Simulation **University of the Ryukyus**
3-rd and 4-th Year Undergraduate **Faculty of Engineering**
Mid-Term Examination **Department of Information Eng.**
2012-11-29 time: 90 minutes (score: as written) Prof. Mohammad Reza Asharif

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1-What is system? ***(10)***

A : The facility or process of interest is usually called a system.

2- In the pilot training system, what is iconic model? ***(10)***

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

3- What is simulation clock? Name 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.**

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

A :
1 **- Complexity of writing computer programs.**
2 **- Large amount of computer time.**
3 **- Not considering of all aspects of real model.**

5- What is 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.

6- In a post-office 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) : *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.**

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

$$I = \int_0^1 [\sin(x)]\log_e(1+x)dx = \int_0^1 g(x)dx$$

a) Use the following uniform distributed random number U(0,1) for, x_i:
U=0.327, 0.104, 0.436, 0.645, 0.785, 0.044

b) Find $\sin(x_i)$, where x_i's are in Radiant.

c) Then find $g(x_i) = [\sin(x_i)]\ \log_e(1+ x_i)$, and fill the following table:

i	*1*	*2*	*3*	*4*	*5*	*6*
$\sin(x_i)$	*032*	*0.1*	*0.422*	*0.6*	*0.706*	*0.04*
$g(x_i)$	*0.09*	*0.009*	*0.152*	*0.298*	*0.409*	*0.0017*

Using Monte-Carlo with 6 points: I=0.16

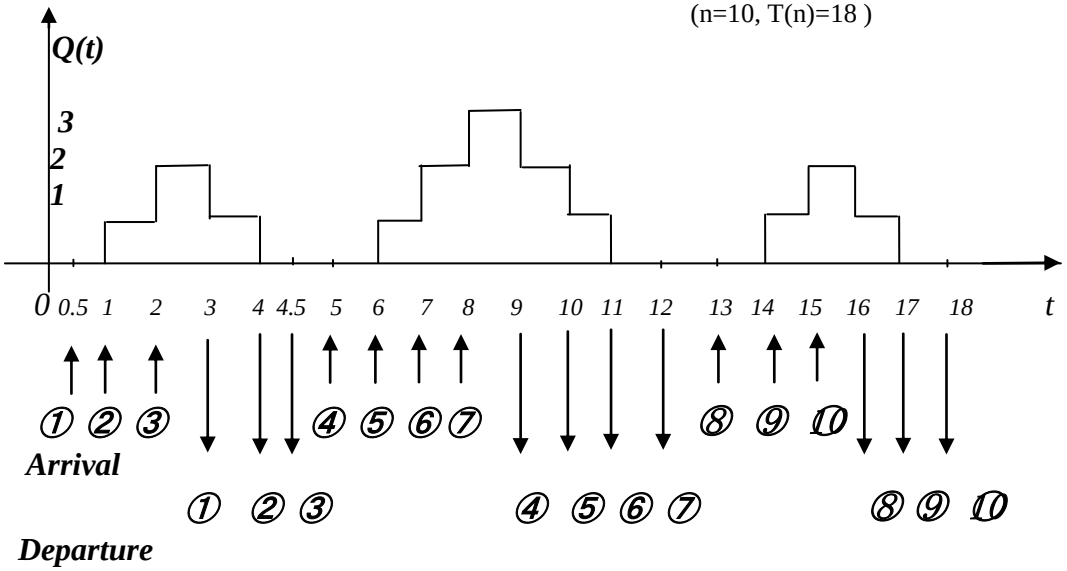
$I=(b-a)(\ \Sigma_{i=1}^{6}\ g(xi)\ )/6$

$I= (0.09+0.009+0.152+ 0.298+ 0.409+ 0.0017)/6$

$I=(0.9597)/6 = 0.16$

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=10, T(n)=18)



a)

D1=0,

D2=3-1=2,

D3=4-2=2,

D4=0,

D5=9-6=3,

D6= 10-7=3,

D7=11-8=3,

D8=0,

D9=16-14=2,

D10=17-15=2,

d(n)= $\Sigma_{i=}^{10}{}_{1}$ Di/n=(0+2+2+0+3+3+3+0+2+2)/10 =17/10 = 1.7 ADQ (time)

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b)

T0=1+(6-4)+(14-11)+(18-17) = 1+2+3+1 = 7

T1= (2-1)+(4-3)+(7-6)+(11-10)+(15-14)+(17-16) = 1+1+1+1+1+1 = 6

T2=(3-2)+(8-7)+(10-9)+(16-15) = 1+1+1+1 = 4

T3=(9-8)=1

q(n)= $\Sigma_{i=}^{\infty}{}_{0}$ i Ti/T(n)= (0x7+1x6+2x4+3x1)/18=(6+8+3)/18

q(n) =17/18= 0.94 ANCQ (men)

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c) u(n)= $\Sigma_{i=}^{18}{}_{0}$ B(t)

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u(n)=[(4.5-0.5)+(12-5)+(18-13)]/18

u(n)=(4+7+5)/18=16/18=0.89

u(n)=89% server utility (busy)%
