BUS 393 HEADWAY ADJUSTMENT

APPLY QUEUING THEORY TO IMPROVE PASSENGERS' WAITING TIME

Sydney's buses and trains are facing more pressure as the use of public transport is increasing by more than 10% comparing to last year, which means that it has become very important to make adjustment on buses to meet the passengers' demands.[1] This research use queuing theory to improve bus headway so as to minimize customers' total waiting time. Model data is derived from real Opal Card Data.

Motivation & Assumption

The aim of this model is to adjust headway of a bus lane without adding fleets of buses to minimize the total delay (passenger-minute) in the bus station. Use M/N/1 model and the bus station is regarded as a server.

First select a certain bus station (Central Station, Elizabeth St, Stand E) of lane 393. Analyze the time of the first tag for the journey from selected bus station on a workday. Count the fleets of buses from 6:30-23:00.

Assume all the buses can arrive on time, ignore other factors which can influence bus headway, such as traffic congestion. And all the passengers waiting at the bus-stop will get on the next arriving bus.

According to different arrival rates, divide the work-day into 5 periods. Assume that arrivals are deterministic in these 5 distinct phases. Then allocate fleets of buses to 5 phases according to their arrival rates. the arrivals are stochastic, use a Poisson model to simulation the arrivals.

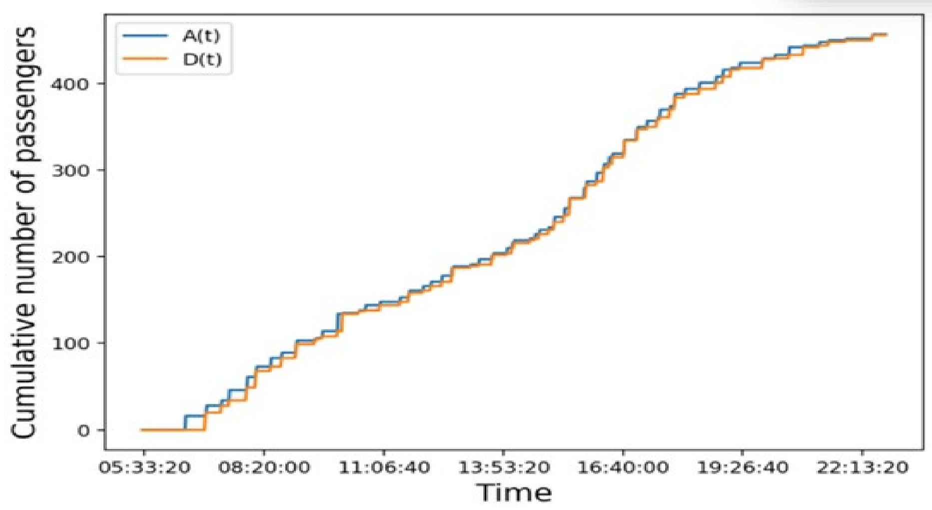

Fig 1. Observed arrivals and departures in a certain bus timetable

Assuming fixed passenger arrivals, the current timetable results in 4636 passenger-minutes of delay. That's an average waiting time of 10.14 minutes of delay per passenger.

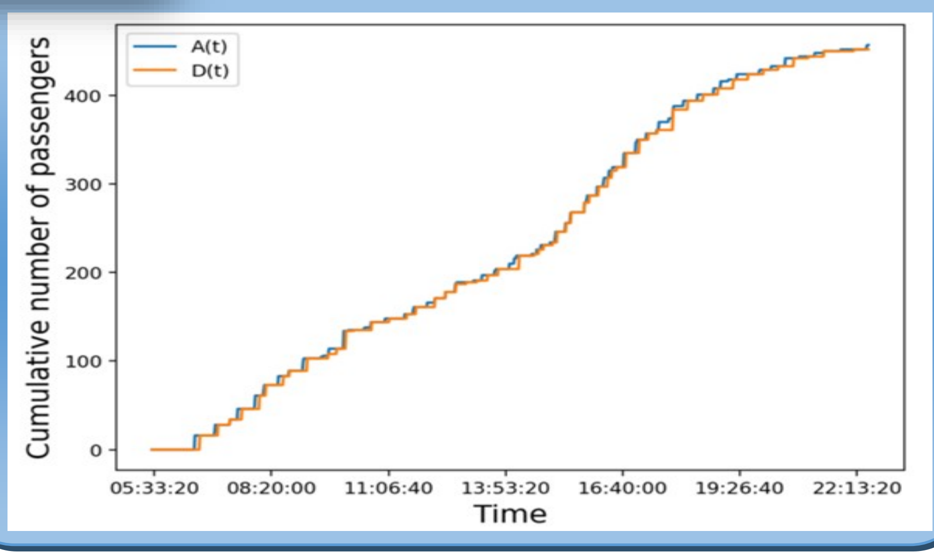

Fig 2. Predicted arrivals and departures in a new bus timetable

Assuming fixed passenger arrivals, the current timetable results in 2491 passenger-minutes of delay. That's an average waiting time of 5.45 minutes of delay per passenger.

Conclusion for Model Assessment

Comparing the predicted data with the observed data, after adjustment on bus headway, we can find out that this model with a new bus timetable have an excellent effect on reducing the waiting time of passengers.

Stakeholder Influence

Bus Operator Total service number of times of bus Route 393 will stay unchanged, cost of operation will not increase.

Government (Transport for NSW) Transport for NSW department is responsible to provide bus schedule timetable information, including online websites and time-table sheets in every bus-stops. Cost may occur due to changes are made.

Travellers (UNSW students) Most UNSW students travel in peak period. After adjustment, buses will come more frequent in peak hour and makes it more convenient for student to board on bus.

Travellers (the others) If other travellers come to the bus-stop in off-peak period, their waiting time to board the bus will be longer than before, which can cause them inconvenience.

Generalization and Future Work

This project has the potential to be generalized into other cities which are facing the same transport problem due to the large number of passengers. Adjust the headway by analyzing the data (peak hour and peak-off time) ,which is the core of this project , is an efficient method to deal with problem.

Due to that some passengers are memorable to the time schedule of bus arrival time which would influence the result of analyse, the investigation about the proportion of time-schedule passengers would be a new prospective to the project. In addition, some other factors such as holidays and activities should also be a part of the future work.

Solution Feasibility: A new public transport solution of 'on demand' minibus is aimed to connect suburban residents to their working area, which shows that the bus frequency is difficult to schedule to meet the actual needs. [2] According to the news, Sydney's bendy long buses will be replaced by double-deckers, which makes the bus-stop less likely queuing since more horizontal spaces will be available, and higher frequency of buses at peak hour possible. [3]

Reference: [1] Jacob, S. (2016). Sydney's public transport use soars, even as its buses run late. Retrieved 7 September 2017, from http://www.smh.com.au/nsw/sydneys-public-transport-use-soars-even-as-its-buses-run-late-20161201-gt1l5c.html; [2] Julian, B. (2017). Sydney moves to 'on demand' small scale public transit. But will it work?. Retrieved 7 September 2017, from https://www.themandarin.com.au/82532-sydney-on-demand-small-scale-public-transit/; [3] Jacob, S. (2017). Old becomes new again: Double-decker buses to replace bendies on Sydney streets. Retrieved 7 September 2017, from http://www.smh.com.au/nsw/old-becomes-new-again-doubledecker-buses-to-replace-bendies-on-sydney-streets-20170613-gwpxt6.html

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