Simulation **University of the Ryukyus**
3-rd and 4-th Year Undergraduate **Faculty of Engineering**
Mid-Term Examination **Department of Information Eng.**
2014-12-5 time: 90 minutes (score: as written) Prof. Mohammad Reza Asharif

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1- In M/M/1 queue with single-server: ***(10)***

a) What are events?

b) What are state variables?

A(a) : *Events:*

***1* - The arrival time of customer.**

***2* - The departure time of customer after being served.**

A(b) : *State variables*

***1* - The status of the server: idle, busy.**

***2* - The number of customers waiting in queue.**

***3* - The time of arrival of each customers waiting in queue.**

2- Define the Monte Carlo simulation. ***(10)***

A: A simulation methodology which employs random numbers, U(0,1), for solving certain stochastic or deterministic problems is called Monte Carlo simulation.

3- What is iconic model? ***(10)***

A: A physical model which represents actual system is called iconic model.
EX: a cockpit disconnected from airplane.

4- In which simulation model, a) time is considered? b) random numbers are used? ***(10)***

A: *a)* Dynamic model.
***b)* Stochastic model**

5- Explain simulation clock and two approaches for the simulation clock advancing. ***(10)***

A: A variable or a mechanism that keeps track of the current time in a simulation, is called simulation clock.

***1* - Next-event time advance.**

***2* - Fixed-increment time advance.**

6- Classify simulation models into three different dimensions. ***(10)***

A : *1* - Static vs. dynamic simulation models.

***2* - Deterministic vs. stochastic simulation models.**

***3* - Continuous vs. discrete simulation models.**

7-Find the value of the following integral by using the Monte-Carlo method (use 6 points). ***(15)***

$$I = \int_1^e \sin[\pi \log_e(x)]dx = \int_1^e g(x)dx$$

a) Use the following uniform distributed random number U(0,1):

U_i = 0.742, 0.514, 0.631, 0.818, 0.364, 0.257

b) Find $1 < x_i < e$ ***from:*** $x_i=(e-1)u_i+1$, $e = 2.72$

c) Find $\log_e(x_i)$

d) Then find $g(x_i) = \sin[\pi / \log_e(x_i)]$, ***and fill the following table:***

i	1	2	3	4	5	6
x_i	2.28	1.88	2.08	2.4	1.63	1.44
$\log_e(x_i)$	0.82	0.63	0.73	0.88	0.49	0.37
$g(x_i)$	0.52	0.92	0.75	0.38	1.0	0.91

Using Monte-Carlo with 6 points: I=1.28

Use the following equation:

$$I=(b-a)(\Sigma_{i=1}^{6} g(xi))/6$$

$$I=(e-1)(0.52+0.92+0.75+0.38+1.0+0.91)/6$$

$$I=(1.72)(4.48)/6 = 7.7/6=1.28$$

8-In the following single server queuing MM1 system, find: ***(15)***

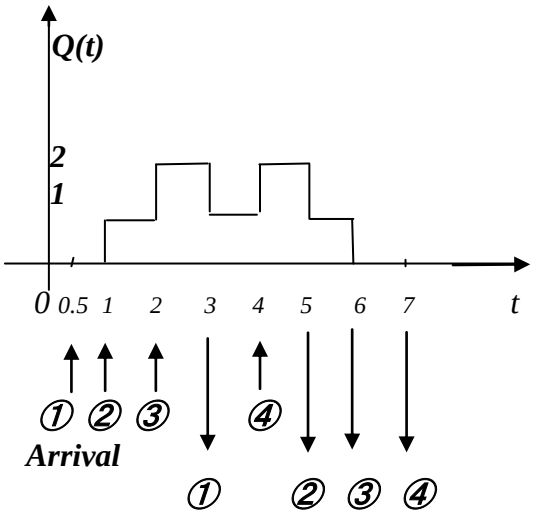
a) Average delay in queue (d(n): ADQ).

b) Average number of customers in the queue (q(n): ANCQ).

c) Efficiency of utilization of the server (u(n): %).

(↑ i means i th arrival *and* ↓ i means i th departure)

(n=4, T(n)=7)



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2014/11/28

a)

D1=0,

D2=3-1=2,

D3=5-2=3,

D4=6-4=2,

d(n)= $\Sigma_{i=1}^{4}$ Di/n=(0+2+3+2)/4 =7/4 = 1.75 ADQ (time)

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b)

T0=1+(7-6) = 1+1 = 2

T1= (2-1)+(4-3)+(6-5) = 1+1+1 = 3

T2=(3-2)+(5-4) = 1+1 = 2

q(n)= $\Sigma_{i=0}^{\infty}$ i Ti/T(n)= (0x2+1x3+2x2)/7=(3+4)/7

q(n) =7/7= 1 ANCQ (men)

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c) u(n)= $\Sigma_{i=0}^{7}$ B(t)

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u(n)=(7-0.5)/7

u(n)= 6.5/7= 0.93

u(n)=93% server utility (busy)%
