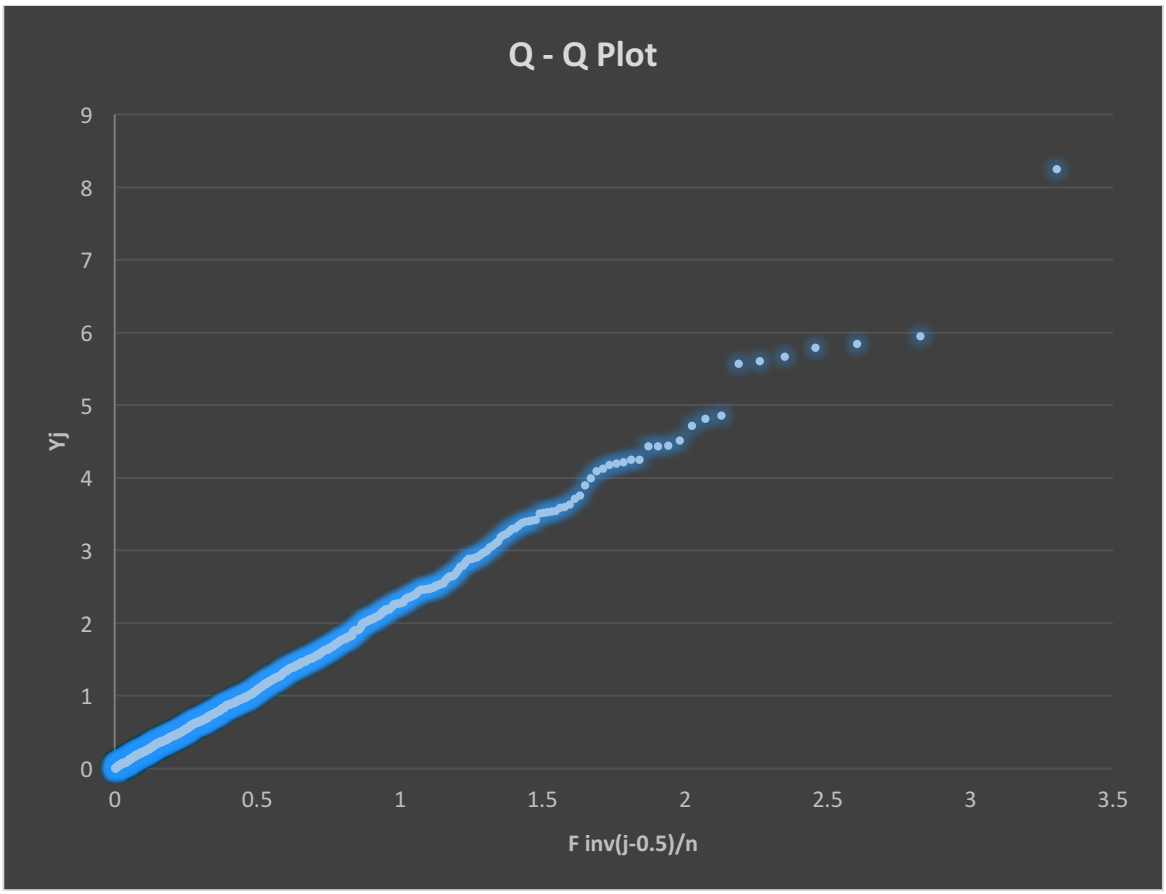
OR 2 Assignment 4

Qn1

a) The Q _ Q plot is given below. The details of calculations and Data are in Excel Submitted along under the Work Sheet Qn1.



The Q-Q Plot is a straight line which shows that the data fits an exponential distribution. The slope is also approximately equal to 1 which proved that the parameters also fits the distribution parameters.

b) Mean and Variance are calculated in the excel Directly from the data.

Mean	0.978580982
Variance	1.009090257

C)

Interval	Px	Oi	Ei = npx	(Oi-Ei)2	(Oi-Ei)2/Ei
0-0.5	0.39346934	414	393.4693403	421.5079882	1.071260058
0.5-1	0.238651219	245	238.6512185	40.30702601	0.168895119
1-1.5	0.144749281	131	144.749281	189.0427286	1.306001158
1.5-2	0.087794877	75	87.79487691	163.7088752	1.86467458
2-2.5	0.053250285	59	53.25028461	33.05922703	0.620827236
2.5-3	0.03229793	27	32.29793026	28.068065	0.869036027
3-3.5	0.019589685	16	19.58968495	12.88583801	0.657786894
3.5-4	0.011881745	12	11.88174453	0.013984355	0.001176961
4-4.5	0.007206642	10	7.20664235	7.802846958	1.082729873
4.5-5.5	0.007022225	11	7.0222251	15.82269316	2.253230697
				Total:	9.895618604

Chi Square Value = 9.85
K-S-1 = Degrees of Freedom = 10 -1 - 1 = 8

Critical Value (alpha = 0.05,8) = 15.5

Since Chi Square Value is less than Critical Value, The hypothesis is not rejected. The generated Values fits the exponential Distribution.

d) Chi Square Value = 9.85
K-S-1 = Degrees of Freedom = 10 -1 - 1 = 8

Critical Value (alpha = 0.10,8) = 13.4.

Even with this low Critical value, the Chi Square test passes since Chi Square value of 9.89541 is less than Critical Value. The Hypothesis is still not rejected and generated data continues to fit the exponential Distribution.

2) A)
Calculation all in attached excel sheet Qn2.

Injuries	**Frequency**
0	35

1	40
2	13
3	6
4	4
5	1
6	1
Mean =	1.13

Chi Square Test below:

Oi	Ei=npx	Oi Grouped	Ei grouped	(Oi-Ei)2 / Ei
35	32.30332564	35	32.30332564	0.225117769
40	36.50275798	40	36.50275798	0.335062402
13	20.62405826	13	20.62405826	2.818371805
6	7.768395277	12	10.55234	0.198602346
4	2.194571666			
1	0.495973196			
1	0.093408285			
			Chi Square Value	3.58
			Degree of Freedom k-s-1	2
			Critical (0.01,2)	9.21

Here is the S = 1, since we calculated the mean from the data before applying the chi square test

Result: Since the Chi Square value is less than Critical Value, Hypothesis is not rejected.

2(B).

Now the mean is provided = 1;

Oi	Ei=npx	Oi Grouped	Ei grouped	(Oi-Ei)2 / Ei

35	36.78794412	35	36.78794412	**0.086896516**
40	36.78794412	40	36.78794412	**0.280453372**
13	18.39397206	13	18.39397206	**1.581764639**
6	6.13132402	12	8.0218	**1.972883298**
4	1.532831005			
1	0.306566201			
1	0.051094367			
			Chi Square Value	3.92
			Degree of Freedom k-s-1	3
			Critical(0.01,2)	11.34

Here S = 0, since mean was provided. Therefore, the degrees of freedom changed to 3. Critical **value was 11.34. The Chi Square value was less than Critical value and therefore Hypothesis was not rejected.**

2(C). In the first case the mean was not provided to us but calculated. So the value of s = 1 and degrees of freedom became 2. The critical value was slightly less as compared to second case where mean was provided. When mean was provided, we took S = 0 and degrees of freedom increased to 3 and therefore critical value increased.

3)

No. of nights	Patrons(Xt)	Xt*Xt+1
1	20	280
2	14	294
3	21	399
4	19	266
5	14	252
6	18	378
7	21	525
8	25	675
9	27	702
10	26	572
11	22	396
12	18	234
13	13	234
14	18	450
15	25	575

16	23	460
17	20	420
18	21	0
		7112

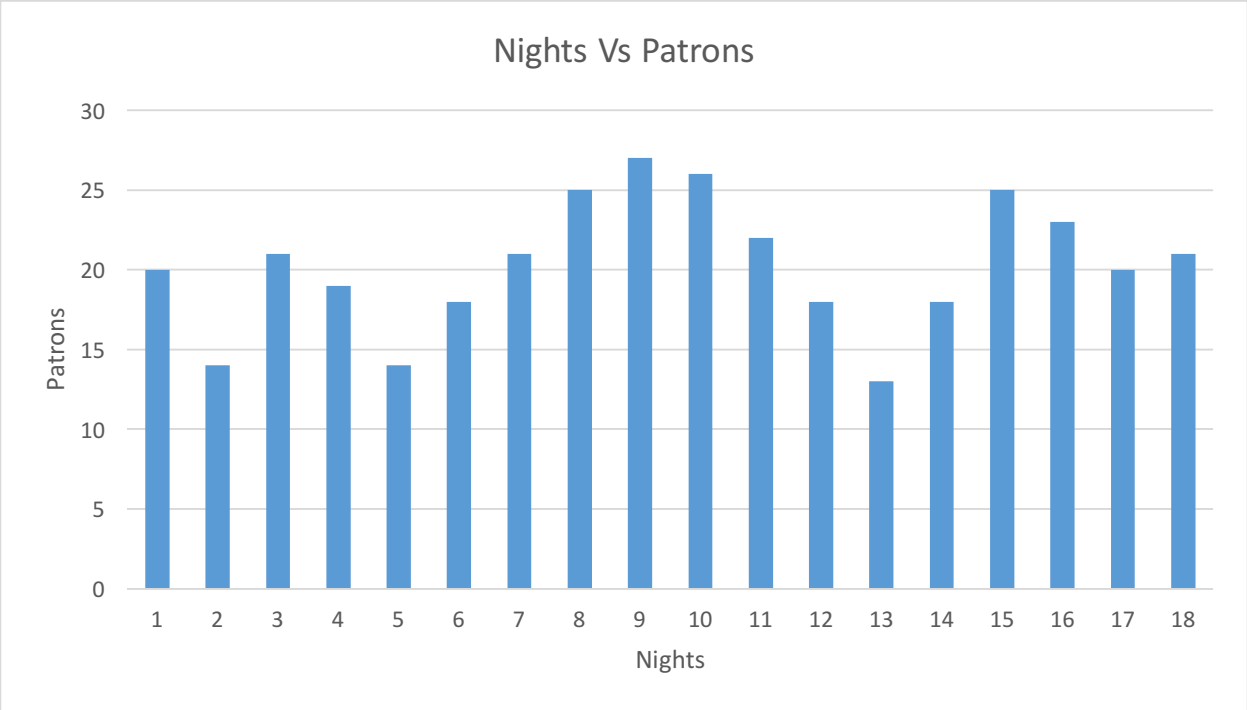
Mean 20.27777778
Variance 16.68300654

Covariance	7.164669572
Correlation	0.429459136

Parameters For AR(1)	
Square of sigma epsilon	13.60607373
Correlation	0.429459136
Mean	20.27777778

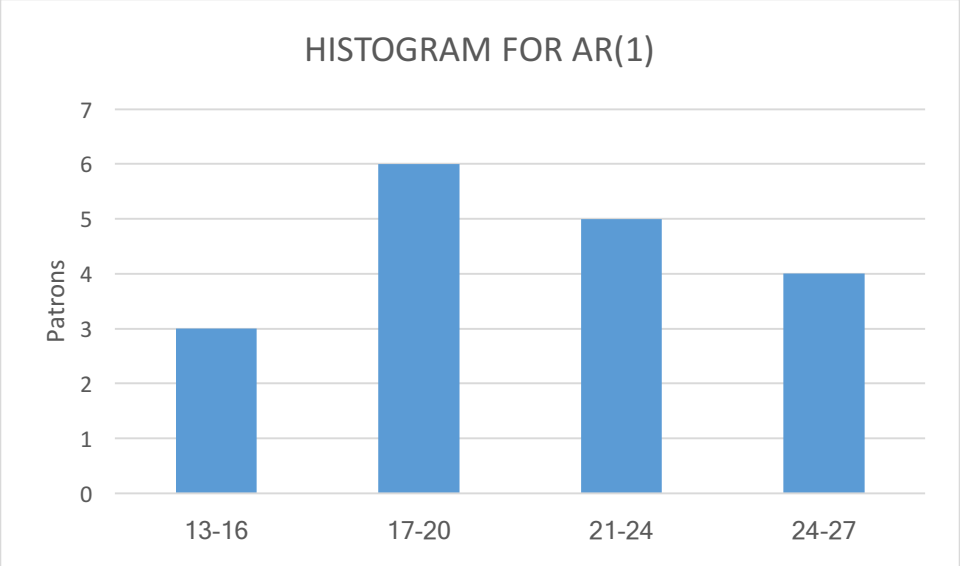
PARAMETERS FOR EAR(1)	
lamda	0.049315068
correlation	0.429459136

The below Plot looks like the data follows a Normal Distribution.



Its better to group the data in order to get a better fit to the Distribution.

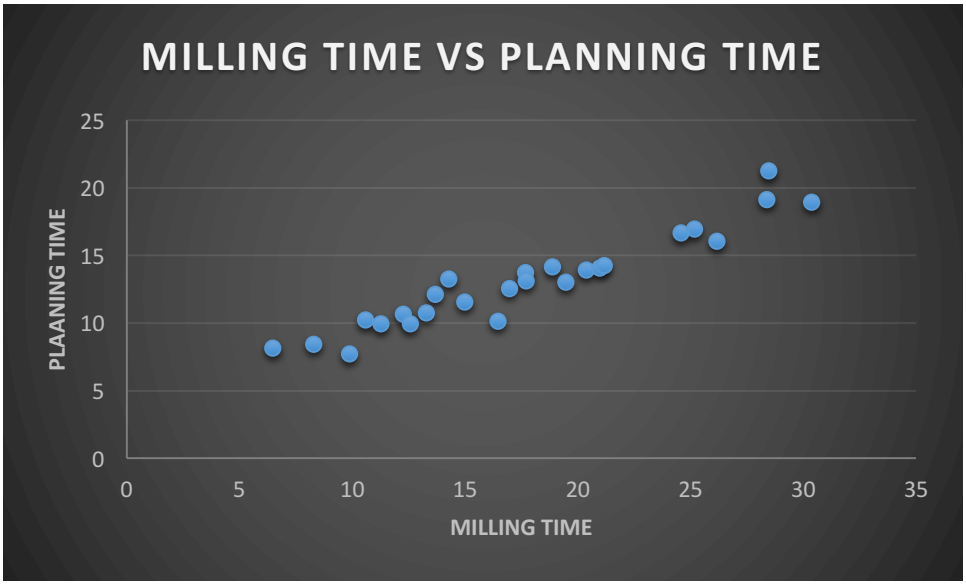
Groups	Frequency
13-16	3
17-20	6
21-24	5
24-27	4



The number of Nights ------ >

Based on the Histogram, we could decide that the AR(1) model is a better fit to the time series as compared to EAR(1).

4. a) The below is the plot between milling time and planning time.



As we can see that, as the milling time increases, the planning time also increases. There is a positive correlation between the Milling time and Panning time.

b) The correlation for the Sample data is below (Used excel for all calculation)- Attached

Covariance	21.93688
Correlation	0.917803779

c) Method to fit bivariate normal distribution

1. Generate Z1 and Z2, two independent standard normal random variables
2. Set X1 = $\mu 1 + \sigma 1 Z1$; Calculated $\mu 1 = 17.732$, $\sigma 1 = 6.711105224$
3. Set X2 = $\mu 2 + \sigma 2 (\rho Z1 + Z2\sqrt{1-\rho^2})$; Calculated $\mu 1 = 13.06$, $\sigma 1 = 3.561483773$
4. Fit X1 and X2 using a plot

Qns5)
SIMULATIONS USING 5000 CUSTOMERS

SIMULATIONS USING 5000 CUSTOMERS				
ARRIVAL TIME	2.5 Mins			
SERVICE TIME	2 MINS			
Simulation #	SEED	Delay		
1	99999	7.870385405		
2	12345	7.443754703		
3	55335	8.066133319		
4	55555	7.788086788		
5	45632	8.050796131		
6	4532	7.786179947		
7	53421	7.525991815		
8	77012	7.786503547		
9	55555	7.788086788		
10	33333	7.923920811		
Mean		7.802983925		
Sigma		0.199051995		
Point Estimator		7.802983925		
T(alpha/2,n-1)		2.26		
INTERVALS	INTERVAL 1	INTERVAL 2		
Confidence Interval	7.945241361	7.66072649		
Prediction Interval	8.231906231	7.37406162		
WORST CASE	3.231906231			
BEST CASE	2.37406162			

b)

Point Estimator		7.802983925
T(alpha/2,n-1)		2.26
INTERVALS	INTERVAL 1	INTERVAL 2
Confidence Interval	7.945241361	7.66072649
Prediction Interval	8.231906231	7.37406162

Given mean = 5, epsilon = 0.5

WORST CASE	2.675365752
BEST CASE	1.069425548

The best case and Worst Case are greater than Epsilon, therefore more simulations are necessary. The simulation is inconsistent with System behavior.

c)

SIMULATIONS USING 50000 CUSTOMERS				
ARRIVAL TIME	2.5 Mins			
SERVICE TIME	2 MINS			
Simulation #	SEED	Delay		
1	99999	6.857295932		
2	12345	7.221703847		
3	55335	7.19912775		
4	55555	6.535368534		
5	45632	7.23503626		
6	4532	6.863939773		
7	53421	6.222085679		
8	77012	7.150780566		
9	55555	7.057166458		
10	33333	6.381451702		
Mean		6.87239565		
Sigma		0.372638118		
Point Estimator		6.87239565		
T(alpha/2,n-1)		2.26		
INTERVALS	INTERVAL 1	INTERVAL 2		
Confidence Interval	7.138710705	6.606080595		
Prediction Interval	7.675365752	6.069425548		
WORST CASE	2.675365752			
BEST CASE	1.069425548			

As we can see that after increasing the number of customers, the Confidence interval has changed. The worst Case and Best case are much better as compared to Simulation with 5000 customers. However, the best case and Worst Case are greater than Epsilon (0.5), therefore more simulations are necessary. The simulation is still inconsistent with System behavior.