Report for the Project 4

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Section One: Objectives and Work Performed

The objective of this report is to help bus company to allocate the bus and find a suitable strategy to reduce the cost and passengers' waiting time. Using the simulation, we could use computer to calculate the best way to fulfill the idea.

Section Two: Methodology

I use Bus.java, BusEvent.java, Segment.java, Passenger.java, PassengerEvent.java and BusSim.java to simulate the situation of bus running. The main method is in the BusSim.java file. To get the statistics I need, I use the data structure PQ and Linked List to contain the data.
The statistics I collect are the waiting time of passengers, including the average waiting time and maximum waiting time, average arrival interval of passengers in different stop, the maximum number of passengers on the bus, how many times the bus is full and total times of it. (Both will be counted when the bus successfully add a new passenger) Furthermore, I use the statistic Stop Multi Passenger, which is counted and recorded when the bus reaches a new stop, to replace the MPPG (mile passenger per gallon) upon the assumption that the distance between all the neighboring stops will be the same. In this way, Stop Multi Passenger will reflect one of the cost of bus company. Therefore, the total cost of bus company will be measured in the number of buses and total Stop Multi Passenger. The size of bus will have two choice and will be allocated randomly. Other more information can be found in Readme.md.

Section Three: Findings

When it comes to equilibrium, I find that when the limit time exceeds 10,000 seconds, the average waiting time and bus full rate won't change a lot and reaches a stable value (other variables don't change). But when the time limit is less than 10,000, the result will fluctuate fiercely.
Here are some results of experiments:
If T = 10,000; The size of bus are 40 and 20

Number of Bus	1	5	10	15	18
Average waiting time	4068.05	680.22	1034.31	300.03	159.12
Maximum waiting time	8281	1594	7081	1562	734
Average arrival internal	121.14	118.50	119.53	120.11	121.71
Maximum number of passenger on one bus	20	40	40	40	40
How many time the bus is full	49	110	50	41	29
The rate of full	26.2%	12.54%	3.96%	2.22%	1.55%
Total Stop Multi Passenger	3031	14003	19815	24045	17993
Average Stop Multi Passenger	3031	2800.6	1981.5	1603	999.61

If T = 10,000; The size of bus are 30 and 10

Number of Bus	1	5	10	15	18
Average waiting time	3562.65	685.49	985.44	357.27	171.72
Maximum waiting time	8176	1887	7935	1642	851
Average arrival internal	120.19	119.75	118.73	118.98	121.40
Maximum number of passenger on one bus	30	30	30	30	30
How many time the bus is full	45	93	152	139	146
The rate of full	16.19%	11.37%	12.93%	7.53%	7.85%
Total Stop Multi Passenger	6545	13707	15802	24323	17883
Average Stop Multi Passenger	6545	2741.4	1580.2	1621.53	993.5

If T = 100,000; The size of bus are 30 and 10

Number of Bus	1	5	10	15	18
Average waiting time	34197.27	10802.05	5128.78	1387.12	642.16
Maximum waiting time	74849	41095	91589	10913	1875
Average arrival internal	119.55	120.07	120.36	119.66	120.00
Maximum number of passenger on one bus	30	30	30	30	30
How many time the bus is full	499	2217	1912	3462	2021
The rate of full	17.39%	31.70%	19.02%	18.34%	10.62%
Total Stop Multi Passenger	74850	109236	98935	283480	219842
Average Stop Multi Passenger	74850	21847.2	9893.5	18898.67	12213.44

<u>Section Four: Conclusions</u>

Upon the experiments, we can find that the combo [10,30] is more productive than combo [20,40], especially when the number of bus is 10. We can try other combo either to find the best one. (with the lower average waiting time, higher rate of full and lower average Stop Multi Passenger) Further more, the results still have some randomness because there are many random variables in the experiment (like the ratio of two different size, the order of allocating bus). We need to do more tries to get a more accurate result.