**Important**: These questions do not completely cover all the material you will be responsible for on the exam

1. At time 20.0 the value of a (time-varying) state variable *X* is 4, and its time-varying average is 9.2. At time 25.0 *X* undergoes a state transition from 4 to 3, and has no other state transitions in between. What is the new value of the time-varying mean of *X* at time 25.0? Show your work.
2. Suppose the state variable *X* in the previous question represents the number in a system. Does Little’s formula hold for *X* at time 25.0? Justify your answer.
3. The Event List for a Multiple Server Queue is in the following state just after an event has just been processed (The Event Graph model for a Multiple Server Queue is shown on the following page):

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Current  Time** | **Current Event** | **Q** | **S** | **Event List** | |
| *????* | ????? | 1 | 2 | 3.5 | StartService |
|  |  |  |  | 7.1 | Arrival |
|  |  |  |  | 8.0 | EndService |
|  |  |  |  | 8.5 | EndService |

For each of the following questions, please circle the number for the *one* answer that best answers the question. Be sure that your answer is *clearly* indicated.

1. What is the current value of simTime?
2. 3.5
3. 7.1
4. 8.0
5. 8.5
6. It cannot be determined from the information given.
7. What event has just been processed by the Event List?
8. Run
9. StartService
10. EndService
11. Arrival
12. It cannot be determined from the information given.
13. What will be the next event to occur (i.e. be processed by the Event List)?
14. Run
15. StartService
16. EndService
17. Arrival
18. It cannot be determined from the information given
19. What will be the second event to occur?
20. Run
21. StartService
22. EndService
23. Arrival
24. It cannot be determined from the information given
25. How many total servers are in this system (i.e. what is the value of *k*)?
26. 1
27. 2
28. 3
29. More than 3
30. It cannot be determined from the information given

# Multiple Server Queue Event Graph



1. A facility carries a certain part in inventory. Customers arrive at random intervals to purchase one of these items. If the facility is out of the item, then it is “backordered.” When the inventory “position” (including items on order) reaches a certain level (call it *r*), an order is placed for a quantity (call it *Q*), which takes a random amount of time to arrive.

Formulate an Event Graph model for this situation. Be sure to carefully define your parameters and state variables. *Hint*: define a state variable for the “net on-hand” inventory, which is positive if there are items in stock and negative if there are backorders.

1. The Event Graph components below[[1]](#footnote-1) were designed in order to “drive” a multiple server queue component with an Arrival Process by adapting the Arrival event in the Arrival Process to the JoinQueue(c) event in the Server Component. However, when it was implemented and ran, no events in the Server Component were ever executed.
2. Why not?
3. Modify the ArivalProcess component so that the JoinQueue event will occur in the Server Component, and show the listeners. Assume that the argument (c) of the JoinQueue event is an Entity. Show the diagram that will make this.



1. The Server Component in question neglected to count the number of customers that had completed processing. Write a separate Event Graph component that will count the number of customers that complete processing and show how it would be connected to the Server Component in order to carry that out. (Assume that the dilemma of part b has been solved.)
2. Write the Simkit code for the following Event Graph:

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | **Type** | **State Variables** | **Type** |
| {t1} | RandomVariate | numFlips (0) | int |
| {t2} | RandomVariate | numFlops (0) | int |

**Event Graph**



1. The state transitions for the events are not shown in the figures. [↑](#footnote-ref-1)