Mid → Masud sir part - chap - 1

*Define the following terminologies : i) System ii) Model iii) Simulation iv) Analytical solution.

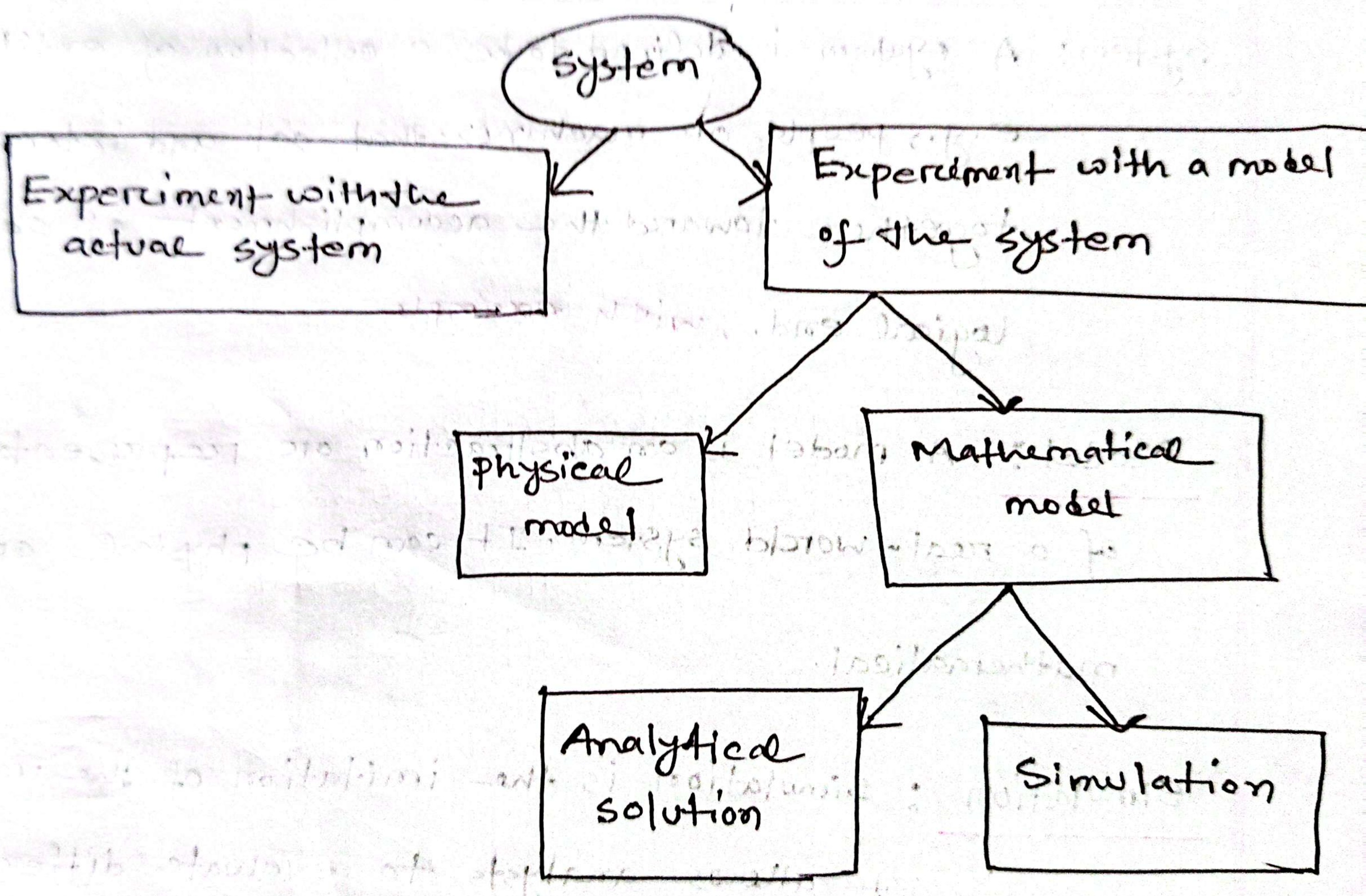
System: A system is defined to be a collection of entities, e.g., people or machines, that act and interact together toward the accomplishment of some logical end. , with example

Model : A model is an abstraction or representation of a real-world system. It can be physical or mathematical.

Simulation : Simulation is the imitation of the reality. It allows analysts to evaluate different scenarios without affecting the actual system.

Analytical solution : An analytical solution is a mathematical expression that provides an exact answer to a problem.

* Demonstrate different ways in which system might be studied.



* Distinguish analytical solution versus simulation.

Analytical solution	Simulation
1) Deriving exact mathematical solution.	1) Deriving numerically approximate solution.
2) Used algebraic manipulation method.	2) Computer based modeling method.
3) Results are closed form equation.	3) Results are numerical values or graph.
4) suitable for simple system.	4) suitable for complex system.

* What are the steps of simulation for a single-server system?

a) Problem statement

b) Intuitive Explanation

c) Program Organization and Logic

d) C program

e) Simulation Output and Discussion

f) Alternative stopping rules

G) Determining the Events and Variables.

* Describe the problem statement and intuitive explanation of a single-server queueing system.

* Difference between Monte-carlo and stochastic simulation

Monte-carlo	Stochastic
1) It is a computational technique used to estimate the behavior of a system by generating a large number of random samples.	1) It refers to any simulation that incorporate, randomness or uncertainty into the model.
2) Here we create a model of the system and then simulate it many times.	2) In stochastic simulation, the system is modeled as a stochastic process.
3) Are commonly used in finance, risk analysis and engineering.	3) Are commonly used in epidemiology, and environmental modeling.

* Discuss about the component used in next event time advance approach.

There are several components are used in next event time advance approach these are;

1. Simulation clock.
2. Event list
3. Event Routine
4. State variable.
5. Statistical counter
6. Initialization Routine
7. Termination condition
8. Output Routine
9. Random number generator.

Next event time advance mechanisms —

t_i = time of arrival of the i_{th} customer ($t_0 = 0$)

$A_i = t_i - t_{i-1}$ = Interarrival time.

S_i = time that server actually spends serving i_{th} customer.

D_i = Delay in queue of i_{th} customer

C_i = ~~Delay in queue o~~ $t_i + D_i + S_i$

e_i = time of occurance.

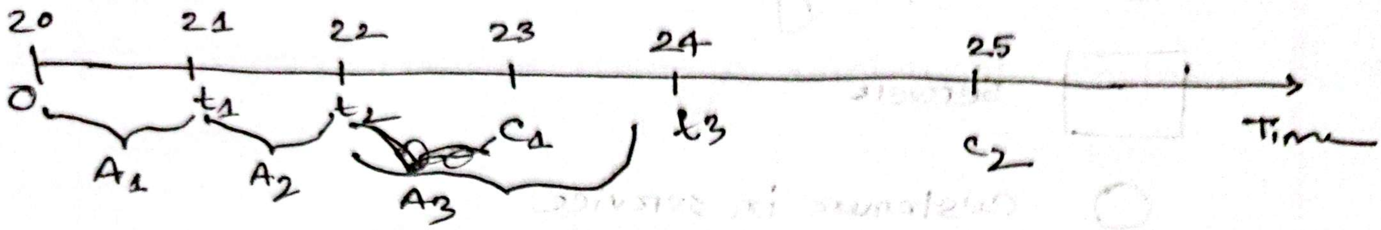
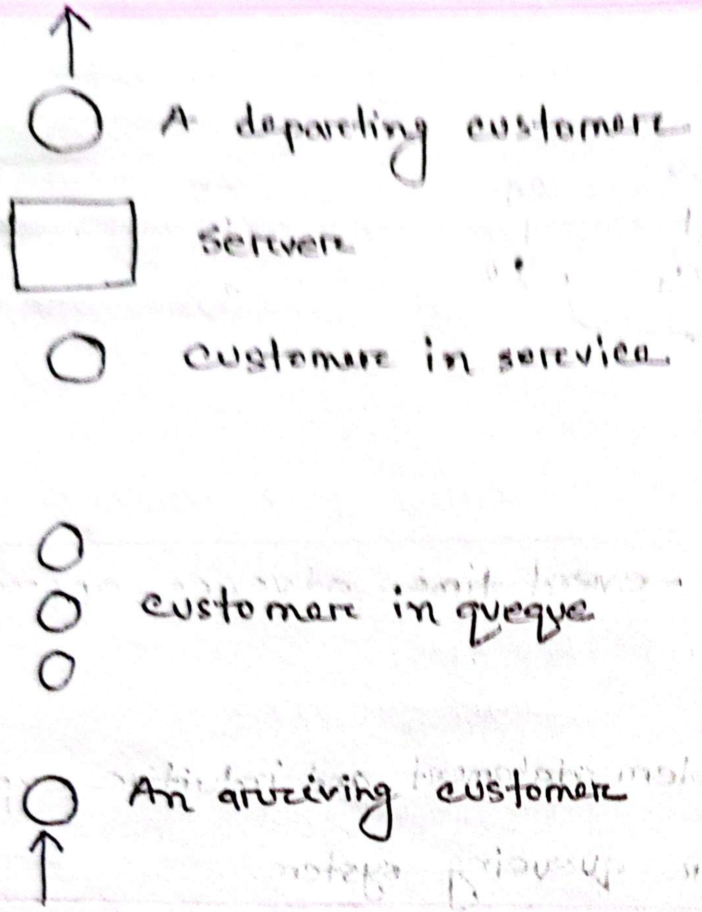


Figure: The next-event time advance approach.

* Describe the problem statement and intuitive explanation of a single-server queueing system.

* consider a single-server queuing, there are several IID random variables interarrival, service times, and customer delays. Describe the problem statement of the single-server queuing system.



A customer who arrives and finds the server idle enters service immediately, and the service times $S_1, S_2, \ldots$ of the successive customer are IID random variables that are independent of the interarrival times.

⇒ Performance measure

1) Expected average delay : For a single run simulation resulting in customer delays $D_1, D_2 \cdots D_n$ an obvious estimator of $d(n)$ is;

$$\hat{d}(n) = \frac{\sum_{i=1}^{n} D_i}{n}$$

2) ~~Average~~ Expected average number of customer in the queue :

$P_i \Rightarrow$ This is the portion of time during the simulation when there are exactly i customer in the queue.

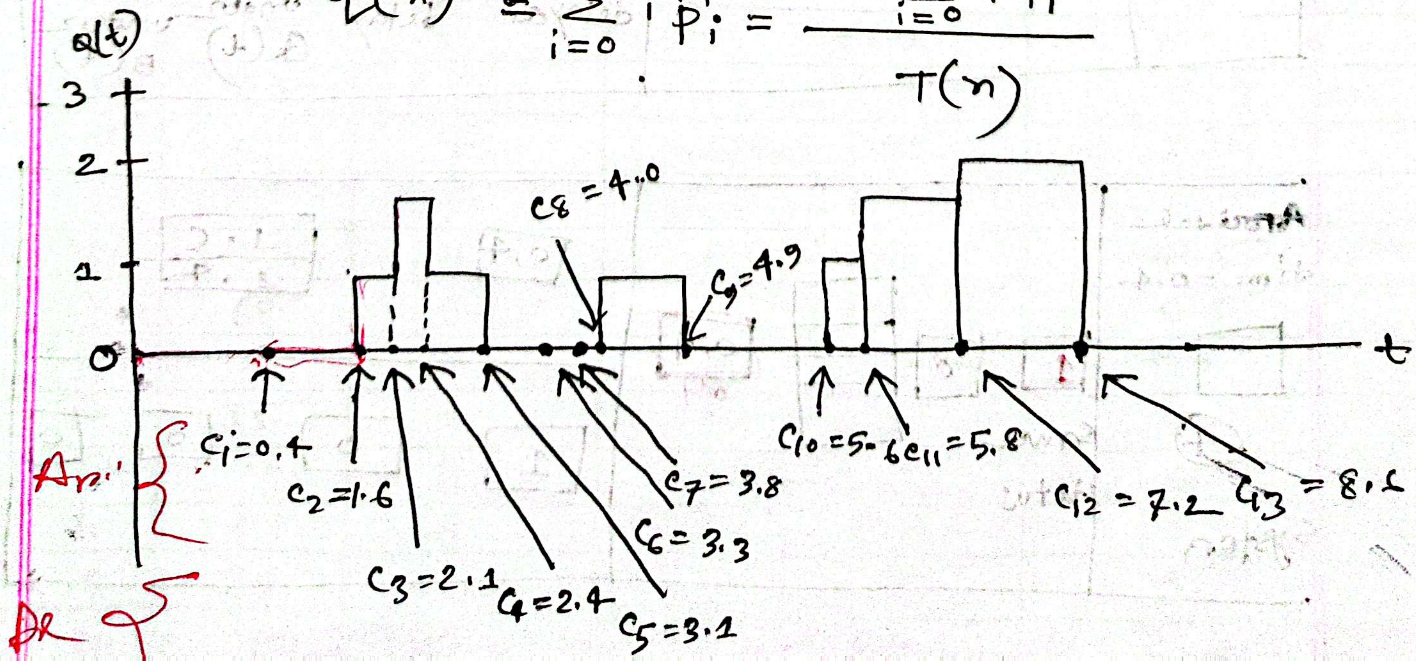
$T_i \Rightarrow$ This is the total time of the queue ~~exactly~~ is of length, i

$T(n) \Rightarrow$ Total simulation time

$$P_i = \frac{T_i}{T(n)}$$

Average number of customer in the queue

$$\hat{q}(n) = \sum_{i=0}^{\infty} i \hat{P}_i = \frac{\sum_{i=0}^{\infty} i T_i}{T(n)}$$



$$\hat{u}(n) = \frac{(3.3-0.4)+(8.6-3.8)}{8.6} = \frac{7.7}{8.6} = 0.90$$

This indicating that the server was busy about 90 percent of the time during simulation.

Intuitive Explanation

Given Interval time

$A_1 = 0.4,\ A_2 = 1.2,\ A_3 = 0.5, \ldots$

Service time,

$S_1 = 2,\ S_2 = 0.7\ \ S_3 = 0.2, \ldots$