Modeling & Simulation

Assignment # 2

Assignment Submission Date: 16th-January-2023

(Assignment should be written on A4 papers)

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1. Patients arrive for a physical examination according to Poisson process at the rate 1 per hour. Treatment for the patient is completed at the rate of 1 per 45 minutes. Compute the average number of delayed patients, for this system if 2 attenders are available.
2. A tool crib with one attendant serves a group of 10 mechanics. Mechanic work for an exponentially distributed amount of time with mean 20 minutes, then go to the crib to request special tool. Service times by attendant are exponentially distributed, with mean 3 minutes. Would it be advisable to have a second attendant, justify by comparing answers?
3. The port of trop can service 3 ships at a time; however there is a mooring space for three more ships. Trop is a favorite port of call but if no mooring space is available the ships have to go to the port of poop. Averages of seven ships arrive each week, according to a poison process. The port of trop has the capacity to handle an average of eight ships a week, with service times exponentially distributed. Determine the operational characteristics; explain the situation of port of trop by analyzing outputs of the operational characteristics.
4. Classic car care has 3 workers who washes car in four steps method – soap, rinse, dry and vacuum. The time to complete each step is exponentially distributed with mean 9 minutes. Every car goes through every step before another car begins the process. On the average, one car every 45 minutes arrives for a wash job, according to a Poisson process. What is the average time a car waits to begin the wash job? What is the average number of cars in the car wash system? What is the average time required to wash a car? (Consider it a simple M/M/c problem)
5. The manager of a computer network has collected data on the number of times that service has been interrupted on each day over the past 500 days. The results are as follows:

|  |  |
| --- | --- |
| Interruptions per day | Number of days |
| 0 | 160 |
| 1 | 175 |
| 2 | 86 |
| 3 | 41 |
| 4 | 18 |
| 5 | 12 |
| 6 | 8 |

Examine the distribution of service interruptions follow a Poisson distribution? (Use the 0.01 level of significance.)

1. Suppose the Penn State student population is 60% female and 40% male. Then, if a sample of 100 students yields 53 females and 47 males, can we conclude that the sample is (random and) representative of the population? That is, how "good" do the data "fit" the assumed probability model of 60% female and 40% male (significance level= 0.05)?
2. The manager of a commercial mortgage department of a large bank has collected data during the past two years concerning the number of commercial mortgages approved per week. The results from these two years (104 weeks) indicated the following:

|  |  |
| --- | --- |
| Number of commercial mortgages approved | Frequency |
| 0 | 13 |
| 1 | 25 |
| 2 | 32 |
| 3 | 17 |
| 4 | 9 |
| 5 | 6 |
| 6 | 1 |
| 7 | 1 |

Does the distribution of commercial mortgages approved per week follow a Poisson distribution? (Use the 0.01 level of significance.)

1. One study of grand juries in Alameda County, California, compared the demographic characteristics of jurors with the general population, to see if jury panels were representative. The results for age are shown below. The investigators wanted to know if the 66 jurors were selected at random from the population of Alameda County. (Only persons over 21 and over are considered; the county age distribution is known from Public Health Department data.) The study was published in the UCLA Law Review.

|  |  |  |
| --- | --- | --- |
| Age | Count-wide % | # of jurors observed |
| 21-40 | 42% | 5 |
| 41-50 | 23% | 9 |
| 51-60 | 16% | 19 |
| over 60 | 19% | 33 |
| Total | 100% | 66 |

Use chi square test to find out whether  For each age group, the proportion of jurors is consistent with the county proportion( significance level = 0.05)

1. 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. Use the chi-square test to test the hypothesis that these service times are exponentially distributed. Six intervals with equal probability of 1/6 are used. Use the level of significance α = 0.05.

|  |  |
| --- | --- |
| Xi | Frequency |
| [0,0.220) | 8 |
| [0.220,0.489) | 11 |
| [0.489,0.836) | 9 |
| [0.836,1.325) | 5 |
| [1.325,2.161) | 10 |
| [2.161, ∞) | 7 |

|  |
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|  |

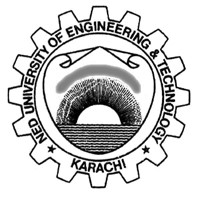
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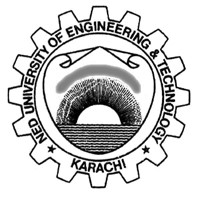
1. Create a petri net from the following metrics, also draw a reachability graph, find out is the petri net bounded and live?

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | E+ = | 1 | 1 | 0 | 0 | 0 | | 0 | 1 | 0 | 1 | 0 | | 0 | 0 | 1 | 0 | 0 | | 0 | 0 | 0 | 0 | 1 | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | E- = | 0 | 0 | 3 | 0 | 1 | | 1 | 0 | 0 | 0 | 0 | | 0 | 1 | 0 | 0 | 0 | | 0 | 0 | 0 | 1 | 0 | | |  |  | | --- | --- | | Mo = | 3 | | 0 | | 0 | | 0 | |

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | E+ = | 1 | 1 | 0 | 0 | | 0 | 0 | 1 | 0 | | 0 | 0 | 0 | 1 | | 0 | 0 | 1 | 0 | | 0 | 0 | 0 | 1 | | |  |  |  |  |  | | --- | --- | --- | --- | --- | | E-= | 0 | 0 | 1 | 0 | | 1 | 0 | 0 | 1 | | 0 | 1 | 0 | 0 | | 0 | 0 | 0 | 1 | | 0 | 0 | 1 | 0 | | |  |  | | --- | --- | | Mo= | 1 | | 0 | | 0 | | 1 | | 1 | |

****F/OBEM 01/18/00

**NED University of Engineering & Technology**

**Department of Software Engineering**

**Course Code & Title: SE-405 Modeling and Simulation**

Assessment Rubric for CEP

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Criterion | Level of Attainment | | | | |
| Below Average  (0) | Average  (0.5) | Good  (1) | Very Good  (1.5) | Excellent  (2) |
| To what level has the student understood the problems? |  |  |  |  |  |
| Has the student is being able to provide correct and complete solutions? |  |  |  |  |  |
| Has the student provided right justification/analysis for solution? |  |  |  |  |  |
| To what extent the work was presentable? |  |  |  |  |  |
| Timely Submission |  |  |  |  |  |

Student’s Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Roll No.: \_\_\_\_\_\_\_\_\_\_\_\_

Total Score = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Instructor’s Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_