SUBSTANTIATION OF METHODS FOR EXPERIMENTAL RESEARCH OF THE PROCESS OF URBAN PASSENGER TRANSPORT MOVEMENT ALONG ROUTES

Khomidov Anvarbek Ahmadjon ugli
Andijon Machine Building Institute, PhD student
https://doi.org/10.5281/zenodo.14376378

Abstract. The movement of urban public transport is carried out in a certain flow. The prospects for the development of public passenger transport in cities are determined by the number of passengers, the distance between their departure and arrival. The greater the transport mobility of the city's population and the distance traveled by passengers in transport, the more work will need to be done to transport passengers and the more the city's transport system will develop.

Kalit so'zlar: passengers, public transport, transport mobility, population.

Underestimation of the estimated volume of passenger transportation leads to insufficient development of urban passenger transport, and overestimation leads to unjustified excessive spending on transport development. Correct determination of the total volume of passenger transportation, transport mobility of the population and its coordination with passenger flow are of great importance in planning urban passenger transport.

The volume of passenger flow in cities is determined based on the transport mobility of the population.

According to Prof. V.A. Cherepanov, settlements with a population of 100 thousand or more can be divided into the following four characteristic groups [85] (Table 3.1).

Table 3.1

Accountable transport mobility of the population

The city's population is in thousand people.	Percentage of total population in cities	Mobility to be reckoned with		The limits of mobility change	Average computational mobility
		Max.	Min.		
100-200	43,5	610	253	300-500	410
200-500	46,7	670	311	370-530	460
500-1000	46,1	695	410	420-600	510
More than 1000	43,7	775	485	550-775	675

As the urban area expands, its population and, accordingly, its mobility associated with the use of public passenger transport also increase. In large cities, as the distance of population mobility increases, the proportion of their walking decreases, and the level of use of public passenger transport increases.

Figure 3.1 shows the transport mobility in large settlements. As can be seen from the figure, the transport mobility of the population is recorded at high, medium and low levels. The lines in the middle are characterized by the following average indicators:

For areas with high transport mobility

$$p = 500 + 0{,}4(H_1 - 300) + 0{,}2(H_2 - 400); \qquad (3.1)$$

For areas with average traffic

$$p = 400 + 0{,}4(H_1 - 300) + 0{,}2(H_2 - 400); \qquad (3.2)$$

For areas with low transport mobility

$$p = 300 + 0{,}4(H_1 - 300) + 0{,}2(H_2 - 400); \qquad (3.3)$$

Here p is the calculated transport mobility indicator of the city;
H_1-the number of settlements with a population of 100 to 200 thousand;
H_2-the number of settlements with a population of 200 thousand to 1 million (for H_2<200 thousand inhabitants, the third term is removed; for H_2<200 thousand inhabitants, the second term is H_1=200).

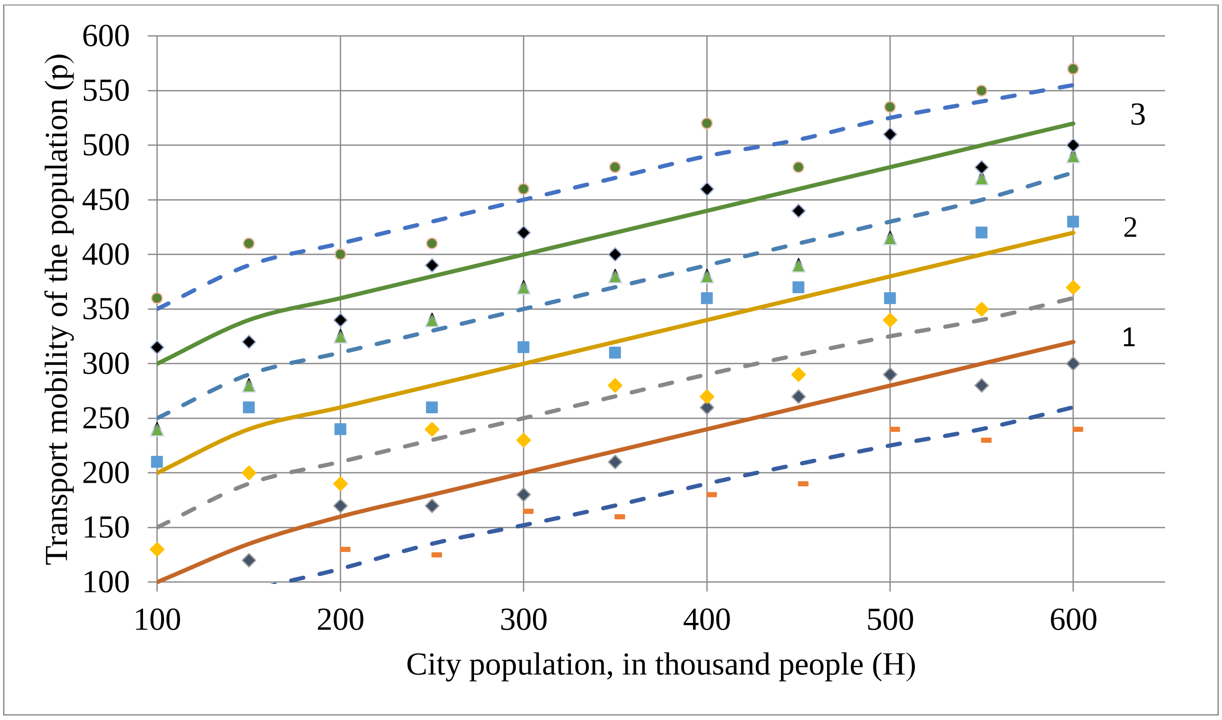

Figure 3.1. Dependence of transport mobility (r) on population size (H)
1-low mobility; 2-medium mobility; 3-high mobility.

A particularly large range of changes in the estimated mobility of the population occurs in cities with a population of 200 to 300 thousand, which is explained by the interaction between the movement of the population on foot and the use of public transport. The total volume of transport of the population in cities (P) is determined by the following expression:

$$P = P_1 + P_2 + P_3, \qquad (3.4)$$

Here, P_1- the volume of transportation of permanent urban residents.
P_2- the volume of passenger traffic coming to the city from outside.
P_3- suburban passenger traffic.

The annual volume of transportation is determined by multiplying the population by their transport mobility, in order to determine the size of the estimated mobility for the projected period, it is advisable to first divide them into the main types of movements. Such divisions into types are carried out conditionally, taking into account the materials obtained from observations and their analysis, data on the composition of the population, and the remaining data, with sufficient probability.

The results of the calculations and the results of the coefficients obtained in general can be checked by comparing them with reports of previous years and with data on the volume of direct transportation at the same time. Such checks ensure the accuracy of the data obtained by calculating the size of the estimated transport mobility and its distribution by elements. This serves as the basis for determining their estimated values for the future, proceeding from the indicators of the adopted sizes.

The total annual volume of transportation of the permanent population of the city (P_1) for the projected period is determined by the following expression:

$$P = H(p_1n_1 + p_2n_2)k_i * k_{mo} * k_q * k_t * k_a \, , \qquad (3.5)$$

Here, H- the number of city residents for the accounting period;
p_1- the number of trips an employee makes to work during a year (one way);
p_2- the number of times a student goes to school during a year (one way);

To ensure the mobility of the population, that is, to meet the need for transportation, it is necessary to organize the movement of urban public transport. For this, planning urban public transport routes is of great importance. The most widely used type of urban public transport is buses. In order to distribute buses along routes, it is necessary to determine their intervals along the routes. This requires determining a number of data. The distribution of bus routes is part of the distribution of urban passenger transport routes and consists of a number of subsystem tasks that are performed sequentially (Figure 3.2).

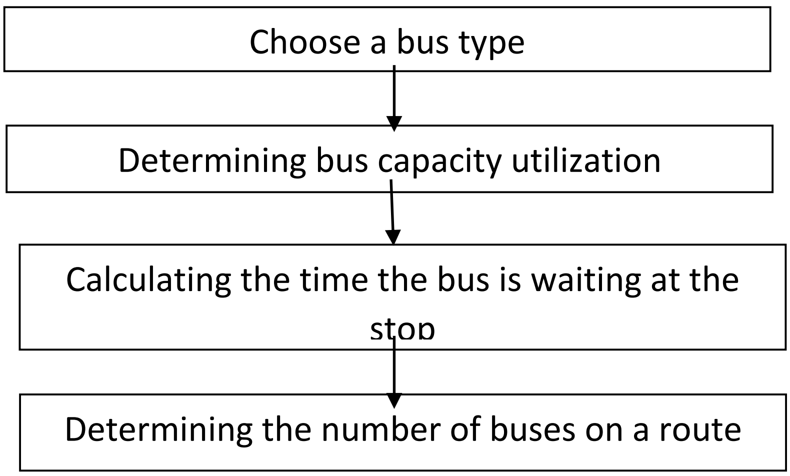

Figure 3.2. Sequence of bus distribution tasks in the traffic direction

IBAST | Volume 4, Issue 12, December

This system consists of the following: selecting the type of bus, using the capacity of the bus, calculating the number of buses that need to operate on the route.
Selecting the type of bus. The correct selection of the type of bus prevents the occurrence of traffic jams due to the overloading of the road network with traffic due to the use of small-capacity buses on routes with high capacity, and prevents the occurrence of high-performance intervals, and prevents the decrease in the efficiency of their operation due to the use of high-capacity buses on routes with high passenger flow. The main determining factors are the passenger flow capacity or the level of bus capacity utilization during "peak" hours, the unevenness of the passenger flow across route sections and hours of the day, the size of the permissible intervals, the capacity of the road network and road conditions, and the cost of using the traffic structure (transportation cost).
Bus capacity utilization. We assume that the number of buses operating on the route is sufficient to transport the existing passenger flow. This situation can be expressed by the following inequality:

$$\sum_{j=1}^{i}\left(P_{jk}-Q_{jk}\right) \le A_k \qquad i=\overline{1\ldots n_k}\ , \qquad (3.6)$$

Here, P_{jk} - the number of passengers boarding the bus from stop j in route k,
Q_{jk} - the number of passengers who got off the bus at stop j in route k,
A_k- k is the bus capacity used in the direction of travel,
n_k- k is the number of stops in the direction of travel.

Ushbu tengsizlik har qanday bekatda avtobusni to‘ldirgan yo‘lovchilar soni $\sum_{j=1}^{i}\left(P_{jk}-Q_{jk}\right)$, avtobusning sig‘imi A_k dan ortiq bo‘lmasligi kerak. Avtobusning sig‘imdan foydalanish koeffitsientidan foydalanilgan taqdirda (2.6) ifoda quyidagi ko‘rinishda ifodalanishi mumkin
This inequality states that the number of passengers filling the bus at any stop $\sum_{j=1}^{i}\left(P_{jk}-Q_{jk}\right)$, should not exceed the capacity of the bus A_k. In the case of using the capacity utilization coefficient of the bus, expression (2.6) can be expressed as follows

$$\eta_{ik} \le 1 \qquad n=\overline{1\ldots\ n}$$

Here η_{ik}- The coefficient of loading or fullness of the bus with passengers at stop i in route k.
Determining the bus stop time. The bus stop time consists of two quantities: the number of passengers getting off the bus; the number of passengers getting on the bus. The number of passengers getting off the bus does not affect its capacity, but the number of passengers getting on the bus at the stop is directly related to its capacity. This relationship can be expressed with sufficient accuracy by a logarithmic function.

$$\tau_{ik}^{get\ on} = -\theta_k \ln(1-\eta_{ik})\ , \qquad (3.7)$$

Here, $\tau_{ik}^{get\ on}$- The time of boarding the bus at stop i on route k,
θ_k- Average time for passengers to board a bus in route k,
η_{ik}- The passenger occupancy coefficient of the bus at stop i in route k using formula (3.6).

References:

1.K M Nissen. How does weather affect the use of public transport in Berlin? (2020)

2. Markus Hofmann, Margaret O'MahonyThe Impact of Adverse Weather Conditions on Urban BusPerformance Measures – an Analysis Using ITS Technology(2005)

3.Sui Tao, Jonathan Corcoran, Francisco Rowe, Mark Hickman, (2018), To travel or not to travel: 'Weather'is the question. Modelling theeffect of local weather conditions on bus ridership,Transportation Research Part Cjournal homepage: www.elsevier.com/locate/trc.

4.Syeed Anta Kashfi.Adverse weather effects on bus ridership.26th ARRB Conference – Research driving efficiency, Sydney, New South Wales 2014

5.Абдуллаев Ботир Инатович, Ахмедов Дилмурод Тошпўлатўғли, Мўминов Тўлқин Шойқулович Йўловчининг манзилига етиб бориш вақти ва унга таъсир этувчи кўрсаткичлар Илм-фан ва инновацион ривожланиш журнали 2021йил 1- сон 75 бет.

6.Qun Chen, Global Optimization for Bus Line Timetable Setting Problem, (2014),Hindawi Publishing CorporationDiscrete Dynamics in Nature and SocietyVolume 2014, Article ID 636937, 9 pagestp://dx.doi.org/10.1155/2014/636937.

7.hikersbay.comэлектрон манба маълумотлари.

8.Abdullaev, B., Yuldoshev, D., Muminov, T., & Axmedov, D. (2021, April). Improving the method of assessing road safety at intersections of single-level highways. In E3S Web of Conferences (Vol. 264, p. 05027).

9.Ahmed M. El-Geneidy, James G. Strathman, Thomas J. Kimpel, and David T. Crout, (2005), Transportation Research Record Journal of the Transportation Research Board

10.Гудков В.А., Миротин Л.Б., Вельможин А.В., Ширяев С.А. Пассажирские автомобильные перевозки: Учебник. Под ред. В.А. Гудкова. - М.: Горячая линия - Телеком, 2006. - 448 с.

11.Спирин И.В. Организация и управление пассажирскими автомобильными перевозкаи, М., Акакдемия, 2010. – 400 с. 14. Бутаев Ш.А. ва б. Ташиш жар