**Problems based on Input Modelling:**

**1.** The highway between Atlanta, Georgia and Athens, Georgia has high incidence of accidents along its 100 kilometers. Public safety officers say that occurrence of accidents along the highway is randomly (Uniformly) distributed, but the news media say otherwise. The Georgia department of public safety published records for the month of September. These records indicated the point at which 30 accidents involving an injury or death occurred, as follow (the data points representing the distance from the city limits of Atlanta):

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 88.3 | 40.7 | 36.3 | 27.3 | 36.8 |
| 91.7 | 67.3 | 7.0 | 45.2 | 23.3 |
| 98.8 | 90.1 | 17.2 | 23.7 | 97.4 |
| 32.4 | 87.8 | 69.8 | 62.6 | 99.7 |
| 20.6 | 73.1 | 21.6 | 6.0 | 45.3 |
| 76.6 | 73.2 | 27.3 | 87.6 | 87.2 |

Use the Kolmogorov-Smirnov test to discover whether the distribution of location of accidents is uniformly distributed for the month of September.

**2.** The time required for 50 different employees to compute and record the number of hours worked during the week was measured, with the following results in minutes:

|  |  |  |  |
| --- | --- | --- | --- |
| Employee | Time (minutes) | Employee | Time (minutes) |
| 1 | 1.88 | 26 | 0.04 |
| 2 | 0.54 | 27 | 1.49 |
| 3 | 1.90 | 28 | 0.66 |
| 4 | 0.15 | 29 | 2.03 |
| 5 | 0.02 | 30 | 1.00 |
| 6 | 2.81 | 31 | 0.39 |
| 7 | 1.50 | 32 | 0.34 |
| 8 | 0.53 | 33 | 0.01 |
| 9 | 2.62 | 34 | 0.10 |
| 10 | 2.67 | 35 | 1.10 |
| 11 | 3.53 | 36 | 0.24 |
| 12 | 0.53 | 37 | 0.26 |
| 13 | 1.80 | 38 | 0.45 |
| 14 | 0.79 | 39 | 0.17 |
| 15 | 0.21 | 40 | 4.29 |
| 16 | 0.80 | 40 | 0.80 |
| 17 | 0.26 | 42 | 5.50 |
| 18 | 0.63 | 43 | 4.91 |
| 19 | 0.36 | 44 | 0.35 |
| 20 | 2.03 | 45 | 0.36 |
| 21 | 1.42 | 46 | 0.90 |
| 22 | 1.28 | 47 | 1.03 |
| 23 | 0.82 | 48 | 1.73 |
| 24 | 2.16 | 49 | 0.38 |
| 25 | 0.05 | 50 | 0.48 |

Use the chi-square test to test the hypothesis that these service times are exponentially distributed. Let the number of class intervals be k = 6. Use the level of significance α = 0.05.

3. Studentwiser Beer Company is trying to find out the distribution of the breaking strength of their glass bottles. Fifty bottles are selected at random and tested for breaking strength, with the following results (in pounds per square inch):

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 218.95 | 232.75 | 212.80 | 231.10 | 215.95 |
| 237.55 | 235.45 | 228.25 | 218.65 | 212.80 |
| 230.35 | 228.55 | 216.10 | 229.75 | 229.00 |
| 199.75 | 225.10 | 208.15 | 213.85 | 205.45 |
| 219.40 | 208.15 | 198.40 | 238.60 | 219.55 |
| 243.10 | 198.85 | 224.95 | 212.20 | 222.90 |
| 218.80 | 203.35 | 223.45 | 213.40 | 206.05 |
| 229.30 | 239.20 | 201.25 | 216.85 | 207.25 |
| 204.85 | 219.85 | 226.15 | 230.35 | 211.45 |
| 227.95 | 229.30 | 225.25 | 201.25 | 216.10 |

Using input modeling software, apply as many tests for normality as are available in the software. If the chi-square test is available, apply it with at least two different choices for the number of intervals. Do all of the tests reach the same conclusion?

**4.** The Crosstowner was a bus that cut a diagonal path from northeast Atlanta to southwest Atlanta. The time required to complete the route was recorded by the bus operator. The bus runs from Monday through Friday. The times of the last fifty 8:00 A.M. rums, in minutes, are as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 92.3 | 92.8 | 106.8 | 108.9 | 106.6 |
| 115.2 | 94.8 | 106.4 | 110.0 | 90.9 |
| 104.6 | 72.0 | 86.0 | 102.4 | 99.8 |
| 87.5 | 111.4 | 105.9 | 90.7 | 99.2 |
| 97.8 | 88.3 | 97.5 | 97.4 | 93.7 |
| 99.7 | 122.7 | 100.2 | 106.5 | 105.5 |
| 80.7 | 107.9 | 103.2 | 116.4 | 101.7 |
| 84.8 | 101.9 | 99.1 | 102.2 | 102.5 |
| 111.7 | 101.5 | 95.1 | 92.8 | 88.5 |
| 74.4 | 98.9 | 111.9 | 96.5 | 95.9 |

How are these run times distributed? Develop and test a suitable model.

**5.** The time required for the transmission of a message (in minutes) is sampled electronically at a communications center. The last 50 values in the sample are as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 7.936 | 4.612 | 2.407 | 4.278 | 5.132 |
| 4.599 | 5.224 | 2.003 | 1.857 | 2.696 |
| 5.259 | 7.563 | 3.937 | 6.908 | 5.002 |
| 6.212 | 2.759 | 7.172 | 6.513 | 3.326 |
| 8.761 | 4.502 | 6.188 | 2.566 | 5.515 |
| 3.785 | 3.742 | 4.682 | 4.346 | 5.359 |
| 3.535 | 5.061 | 4.629 | 5.298 | 6.492 |
| 3.502 | 4.266 | 3.129 | 1.298 | 3.454 |
| 5.289 | 6.805 | 3.827 | 3.912 | 2.969 |
| 4.646 | 5.963 | 3.829 | 4.404 | 4.924 |

How are the transmission times distributed? Develop and test an appropriate model.

**6.** The time (in minutes) between requests for the hookup of electric service bus was accurately recorded at the Gotwatts Flash and Flicker Company, with the following results for the last fifty requests:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 0.661 | 4.910 | 8.989 | 12.801 | 20.249 |
| 5.124 | 15.033 | 58.091 | 1.543 | 3.624 |
| 13.509 | 5.745 | 0.651 | 0.965 | 62.146 |
| 15.512 | 2.758 | 17.602 | 6.675 | 11.209 |
| 2.731 | 6.892 | 16.713 | 5.692 | 6.636 |
| 2.402 | 2.984 | 10.613 | 3.827 | 10.244 |
| 6.255 | 27.969 | 12.107 | 4.636 | 7.093 |
| 6.892 | 13.243 | 12.711 | 3.411 | 7.897 |
| 12.413 | 2.169 | 0.921 | 1.900 | 0.315 |
| 4.370 | 0.377 | 9.063 | 1.875 | 0.790 |

How are the times between requests for service distributed? Develop and test a suitable model.

**7.** A simulation is to be conducted of a job shop that performs two operations: milling and planing, in that order. It would be possible to collect data about processing times for each operation, then generate random occurrences from each distribution. However, the shop manager says that the times might be related; large milling jobs take lots of planning. Data are collected for the next 25 orders, with the following results in minutes:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Order | Milling Time (Minutes) | Planing Time (Minutes) | Order | Milling Time (Minutes) | Planing Time (Minutes) |
| 1 | 12.3 | 10.6 | 14 | 24.6 | 16.6 |
| 2 | 20.4 | 13.9 | 15 | 28.5 | 21.2 |
| 3 | 18.9 | 14.1 | 16 | 11.3 | 9.9 |
| 4 | 16.5 | 10.1 | 17 | 13.3 | 10.7 |
| 5 | 8.3 | 8.4 | 18 | 21.0 | 14.0 |
| 6 | 6.5 | 8.1 | 19 | 19.5 | 13.0 |
| 7 | 25.2 | 16.9 | 20 | 15.0 | 11.5 |
| 8 | 17.7 | 13.7 | 21 | 12.6 | 9.9 |
| 9 | 10.6 | 10.2 | 22 | 14.3 | 13.2 |
| 10 | 13.7 | 12.1 | 23 | 17.0 | 12.5 |
| 11 | 26.2 | 16.0 | 24 | 21.2 | 14.2 |
| 12 | 30.4 | 18.9 | 25 | 28.4 | 19.1 |
| 13 | 9.9 | 7.7 |  |  |  |

1. Plot milling time on the horizontal axis and planning time on the vertical axis. Do these data seem dependent?
2. Compute the sample correlation between milling time and planning time.
3. Pit a bivariate normal distribution to these data.