

Temporal Analysis of Bus Demand in the City of São Paulo: A Cut from 2015 to 2023

*Análise Temporal da Demanda por Ônibus na Cidade de São Paulo:
um recorde de 2015 a 2023*

*Análisis Temporal de la Demanda por Autobús en la Ciudad de São
Paulo: Um Corte de 2015 a 2023*

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Abstract: Accelerated economic growth and urban expansion in major Brazilian cities at the beginning of the 20th century significantly transformed the urban landscape, with residential areas moving away from urban centers and productive zones, thus creating the need for transportation systems. At the beginning of 2020, the general situation in cities became more complicated due to the emergence of the COVID-19 pandemic, which changed not only people's lives and social dynamics but also caused significant declines in urban transportation. This study focuses on the quantitative analysis of the number of passengers transported by the urban public transportation system by bus in the city of São Paulo, with daily data between January 2015 and December 2023. The objective is to analyze daily demand, considering the pre- and post-pandemic periods, and verify the historical behavior of the data. The results show that daily and monthly demand had already fallen before 2020, had a significant reduction at the beginning of the Pandemic in 2020, and recovered afterward. However, everything indicates that the demand for buses was inserted to a new level, falling from 10 million passengers per day to something around 6.5 million passengers per day.

Keywords: Urban Public Transport; SPTrans; Daily bus demand; City of São Paulo; Covid-19.

Resumo: O crescimento econômico acelerado e a expansão urbana nas principais cidades brasileiras no início do século XX transformaram significativamente a paisagem urbana, com o afastamento das áreas residenciais dos centros urbanos e zonas produtivas, surge então a necessidade de sistemas de transportes. No início de 2020 a situação geral das cidades se complica devido ao surgimento da Pandemia de Covid-19, que alterou não só a vida das pessoas e a dinâmica social, mas também infringiu quedas significativas no transporte urbano como um todo. Este estudo concentra-se na análise quantitativa do número de passageiros transportados pelo sistema de transporte público urbano por ônibus na cidade de São Paulo, com dados diários compreendidos entre janeiro de 2015 e dezembro de 2023. O objetivo é analisar a demanda diária, considerando os períodos pré e pós-pandemia, para verificar o comportamento dos dados historicamente. Os resultados mostram que a demanda, tanto diária quanto mensal, já vinha caindo antes de 2020, teve grande redução no início da Pandemia, em 2020, e recuperação na sequência, mas tudo indica que a demanda por ônibus foi inserida em um novo patamar, caindo dos 10 milhões de passageiros por dia para algo em torno de 6,5 milhões de passageiros por dia.

Palavras-chave: Transporte Público Urbano; SPTrans; Demanda diária por ônibus; Cidade de São Paulo; Covid-19.

Resumen: El acelerado crecimiento económico y la expansión urbana en las principales ciudades brasileñas a principios del siglo XX transformaron significativamente el paisaje urbano, con el distanciamiento de las áreas residenciales de los centros urbanos y las zonas productivas, surge la necesidad de sistemas de transporte. A principios de 2020, la situación general de las ciudades se complicó debido a la aparición de la Pandemia de Covid-19, que no solo cambió la vida de las personas y la dinámica social, sino que también provocó caídas significativas en el transporte urbano en su conjunto. Este estudio se centra en el análisis cuantitativo del número de pasajeros transportados por el sistema de transporte público urbano en autobús en la ciudad de São Paulo, con datos diarios entre enero de 2015 y diciembre de 2023. El objetivo es analizar la demanda diaria, considerando los periodos pre y post pandemia, para verificar el comportamiento de los datos históricamente. Los resultados muestran que la demanda, tanto diaria como mensual, ya venía cayendo antes de 2020, tuvo una gran reducción al inicio de la Pandemia, en 2020, y recuperación después, pero todo indica que la demanda de autobuses se insertó en un nuevo nivel, pasando de 10 millones de pasajeros diarios a algo así como 6,5 millones de pasajeros diarios.

Palabras clave: Transporte Público Urbano; SPTrans; Demanda diaria de autobuses; Ciudad de São Paulo; Covid-19.

1. INTRODUCTION

The economic growth and rapid expansion of major Brazilian cities in the early 20th century significantly impacted the urban landscape. As residential areas moved further and further away from the city center and productive zones, there was an urgent need to expand transportation routes and public transportation systems. Unfortunately, many cities face challenges related to inefficient or absent transportation facilities in certain areas and the lack of maintenance of existing systems (Daroncho; Martinez, 2022).

The scenario of large Brazilian cities has been marked by significant investments in public transportation systems, such as buses, an initiative that aims to meet the growing mobility demands of citizens. However, despite the advances, there is still much to be done, especially as cities continue to expand, which makes the expansion of transportation systems crucial to urban life. As urban areas develop, people need to move from their residential areas to places of work, leisure, study, shopping, and services, and this movement must be fast, convenient, accessible, and comfortable (Andrade *et al.*, 2023).

Despite all this, the reduction in the number of passengers on urban transport in São Paulo is notable, not only due to the COVID-19 pandemic. Therefore, the objective of this work is to analyze the daily variation in demand for urban buses in the city of São Paulo from 2015 to 2023, with data on passengers transported by SPTrans, verifying the behavior of this demand not only in the days but in the weeks, months and years, before and after the Covid-19 Pandemic, to establish a standard for the future of bus mobility in the RMSP.

2. THEORETICAL BASIS

Until the 1920s, the predominant mode of transport was public transport and rail transport – trams and trains. According to Leão (1945), in 1933, the city had a tram network that was 258 km long, three times larger than the current length of the subway. At that time, the tram system was responsible for 84% of public transport trips, carrying out approximately 1.2 million trips/day in a city that had 888 thousand inhabitants at the time (Vasconcellos, 1999).

2.1 Urban Mobility

Cities are losing the ability to move people around safely and smoothly, causing problems, especially concerning public transportation. A good solution that could change this lousy scenario, which has been growing especially in large cities, would be to create a transportation plan that is convenient for people and does not harm the environment (Castro, 2024).

Improving traffic flow in urban centers has been a priority for the public sector in recent years to ensure accessibility for both the population and goods; thus, mobility has emerged as a public policy within government agendas (Dias, 2016).

According to Magagnin and Silva (2005), urban mobility can be defined as an attribute related to the movements made by individuals in their study, work, leisure, and other daily activities. The main idea of urban mobility is, in fact, to make these movements practical and flow without congestion, additional costs, and accidents.

It can be said that transportation directly affects how people feel, their health, safety, and how they interact with each other. Vasconcellos et al. (2011) state that large cities generate around 6 million yearly trips. This movement, with greater or lesser comfort, from one place to another will be done according to the choice and need of each person, as it depends on several variables, such as time, speed, efficiency, costs, safety, and convenience, and this will impact the mode of transportation chosen for the trip.

2.2 Covid-19

The World Health Organization (WHO) declared a Public Health Emergency of International Concern (PHEIC), the Organization's highest level of alert, on January 30, 2020, and the first case of COVID-19 was reported in Brazil on February 26, 2020 (UNASUS, 2023). In São Paulo, the quarantine was imposed as of March 23, 2020 (São Paulo, 2024). On May 4, 2020, the WHO formally announced the end of PHEIC (UNASUS, 2023), although most cities and countries had resumed their daily activities by mid-2020.

The COVID-19 pandemic in Brazil was characterized by three major waves, as described by Moura et al. (2022). The first wave occurred from February 23 to July 25, 2020; the second was between November 8, 2020, and April 10, 2021; and the third was from December 26, 2021, to May 21, 2022. In CSP, by the end of 2023, the Pandemic resulted in more than 1.2 million infections and more than 45 thousand deaths (SEADE, 2024b).

2.3 Covid-19 and Urban Mobility

The arrival of the COVID-19 pandemic in Brazil, together with movement restrictions, caused a decrease in demand for public transport, according to Jornal da USP (2021):

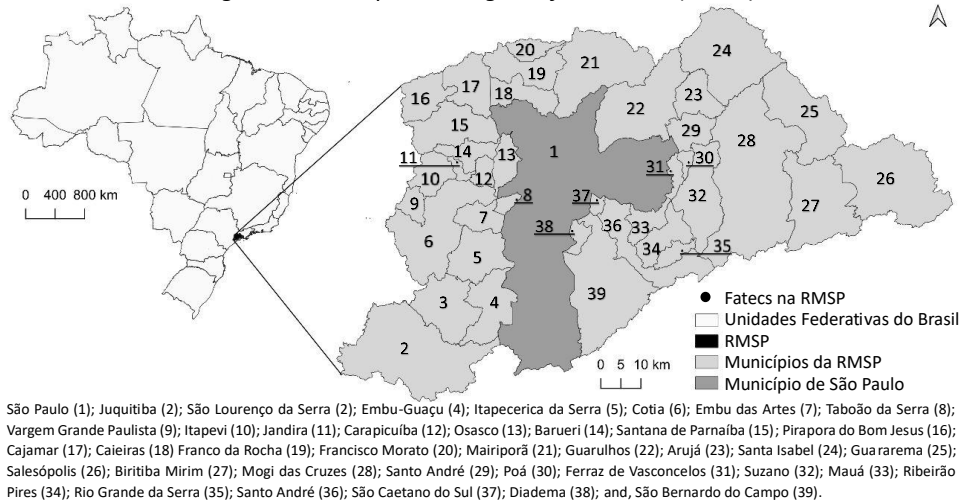
Data from the National Association of Urban Transport Companies shows that, in February of this year, the number of passengers on buses was, on average, 41% lower than before the Pandemic. In March 2020, this drop reached 80%. However, despite all the restrictions, some people must continue traveling and using public transport.

Considering that the movement of people in cities after social distancing is a strategic priority in the resumption of activities, Ferreira (2020) highlights the need for changes in customs regarding transportation and workplaces (such as remote work, for example) that are more ecological. "Rethinking mobility after quarantine includes considering fast-moving transit lanes and the use of active transportation (biking, scooters, walking) that reduce transit time and improve people's health" (Ferreira, 2020).

3.0 Study location and data

The aforementioned study was carried out in the City of São Paulo (CSP), which has just over 11 million inhabitants and occupies an area of 1.5 km². It makes up the Metropolitan Region of São Paulo (RMSP) with another 38 municipalities (Figure 1), which has a population of approximately 21 million inhabitants and occupies an area of 7.9 km² (IBGE, 2024 and SEADE, 2024a).

Figure 1– Metropolitan Region of São Paulo (RMSP)



Source: Adapted from Daroncho et al. (2023)

This study used data on daily passengers transported by urban buses between 2015 and 2023 in the CSP by urban transport companies managed by São Paulo Transportes – SPTrans (SPTRANS, 2024). In this analysis, which constitutes an initial research situation, all data were considered without checking holidays and holiday extensions, strikes and stoppages, significant events, and other situations that may generate positive or negative impacts on the number of passengers transported daily.

4. RESULTS AND DISCUSSION

The daily data on passengers transported at CSP were organized annually (Table 1) to facilitate initial analysis and comparison. Table 1 shows that the number of passengers transported has decreased since 2017, with the Pandemic and quarantine. 2020, this drop was more pronounced, and in 2021, it is already beginning to recover, although still subtle. The number of passengers transported in 2023 was 23.5% on weekdays and 23.2% from Monday to Friday, below the number transported in 2019, and 31.8% on weekdays and 31.1% from Monday to Friday, below the number transported in 2016, for the annual daily average and the annual daily average from Monday to Friday. Furthermore, demand growth from 2022 to 2023 in the week was 1.1%, and growth from Monday to Friday was only 0.5%, showing that the system may have reached its limit post-pandemic.

Analyzing the daily data from 2015 to 2023 (Figure 2), we can see a downward oscillation in the data from 2016 onwards, as well as the behavior after the start of the Pandemic. The points in the range of 4 million passengers per day in the period before the Pandemic and the points in the range of 2 million passengers per day in the period after the Pandemic will be analyzed later, as they refer to days with atypical occurrences, such as holidays and holiday extensions, strikes and stoppages or other events that caused demand to fall on a specific day.

Table 1– Overall annual daily average and annual daily average Monday to Friday

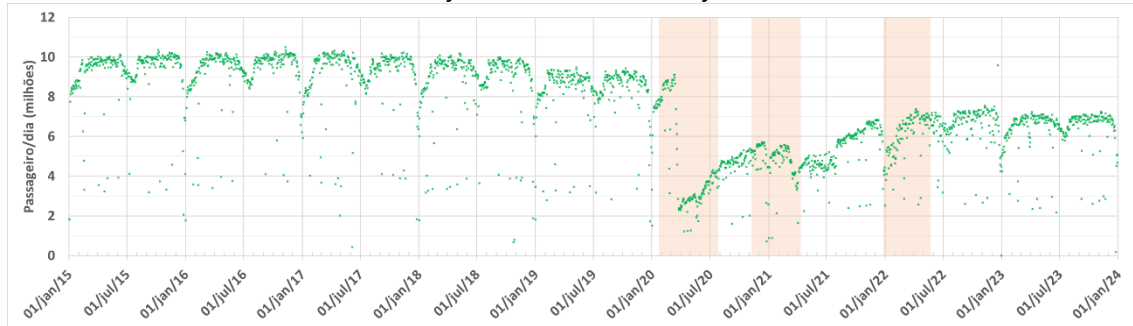
Year	Annual daily average	Annual variation (%)	Annual daily average (Monday to Friday)	Annual variation (%)
2015	7,829,754		9,113,894	
2016	7,969,749	1.8%	9,259,814	1.6%
2017	7,772,678	-2.5%	9,053,663	-2.2%
2018	7,577,806	-2.5%	8,738,128	-3.5%
2019	7,093,296	-6.4%	8,305,336	-5.0%
2020	4,096,464	-42.2%	4,783,143	-42.4%
2021	4,354,840	6.3%	5,114,733	6.9%
2022	5,367,588	23.3%	6,346,966	24.1%
2023	5,424,010	1.1%	6,380,758	0.5%
2020a	6,575,130	-	7,746,052	-
2020b	3,949,804	-	3,983,288	-

a) Average between 01/01/20 and 15/03/20 (period before quarantine)

b) Average between 03/23/20 and 12/31/20 (post-quarantine period)

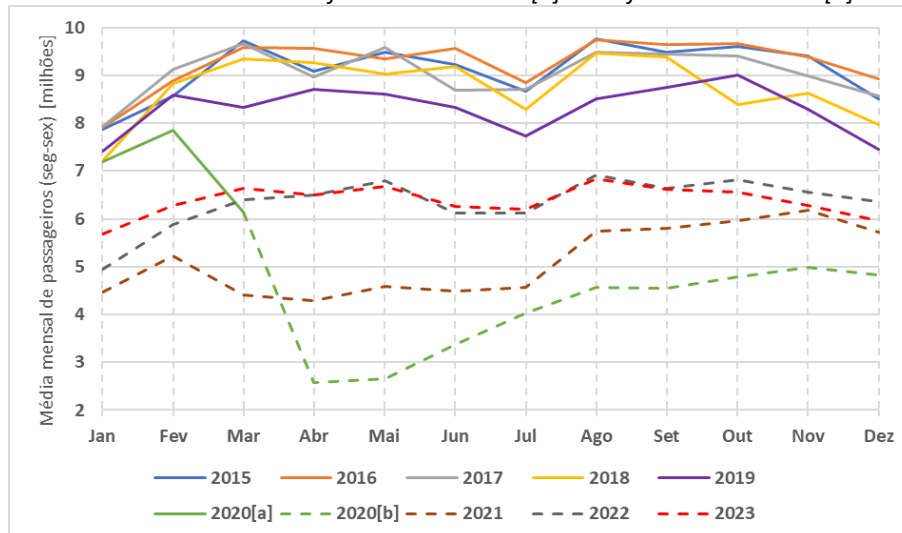
Source: Prepared by the authors with data from SPTrans (2024)

Figure 2– Passengers transported daily from Monday to Friday from 2015 to 2023. The orange columns refer to the three waves of Covid-19 in Brazil.



Source: Prepared by the authors with data from SPTrans (2024)

Figure 3– Monthly daily average of passengers transported from Monday to Friday. The year 2020 was divided into before the Pandemic [a] and after the Pandemic [b].



Source: Prepared by the authors with data from SPTrans (2024)

The monthly daily averages analysis shows the data series' behavior. As shown in Figure 3, this data can be analyzed to verify a monthly average daily behavior pattern.

The data showed fairly consistent monthly behavior from 2015 to 2018. This behavior changed and fell in the last three months of 2018. 2019 began very similarly to 2018, but from March onwards, a new pattern in passenger volume can be seen, with the volume falling into a new range (between 8 and 9 million passengers on average).

The year 2020 starts similarly to 2018 but loses momentum in February and March due to the beginning of the health restrictions resulting from the Pandemic, showing considerably lower values. The values from April onwards suffer from the health restrictions measures imposed by the Pandemic. The data shows a recovery that began in May 2020, with the average daily monthly volume growing practically linearly until August 2020 and setting a new level between 4.5 million and 5 million trips. This range lasts until July 2021, as the data rises to a new range in August, very close to the 6 million average daily trips in the month.

The years 2022 and 2023 have very similar daily averages. The year 2023 begins with higher volumes than 2022, but between April and September, the data is practically identical in both years. The data differs again in October, November, and December when trips in 2023 are below the values observed in 2022.

The average number of passengers transported per day in 2015 (9.11 million), 2016 (9.26 million), and 2017 (9.05 million) was 9.14 million, and the average number of passengers transported per day in 2022 (6.35 million) and 2023 (6.38 million) was 6.36 million, or 30% below.

5. FINAL CONSIDERATIONS

This study analyzed the historical variation in demand for public transportation by urban bus in São Paulo. The analysis of the daily historical series, covering the years 2015 to 2023, demonstrated that falling demand predates the COVID-19 pandemic. It is clear that the COVID-19 pandemic, which caused significant changes in travel patterns and behavior, greatly affected demand in TPU, but the decline has been occurring since 2017.

After the Pandemic, urban bus transport has been recovering, day after day, month after month. However, it seems to have reached a level of growth stagnation in 2023, when it grew only 0.5% compared to the previous year, remaining, on average, 30% below the values before the Pandemic.

The aim here was not to analyze the facts that led to the drop in demand but to present the data and verify that this situation is accurate. It can affect not only the financial health of companies but also complicate the entire TPU and urban accessibility in the fifth largest city on the planet.

As future suggestions, some works analyze the facts generating this drop in demand, such as the migration of demand to the Metro, which is being expanded, the change in the way of working to remote work, the preference for local commerce (proximity retail) and the possible migration of inhabitants of the City of São Paulo to other nearby or not nearby cities.

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