Simulation (Solutions) University of the Ryukyus
3-rd and 4-th Year Undergraduate Faculty of Engineering
Mid-Term Examination Department of Information Eng.
2010-11-26 time: 90 minutes (score: each 10) Prof. Mohammad Reza Asharif

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1- What is a system?

A1 : The facility or process of interest is usually called a system.

2-What is an iconic model?

A2 : A physical model which represents actual system is called iconic model. EX: a cockpit disconnected from airplane.

3-In a single server, what are the "state variables"?

A3 :

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.

4- What are the "events" in a single server model?

A4 : Events:

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

5- What is the simulation clock?

A5 : A variable or a mechanism that keeps track of the current time in a simulation, is called simulation clock.

6- Which models use random number? A) Deterministic B) Stochastic

A6 : B) Stochastic model

7- Name two approaches for the simulation clock advancing.

A7 :

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

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

$$I = \int_0^{2\pi} e^{(\sin x)} dx$$

a) Generate U(0,1)by computer or any means (if you cannot use the following RNG):
U=0.480 0.615 0.352 0.730 0.189 0.281
b) Use the relation: X=(2 Π)U to map from U(0,1) into X(0, 2 Π)
c) Then use $g(x_i)= e^{(\sin xi)}$ to find $g(x_i)$ and fill the following table:

Table 1

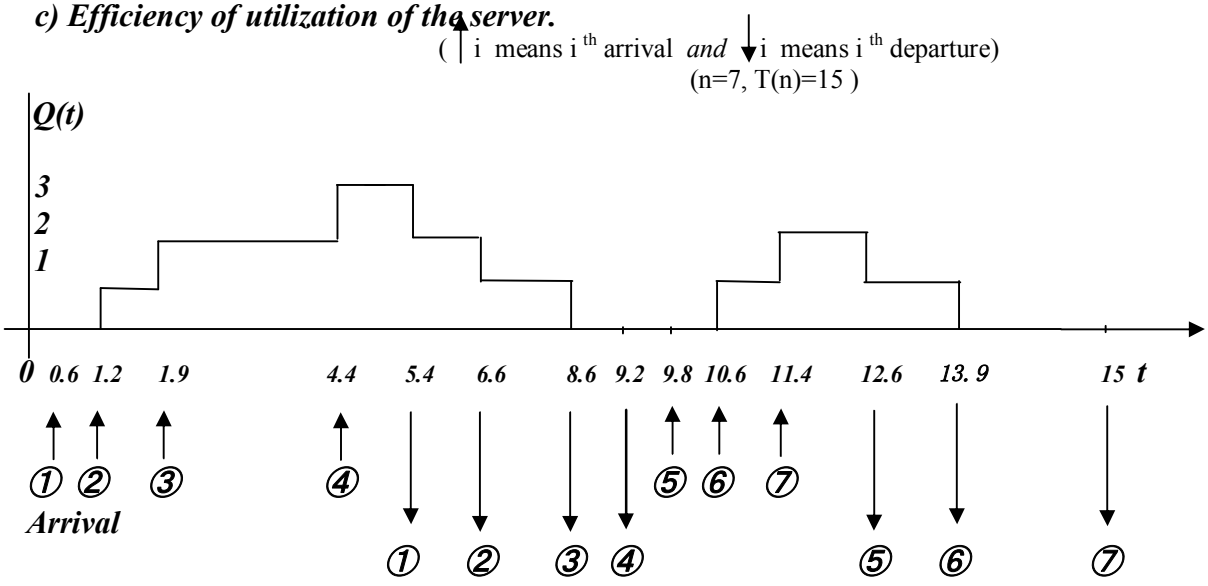
i	*1*	*2*	*3*	*4*	*5*	*6*
x_i	**3.015**	*3.864*	**2.211**	**4.586**	**1.187**	**1.765**
$g(x_i)$	**1.133**	**0.516**	**2.23**	**0.371**	**2.528**	**2.667**

Using Monte-Carlo with 6 points: I=9.89

I=2pai(9.445)/6=9.89

I=(b-a)(Σ i=1 to 6 g(xi))/6

9-In the following single server queuing MM1 system, find:
a) Average delay in queue.
b) Average number of customers in the queue.
c) Efficiency of utilization of the server.



a)

D1=0, D2=5.4-1.2=4.2, D3=6.6-1.9=4.7, D4=8.6-4.4=4.2, D5=0, D6= 12.6-10.6=2, D7=13.9-11.4=2.5
d(n)= Σ i=1 to n Di/n=(0+4.2+4.7+4.2+2+2.5)/7=17.6/7=2.51 ADQ (time)

b)

T0=1.2+(10.6-8.6)+(15-13.9)=1.2+2+1.1=4.3
T1=(1.9-1.2)+(8.6-6.6)+(11.4-10.6)+(13.9-12.6)=0.7+2+0.8+1.3=4.8
T2=(4.4-1.9)+(6.6-5.4)+(12.6-11.4)=2.5+1.2+1.2=4.9
T3=(5.4-4.4)=1
q(n)= Σ i=0 to ∞ i Ti/T(n)= (0x4.3+1x4.8+2x4.9+3x1)/15=(4.8+9.8+3)/15=
q(n) =17.6/15=1.17 ANCQ (men)

c) u(n)= Σ t=0 to 15 B(t)

u(n)=[(9.2-0.6)+(15-9.8)]/15=(8.6+5.2)/15=13.8/15=0.92=92% server utility (busy)%