OR 2 Assignment 4

Qn1

1. 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.

1. 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 -0 - 1 = 9

Critical Value (alpha = 0.05,9) = 16.9

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 -0 - 1 = 9

Critical Value (alpha = 0.10,9) = 14.7.

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 = μ1 + σ1Z1; Calculated μ1 = 17.732, σ1 = 6.711105224
3. Set X2 = μ2 + σ2 (ρZ1+Z2 ); Calculated μ1 = 13.06, σ1 = 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.**