How the distribution of arrival times at a railway station varies with headway: A study using smart card data.

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Abstract Best practice suggests that if public transport services are frequent enough then customers will no longer require a timetable in order to match their arrival time at the public transport stop to the departure time of the service and will simply ‘turn-up and go’. There are many case studies and practitioners’ guides that extoll the virtues of a ‘turn-up and go’ network for passengers, operators and the broader society. However, there is not yet sufficient evidence as to how frequent a service has to be before users ignore the timetable and simply arrive at the public transport stop randomly. Operators in the English speaking world have converged on a headway of no more than 15 minutes between services during weekday off-peak hours as defining a ‘frequent service’. However, some operators do use a standard that is more frequent (12 or 10 minute headways) or less frequent (up to 20 minute headways). This paper adds to the literature on public transport planning by using smart card data from Brisbane, Queensland and Sydney, New South Wales in Australia to model the actual distribution of passenger arrival times at railway stations and to note how these vary by headway.
1 Introduction

One of the greatest challenges facing urban governments is how to promote sustainability in the way in which people travel. This goal is fuelled by the growing congestion experienced by many cities with its cost to the economy. Governments are at the same time constrained by their ability to provide more infrastructure, particularly transport infrastructure, to provide greater choice for travellers and to provide the opportunity for mode shift from private car to more sustainable modes of transport. Perhaps more importantly, budgets for subsidising public transport are also constrained, given that transport competes for funding with other portfolios.

This means that, in planning the public transport network, care needs to be taken to provide the network with the best ability to encourage travel. In planning public transport networks, trade-offs are made between coverage and frequency when the (subsidy) budget is constrained. The empirical evidence suggests that frequency is important in growing patronage (Currie and Wallis 2008, Hensher et al. 2010), and this underpins the best practice, outlined in Mulley, Nelson and Neilson (2005) and Walker (2008) which suggests that networks which concentrate resources on core routes have a better chance of creating mode shift.

This in turn implies that, beyond a certain headway, public transport services become frequent enough that customers no longer require a timetable in order to match their arrival time at the public transport stop to the departure time of the vehicle and will instead simply ‘turn up and go’. The benefits of a turn up and go service are discussed in Hitrans and Walker but include encouraging greater usage of public transport and reducing the burden on customers of planning their journey, higher revenue for operators and a network that is simpler to plan (as transfers between frequent services no longer need to be timetabled) and market to potential customers.

Purported benefits to society include more greater chance of mode shift and a consequential reduction in congestion, cost effective public transport, fewer people needing to purchase a car, reduced pollution etc. Thus concentrating resources on core routes require some understanding of what ‘turn up and go’ means in the context of the urban area under consideration, as the actual frequency of a turn up and go service is likely to vary according to urban land patterns and typical journey lengths.

This paper addresses the question of how frequent must a service be in order to trigger ‘turn up go’ behaviour from passengers. Most operators in English speaking countries who advertise frequent or turn up and go networks use a headway of 15 minutes or better during weekday off peak periods as the point at which a service can be advertised as frequent. This is the case in the United States cities of Anchorage, Houston, Los Angeles and Portland, where it is often associated with network reviews.
conducted by the transit planning agency Jarrett Walker + Associates ([http://jarrettwalker.com](http://jarrettwalker.com)). The 15 minute headway is also standard in Australia with Sydney (Metrobus and Liverpool to Parramatta Transitway), Melbourne, Brisbane, Adelaide, the Gold Coast and Canberra advertising their frequent networks with a headway of 15 minutes or better. In Canada, Vancouver uses the same standard as does Auckland and Wellington in New Zealand.

Defining a frequent service as a headway of no more than 15 minutes is not universal, however. Some operators use a longer headway: Boston uses a standard of up to 16 minutes between services, Launceston in Tasmania advertises headways of 10 to 20 minutes as ‘turn-up and go’. Other cities use shorter headways to define frequent services: London use a 12 minute headway and Toronto uses a 10 minute headway. Sydney’s new B-Line buses are advertised as 8-12 minute headways and Sydney has medium term goal of 10 minutes for its frequent network. Overall, there appears to be no systematic approach as to what might be defined as frequent enough to be ‘turn up and go’ and little evidence of a quantitative analysis of travel behaviour to substantiate the choice.

This paper will contribute to the literature on travel behaviour by analysing smart card data from the Australian city Sydney to look at how travellers’ arrival times at rail stations react to different headways.

2 Literature review and problem formulation

2.1 Problem formulation and research question
The paper will present a literature review that contextualises the issues surrounding the network planning issues concerning frequency and hence the importance of knowing the minimum frequency for ‘turn up and go’ services. The aim of the paper is to identify using smart card data and in the context of the case studies, a method for identifying how long travellers spend at train stations before travelling. By considering different frequency of services, this should identify the ‘turn up and go’ frequency.

3 Model

3.1 Smart card data
Smart card data provides the opportunity to investigate the research question on the train network in Sydney. On this network it is possible to identify the frequency of service associated with each tap-on of the traveller and from this determine how long the passenger waits for a train. Unfortunately, this same methodology cannot be applied to bus travellers since bus services us on board fare collection and the tap-on occurs once the service arrives.
Smart card data for one day (Tuesday 1 March 2016) has been provided by Transport for NSW. This data has been interrogated to look at the average time a passenger waits before boarding, classified by the average headway of services.

The method determines the waiting time as the difference between the departure time and the tap-on time. In some cases this leads to a waiting time greater than the headway because in large stations, the tap-on location may be a distance from the platform from which the train departs. Average head-way frequency is the average number of headway minutes (time between 2 consecutive services) of the next three services after the departure time at which the passenger boards, on the basis that the passengers’ behaviour is determined by the immediate future service frequencies.

4 Results

The initial results for Sydney are shown in Table 1. These are encouraging in showing the ‘turn up and go’ frequency to be no longer than a 15 minute headway: At this headway there is a very small proportion of travellers waiting longer than this. For headways smaller than this it is clear there is an element of ‘turn up and go’ although further analysis needs to look at likely times between tap-on and boarding.

Figure 1: Distribution of wait time by service headway (time between 2 consecutive services)
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References


