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## Extraboard team sizing: An analysis of short unscheduled absences among regular transit drivers

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### ABSTRACT

Several factors contribute to short-duration unscheduled absences of bus transit drivers. This article aims to understand these factors at the aggregate level and to anticipate future total absence that will need to be filled for a large-size transit operator. The aggregate level is defined as the total number of regular driver absences per garage, day of week and time period that need to be covered by the extraboards. This study analyzes absenteeism data obtained from OC Transpo, the transit provider of the city of Ottawa, Canada. A multilevel regression model is generated to investigate regular drivers' absences. The short-unscheduled absence is estimated in relation to temporal factors, drivers' personal characteristics, aspects of assigned work, and service delivery characteristics. Furthermore, using the model's coefficients, sensitivity analyses are conducted to demonstrate the advantages of this technique over traditional ones adopted by various transit agencies. This study provides transit planners and policy makers with a practical methodology that can be used to support extraboard planning practice and help reduce the incidence of missed trips due to absences while having the appropriate size of extraboard drivers.

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## 1. Introduction

Transit providers maintain a reserve pool of back-up drivers, known as the spare-board or extraboard, to fill open work assignments when regular-duty drivers are absent, non-scheduled service occurs, or work left open after the booking process has been completed. Non-scheduled service, work left open after the booking process, and employees' planned scheduled absences are known far enough in advance for workforce planning, which are not in this paper's scope. In contrast, unscheduled absences among bus drivers vary considerably on a daily basis, requiring transit agencies to anticipate for them in extraboard planning. Thus, extraboard planning predicts the amount of open work per day that will need to be filled during a 2–4 months booking period, which lead in many cases to acquiring more extraboard drivers to cover all short unscheduled absences as well as other needs. Short unscheduled absences are defined as unscheduled absences extending from one to three days, which account for most of the day-to-day variation in the amount of open work that must be filled by extraboard drivers. Short unscheduled absences occur for many reasons, such as short-term illness, family commitments, late arrival to work, social reasons and many other unreported reasons.

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The extraboard planning process, which is known also as 'sizing,' is an essential exercise related to predicting unscheduled absences among regular-duty drivers. Transit agencies might have to cancel trips or decrease frequency along certain routes if the size of the extraboard is insufficient to deal with the variation in these absences. Trip cancellation has a direct impact on passengers' perception of service quality, since waiting time is doubled and buses will be crowded. If this gap between extraboard and absences increases, the number of canceled trips increases, leading to a decrease in passenger trust and loyalty, which consequently decreases transit use and agencies' revenues (Furth and Muller, 2007; Perk et al., 2008; Vuchic, 2005). Some agencies try to cover this increase by paying some regular drivers overtime to cover for the differences between the absences and the extraboard size. Overtime is generally paid at a higher rate and is bounded by union regulations due to the burden falling on the regular drivers making it even harder in some cases for an agency to cover all the absences. On the other hand, the presence of too many extraboard drivers compared to the amount of open work (e.g. unscheduled absences) presents a burden on the transit agency through increasing the general operating costs. Accordingly there is a need to generate a methodology that can accurately predict the amount of extraboard drivers needed per day, time period and garage for every transit agency to efficiently ensure service delivery in an efficient way.

This paper predicts the short term absences among regular-duty drivers to help in defining a more accurate extraboard size that can meet the day to day variations. The study will help in reducing the need for overtime drivers and/or excess number of extraboard drivers where no work is open for them. It analyzes short-duration absences among bus drivers at the OC Transpo, the transit operator (and provider) for the city of Ottawa, Ontario, Canada, using data drawn from the agency's human resource and scheduling databases. The paper starts with a literature review of drivers' absenteeism and strategies in sizing the extraboard drivers. This is followed by a description of the case study and data used. The next section pertains to the methodology used to prepare and analyze the data for predicting drivers' absence and anticipating the required size. It is then followed by a discussion of those results and finally a conclusion.

## 2. Literature review

Extraboard drivers can be defined as the 'backup drivers', which is the pool of reserved drivers who fill open work resulting from unscheduled absences and other causes (DeAnnuntis and Morris, 2008). The strategies and processes of covering regular driver absence (or estimating the extraboard) consist of three integrated stages according to practice (Kaysi and Wilson, 1990; Koutsopoulos, 1990). The first is the strategic stage, which is generally related to estimating or hiring the optimum size of extraboard workforce. The second is the tactical stage, which is related to answering the questions of where and when these extraboard drivers should be (garage and day), according to the expected open work that needs to be filled. These two stages are usually done every 2–3 months according to the booking time frame. The last stage is the operational stage, which is related to daily unexpected open work based on specific times of day. This sometimes requires extraboard and regular drivers to work unscheduled overtime, which affected by many complicated factors, including work rules and a transit agency's unscheduled overtime work policy (Strathman et al., 2012). Generally, an optimum balance between unscheduled overtime assignments and extraboards are required in order to increase transit agencies' efficiency without service interruptions (Koutsopoulos and Wilson, 1987).

Some researchers theoretically interpret absence as a response to work dissatisfaction (Muchinski, 1977; Porter and Steers, 1973), others link it to unpleasant or hazardous job conditions (Allen, 1981). In other cases absences can be related to social (family) emergencies. Social absences are generally more tolerated by colleagues and management (Chadwick-Jones et al., 1982). In this theoretical framework, the greatest potential to reduce absenteeism lies in recognizing the implicit social relationship between both drivers and management. Stress, traffic congestion, delays and dealing with difficult passengers (Gardell et al., 1982; Greiner et al., 1998; Long and Perry, 1985; Volinski, 1999) are correlated with increasing short-term absence frequency. These previous theoretical factors of absence, to an extent, affect all drivers in a transit agency, since workloads are shifted from one driver to another during their span of service.

Empirical studies have shown that drivers' personal situation factors have an effect on their absences. Among these factors are gender, experience, age and whether or not they are on probation (for drivers during the first six-months of employment) (Allen, 1981; Drago and Wooden, 1992; Keller, 1983; Leigh, 1986). Temporal factors such as seasonality (winter to summer), months, days of the week, and holidays influence drivers' absence, which consequently affects the number of extraboards needed during these periods (Kenyon and Dawkins, 1989; Shiftan and Wilson, 2001; Strathman et al., 2009a, 2012). Assigned work and service delivery characteristics (e.g. assignment type, garage, driving time, assignment time of day, and rotating shift work between time periods) have an effect on drivers' absence behavior (Fitzgibbons and Moch, 1980; Strathman et al., 2009a). However, these previous studies focused on individuals at the disaggregate level (Shiftan and Wilson, 2001; Strathman et al., 2009a), which is more interesting from a human resources point of view. For this disaggregate approach to be useful to transit drivers assigning bookings, predictions have to be made using the same unit of analysis, which is the individual driver. In other words, a prediction matrix needs to be generated for each driver during every booking while accounting for all the previously mentioned characteristics, which can be time consuming and adds complexity to the process. Also the prediction will lead to a probability value, which can impose further challenges on transit planners. Since the goal of this process is to reach an estimate of the extraboard size in a particular day in a booking, such estimations can be generated directly at the aggregate level to reduce the complexity in the prediction process and to generate a practical tool that is easy to use by transit operators. Therefore, the main purpose of the present study is to model the

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