Simulation **University of the Ryukyus**
3-rd and 4-th Year Undergraduate **Faculty of Engineering**
Mid-Term Examination **Department of Information Eng.**
2015-11-27 time: 90 minutes (score: as written) Prof. Mohammad Reza Asharif

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1- What is the Monte Carlo simulation. (10)

A simulation methodology which employs random numbers, U(0,1), for solving certain stochastic or deterministic problems

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

1 - Static vs. dynamic simulation models.
2 - Deterministic vs. stochastic simulation models.
3 - Continuous vs. discrete simulation models.

3- Explain about kind of problems that exist with simulation method? (10)

1 - complexity of writing computer programs.
2 - Large amount of computer time.
3 - Not considering of all aspects of real model.

4- What is state of a system? Give an example. (10)

State of a system is the collection of variables necessary to describe a system at a particular time. EX: In bank system : The number of busy tellers, the number of customers in the bank, the time of arrival of each customer in the bank.

5- Write the differential equations for predator-prey problem. (10)

$$\frac{dx}{dt} = rx(t) - ax(t)y(t)$$

$$\frac{dy}{dt} = -sy(t) + bx(t)y(t)$$

6- Name two approaches for the simulation clock advancing. (10)

1 - Next-event time advance.
2 - Fixed-increment time advance.

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

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

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

$U_i =$ 0.09, 0.16, 0.48, 0.84 0.65, 0.79

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 $g(x_i) = \cos[\pi \log_e(x_i)]$***, and fill the following table:***

i	1	2	3	4	5	6
x_i	1.15	1.28	1.83	2.44	2.12	2.36
$\log_e(x_i)$	0.14	0.25	0.60	0.89	0.75	0.86
$g(x_i)$	0.9	0.71	-0.31	-0.94	-0.71	-0.9

Using Monte-Carlo with 6 points: I=0.36

Use the following equation:

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

I=-(e-1)(0.9+0.71- 0.31- 0.94- 0.71- 0.9)/6

I=-(1.72)(-1.25)/6 = 2.15/6= 0.36

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

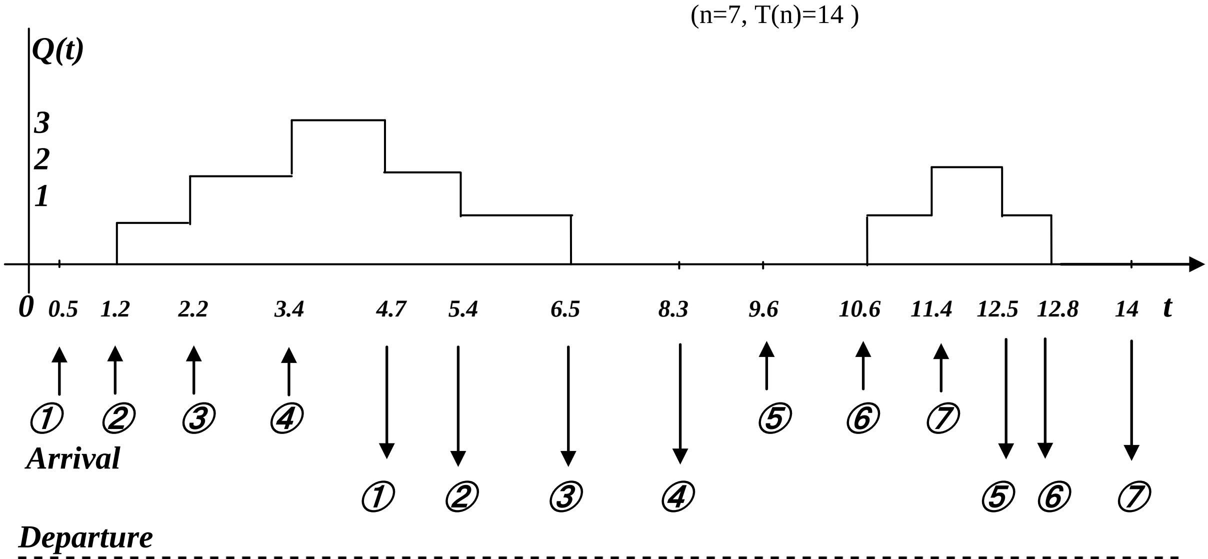
a) Average delay in queue (d(n): ADQ).

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=7, T(n)=14)



a)

D1=0, D2=4.7-1.2=3.5, D3=5.4.-2.2=3.2, D4=6.5-3.4=3.1, D5=0, D6= 12.5-10.6=1.9, D7=12.8-11.4=1.4

d(n)= Σi=1 to n Di/n=(0+3.5+3.2+3.1+0+1.9+1.4)/7=13.1/7=1.87 ADQ (time)

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b)

T0=1.2+(10.6-6.5)+(14-12.8)=1.2+4.1+1.2=6.5
T1=(2.2-1.2)+(6.5-5.4)+(11.4-10.6)+(12.8-12.5)=1+1.1+0.8+0.3=3.2
T2=(3.4-2.2)+(5.4-4.7)+(12.5-11.4)=1.2+0.7+1.1=3
T3=(4.7-3.4)=1.3

q(n)= Σi=0 to ∞ i Ti/T(n)= (0x6.5+1x3.2+2x3+3x1.3)/14=(3.2+6+3.9)/14=
q(n) =13.1/14=0.94 ANCQ (men)

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c) u(n)= Σt=0 to 14 B(t)

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u(n)=[(8.3-0.5)+(14-9.6)]/14=(7.8+4.4)/14=12.2/14=0.87=87% server utility (busy)%
