Event-based Simulation

This type of simulation is <u>not</u> time-stepped; simulation time can be continuous real variable rather than integer.

Three basic elements:

(1) Simulation Time — sometimes simulators call this the simulation <u>clock</u>

(2) Simulated Objects — the simulation state is partitioned into objects

(3) Event List — a list of "events" to be simulated

EXAMPLE: airplanes arriving and departing by a schedule

Usually, each item in the event list has this format:

simulation time	Object / method handling the event

↑ scheduled sim time to execute this event.

The simulation cycle:

1. Find event e in event list with minimum sim time
2. Remove e from event list
3. Assign simClock = e.simTime
4. Invoke e.handler (call the object method associated with this event)

Simulator Logic

```
while eventList not empty:
        simulateCycle()
```

Does this mean we need to initialize the simulation with a list of all the events it will simulate?

No!

How Recurring events can be simulated

- Start with one initial event (t_0, X) where t_0 is scheduled simtime, X is object to "fire" at simtime t_0
- when simulator invokes X.fire(), the fire() method of X adds a new event (t_1, X) to the event list, where $t_1 > t_0$

Note: the fire() method could do many other things — schedule more events, print values, change values (of simulation state), etc.

EXAMPLE :

Simulate customers arriving and getting service from an ATM machine.

We'll simulate using a statistical model approach (easier than recording real persons visiting a real ATM).

What is a realistic statistical model of customer arrival ?

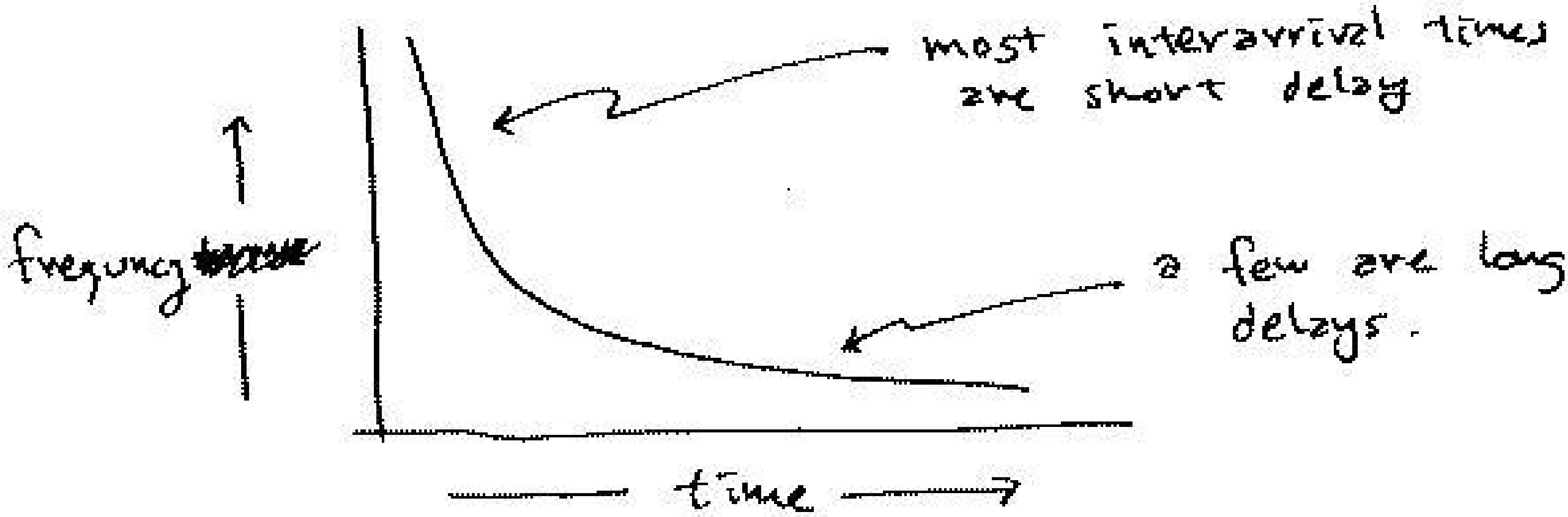
Suppose we measure the amount of time <u>between</u> one customer arriving and the next one arriving.

$t_1 \quad t_2 \quad t_3\, t_4\, t_5 \quad t_6 \quad t_7 \quad \cdots$

t_i = time when customer i arrives

$t_i - t_{i-1}$ = "inter arrival" time, e.g., the delay between arrival of customer_i and customer_{i-1}

Measurements of real systems suggest that interarrival times have this kind of distribution pattern



This distribution is the exponential distribution $\lambda e^{-\lambda t}$ = Probability (delay is t)

To <u>simulate</u> this pattern, we use a "biased" random choice of interarrival time, where the "bias" matches up with the exponential distribution.

Idea: in the simulation, the event of one customer arriving schedules the next arrival to be after a randomly chosen delay.