Determining of Passenger Load Factor for Public Bus Transportation in Northern Peninsular Malaysia

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Abstract Over the decade, Malaysia showed excellent improvement in upgrading social mobility as the country moving to become a developing nation. The important factor of social mobility that needs to be highlighted is transportation. Day-to-day activities require transportation to move from one place to another. Having systematic and reliable public transportation ensures the well-being and satisfaction of users. This paper proposes to determine the passenger load factor specifically for public bus transportation in Northern Peninsular Malaysia. The number of passengers and the number of seats in a bus is needed to rate the passenger load factor according to their Quality of Service (QOS) from Transit Capacity and Quality Service Manual (TCQSM) 3rd Edition. The results of passenger load factor for Kangar, Alor Setar, Georgetown, and Ipoh in Northern Peninsular Malaysia were found to be at 0.07, 0.23, 0.56, and 0.14 respectively. The capital cities investigated in this study are rated as A for their QOS except for Georgetown at B. Although the QOS rated as excellent, some aspects need to be improvised such as better on-time performance and longer duration of service hours to encourage more users of public bus transportation and eventually increase the passenger load factor.

Keywords Public bus · Northern Peninsular Malaysia · Passenger load · Quality of Service · Public transportation

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1 Introduction

Nowadays, speed is no longer a primary factor for the transportation system but, the comfort, security, and safety of the transportation is more important [1]. The development of a transportation system in a city considers the provision of infrastructure, private transportation, and public transportation. So, the role of the government is significant in improving the public transportation system of a city [1, 2]. The public transportation system is highlighted as a transformation to provide greater sustainability [3] because it can reduce traffic congestion thus, reducing the accumulation of traffic pollutants in the atmosphere [4]. Public transportation benefits the transportation sector by lowering air pollution to the well-being of the environment [5–7].

Among all the public transportation services available, buses receive the most riders which made up to 600,000 trips each day [8, 9]. Over the years, authorities and bus providers have made a lot of improvements on the service quality of bus including the management and monitoring system [10]. Transport planners also agreed that sustainable development of public transportation can be accomplished by providing the highest service quality [11]. Good quality of service is measured by customers' perception and demand [12]. Norhisham et al. reviewed four bus transit manuals of four different countries and experts suggested six attributes regarding the service quality of bus including service hours, passenger load factor, comparison car and bus travel, frequency of bus, on-time performance, and coverage of service area [13].

While research by Shen and Feng explained that two categories influence passenger's comfort when traveling by bus namely, vehicle facilities (related to comfortable seating) and passenger load factor (related to the frequency of buses) [14]. The influence factors for public bus quality of service arise from the problems faced by the passengers [15]. In a sustainable view, a high passenger load factor can lower down the emission gas per passenger. There are various studies of public transport passenger load factor because it is a notable indicator to bus service quality, useful for current and new users, relatively crucial factor for customer's satisfaction [1, 11, 16, 17]

According to Kittelson and Associates and KFH Group et al., the definition of passenger load factor is a ratio of actual bus riders to the number of seats on the bus [18]. The number of passenger load factor and ratio of bus occupancy is strongly connected from one another for the regular users on existing bus routes [19]. Low bus occupancy and passenger load factor may cause by low service quality and safety concerns [20].

This study focuses on determining the passenger load factor for public bus transportation in Northern Peninsular Malaysia. The passenger load factors of the cities in Northern Peninsular Malaysia will be rated according to their quality of service (QOS) of Transit Capacity and Quality Service Manual (TCQSM) Third Edition [18].

2 Methods

Determination of passenger load factor for Northern Peninsular Malaysia involved capital cities of Kangar, Alor Setar, Georgetown, and Ipoh. The parameters used to determine passenger load factors are the number of passengers and the number of seats in a route of the public bus. So, the number of passengers and number of seats in the public bus of each route is the primary data that will be bind together with secondary data in the manual of Transit Capacity and Quality Service Manual (TCQSM) Third Edition [21]. The analysis implied in this study considers deductive and inductive approaches which are considered as a conceptual analysis of passenger load factor [22]. To collect the data of the parameters, the steps taken are:-

1. Get ready at the bus terminal of the city.
2. Once a bus arrived at the starting point of the route, record the number of passengers and seats in the bus.
3. Then, at each stop of the route, record the number of passengers that come in and out of the bus.
4. Keep recording the number of passengers and ride the bus until the last stop.
5. Repeat step 1 until 4 for the return route or different route of the bus.

Once all the data is already being collected, the passenger load factor can be calculated using Eq. 1. Then, the passenger load factor is analyzed based on their respective quality of service. The quality of service (QOS) is rated based on the range and comment indicated from Transit Capacity and Quality Service Manual (TCQSM) 3rd Edition [18] as shown in Table 1. The rate of QOS is chosen based on different ranges of passenger load factors. For QOS A, B, C, D, and E, the range of passenger load factor are 0.00–0.50, 0.51–0.75, 0.76–1.00, 1.01–1.25, and 1.26–1.50 respectively. Only four routes being considered for each city because the passenger load factor and QOS are determined as an average.

Table 1 Quality of service for passenger load factor as indicated in Transit Capacity and Quality Service Manual (TCQSM) Third Edition [18]

Quality of Service	Passenger Load Factor (passenger/seat)	Comments
A	0.00–0.50	No passenger needs to sit next to another
B	0.51–0.75	Passenger can choose where to sit
C	0.76–1.00	All passengers can seat
D	1.01–1.25	Comfortable standee load for design
E	1.26–1.50	Maximum schedule load

$$\text{Passenger Load Factor} = \text{Number of Passengers} \div \text{Number of Seats} \quad (1)$$

3 Results and Discussion

A total of four bus routes are considered in calculating appropriate Quality of Service (QOS) based on their passenger load factor. The results of passenger load factor for bus routes at four individual capital cities are illustrated in Fig. 1 until Fig. 4. In Kangar, the passenger load factor for route T10 (Changlun by Arau), T11 (Arau), T12 (Kuala Perlis), and T100 (Seriab by Penggau) are 0.06, 0.09, 0.08, and 0.04 respectively. All route is at QOS A in range 0.00 to 0.50. The average passenger load factor for four routes in Kangar is 0.07, classified as QOS A. Bus riders in Kangar do not face any shortcomings in finding a seat when riding a bus as it has a low passenger load. It is also proven by Sani et al. [23] that citizens in Perlis choose to move from one place to another by motor instead of public transport because the routes are very limited.

The passenger load factor in Alor Setar is graphically shown in Fig. 2 of four routes namely, Kangar to Jitra, Sintok (UUM), Kuala Kedah, and Kuala Nerang. The results of the calculated passenger load factor for the route of Kangar to Jitra, Sintok (UUM), Kuala Kedah, and Kuala Nerang are 0.26, 0.29, 0.18, and 0.17 respectively. The results of passenger load factor for the bus routes in Alor Setar are below 0.50 which is at QOS A as established in TCQSM 3rd Edition. Hence, no bus riders are required to sit next to each other.

The passenger load factor in Georgetown is different from the other two capital cities of Kangar and Alor Setar because the range of passenger load factor varies. Bus routes 11 (Batu Lanchang), 101 (Tok Bahang), 204 (Bukit Bendera), and CAT (Weld Quay) recorded their passenger load factor at 0.27, 0.49, 0.55, and 0.92 respectively.

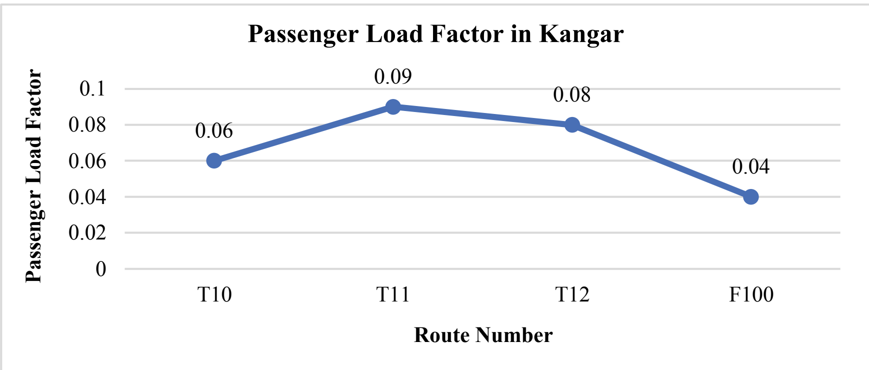

Fig. 1 Passenger load factor for bus service in Kangar

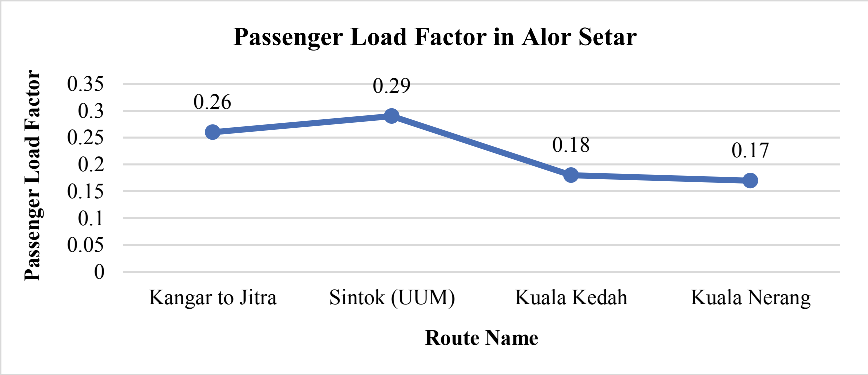

Fig. 2 Passenger load factor for bus service in Alor Setar

The bus routes of 11 and 101 are under QOS A, while bus routes of 204 and CAT are under QOS B and C respectively. The average passenger load factor for the bus routes in Georgetown is 0.56 which is classified as QOS B. According to TCQSM 3rd edition, the passenger load factor for public bus service at Georgetown indicates that passengers are free to choose their seat when riding the public bus either beside other riders or not upon availability (Fig. 3).

As for Ipoh, the passenger load factor for the bus routes is shown in Fig. 4. Route T30b (Chemor), T34 (Gopeng), T37 (Bandar Sri Botani), and F103 (Ampang) recorded a passenger load factor of 0.08, 0.22, 0.09, and 0.15 respectively which are in QOS A. Meanwhile for overall passenger load factor in Ipoh is 0.14 at QOS A. Based on the manual of TCQSM 3rd edition, the passengers can select any seat they want when riding a public bus in Ipoh due to the low passenger load factor. During the research, the state of Perak was having up to 30 new cases of Covid-19 daily hence, the anticipation of bus riders is declining. The citizens avoid public transport

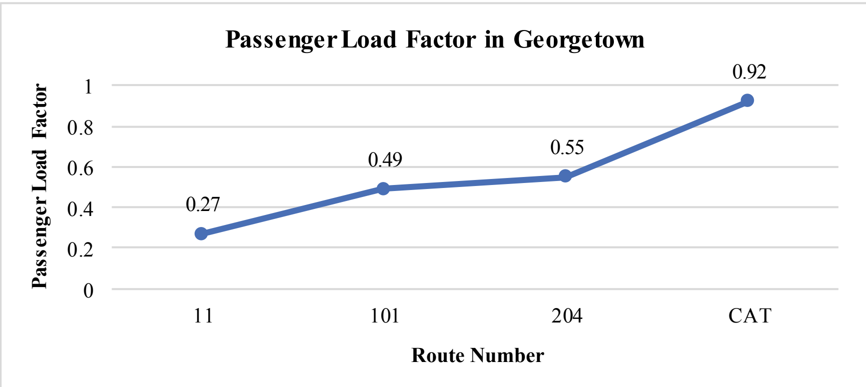

Fig. 3 Passenger load factor for bus service in Georgetown

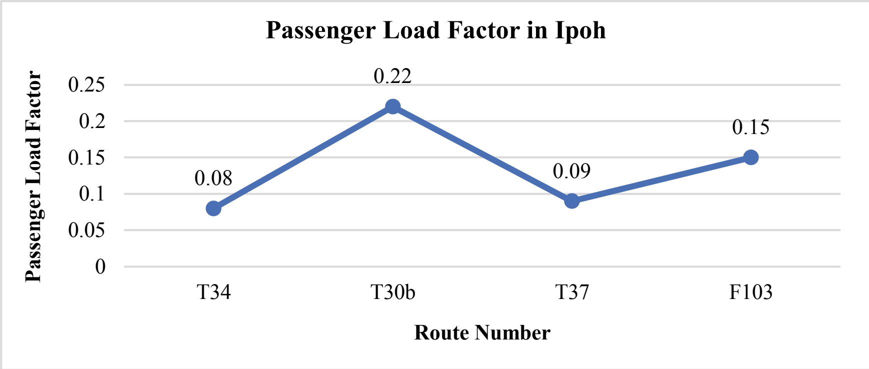

Fig. 4 Passenger load factor for bus service in Ipoh

especially with a high volume of passengers because the social distancing becomes invalid.

The quality of service (QOS) for public bus service per the passenger load factor at four of the capital cities in Northern Peninsular Malaysia were found to be at QOS A except for Georgetown at QOS B. The research was done during pandemic Covid-19 hence the rate of QOS may be different if the pandemic is under control. Apart from that, some state in Northern Peninsular Malaysia has small coverage of bus routes due to the size of the state, for example, Perlis. Therefore, citizens tend to choose private transportation rather than public transportation.

4 Conclusions

All and all, the average passenger load factor for Kangar, Alor Setar, Georgetown, and Ipoh were found at 0.07, 0.23, 0.56, and 0.14 respectively. The passenger load factors for public bus service at the capital cities were established as QOS A except for Georgetown at QOS B following the TCQSM 3rd Edition. This means that the bus riders at Kangar, Alor Setar, and Ipoh can select any seats in the public bus without having to share with other riders due to the low passenger load. As for Georgetown, bus riders can still pick any seats they want but the seat can either be with another bus rider or alone. Public bus service in all the capital cities needs to be upgraded in terms of their passenger load and utilization, although most of it has been rated as QOS A. Improving the passenger load factor will increase the productivity of the service. Other recommendations that can be highlighted are better on-time performance and higher duration of service which are closely related to passenger load factor. An increase in the bus rider's participation is influenced by the factors (passenger load factor, on-time performance, and service frequency). This research is done during the pandemic of Covid-19 so the results may be different when the pandemic is under control. Further research on the passenger load factor can be done in the situation of endemic Covid-19 to see the difference in the outcome of the study. Changes in trends and technology give opportunities to the researchers to have unlimited resources, hence the interpretation of passenger load factor for the public bus will be upgraded over time [24].

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