Lab L4: Transient elimination and batch means

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I. Introduction

In the simulation process, the system uses the M/G/1 model to simulate the queuing theory and compare it with the M/M/1 model. Random exponential data with different lambda are selected for customer arrival times. The objective is to study the correlation between lambda and drop probability, lambda and average queue delay.
It has to test the different effects of three types of service times on the system, deterministic service times, exponential service times, and super-exponential service times, respectively.
At the end of the lab, based on the three service times, a visualization of the output metrics was chosen to show the impact of different lambda's on the overall queue.

II. The Simulation Model

A. Stochastic Elements

Based on Lab L1 simulation, there are some Stochastic Elements will be considered.
Lambda Value. The arrival time of client is a random exponential data with different lambda. we choose the list as input of exponential distribution, [0.2, 0.4, 0.6, 0.8, 0.9, 0.95, 0.99,0.998]
Simulation Time. The simulation time is a key condition where determines when to stop the simulation. Here the simulation time is 500s.
Waiting Line. The "wait queue" affects the process of the simulation, in my experiments it was 10. if the queue length exceeds 10, new clients leave the wait queue.
Hyper-exponential distribution The M/G/1 model try to generate a random data as a service time with a Hyper-exponential distribution. The requirement is that, average = 1 and standard deviation =10.
Other Other elements in the simulation will be set to 0.

B. Input Parameters

Arrival Time. For the simulation, the arrival time and service time of clients are critical. The arrival time is obtained from a exponential distribution with different lambda. When a client arrive, the next arrival time of next client will be fielded, ad record a FES-FIFo list.
Service Time. Service time is random for every client, it will be generate and follow different statistical distribution. The difference of service time will cause the waiting time of client and impact the length of queue.
Service policy. In the simulation, we use a first-come, first-served strategy. This will apply to most realistic events.
FES-FIFO. The FES-FIFO list will record all events of clients, including depart and arrive. In the starting of simulation, it can provide a initial event.

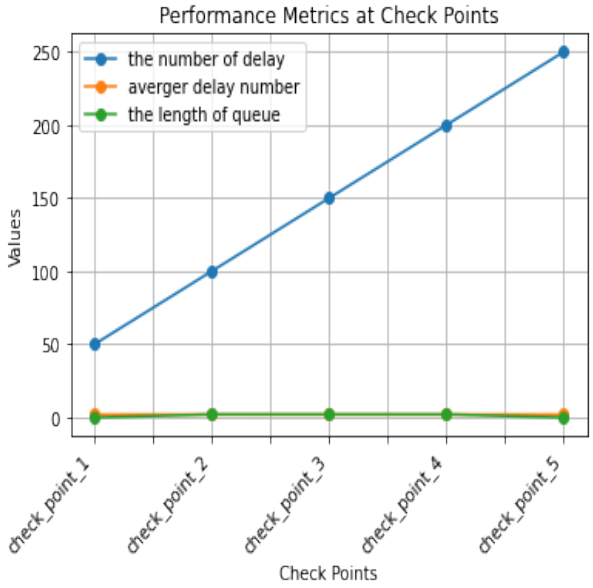

Fig. 1. checkpoint

C. Output

Mean Queue Length. The average queue length refers to the average number of clients throughout the processing of the queue.
Mean Delay Time. If a customer arrives before the end of the last customer service, he will check the length of the queue. If there are more than 10, he will leave, instead he will stay in the queue.
The Number of Arrival Clients. How many customers arrive at the end of the simulation.
The Number of Departure Clients. How many customers leave at the end of the simulation.

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TABLE I
METRIC OF OUTPUT

	The all outputs VS lambda				
arrival lambda	*Number of arrivals*	*Number of departures*	*average delay*	*delay rate*	*dropping probability*
0.200	198.0	197.0	6.215646	0.5063	0.0000
0.400	398.0	396.0	7.233558	0.5032	0.0025
0.600	595.0	591.0	3.682596	0.5004	0.0017
0.800	803.0	779.0	3.869682	0.5032	0.0249
0.900	920.0	914.0	4.083050	0.5022	0.0043
0.950	973.0	928.0	3.754172	0.5043	0.0442
0.990	975.0	831.0	4.008808	0.5027	0.1446
0.998	945.0	922.0	3.331851	0.5024	0.0212

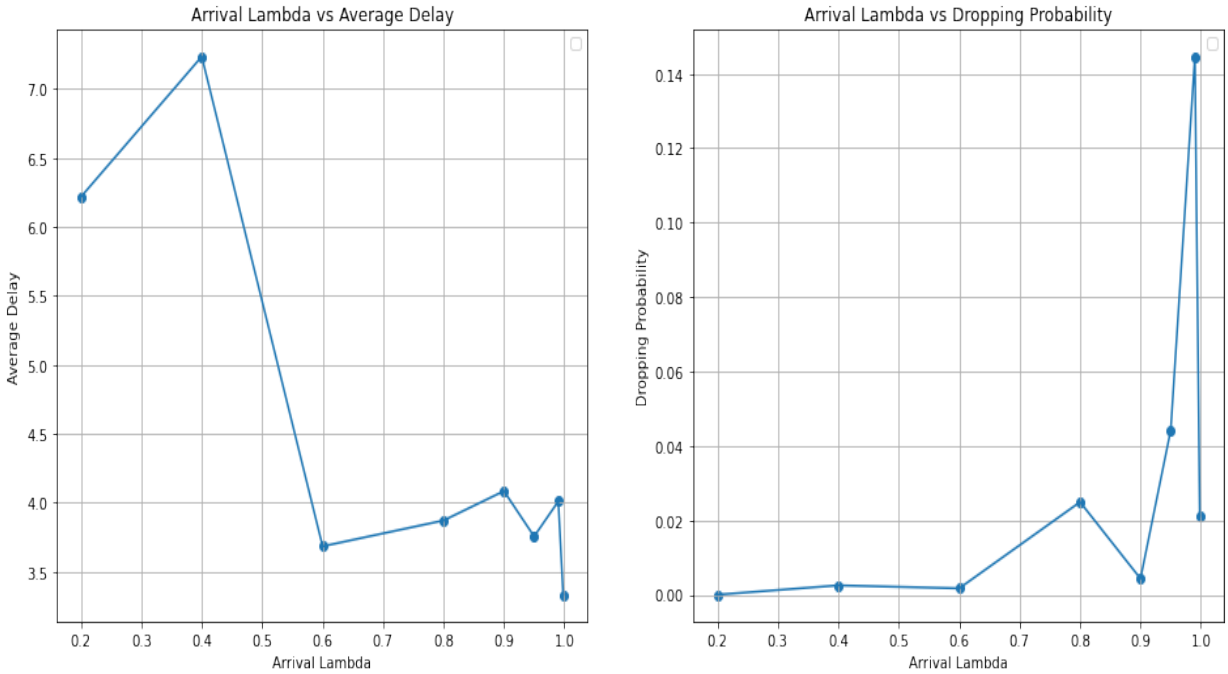

Fig. 2. Graduation grades and year

D. Output Metrics

Average delay The average delay time can be derived by dividing the total delay time by the number of departing customers.

Delay rate Probability of having a delayed customer among all departing customers.

Dropouts Probability. Percentage of all arriving customers who are not waiting in the queue.

The checkpoints Figure 1 shows the number of delayed clients, the current average number of delayed clients, and the queue length.

III. RESULTS

As shown in Figure 2 and Table 1, they show the performance of the queue based on different lambda values.