Simulation **University of the Ryukyus**
3-rd and 4-th Year Undergraduate **Faculty of Engineering**
Mid-Term Examination **Department of Information Eng.**
2012-12-7 time: 90 minutes (score: as written) **Prof. Mohammad Reza Asharif**

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

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

2- What is simulation clock? Name two approaches for the simulation clock advancing. ***(10)***

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.

3- What are the events in a single server model? ***(10)***

Events:

1 - The arrival time of customer.
2 - The departure time of customer after being served.

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

a) Dynamic model.
b) Stochastic model

5- In a single teller Bank, what are "state variables" of the system? ***(10)***

State of a system is the collection of variables necessary to describe a system at a particular time.

EX: In bank system :

The status of the teller (server); 1- idle, 2-busy
The number of customers in the bank, waiting in queue.
The time of arrival of each customer in the bank.

6- What is the Monte Carlo simulation?

A simulation methodology which employs uniform random numbers, *U(0,1),* for solving certain stochastic or deterministic problems. ***(10)***

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

$$I = \int_0^{\pi} e^{(\sin x)} dx$$

a) Generate U(0,1)by computer or any means (if you cannot use the following RNG):
U=0.393 0.746 0.166 0.220 0.503 0.827

b) Use the relation: X= π. U to map from U(0,1) into X(0, π), then find sin(xi).

c) Then use $g(x_i)= e^{(\sin xi)}$ to find $g(x_i)$ and fill the following table:

Table 1

i	*1*	*2*	*3*	*4*	*5*	*6*
sin(x_i)	***0.944***	***0.716***	***0.498***	***0.637***	***1.0***	***0.517***
g(x_i)	**2.570**	**2.046**	**1.645**	**1.891**	**2.718**	**1.677**

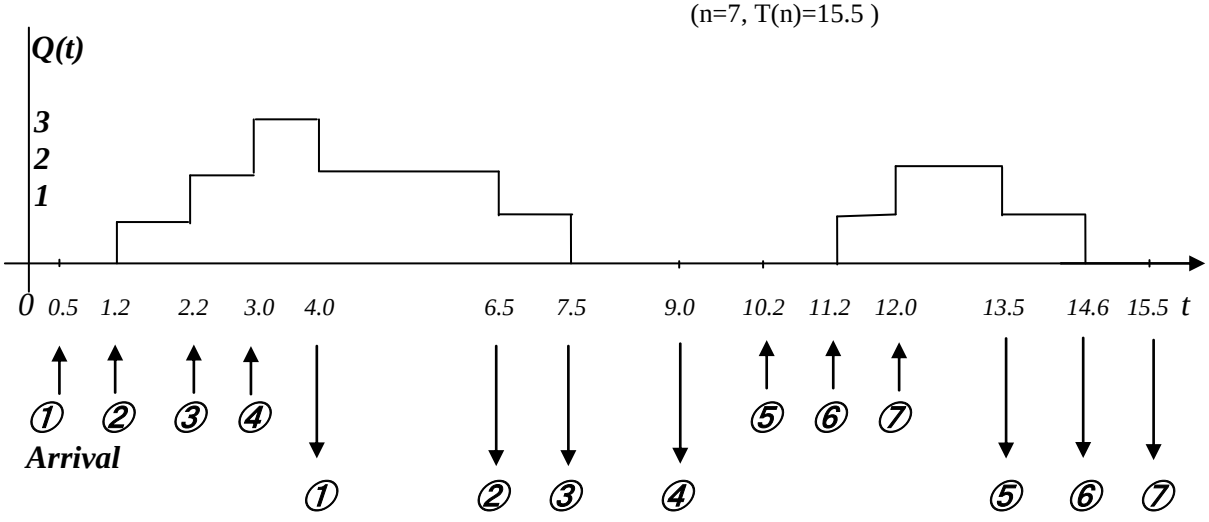
Using Monte-Carlo with 6 points: I= 6.57

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

$I=\pi (12.547)/6 = 6.57$

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)=15.5)



a)

D1=0,

D2=4.0-1.2=2.8,

D3=6.5.-2.2=4.3,

D4=7.5-3.0=4.5,

D5=0,

D6= 13.5-11.2=2.3,

D7=14.6-12.0=2.6

d(n)= Σi=1 to n Di/n=(0+2.8+4.3+4.5+0+2.3+2.6)/7

d(n)=16.5/7=2.35 ADQ (time)

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b)

T0=1.2+(11.2-7.5)+(15.5-14.6)=1.2+3.7+0.9=5.8

T1=(2.2-1.2)+(7.5-6.5)+(12.0-11.2)+(14.6-13.5)=1+1+0.8+1.1=3.9

T2=(3.0-2.2)+(6.5-4.0)+(13.5-12.0)=0.8+2.5+1.5=4.8

T3=(4.0-3.0)=1.0

q(n)= Σi=0 to ∞ i Ti/T(n)= (0x5.8+1x3.9+2x4.8+3x1.0)/15.5=(3.9+9.6+3.0)/15.5=

q(n) =16.5/15.5= 1.064 ANCQ (men)

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c) u(n)= Σt=0 to 15.5 B(t)

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u(n)=[(9.0-0.5)+(15.5-10.2)]/15.5

u(n)=(8.5+5.3)/1.5=13.8/15.5=0.89

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