Marking Scheme
Modeling and Simulation 750472

BASIC PART:

Objective: This part aims to test the student's skills how to improve random variables.

Q1/ [10 marks]:

Let us define the following random number and the corresponding random variables.

Random number (R)	Random variable= - (1 / 3) *LN(R)
0.1	0.767528
0.23	0.489892
0.61	0.164765
0.32	0.379811
0.46	0.258843
0.567	0.189132
0.29	0.412625
0.83	0.06211
0.44	0.27366
0.16	0.61086

Where

$$R'_i = a + R_i (b - a)$$

$$\omega_i = \frac{\left(\frac{\text{Vol of Layer}}{\text{Total Number of RNs}} . \right)}{b - a}$$

Implement **Layer Technique** to improve random variables.

Ans:

Set layers **(3 marks)**

Layer1: 0<= NRi <0.64 Vol=4
Layer2: 0.64<= NRi <0.96 Vol=4
Layer3: 0.96<= NRi <=1 Vol=2

Table **(5 marks)**

Ri	Xi	NRi	Nxi	Wi	NXXi
0.1	0.767528	0.064	0.916291	0.46875	1.954754
0.23	0.489892	0.1472	0.638654	0.46875	1.362463
0.61	0.164765	0.3904	0.313528	0.46875	0.668859
0.32	0.379811	0.2048	0.528574	0.46875	1.127624
0.46	0.258843	0.7872	0.079758	1.25	0.063806
0.567	0.189132	0.82144	0.065565	1.25	0.052452
0.29	0.412625	0.7328	0.103627	1.25	0.082902
0.83	0.06211	0.9056	0.033053	1.25	0.026442
0.44	0.27366	1.1008	-0.03201	5	-0.0064
0.16	0.61086	1.0112	-0.00371	5	-0.00074
	3.609227				5.332157
mean	0.360923			mean	0.533216
error	2.639077			error	2.466784

Improve by check the error from 2.63 → to 2.466 (2 marks)

FAMILIAR PART:

Objective: The aim of this part is to check student understanding RVs generation under any distribution and how to using simulation method on any network system.

Q2/(10 marks)

The following table shows the distribution of service time for 65 clients arrived to CPU .

Answer the following:

Determine the service times under **Continuous Empirical Distribution** of two clients **C1**, **C2** corresponding to random numbers **r1=0.3** and **r2 = 0.9** respectively.

Ans:

Table: (6 marks)

Service time X	No. of Clients	PDF	CDF=Ri
0 – 25	11	0.169230769	0.169230769
25 - 50	12	0.184615385	0.353846154
50 – 75	9	0.138461538	0.492307692
75 – 100	14	0.215384615	0.707692308
100 – 125	3	0.046153846	0.753846154
125 – 150	1	0.015384615	0.769230769
150 – 175	5	0.076923077	0.846153846
175 – 200	7	0.107692308	0.953846154
200 +	3	0.046153846	1
	65	1	

If R1= 0.3 then Xi=25, Xi+1=50 Yi=0.16923, Yi+1=0.3538

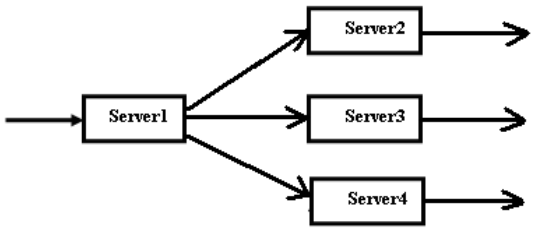
Xj=Xi + (Yj-Yi) * (Xi+1 –Xi)/(Yi+1 – Yi) = 42.79891304 (2 marks)

If R2=0.9 then Xi= 175, Xi+1=200, Yi=0.84, Yi+1=0.95

Xj=Xi + (Yj-Yi) * (Xi+1 –Xi)/(Yi+1 – Yi) = 188.6363636 (2 marks)

Q3(10 marks)

Assume that we have the following system networks.



Perform **Activity scanning** discrete simulation with fix time for delay equal to two time units on **server 1 and 2** while the system implements **next event scheduling** technique on **other servers**. The following timetable has been used to find **total waiting time** and **utilization.**

Ans:

Table: (4 marks)

P#	Int. Arr	Arrival	Service	Dep/S1	Dep/Si	W
1	1	1	2	5	9 / s2	0
2	1	2	3	10	13 / s3	3
3	1	3	2	14	16 / s4	7
4	1	4	3	19	24 / s2	10
5	1	5	1	22	24 / s3	14

Total Waiting Time first layer = 34 **(1 marks)**

Total service time first layer : 11 **(1 marks)**

Utilization first layer: (1 marks)

Where $\mu = \frac{N}{\sum S_i} = \frac{5}{11} = 0.4545$

$\lambda = \frac{N}{T'} = \frac{5}{5} = 1$

$\rho = \frac{\lambda}{\mu} = \frac{1}{0.4545} = 2.2$

Total Waiting Time second layer = 0 **(1 marks)**

Total service time first layer : 10 **(1 marks)**

Utilization first layer: (1 marks)

Where $\mu = \frac{N}{\sum S_i} = \frac{5}{10} = 0.5$

$\lambda = \frac{N}{T'} = \frac{5}{4} = 1.25$

$\rho = \frac{\lambda}{\mu} = \frac{1}{0.4545} = 2.2$

UNFAMILIAR PART:

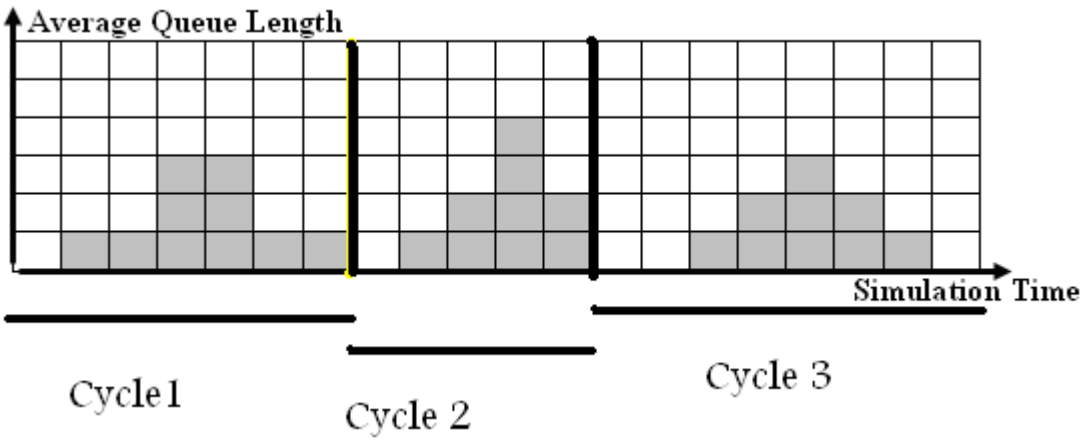
***Objective*:** The aim of this part is to test student's capabilities to gather the observations by using a suitable approach.

Q4/(10 marks)

We have 3 procedures for gathering observations; show the main features of **cycle-procedure** and implement this **procedure** on the following time analysis:

Ans:

Find cycle (2 marks)



Where the experimental observation is **μ=0.5** and the student t-distribution is equal to **t_α=0.367.** Where the error is computed according to $\bar{X} \pm t_\alpha \frac{S}{\sqrt{n}}$

Table: (5 marks)

i	Zi	ti	yi
1	1	7	0.131579297
2	1	5	0.202995111
3	2	7	0.298259854
	1.3333	6.3333	0.210944754
			0.083624157
		error P	0.228663672
		error N	0.193225837

Testing (3 marks)

Then the inequality $0.1932 < 0.21 < 0.228$ is satisfied.