IE306 Assignment 2

Spring 2020

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Question 1 :

We tried to test whether it is safe to assume that inter-arrival times are distributed uniformly between 0 and 400 seconds by using the Kolmogorov-Smirnov test with a significance level of 0.05. First of all , we sort day1 and day2 in ascending order. Then we count number of samples, and maximum value. We compute (i/N) and Ri for both days. Then we compute ((i− 1)/N), ((i/N) − Ri) and (Ri − ((i− 1)/N)) . Maximum of the calculated values is D. We found D for Day 1 as 0,647495446 and Day 2 as 0,597320128 . We found testing $D_{0.05,488}$ value as 0,061564307 and since our D values from observations have higher values, we reject that inter-arrival times are distributed uniformly between 0 and 400 seconds.

Question 2 :

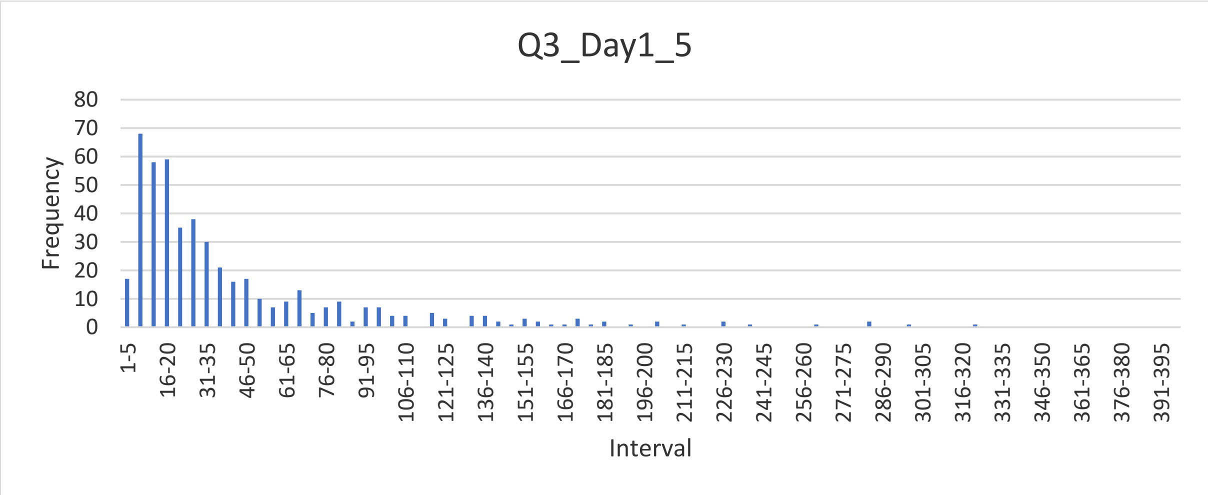
We found sample mean, standard deviation and other descriptive statistics.

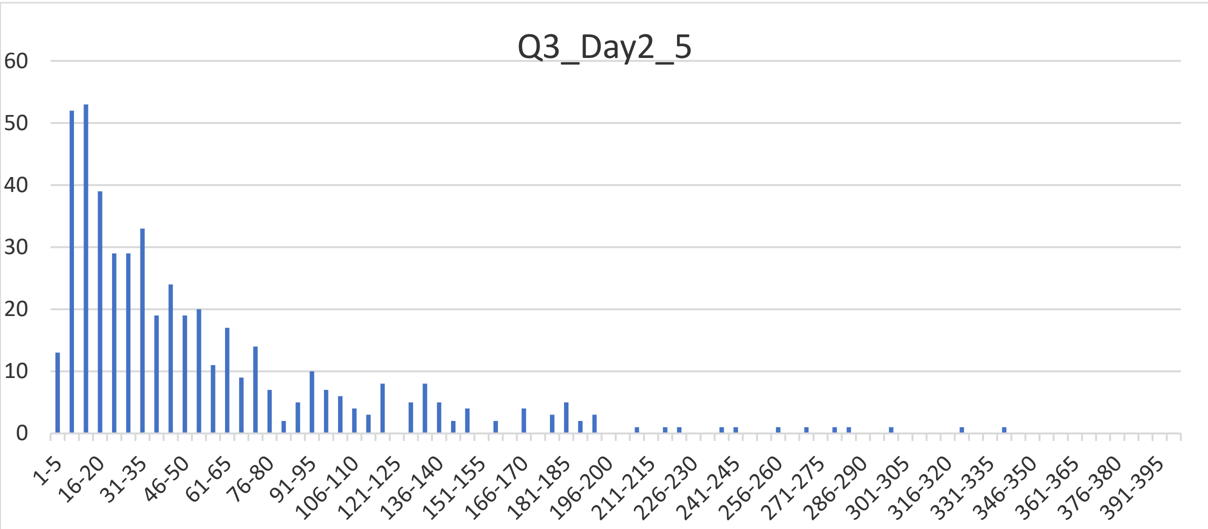
	Day 1	Day 2
Sample Mean:	45	54
Standart Deviation:	52,812353	55,0840901
Lambda:	0,018934964	0,01815406
Variance:	2783,429169	3028,03924
Mod:	10,22222222	20
Median:	26	35
Max:	434	339
Min:	1	0
Range:	433	339
Sum:	21829	26240
Count:	488	488

Question 3 :

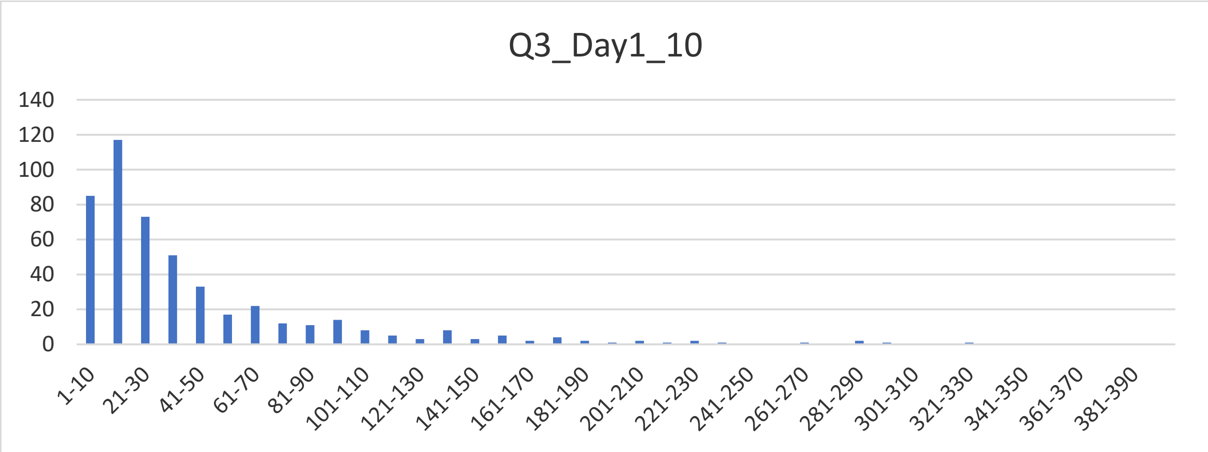
We drew frequency histograms of the data for 5, 10 and 20 second intervals

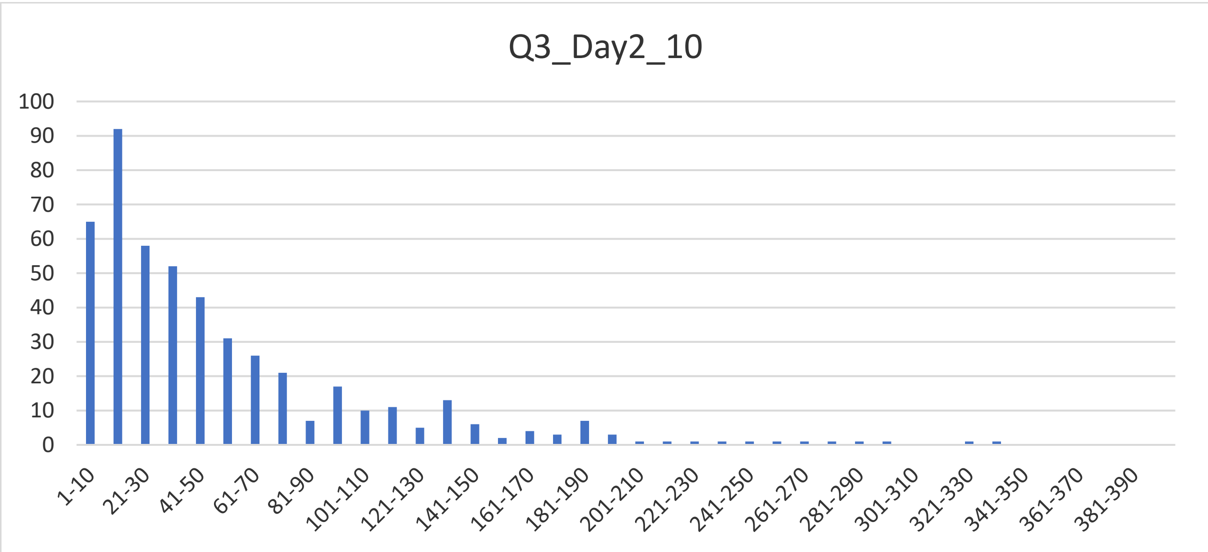
- *5 second interval*



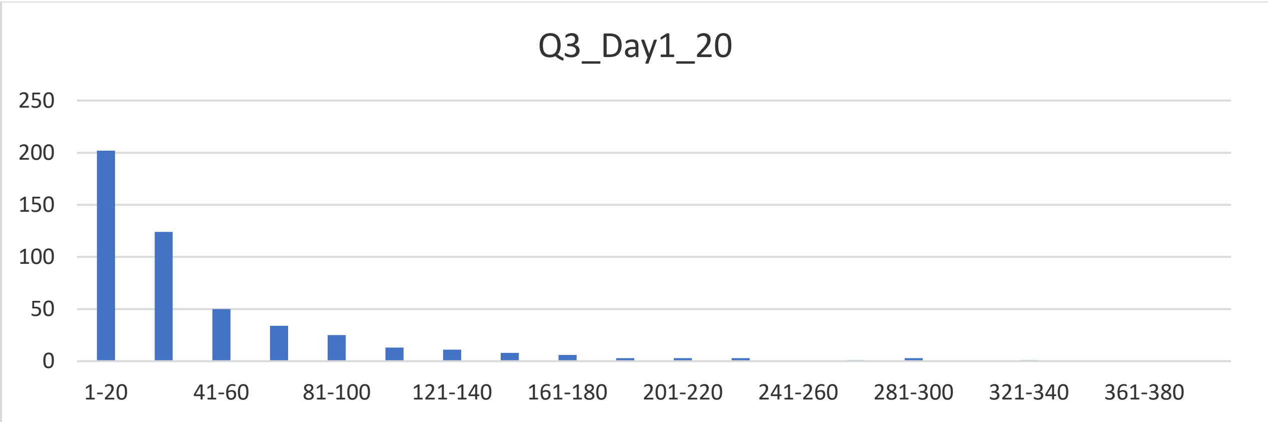


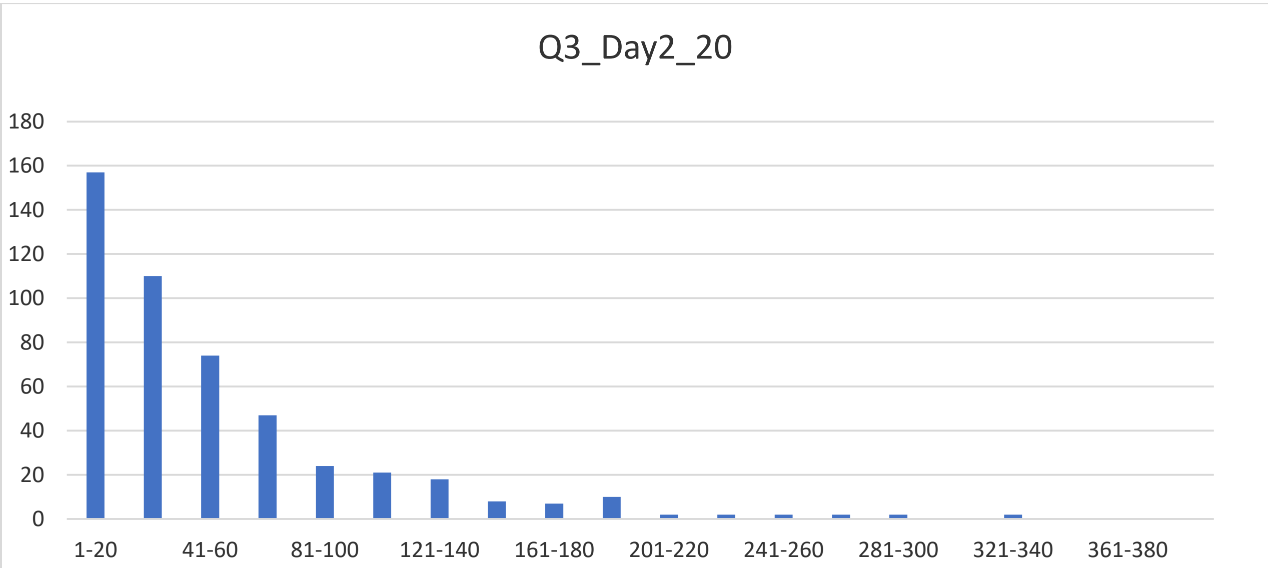
- *10 second interval*





- *20 second interval*





Comment on the shape of the histograms :

All of them looks like exponential distribution ,especially Day1_20 and Day2_20 .

Question 4 :

We performed 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 question 2. In this question the intervals are constant however expected numbers are not constant . We need to calculate expected numbers corresponding to their intervals . Expected value for an interval is F(M,lambda,True)−F(m−1,lambda,True) where F is cumulative distribution function, M is the biggest element of interval and m is the smallest element of interval, and lambda is 1/mean. This way, we can achieve the expected probability for each interval. Then we multiply these probabilities with total number of elements which gives us the expected number of minutes for each interval. Then ,by using following formula we calculated the chi-square value for each day, where n is number of intervals(400/10).

$$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

We used 38 as degree of freedom. When we use degrees of freedom formula (n-k-1, n is number of intervals, k is the number of values we obtained from sample which is 1 since we obtained mean from sample), it gives us 38.

If our calculated chi-squared value is bigger than the theoretical chi-squared value which has 38 degrees of freedom,we would reject the null hypothesis that the data comes from an exponential distribution.

For Day1;

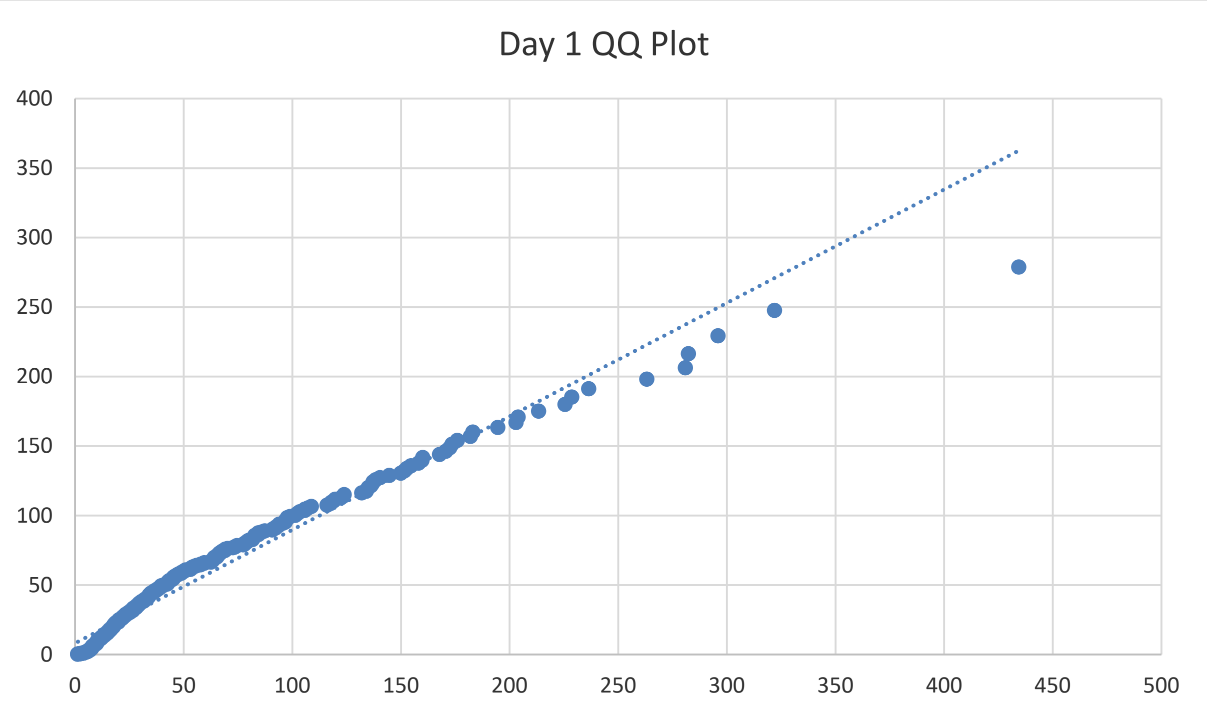
According to the chi-square test we reject the null hypothesis that the data comes from an exponential distribution.

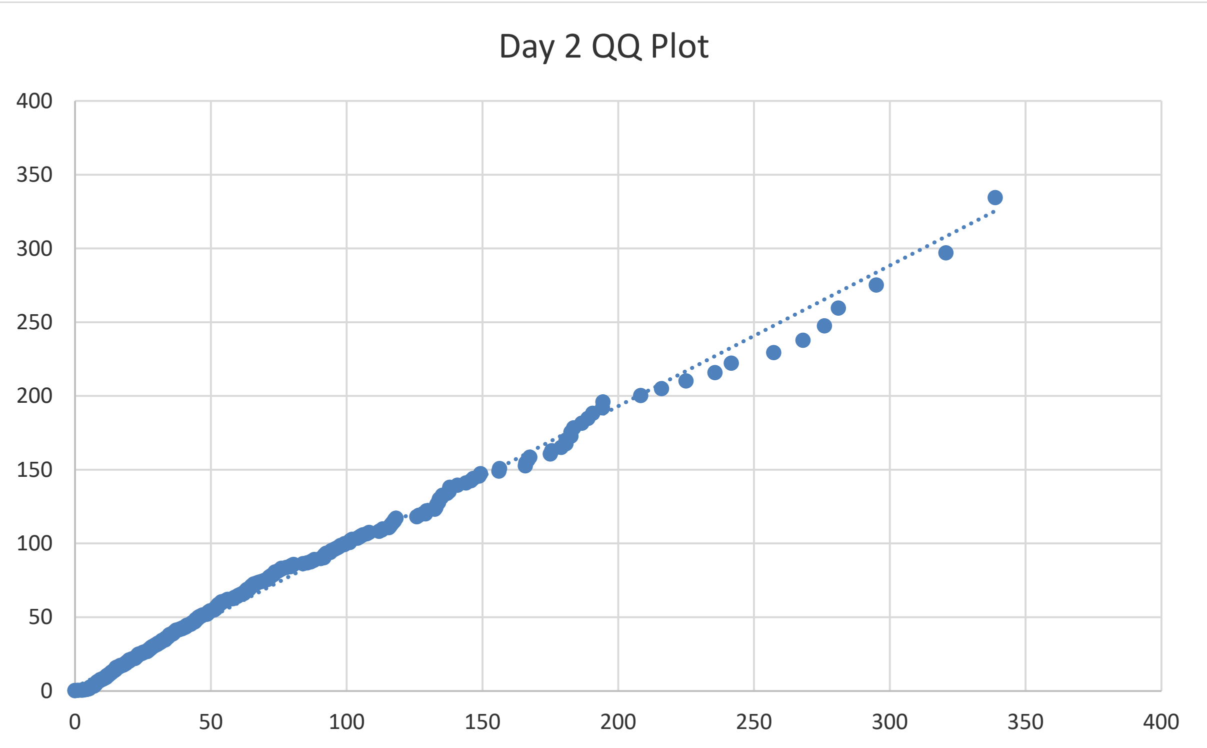
For Day2;

According to the chi-square test we fail to reject the null hypothesis that the data comes from an exponential distribution.

Question 5 :

We drew the QQ-plot to test whether the data comes from an exponential distribution.

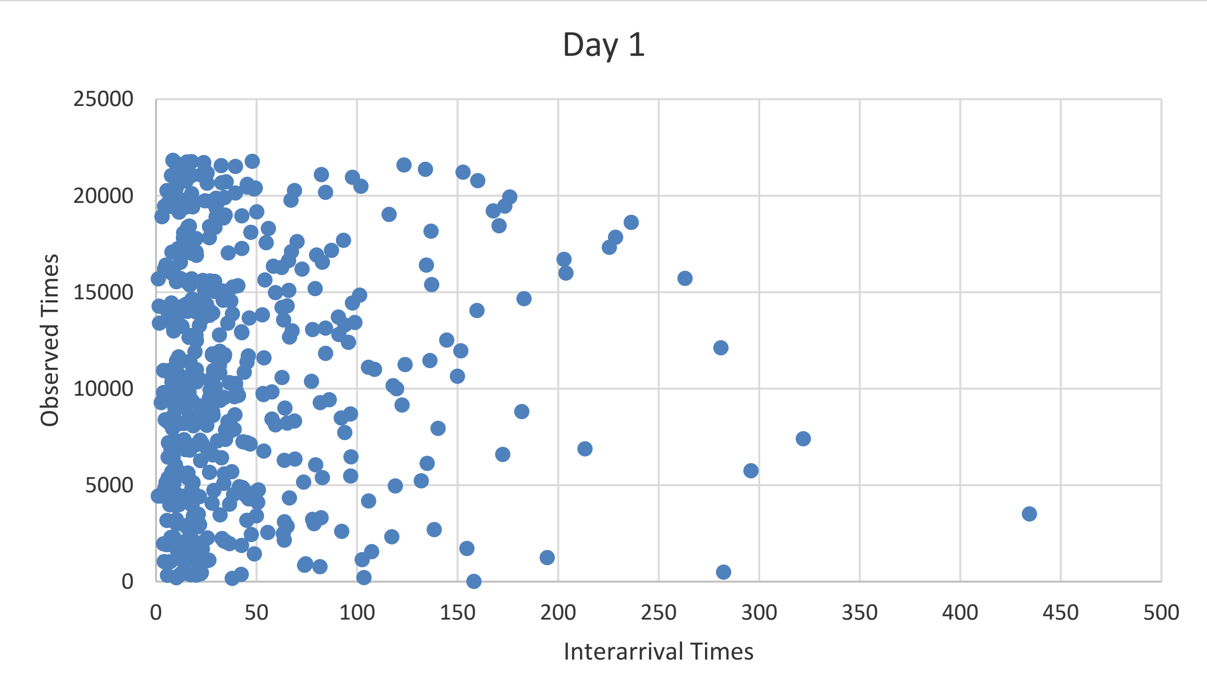


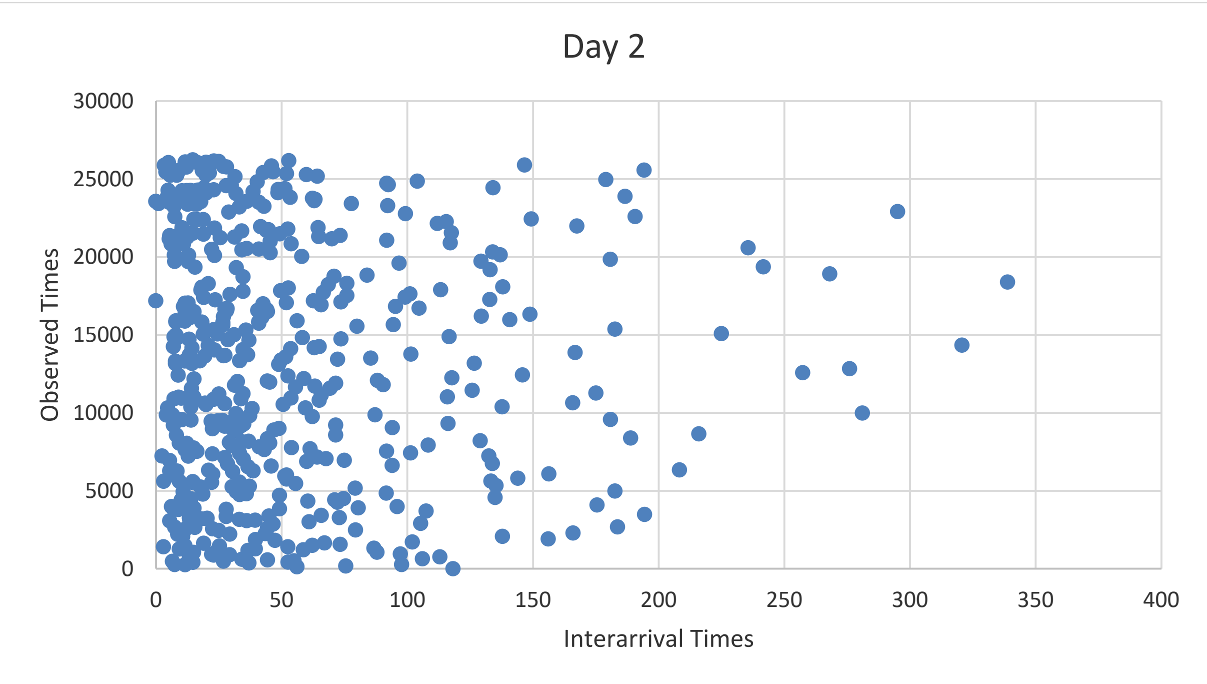


Q-Q plot show us that the data is nearly distributed exponentially.

Question 6 :

We plot the inter-arrival times with respect to observation times.

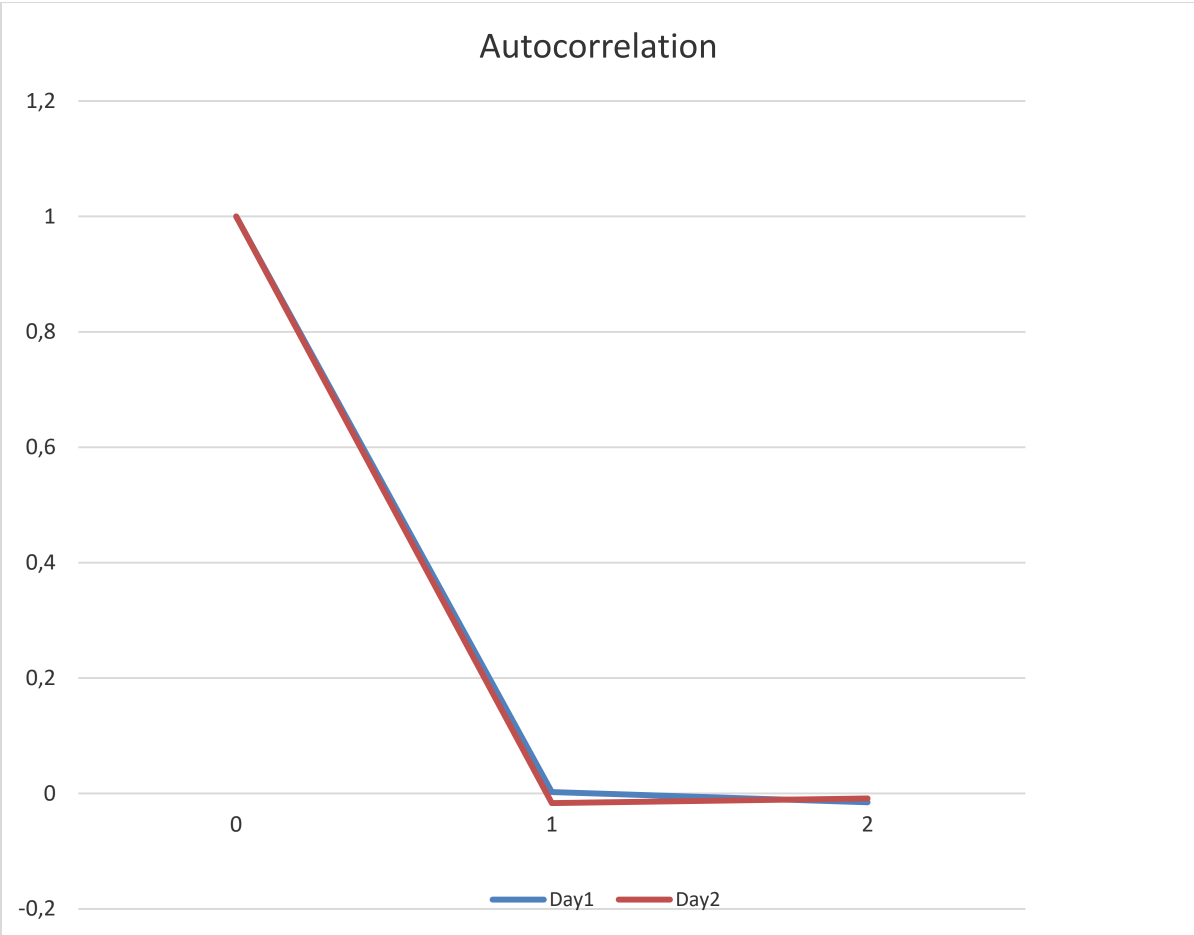




Since all the values are stacked between 0-50 then gradually decreased so we can say that this is exponential distribution.

Question 7 :

	Day 1	Day 2	Lag
Correlation	1	1	0
Correlation	0,002393	-0,01665	1
Correlation	-0,01529	-0,00848	2



When computing autocorrelation, the resulting output can range from 1 to -1, in line with the traditional correlation statistic.

Since all the results are near to zero , we can say that there is no auto-correlation.