**3) Problem and Model**

**3.1) Problem Description**

We have a problem such that there are people with a determined population, like an isolated village in Japan, in which people are continuously getting sick and healing back, and a person can get sick as soon as she feels good. There is a hospital with fixed number of beds. People got sick chooses whether they want to go to the hospital or not. The probability of a person’s choosing to go to the hospital is 0.2. Probability of choosing to heal in home is 1-0.2 = 0.8.  
If all the beds in the hospital are in use, the sick person is sent to his home and he is expected to heal in his home. These people get healed a little slower than the ones in the hospital. People who choose to heal in home are also get healed a little slower than the others.

**3.2) Model**

We try and create discrete event simulation with exponential arrival and departure rates. There are three different departure rates for the people who get sick. Our system(hospital) has fixed number of servers(beds and homes), which have three different service rate.  
  
They are: ceiling(1453/24) = 61 beds and 1453 homes.   
  
beds service rate is 1/6 days-1, chosen home service rate is 1/10 days-1, and obligatory home service rate is 1/6\*r days-1.  
r is a real number uniformly distributed between [1,2] (U[1,2]).   
  
Our arrival rate (people getting sick) is 1453/300 patients/day.

In other words, λ = N/300[patients/day], (µ1)-1 = 6[days], (µ1)-1 = 10[days], and (µ3)-1 = (µ1)-1\*r.

Our simulation model is subject to the fix arrival rate model, that is, it does not represent a simulation of a realistic pandemic, in which our arrival rate would be variable with respect to current sick and healthy people amount.   
Our model takes advantage of memoryless property of exponentially distributed arrival rate, as it creates a person and makes him sick immediately, then determines his decision of place to heal with probability using a random number generator. Then, it determines his healing time(service time) according to his decision and the service rate of his decision, using a random.expovariate with the related service rate. Thus, his healing time is determined as soon as he created, in other words, he gets sick. After this the simulation determines an interarrival time according to our arrival rate, using a random.expovariate. Thus, the next person’s arrival time(getting sick time) is determined.  
-This way of thinking lacks the requirements of the pandemic simulation and differential equations to calculate them.-  
 After getting sick, a person get healed and a departure event occurs. Our model do not record a person’s past data related to his sickness time. But it records every single arrival and departure events time as a timestamp to be used in calculating model responses. They are:  
Our model also records interarrival times (as tuples of arrival and departure times) of current number of full beds in a list so that it will be used in calculating model responses. (bed\_list)  
Our model also records every sick persons service time in a list (service\_times)  
Our model also records number of sick people in the system at the moment of an event occurs (num\_of\_sick)  
Our model also records number of used beds in the system at the moment of an event occurs. It also determines index of <bed\_list> list variable. (num\_of\_used\_beds)

**Part 4) Numerical Analysis**

Empty beds at start:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Event\_No | Sick\_No | Simulation\_Time | Num\_of\_Sick | Beds\_Full | Treatment\_Way | Event\_Type |
| 1 | P1 | 0.321766 | 1 | 0 | 2 | A |
| 2 | P2 | 0.49003 | 2 | 1 | 1 | A |
| 3 | P3 | 0.627744 | 3 | 1 | 2 | A |
| 4 | P4 | 0.77467 | 4 | 2 | 1 | A |
| 5 | P5 | 1.24933 | 5 | 2 | 2 | A |
| 6 | P6 | 1.32991 | 6 | 2 | 2 | A |
| 7 | P7 | 1.64325 | 7 | 2 | 2 | A |
| 8 | P8 | 1.91233 | 8 | 2 | 2 | A |
| 9 | P2 | 1.98468 | 7 | 1 | 1 | D |
| 10 | P9 | 2.14992 | 8 | 1 | 2 | A |
| 11 | P10 | 2.1704 | 9 | 1 | 2 | A |
| 12 | P11 | 2.35443 | 10 | 1 | 2 | A |
| 13 | P12 | 2.62299 | 11 | 1 | 2 | A |
| 14 | P13 | 2.76844 | 12 | 1 | 2 | A |
| 15 | P14 | 2.79634 | 13 | 1 | 2 | A |
| 16 | P15 | 2.9724 | 14 | 1 | 2 | A |
| 17 | P16 | 3.06722 | 15 | 1 | 2 | A |
| 18 | P17 | 3.11166 | 16 | 1 | 2 | A |
| 19 | P18 | 3.29814 | 17 | 1 | 2 | A |
| 20 | P19 | 3.39188 | 18 | 1 | 2 | A |
| 21 | P20 | 3.71386 | 19 | 1 | 2 | A |
| 22 | P6 | 3.75079 | 18 | 1 | 2 | D |
| 23 | P11 | 3.92109 | 17 | 1 | 2 | D |
| 24 | P21 | 4.08976 | 18 | 1 | 2 | A |
| 25 | P22 | 4.17272 | 19 | 1 | 2 | A |
| 26 | P23 | 4.18468 | 20 | 1 | 2 | A |
| 27 | P5 | 4.27202 | 19 | 1 | 2 | D |
| 28 | P24 | 4.44442 | 20 | 1 | 2 | A |
| 29 | P25 | 4.72829 | 21 | 1 | 2 | A |
| 30 | P21 | 4.74129 | 20 | 1 | 2 | D |
| 31 | P26 | 5.30165 | 21 | 1 | 2 | A |
| 32 | P27 | 5.31075 | 22 | 1 | 2 | A |
| 33 | P28 | 5.51794 | 23 | 1 | 2 | A |
| 34 | P29 | 5.55627 | 24 | 1 | 2 | A |
| 35 | P30 | 5.57275 | 25 | 1 | 2 | A |
| 36 | P31 | 5.63227 | 26 | 1 | 2 | A |
| 37 | P32 | 5.67749 | 27 | 1 | 2 | A |
| 38 | P33 | 5.67869 | 28 | 1 | 2 | A |
| 39 | P32 | 5.74014 | 27 | 1 | 2 | D |
| 40 | P14 | 5.78889 | 26 | 1 | 2 | D |
| 41 | P12 | 5.91983 | 25 | 1 | 2 | D |
| 42 | P34 | 5.93585 | 26 | 1 | 2 | A |
| 43 | P35 | 5.98566 | 27 | 1 | 2 | A |
| 44 | P36 | 6.44219 | 28 | 1 | 2 | A |
| 45 | P37 | 6.89141 | 29 | 1 | 2 | A |
| 46 | P4 | 7.3759 | 28 | 0 | 1 | D |
| 47 | P38 | 7.46509 | 29 | 0 | 2 | A |
| 48 | P39 | 7.5957 | 30 | 0 | 2 | A |
| 49 | P1 | 7.73544 | 29 | 0 | 2 | D |
| 50 | P40 | 8.04827 | 30 | 0 | 2 | A |

Half full beds at start:

Note that first 31 of them are arrivals at time 0 in order to simulate half full beds at the beginning and there are the next 50 events afterwards. You can see that their treatment way is 1 so they are in the hospital. As this is Markovian, memoryless property allows us to do this.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Event\_No | Sick\_No | Simulation\_Time | Num\_of\_Sick | Beds\_Full | Treatment\_Way | Event\_Type |
| 1 | P1 | 0 | 1 | 1 | 1 | A |
| 2 | P2 | 0 | 2 | 2 | 1 | A |
| 3 | P3 | 0 | 3 | 3 | 1 | A |
| 4 | P4 | 0 | 4 | 4 | 1 | A |
| 5 | P5 | 0 | 5 | 5 | 1 | A |
| 6 | P6 | 0 | 6 | 6 | 1 | A |
| 7 | P7 | 0 | 7 | 7 | 1 | A |
| 8 | P8 | 0 | 8 | 8 | 1 | A |
| 9 | P9 | 0 | 9 | 9 | 1 | A |
| 10 | P10 | 0 | 10 | 10 | 1 | A |
| 11 | P11 | 0 | 11 | 11 | 1 | A |
| 12 | P12 | 0 | 12 | 12 | 1 | A |
| 13 | P13 | 0 | 13 | 13 | 1 | A |
| 14 | P14 | 0 | 14 | 14 | 1 | A |
| 15 | P15 | 0 | 15 | 15 | 1 | A |
| 16 | P16 | 0 | 16 | 16 | 1 | A |
| 17 | P17 | 0 | 17 | 17 | 1 | A |
| 18 | P18 | 0 | 18 | 18 | 1 | A |
| 19 | P19 | 0 | 19 | 19 | 1 | A |
| 20 | P20 | 0 | 20 | 20 | 1 | A |
| 21 | P21 | 0 | 21 | 21 | 1 | A |
| 22 | P22 | 0 | 22 | 22 | 1 | A |
| 23 | P23 | 0 | 23 | 23 | 1 | A |
| 24 | P24 | 0 | 24 | 24 | 1 | A |
| 25 | P25 | 0 | 25 | 25 | 1 | A |
| 26 | P26 | 0 | 26 | 26 | 1 | A |
| 27 | P27 | 0 | 27 | 27 | 1 | A |
| 28 | P28 | 0 | 28 | 28 | 1 | A |
| 29 | P29 | 0 | 29 | 29 | 1 | A |
| 30 | P30 | 0 | 30 | 30 | 1 | A |
| 31 | P31 | 0 | 31 | 31 | 1 | A |
| 32 | P28 | 0.0158383 | 30 | 30 | 1 | D |
| 33 | P30 | 0.296412 | 29 | 29 | 1 | D |
| 34 | P23 | 0.472603 | 28 | 28 | 1 | D |
| 35 | P21 | 0.550606 | 27 | 27 | 1 | D |
| 36 | P11 | 0.560035 | 26 | 26 | 1 | D |
| 37 | P4 | 0.94051 | 25 | 25 | 1 | D |
| 38 | P32 | 1.02674 | 26 | 25 | 2 | A |
| 39 | P33 | 1.19161 | 27 | 26 | 1 | A |
| 40 | P25 | 1.19595 | 26 | 25 | 1 | D |
| 41 | P24 | 1.21534 | 25 | 24 | 1 | D |
| 42 | P9 | 1.24251 | 24 | 23 | 1 | D |
| 43 | P22 | 1.25914 | 23 | 22 | 1 | D |
| 44 | P34 | 1.37542 | 24 | 22 | 2 | A |
| 45 | P35 | 1.55883 | 25 | 22 | 2 | A |
| 46 | P36 | 1.76072 | 26 | 22 | 2 | A |
| 47 | P33 | 1.9673 | 25 | 21 | 1 | D |
| 48 | P37 | 1.99674 | 26 | 21 | 2 | A |
| 49 | P38 | 2.05636 | 27 | 21 | 2 | A |
| 50 | P12 | 2.06165 | 26 | 20 | 1 | D |
| 51 | P39 | 2.17102 | 27 | 21 | 1 | A |
| 52 | P34 | 2.43059 | 26 | 21 | 2 | D |
| 53 | P40 | 2.57582 | 27 | 21 | 2 | A |
| 54 | P32 | 2.66775 | 26 | 21 | 2 | D |
| 55 | P17 | 3.13884 | 25 | 20 | 1 | D |
| 56 | P41 | 3.14992 | 26 | 20 | 2 | A |
| 57 | P42 | 3.15699 | 27 | 20 | 2 | A |
| 58 | P43 | 3.26417 | 28 | 20 | 2 | A |
| 59 | P26 | 3.38481 | 27 | 19 | 1 | D |
| 60 | P44 | 3.39208 | 28 | 19 | 2 | A |
| 61 | P18 | 3.48845 | 27 | 18 | 1 | D |
| 62 | P45 | 3.53232 | 28 | 18 | 2 | A |
| 63 | P5 | 3.74638 | 27 | 17 | 1 | D |
| 64 | P8 | 4.01551 | 26 | 16 | 1 | D |
| 65 | P1 | 4.0185 | 25 | 15 | 1 | D |
| 66 | P45 | 4.16977 | 24 | 15 | 2 | D |
| 67 | P46 | 4.23554 | 25 | 15 | 2 | A |
| 68 | P36 | 4.28421 | 24 | 15 | 2 | D |
| 69 | P47 | 4.4452 | 25 | 15 | 2 | A |
| 70 | P48 | 4.54478 | 26 | 15 | 2 | A |
| 71 | P40 | 4.69244 | 25 | 15 | 2 | D |
| 72 | P49 | 4.78013 | 26 | 15 | 2 | A |
| 73 | P50 | 5.03974 | 27 | 15 | 2 | A |
| 74 | P51 | 5.0954 | 28 | 16 | 1 | A |
| 75 | P52 | 5.1818 | 29 | 16 | 2 | A |
| 76 | P43 | 5.18985 | 28 | 16 | 2 | D |
| 77 | P53 | 5.35332 | 29 | 17 | 1 | A |
| 78 | P27 | 5.35424 | 28 | 16 | 1 | D |
| 79 | P54 | 5.84752 | 29 | 16 | 2 | A |
| 80 | P55 | 6.02236 | 30 | 16 | 2 | A |
| 81 | P54 | 6.18853 | 29 | 16 | 2 | D |

Beds are full at start:

Note that first 61 of them are arrivals at time 0 in order to simulate half full beds at the beginning and there are the next 50 events afterwards. You can see that their treatment way is 1 so they are in the hospital. As this is Markovian, memoryless property allows us to do this.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Event\_No | Sick\_No | Simulation\_Time | Num\_of\_Sick | Beds\_Full | Treatment\_Way | Event\_Type |
| 1 | P1 | 0 | 1 | 1 | 1 | A |
| 2 | P2 | 0 | 2 | 2 | 1 | A |
| 3 | P3 | 0 | 3 | 3 | 1 | A |
| 4 | P4 | 0 | 4 | 4 | 1 | A |
| 5 | P5 | 0 | 5 | 5 | 1 | A |
| 6 | P6 | 0 | 6 | 6 | 1 | A |
| 7 | P7 | 0 | 7 | 7 | 1 | A |
| 8 | P8 | 0 | 8 | 8 | 1 | A |
| 9 | P9 | 0 | 9 | 9 | 1 | A |
| 10 | P10 | 0 | 10 | 10 | 1 | A |
| 11 | P11 | 0 | 11 | 11 | 1 | A |
| 12 | P12 | 0 | 12 | 12 | 1 | A |
| 13 | P13 | 0 | 13 | 13 | 1 | A |
| 14 | P14 | 0 | 14 | 14 | 1 | A |
| 15 | P15 | 0 | 15 | 15 | 1 | A |
| 16 | P16 | 0 | 16 | 16 | 1 | A |
| 17 | P17 | 0 | 17 | 17 | 1 | A |
| 18 | P18 | 0 | 18 | 18 | 1 | A |
| 19 | P19 | 0 | 19 | 19 | 1 | A |
| 20 | P20 | 0 | 20 | 20 | 1 | A |
| 21 | P21 | 0 | 21 | 21 | 1 | A |
| 22 | P22 | 0 | 22 | 22 | 1 | A |
| 23 | P23 | 0 | 23 | 23 | 1 | A |
| 24 | P24 | 0 | 24 | 24 | 1 | A |
| 25 | P25 | 0 | 25 | 25 | 1 | A |
| 26 | P26 | 0 | 26 | 26 | 1 | A |
| 27 | P27 | 0 | 27 | 27 | 1 | A |
| 28 | P28 | 0 | 28 | 28 | 1 | A |
| 29 | P29 | 0 | 29 | 29 | 1 | A |
| 30 | P30 | 0 | 30 | 30 | 1 | A |
| 31 | P31 | 0 | 31 | 31 | 1 | A |
| 32 | P32 | 0 | 32 | 32 | 1 | A |
| 33 | P33 | 0 | 33 | 33 | 1 | A |
| 34 | P34 | 0 | 34 | 34 | 1 | A |
| 35 | P35 | 0 | 35 | 35 | 1 | A |
| 36 | P36 | 0 | 36 | 36 | 1 | A |
| 37 | P37 | 0 | 37 | 37 | 1 | A |
| 38 | P38 | 0 | 38 | 38 | 1 | A |
| 39 | P39 | 0 | 39 | 39 | 1 | A |
| 40 | P40 | 0 | 40 | 40 | 1 | A |
| 41 | P41 | 0 | 41 | 41 | 1 | A |
| 42 | P42 | 0 | 42 | 42 | 1 | A |
| 43 | P43 | 0 | 43 | 43 | 1 | A |
| 44 | P44 | 0 | 44 | 44 | 1 | A |
| 45 | P45 | 0 | 45 | 45 | 1 | A |
| 46 | P46 | 0 | 46 | 46 | 1 | A |
| 47 | P47 | 0 | 47 | 47 | 1 | A |
| 48 | P48 | 0 | 48 | 48 | 1 | A |
| 49 | P49 | 0 | 49 | 49 | 1 | A |
| 50 | P50 | 0 | 50 | 50 | 1 | A |
| 51 | P51 | 0 | 51 | 51 | 1 | A |
| 52 | P52 | 0 | 52 | 52 | 1 | A |
| 53 | P53 | 0 | 53 | 53 | 1 | A |
| 54 | P54 | 0 | 54 | 54 | 1 | A |
| 55 | P55 | 0 | 55 | 55 | 1 | A |
| 56 | P56 | 0 | 56 | 56 | 1 | A |
| 57 | P57 | 0 | 57 | 57 | 1 | A |
| 58 | P58 | 0 | 58 | 58 | 1 | A |
| 59 | P59 | 0 | 59 | 59 | 1 | A |
| 60 | P60 | 0 | 60 | 60 | 1 | A |
| 61 | P61 | 0 | 61 | 61 | 1 | A |
| 62 | P28 | 0.0150295 | 60 | 60 | 1 | D |
| 63 | P22 | 0.0453485 | 59 | 59 | 1 | D |
| 64 | P62 | 0.135696 | 60 | 59 | 2 | A |
| 65 | P63 | 0.165238 | 61 | 59 | 2 | A |
| 66 | P64 | 0.196993 | 62 | 59 | 2 | A |
| 67 | P19 | 0.231765 | 61 | 58 | 1 | D |
| 68 | P65 | 0.246564 | 62 | 58 | 2 | A |
| 69 | P66 | 0.513221 | 63 | 58 | 2 | A |
| 70 | P4 | 0.599672 | 62 | 57 | 1 | D |
| 71 | P35 | 0.819331 | 61 | 56 | 1 | D |
| 72 | P11 | 0.870772 | 60 | 55 | 1 | D |
| 73 | P38 | 0.915473 | 59 | 54 | 1 | D |
| 74 | P67 | 1.0041 | 60 | 54 | 2 | A |
| 75 | P34 | 1.10329 | 59 | 53 | 1 | D |
| 76 | P52 | 1.1307 | 58 | 52 | 1 | D |
| 77 | P68 | 1.27787 | 59 | 52 | 2 | A |
| 78 | P69 | 1.28476 | 60 | 52 | 2 | A |
| 79 | P54 | 1.41855 | 59 | 51 | 1 | D |
| 80 | P9 | 1.50897 | 58 | 50 | 1 | D |
| 81 | P16 | 1.58508 | 57 | 49 | 1 | D |
| 82 | P50 | 1.7072 | 56 | 48 | 1 | D |
| 83 | P27 | 1.76624 | 55 | 47 | 1 | D |
| 84 | P24 | 1.82978 | 54 | 46 | 1 | D |
| 85 | P18 | 1.89288 | 53 | 45 | 1 | D |
| 86 | P1 | 1.90524 | 52 | 44 | 1 | D |
| 87 | P14 | 2.0732 | 51 | 43 | 1 | D |
| 88 | P48 | 2.26002 | 50 | 42 | 1 | D |
| 89 | P49 | 2.31691 | 49 | 41 | 1 | D |
| 90 | P40 | 2.37181 | 48 | 40 | 1 | D |
| 91 | P42 | 2.56996 | 47 | 39 | 1 | D |
| 92 | P10 | 2.64148 | 46 | 38 | 1 | D |
| 93 | P70 | 2.70935 | 47 | 38 | 2 | A |
| 94 | P71 | 2.82378 | 48 | 38 | 2 | A |
| 95 | P72 | 2.87145 | 49 | 38 | 2 | A |
| 96 | P31 | 2.89941 | 48 | 37 | 1 | D |
| 97 | P51 | 2.90378 | 47 | 36 | 1 | D |
| 98 | P58 | 2.95571 | 46 | 35 | 1 | D |
| 99 | P73 | 3.03012 | 47 | 35 | 2 | A |
| 100 | P74 | 3.03537 | 48 | 36 | 1 | A |
| 101 | P72 | 3.17407 | 47 | 36 | 2 | D |
| 102 | P39 | 3.17643 | 46 | 35 | 1 | D |
| 103 | P75 | 3.17977 | 47 | 35 | 2 | A |
| 104 | P76 | 3.34078 | 48 | 35 | 2 | A |
| 105 | P45 | 3.38796 | 47 | 34 | 1 | D |
| 106 | P77 | 3.42137 | 48 | 34 | 2 | A |
| 107 | P67 | 3.65086 | 47 | 34 | 2 | D |
| 108 | P78 | 3.76942 | 48 | 35 | 1 | A |
| 109 | P41 | 3.78344 | 47 | 34 | 1 | D |
| 110 | P79 | 3.87995 | 48 | 34 | 2 | A |
| 111 | P80 | 4.1999 | 49 | 34 | 2 | A |

Part2:

Seed1=123

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Time | Bed start | Probability of being empty | Sample mean of occupied beds | Sample variance of occupied beds | Average proportion of sick people | Sample mean of sickness times | Sample variance of sickness times |
| 1000 | Empty | 0.0031943845650746496 | 5.85297989477414 | 6.063881484836947 | 0.030895619555830672 | 9.180232150229442 | 88.97537548990672 |
| 1000 | Half full | 0.002336995351904022 | 5.891563592551417 | 7.995821843732945 | 0.03137501944364821 | 9.315059920641776 | 94.49521058289425 |
| 1000 | Full | 0.005490851106226614 | 5.99213499468393 | 18.689179834120296 | 0.03061837431380165 | 9.107164355773552 | 88.20404927076879 |
| 10000 | Empty | 0.003712792510544932 | 5.71769477770153 | 5.700146321448181 | 0.030492456037007953 | 9.166157444093958 | 90.13663006554061 |
| 10000 | Half full | 0.003170733492554504 | 5.851010934756371 | 6.012463833545147 | 0.03126107519820915 | 9.25060939737646 | 90.67791656561654 |
| 10000 | Full | 0.00527002093216521 | 5.6678807223614385 | 6.5495416675801374 | 0.03044752500926478 | 9.2259454951747 | 90.53100971728107 |
| 100000 | Empty | 0.0027288954028976105 | 5.838789696690722 | 5.731188151485721 | 0.030703581711942648 | 9.198678771645506 | 89.64665032441356 |
| 100000 | Half full | 0.00357434742890985 | 5.766492553370028 | 5.883626077391689 | 0.03071513396006736 | 9.203657955145509 | 89.52467743660296 |
| 100000 | Full | 0.0032107711517664786 | 5.803447294396889 | 5.785701922313949 | 0.030675034152113145 | 9.206793654106193 | 89.81160517227711 |

Seed2 = 246

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Time | Bed start | Probability of being empty | Sample mean of occupied beds | Sample variance of occupied beds | Average proportion of sick people | Sample mean of sickness times | Sample variance of sickness times |
| 1000 | Empty | 0.004410002510374786 | 6.029567283705626 | 5.85449066348369 | 0.030722223526913325 | 9.111939331415607 | 87.61641087196365 |
| 1000 | Half full | 0.0067077192979913885 | 5.740515990219585 | 7.457975866360358 | 0.031234175178362952 | 9.22986710070396 | 87.26428289137128 |
| 1000 | Full | 0.00382943849628154 | 6.173126070551145 | 17.554873370288117 | 0.03103355798285887 | 9.131583586288768 | 89.83744541505159 |
| 10000 | Empty | 0.002955223578584041 | 5.766186854892481 | 5.929724713363326 | 0.03083092446707773 | 9.22401129404603 | 89.62299396107076 |
| 10000 | Half full | 0.003362026621624998 | 5.755111605080259 | 6.04895094271447 | 0.030572154341827515 | 9.150172051553211 | 87.8367493569232 |
| 10000 | Full | 0.0036824628695981574 | 5.831993338766509 | 6.358915340455512 | 0.030393738575015594 | 9.08685229413532 | 86.63868345672634 |
| 100000 | Empty | 0.002933373417142122 | 5.787234169128349 | 5.781352963484322 | 0.030784083573281135 | 9.222568635742311 | 90.0130062816964 |
| 100000 | Half full | 0.0027968992318267156 | 5.829035456617678 | 5.84068338070469 | 0.030750456723370435 | 9.216180893527536 | 90.06715900013755 |
| 100000 | Full | 0.003388821709059788 | 5.800519213315356 | 5.947531500340241 | 0.03057663656176024 | 9.185875217456616 | 89.65041942092365 |

**Comparison:**

-Probability of being empty is expected to be lower when the hospital is full. But in our case, our simulation converges to an optimal value. Because of this speed we cannot see a difference depending on bed fullness.

-We expected sample mean of occupied beds to differ as bed start condition changes. However, this change gets insignificant as the time interval increases.

-Sample variance of occupied beds are very similar with each other. We expected time independency because of the fact that our simulation converges fast. Also, because of the same reason we don’t see any fluctuations in different starting conditions of beds.

-Average proportion of sick people has converged to 0.03 even at the least time interval. We can say that it is independent of time because it is affected by healing rate.

-Healing rate determines sample mean of sickness times. So, it is irrelevant to total time or other factors. And we can see it directly from our table, time or fullness of hospital didn’t change the result.

-Sample variance of sickness times occurs due to healing rate differences which are given as mu1, mu2 and mu3. And this difference doesn’t change with time or fullness of the hospital as we can observe at our table.

-Seed2’s numerical values are parallel with Seed1. Since the simulation depends on lambda and mu values, random numbers do not change the behaviour of simulation.

Introduction

Our problem here is to simulate a population that has a hospital and people get sick with a rate of 1/300. People get sick and they decide whether to go to hospital or not. We use exponential random values while deciding if a person gets sick, if a person decides to go to hospital while he is sick. And also we are given the rate of healing, with random exponential variables we determine the time it takes to heal. Our simulation is a multiple server process based simulation. It works as intended.