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NUMBER OF REMARKABLE COURSES AS A MEASURE OF LEVEL OF INHABITANT'S TRANSPORT SERVICE STANDARD

Summary. Whatever kind of passenger transport it is, one of the most important value, which characterizes supply of transport service is the number of courses for zone in some direction [5]. This article presents objective coefficient of availability of public transport in time, just like inhabitants observe it.

LICZBA KURSÓW POSTRZEGANYCH JAKO MIERNIK JAKOŚCI OBSŁUGI KOMUNIKACYJNEJ MIESZKAŃCÓW

Streszczenie. Niezależnie od rodzaju organizowanej komunikacji jedną z najistotniejszych wartości charakteryzujących podaż usług transportowych jest liczba kursów obsługujących dany rejon komunikacyjny w wybranej relacji [5]. Jednakże często miara ta bywa myląca – brak w niej odniesienia do rozłożenia kursów w czasie. W niniejszym artykule przedstawiony zostanie obiektywny wskaźnik obrazujący dostępność do komunikacji w czasie faktycznie postrzeganą przez jej użytkowników.

1. INTRODUCTION

No coefficient measure can be use without review and as a only value define level of transport service. In this order, it is necessary to know all of the factors of quality.

The circulation for comment is a very good solution. Unfortunately, the whole situation in city, region or country could make those researches false. If the condition of transport is very bad, estimations gained from questionnaire will be better than reality. For example if every course in long time (year or longer) is much late because of some road repair [1], passengers will get used to that. Some potential passengers will not be using public transport. The rest will think that it is a normal situation, and »it just has to be like that«. That is one of the reasons for bigger „acceptation” for delays in bigger cities [6].

Other example is frequency remark. If the biggest frequency in public transport is 2 courses per hour, inhabitants will postulate this for new line. In other region, where municipal transport is much better, will not remember about line with frequency like that. It will be easier for them to change the vehicle but, to know only elementary scheme of main lines (for example with frequency 5 courses per hour or more).

The researches in Komunalny Związek Komunikacyjny GOP (municipal transport organizer in

Upper Silesia) area, says that tramline No. 25 (Dąbrowa Górnicza – Będzin – Wojkowice) was marked badly, because of frequency (regular, 2 course per hour, when other tramlines were coursing every 10 or 20 minutes). After they change this line into busline instead of tramways, inhabitants were dissatisfied, even the frequency was lower (irregular, average about every 45 minutes) [4]. The only explanation of that is the fact that almost every busline in Będzin area are irregular, average about every 1 hour or less frequently).

The result of this contemplation is necessary to use independent objective coefficient to be able to compare quality of public transport for different regions.

2. THE MEANING OF COURSES VARIATION IN TIME

For every passenger the most important feature of transport is among others:

- availability in space and
- availability in time.

Availability in space presents distance between source of travel (for example home) and stop, and also between stop and destination place (for example work place). If this distance is too much, potential passenger will not use public transport.

Availability in time is also very important. For example if some person has to begin work at 7 AM, and the only connection offered him transport at 5 AM, he will feel 2 hours a day as lost in travel. Except the transport of workers to large companies as mines or foundries, necessities for transport of inhabitants are very dispersed. Many companies, offices are situated at one line, but on long distance. It is impossible to satisfy all passengers on one course. However as big as the level of satisfaction will be part of public transport in whole market, as large as the number of courses will be the cost of transport function. Many features make impossible to fullfil rectangular time-table, which in most cases is the best for inhabitants.

If so, the number of courses is not proportional to the level of availability in time, it is impossible to objectively say that some number of courses is satisfactory or not. It is necessary to build other measures.

3. AVAILABILITY OF COURSES REMARK COEFFICIENT

Lower is presented objective availability of courses remark coefficient (1). The most important advantages of it are:

- it is easy to calculate, and
- it is easy for interpretation.

$$W_{pk} = 1 - \frac{d(t)}{2 \cdot \bar{t}} \quad [N] \quad (1)$$

where: W_{pk} - availability of courses remark coefficient [N],

$d(t)$ - average deviation of intervals of time between courses [min.],

\bar{t} - mean value of intervals of time between courses [min.].

In this research a number of intervals has to be the same as the number of courses in research period. The last interval is the complement of the sum of all intervals to the whole research period (2). Example of this calculation is presented in table 1.

$$t_n = T - \sum_{i=1}^{n-1} (t_{i+1} - t_i) \quad [\text{min}] \quad (2)$$

where: T - research period, n - number of courses, t_i – time of depart (number i in series).

Tab. 1

Calculation of last interval in research period

Time of depart	Interval
6:10	6:15 - 6:10 = 5 min.
6:15	6:30 - 6:15 = 15 min.
6:30	6:45 - 6:30 = 15 min.
6:45	(7:00 - 6:00) - (5 min. + 15 min. + 15 min.) = 60 min. - 35 min. = 25 min.

4. AN INTERPRETATION OF RESULTS

Availability of courses remark coefficient is normalized. It means that:

- results of it is between 0 and 1,
- it is dimensionless,
- the same results for different datas, means the same level of service.

1 value is the result for rectangular distribution of courses. 0 value is impossible, but this coefficient is close to zero, if many courses have the departure time almost at the same time, and after (before) that is long break.

By using this coefficient it is possible to calculate in reality:

- part wasted courses,
- remarkable number of courses.

The part of wasted courses is calculated by formula 3:

$$U_{tk} = (1 - W_{pk}) * 100 \quad [\%] \quad (3)$$

where: U_{tk} - part wasted courses [%], W_{pk} - availability of courses remark coefficient [∅].

Remarkable number of courses is calculated by formula 4:

$$L_{kp} = W_{pk} * L \quad [\text{course}] \quad (4)$$

where: L_{kp} - number of remarkable courses [course], W_{pk} - availability of courses remark coefficient [∅], L - number of performed courses [course].

For example if in one hour research will be only 2 courses and the difference of departure times will be 2 minutes, most inhabitants will remark them as one course. It means that about 50% of courses are wasted. The U_{kt} factor will be 46,7%, and value L_{kp} will be 1.067.

5. AVAILABILITY OF COURSES REMARK COEFFICIENT SENSITIVITY CONTROL

The most important thing in building any coefficients is to analyze its sensitivity in different situations. To control availability of courses remark coefficient sensitivity, some experiments have been made, the results of that have been compared with remarks.

The first part of the experiment has been made for three-hours research period – table 2.

Tab. 2

Breaking the rectangular distribution of courses experiments

Experiment No.	Intervals	Description
1	15-15- 0 -15-15-15-15-15-15-15-15-15-15-15-15-15-15	Course added especially to transport workers to (from)big company.
2	15-15- 5-10 -15-15-15-15-15-15-15-15-15-15-15-15-15-15	Course added in rush-hours.
3	15-15-30-15-15-15-15-15-15-15-15-15-15-15-15-15-15	Course cancelled between rush-hours.
4	15-15- 20 -15-15-15-15- 10 -15-15-15-15-15-15-15-15-15-15	Course delayed between rush-hours to make the break for drivers. After break for all drivers back to standard time-table.

Results of these experiments are presented in table 3. To compare there are also results for rectangular distribution of courses. There is no reason to reproach with these results.

In experiment No. 1 passenger in fact remarks that there are more empty seats place in the „vehicle”, but not that there are more courses.

In experiment No. 2 almost none knows that there is an additional course – only passengers which often uses it. Number of remarkable courses is almost the same as without added courses.

Break of courses distribution like in experiment No. 3 is not well interpreted. If a passenger thinks that there is no break, he be waiting very long at the busstop. Probably he will not want to use public transport any more.

Little break of rectangular distribution in experiment No. 4 gets result of presented coefficient only little lower than 1.

Tab. 3

Factors of courses remarkable in experiments No. 1÷4

Experiment No.	L [course]	W_{pk} [N]	U_{tk} [%]	L_{kp} [course]
0	12	1	0	12.00
1	13	0.92	7.69	12.00
2	13	0.93	7.05	12.08
3	11	0.92	7.58	10.16
4	12	0.97	2.78	11.67

After that there have been made experiments similar to experiment No. 4, but this time, only one interval has been changed:

4a. One interval has been made longer by 5 minutes. Research period also has been made longer by 5 minutes.

4b. One interval has been made shorter by 5 minutes. Research period also has been made shorter by 5 minutes .Results are presented in table 4. It is clear that every breaking of rectangular distribution is wrong. It is not important that supply is larger (**4b**) the Important factor is that time-table is difficult to remember, which could be the reason of getting late for the bus.

Tab. 4

The influence of breaking the distribution of courses by changing one interval

Experiment No.	Intervals [min.]	L [course]	W_{pk} [N]	U_{tk} [%]	L_{kp} [course]
4a	15-15-15- 20 -15-15-15-15-15-15-15-15-15-15-15-15-15	12	0.98	2.48	11.70
4b	15-15-15- 10 -15-15-15-15-15-15-15-15-15-15-15-15-15	12	0.97	2.62	11.69

In the second part of experiments 2 lines with rectangular time-table – six courses per hour for every one – has different synchronization between time-tables of these two lines. Research period was 1 hour. The results are presented in table 5. In this case there no reason to abandon presented coefficient, too.

Tab. 5

The influence of different synchronization of two line time-tables

Experiment No.	Intervals [min.]	L [course]	W_{pk} [N]	U_{tk} [%]	L_{kp} [course]
5a	5-5-5-5-...	12	1	0	12.00
5b	4-6-4-6-...	12	0.90	10	10.80
5c	3-7-3-7-...	12	0.80	20	9.60
5d	2-8-2-8-...	12	0.70	30	8.40
5e	1-9-1-9-...	12	0.60	40	7.20
5f	0-10-0-10-...	12	0.50	50	6.00

The last experiment was analysis of real meaning of cutting down expenses by changing frequency of coursing one of two lines from 6 to 5 courses per hour (one line coursing every 10 minutes, and the second every 12 minutes). Results of 2 possible synchronization experiment are presented in table 6. There is only 8 % less courses, but more than 30 % of passengers feels dissatisfied. Number of wasted courses is about 25 %. If anybody looks at intervals, he will know that it is a very uncomfortable situation.

Tab. 6

The influence of unequal frequencies to availability of courses in time factor

Experiment No.	Intervals [min.]	L [course]	W_{pk} [N]	U_{tk} [%]	L_{kp} [course]
-	5-5-5-5-5-5-5-5-5-5	12	1	0	12
6a	0-10-2-8-4-6-6-4-8-2-10	11	0.7455	25.45	8.20
6b	1-9-3-7-5-5-7-3-9-1-10	11	0.7545	24.55	8.30

6. CONCLUSION

These experiments done presents that availability of courses remark coefficient has satisfactory results in every situations. That means that it is very useful in making transport offer.

It is universal because it could be use in every part of transport – from municipal transport to civil aviation.

If somebody wants to use that coefficient he should remember that it is useful, but it does not answer every question. For example the same result will be if only the course is at 4:05 AM, 7:40 AM, and 2:30 PM. But only at 7:40 AM the course will be useful for a child, who wants to get to school [2].

It is also important that regular coursing is not always the best for the whole transport system, and number of remarkable courses is not the most important [3]. Other factors could suggest that is a better and different way to organize public transport. It does not change the fact that presented coefficient is useful to know about.

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