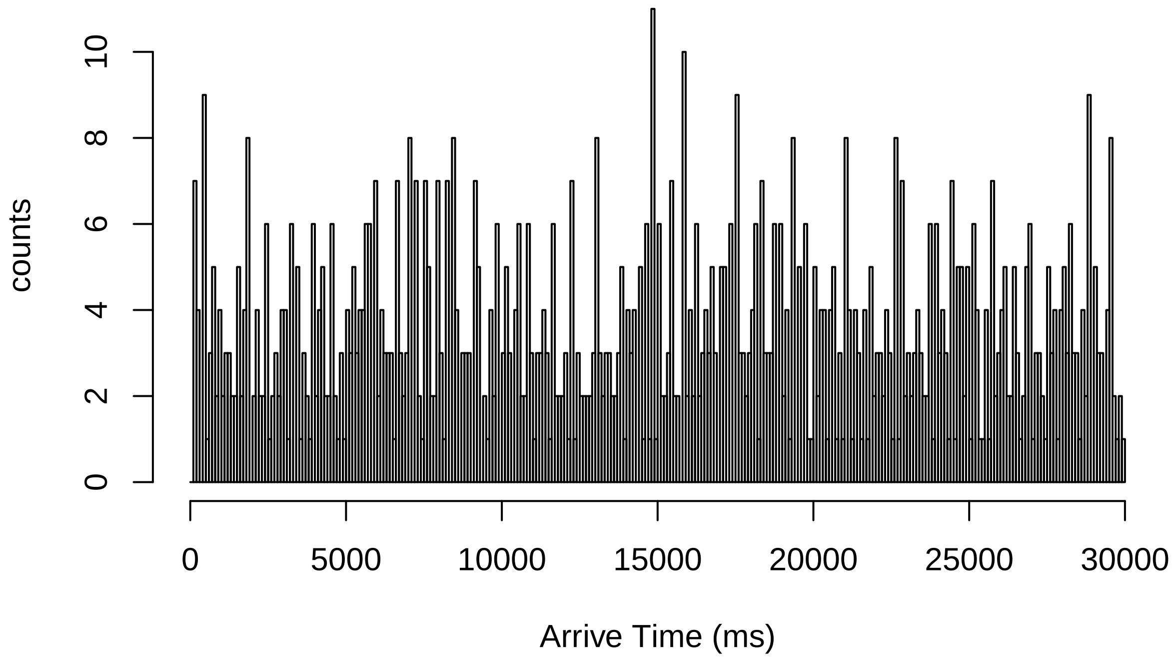

Time series of Spike counts for 1ms width time bins
Counts
0.0
0.2
0.4
0.6
0.8
1.0
0
5000
10000
15000
20000
25000
30000
Arrive Time (ms)

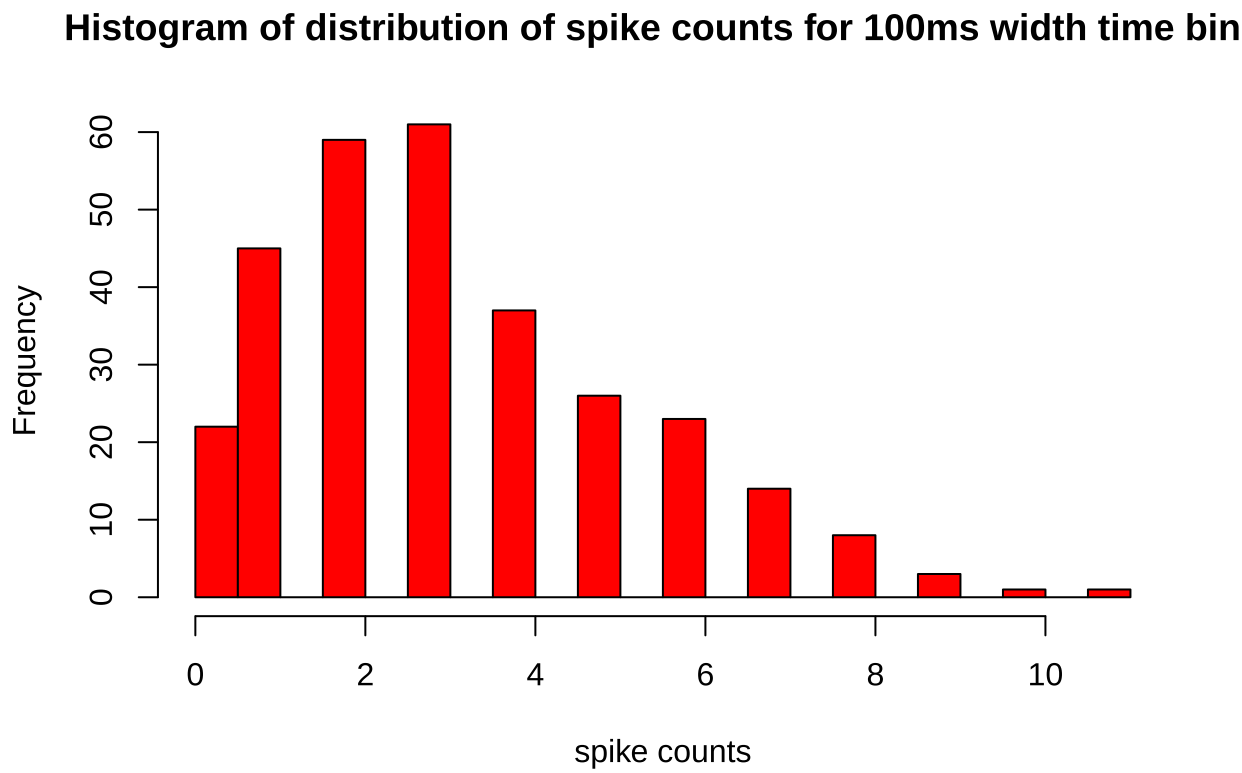

Histogram of distribution of spike counts for 1ms width time bins
Frequency
0
5000
15000
25000
0.0
0.2
0.4
0.6
0.8
1.0
spike counts


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
Arrive Time (ms)

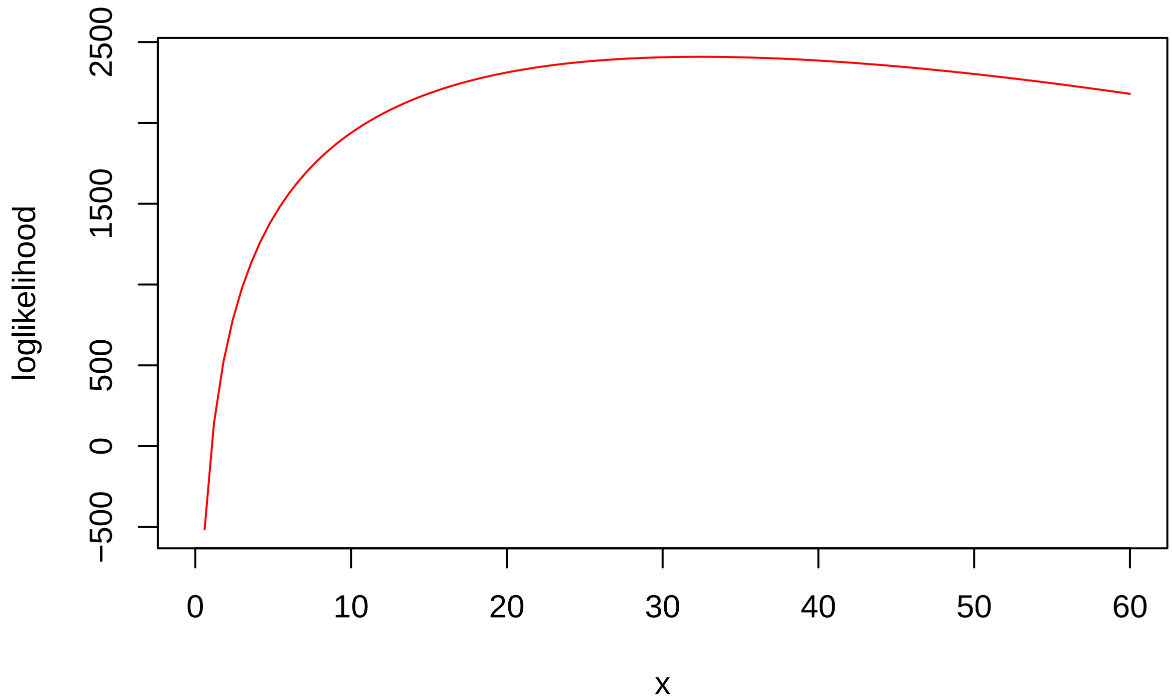

Histogram of distribution of spike counts for 10ms width time bins
Frequency
0
500
1000
1500
2000
0.0
0.5
1.0
1.5
2.0
2.5
3.0
spike counts

Time series of Spike counts for 100ms width time bins






**4.Plot the likelihood as a function of $\lambda$ for values of $\lambda$ 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
```

**The value of $\hat{\lambda}_{ML}$ that maximaize the likelihood is 32.4, and the approximate 95% confidence interval for $\hat{\lambda}_{ML}$ is** $[32.4 - 1.96 \times \frac{\sqrt{972}}{30}, 32.4 + 1.96 \times \frac{\sqrt{972}}{30}]$**, i.e.** $[30.36311, 34.43689]$

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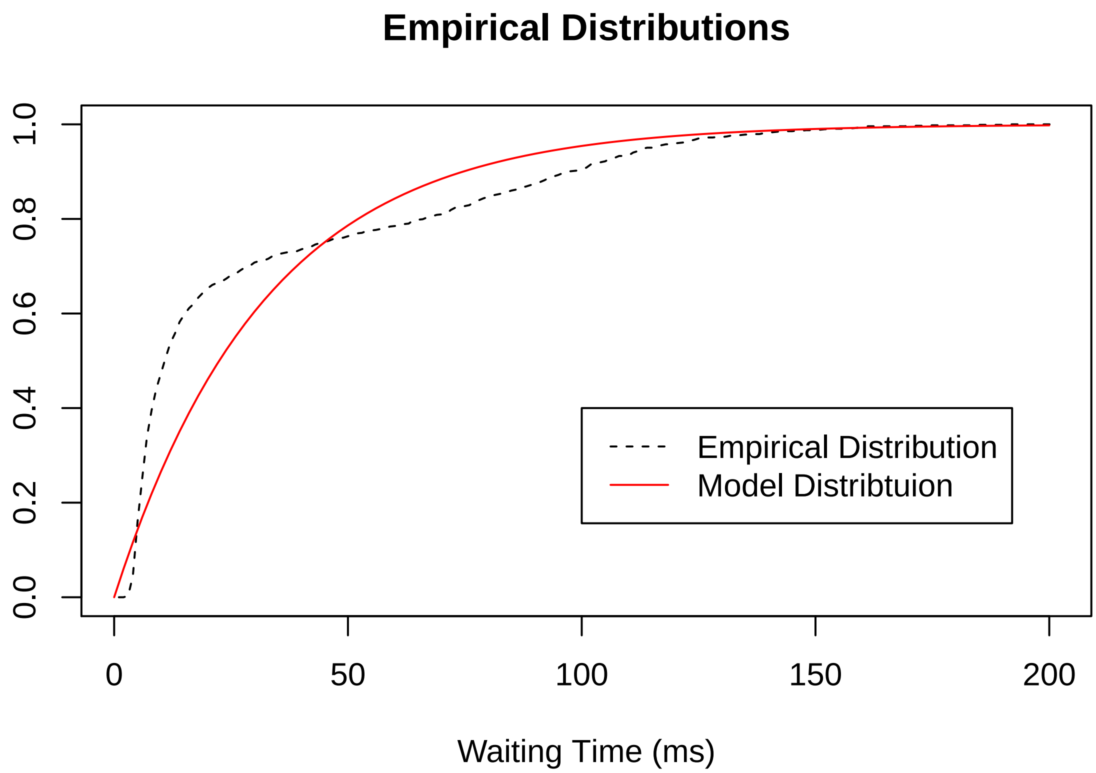
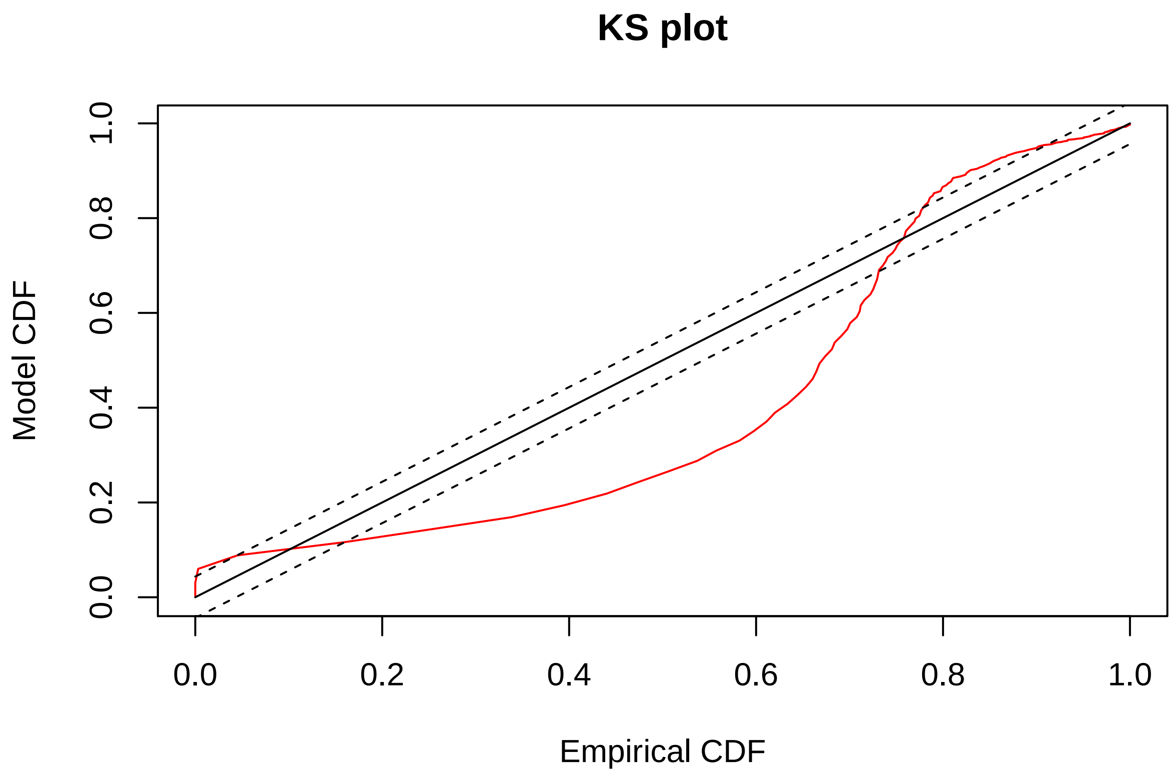
**5.Plot an empirical CDF of the interspike intervals for the data & Plot the exponential CDF on the same plot as your empirical CDF & Construct a KS plot of the empirical CDF on the x-axis against the model CDF on the y-axis**


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




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

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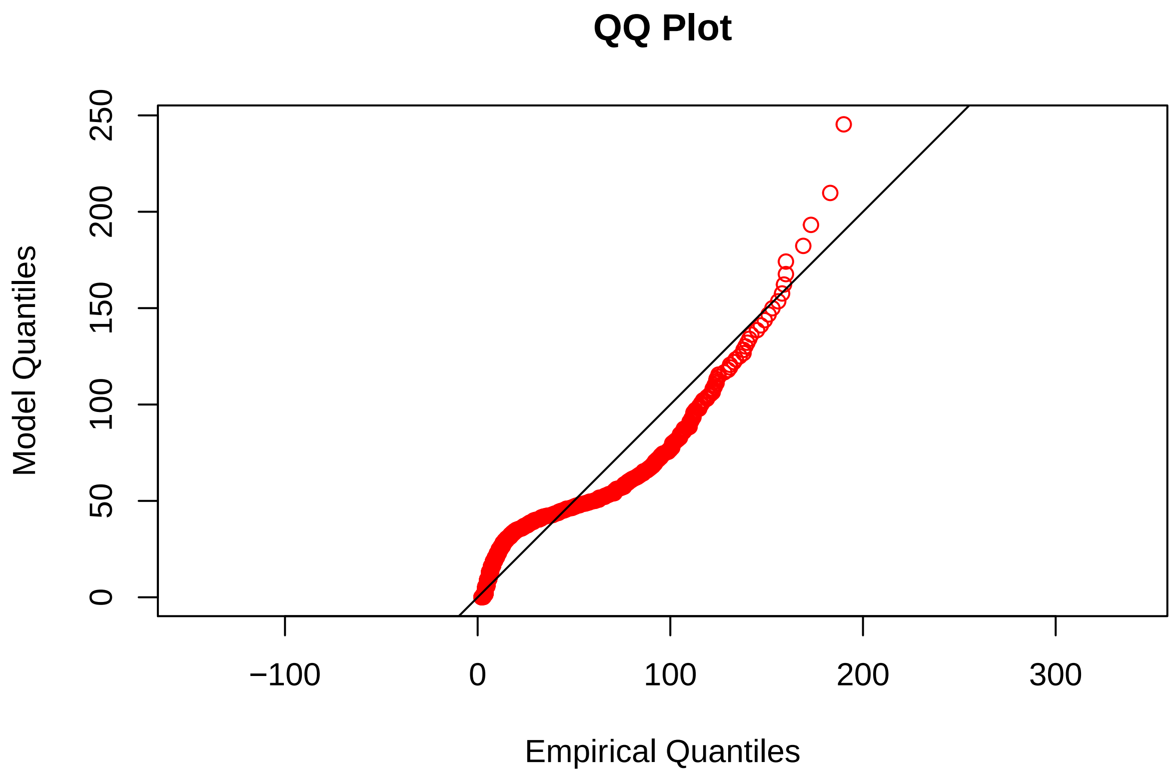
**6.Construct a QQ plot of the empirical vs model quantiles**

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**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
```

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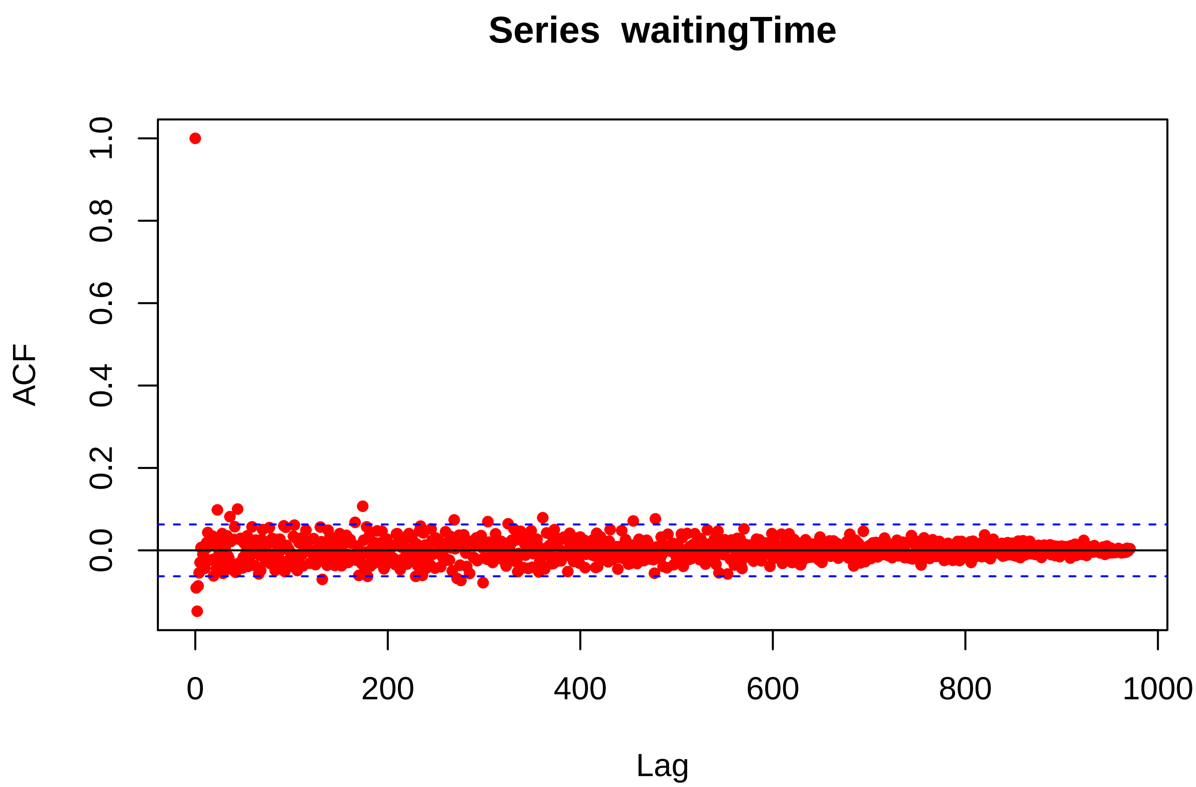
**8.Plot the autocorrelation function of the observed interspike intervals with 95% confidence bounds**


Series waitingTime
ACF
1.0
0.8
0.6
0.4
0.2
0.0
0
200
400
600
800
1000
Lag