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DEVELOPMENT OF RATIONAL ROUTES IN THE TRANSMISSION OF SMALL BATCH CARGO

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Annotation

At this time, cost reduction is one of the most important concerns facing every company or organization that works with the distribution of consumer goods to the general public. This issue will be resolved by reducing the number of cars on routes and the distance they travel, hence lowering operational costs. The Clark–Wright approach and the insertion of punks into routes, taking into account the car's load-bearing capability, are described in this article as solutions to the problem of a sensible sequence of cargo transportation to addresses.

Keywords: fine batch load, Clark-Wright method, routing rational route, consumer, cargo receiver, commute, algorithm, radial, route combination, load bearing, achievement Matrix

Introduction

Automobile transport accounts for more than 88,7% of cargo moved in the Republic of Uzbekistan [1], and its distribution by modes of transport is depicted in the diagram. Small parcel freight accounts for a substantial portion of cargo transported by car.

1-picture. According to a types of transport shipping volume (%)

The issue of small batch transport routing is identifying the scheme by which numerous addressesillarni link; the Bunda's starting and ending locations should be single, and the remaining addresses should only be passed once. This problem is brought to the traditional "kommivoyajer matter" of mathematics in its most basic form.

The Clark–Wright approach is comprised of the following components.

First and foremost, a freight transportation preliminary strategy is created. Each receiver is given a separate pendulum route and a car with a lift that corresponds to the amount of cargo to be conveyed in this circumstance. Two pendulum paths are combined in subsequent iterations to form a distribution route. Within the framework of the area under study, it is desirable to develop a methodology for the routing of small batch cargo transportation.

2. Literature Review

[2] proposes that in assessing the efficiency of lorry transporti's job, the tiny batch of cargo transported be taken into consideration, because the flow of merchandise conveyed in urban auto transport is mostly small batch cargo. In transportation route planning challenges, a genetic algorithm is used (Sun, Y., Lang, M., Wang, D., 2016; Dib, O., Moalic, L., Manier, M.-A., Caminada, A., 2017; Fazayeli, S., Eydi, A., Kamalabadi, I.N., 2018), чумоли колоннаси алгоритми (Sawadogo, M., Anciaux, D., Roy, D., 2012), gibrid algorithm (Kai, K., Haijiao, N., Yuejie, Z., Weicun, Z., 2009) and narrow ways for algorithm (Idri, A., Oukarfi, M., Boulmakoul, A., Zeitouni, K., Masri, A., 2017) wide using.

The narrow ways algorithm (KSP) for in the following years, many scientists have conducted research on the solution of short-path problems on the algorithm of the KSP (Eppstein, D., 1998; Yen, J.Y., 1971; Martins, E.D.Q.V., Pascoal, M.M.B., Santos, J.L.E.D., 1999; Aljazzar, H., Leue, S., 2011; Chen, B.Y., Li, Q., Lam, W.H.K., 2016; Liu, H., Jin, C., Yang, B., Zhou, A., 2018).

They cited several models and methods of solving routing issues in their scientific work, including optimization of load capacity [3], transportation of large loads, delivery of small batch loads, development and optimization of hourly movement tables in various productions, as well as discrete optimization, [4, 5], coordination of working indicators of motor vehicles and loading circuits [6, 9, 10]. However, the fact that cargo flows can be controlled based on the efficient distribution of motor vehicles to routes, the number of vehicles distributed to routes, and the need to keep transportation costs to a minimum in accordance with the selected criteria, and such significant cases are not fully considered.

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3. Research Methodologies

The Clark Wright approach was used in the article to identify the rational order of transporting cargo to addresses and to handle the problem of introducing punks into routes while accounting for the car's load capacity. Other methods, such as statistical analysis, were also applied.

4. Analysis and Discussion of Results

1-table. Coordinates of cargo buyers and the size of the required to the cargo

Cargo must be delivered to 10 recipients from the initial address where the Cargo Terminal (Warehouse) is located. The coordinates of the cargo buyers and the size of the Talabi to the cargo are given in Table 1, The coordinate of the cargo terminal.

Shipping Terminal (Warehouse) kordinat: x0=10, U0=16. To deliver the cargo, a vehicle with a maximum capacity of 800 units is used.

Shipping buyers T / R	Coordinates		Demand for cargo, tons
	X	Y	
1	19	7	180
2	4	25	170
3	11	5	200
4	15	4	290
5	3	10	230
6	14	21	270
7	7	17	210
8	4	16	220
9	5	7	180
10	13	12	390

The question is. How many vehicles will be needed to deliver the cargo? What will be the optimal scheme of Transportation?

These points are determined in the system of coordinates of Decart. The cargo terminal and the location of 10 units of recipients and the volume of cargo delivered to each recipient are shown in Figure 2.

The initial scheme of the route is presented, that is, a separate route is organized to deliver the cargo to each individual recipient (Figure 3). For example, the driver loads 180 units of cargo into the body of the vehicle and delivers it to 1 Punkt, drops it to the same place, then returns to the base, 170 units takes the load and delivers it to 2 Punkt, drops the load and returns to the base again, then 200 units takes the load and delivers it to 3the G.

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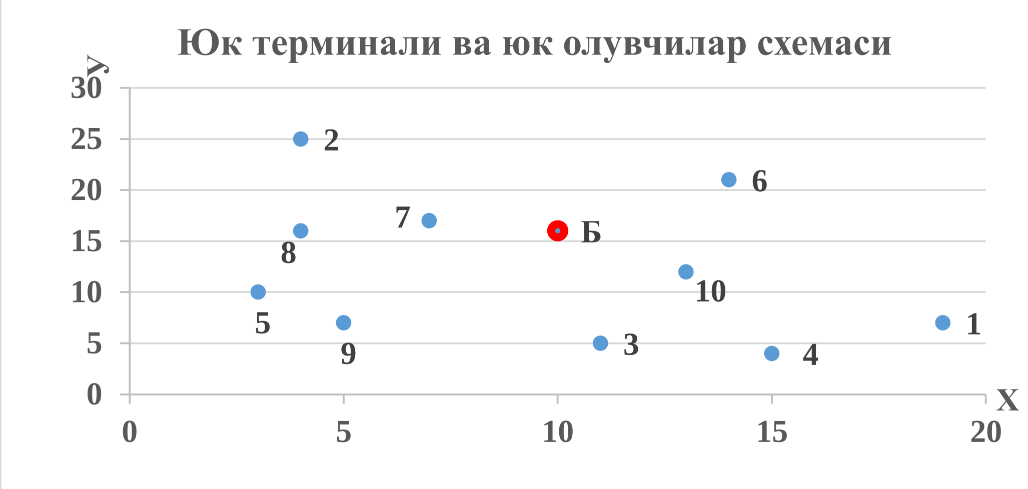
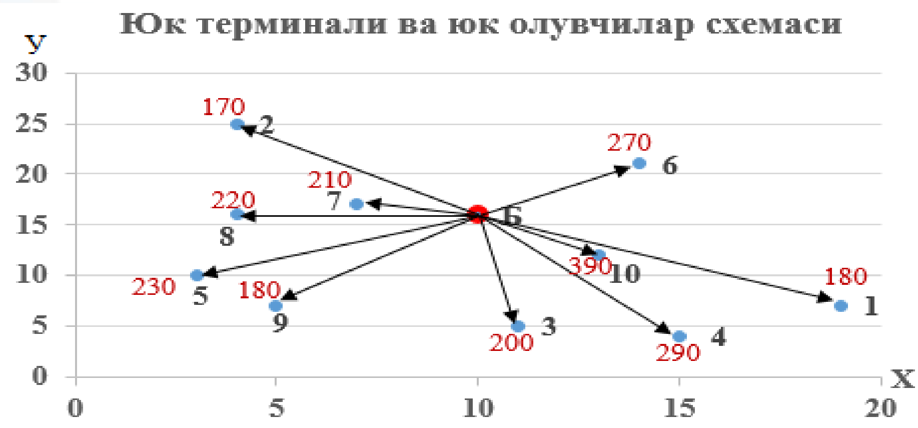


2-picture. Shipping terminal and shipping buyers scheme.

Thus, the initial distribution scheme of the route reflects only the radial direction of the movement of the car itselftiradi. The number of radial routes in Bunda is equal to the number of cargo recipients. In this case, the load distribution scheme will consist of 12 radial directions.



3-picture. The initial scheme of the recipe.

The essence of the method is as follows.

In the first place, a preliminary plan of cargo transportation is drawn up. In this case, each recipient is allocated a separate pendulum (radial) route and a car with a lift corresponding to the amount of cargo to be transported (Figure 3). In the next iterations, two pendulum routes are paired together, resulting in the formation of a distribution route (Figure 4). The remaining pendulum routes and distribution routes are interconnected, and the Bunda option is selected so that as a result of pairing, the cost of Transportation is maximally reduced. If it is not possible to reduce costs as a result of any subsequent pairing, or if the traffic volume on the connecting route

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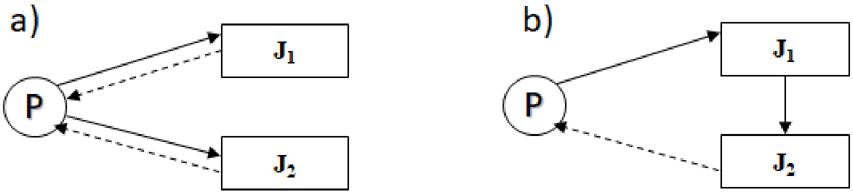
exceeds the load-bearing capacity of the moving content, then the process of solving the Bunda will be interrupted, and The found plan will be optimal.



4-picture. a) radial route; b) Cross-Country Route.

General commute in the first case masofasi will be as follows:

$$l_1 = 2l_{j_1} + 2l_{j2} \qquad (1)$$

The second position is based on the below:

$$l_2 = l_{pj_1} + l_{j_1j_2} + l_{j_2p} \qquad (2)$$

The value of swallowing from it when two radial routes are combined will be as follows:

$$\Delta l_j = (l_{pj_1} + l_{j_2p}) - l_{j_1j_2} \qquad (3)$$

Here Δl_j - the distance from the swallow, that is, the distance from the junction of 1 and 2 punches, km; l_{pj_1}, l_{j_2p} - respectively, the distance between 1 and 2 punches and the cargo terminal, km; - $l_{j_1j_2}$ -1 and 2 punches, km.

On the basis of the Clark-Wright algorithm, the possibilities of reducing the transportation costs of the supply of products in the population's punches are shown [7]. This method allows the use of a computer in solving the issue of obtaining a plan close to optimal and distributing loads to punches. In this, the error does not exceed 5-10%. The advantages of the method are its simplicity, reliability and flexibility, allowing to take into account the additional impacts, which affects the final solution of the issue.

Improvement of the Clark-Wright method using the algorithms profits Warshella and Deykstr [8] was proposed.

Now let's look at the practical solution of the issue. For this, the values in Table 1 are obtained:

Punches A (cargo terminal): x0=10, y0=16.

- Punches 1: x1=19, y1=7.
- Punches 2: x2=4, y2=25.
- Punches 3: x3=11, y3=5.
- E.tc.

A and 1 between the punches distance l_{A1} considered that based on the below examples:

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$$l_{Б1} = \sqrt{(x_Б - x_1)^2 + (y_Б - y_1)^2} = \sqrt{(10-19)^2 + (16-7)^2} = 12{,}7 \text{ km.}$$

$$l_{Б2} = \sqrt{(x_Б - x_2)^2 + (y_Б - y_2)^2} = \sqrt{(10-4)^2 + (16-25)^2} = 10{,}8 \text{ km.}$$

$$l_{Б3} = \sqrt{(x_Б - x_3)^2 + (y_Б - y_3)^2} = \sqrt{(10-11)^2 + (16-5)^2} = 11{,}0 \text{ km, and e.tc}$$

Next step, we have to find distance results of absorbing process:

$\Delta l_{ij} = l_{Bi} + l_{Bj} - l_{ij}$:

1 and 2 for cargo taker:

$\Delta l_{12} = l_{B1} + l_{B2} - l_{12} = 12{,}7 + 10{,}8 - 17{,}0 = 6{,}5$ км;

1 and 3 for cargo taker:

$\Delta l_{13} = l_{B1} + l_{B3} - l_{13} = 12{,}7 + 11 - 13{,}9 = 9{,}8$ км;

2 and 3 for cargo taker:

$\Delta l_{23} = l_{B2} + l_{B3} - l_{23} = 10{,}8 + 11 - 21{,}1 = 0{,}7$ км, ва ҳ.к.

The account results are entered into the table. That is placed in the upper right part of the matrix by the distance between the punches ($l_{j_1 j_2}$), and the lower left by the distance by the absorption values.

Table 3 Intermediate distance and distance absorption Matrix

	Distance between punches ($l_{j_1 j_2}$)										
	Б	12,7	10,8	11,0	13,0	9,2	6,4	3,1	6,0	10,2	5,0
	0,0	1	17,0	13,9	13,6	17,5	6,4	8,0	15,0	17,2	7,8
	0,0	6,5	2	21,1	23,7	15,0	10,8	8,5	9,0	8,1	15,8
distance absorption Matrix	0,0	9,8	0,7	3	4,1	9,4	16,3	12,7	13,0	13,4	7,3
	0,0	12,1	8,8	19,9	4	13,4	17,3	15,3	16,3	16,4	8,3
	0,0	4,4	5	10.8	8.8	5	15,6	8,1	6,1	7,3	10,2
	0,0	12.7	6.4	1.1	2.1	0.0	6	8,0	10,2	9,8	9,1
(Δl_j)	0,0	7.8	5.4	1.4	0.8	4.2	1.5	7	3,1	2	7,8
	0,0	3.7	7.8	4.0	2.7	9.1	2.2	6.0	8	1,4	9,8
	0,0	5.7	12.9	7.8	6.8	12.1	6.8	11.3	14.8	9	9,4
	0,0	9.9	0.0	8.7	9.7	4.0	2.3	03	1.2	5.8	10

Now let's look at the method of combining marsharuts, taking into account the value of the winnings. To do this, we enter a separate J column of indicators into the matrix of achievements. We agree that if the P_j Punches to be entered on the route is the starting or final destination, then the value above this line will be 0 , if the internal Punches, J and the pendulum will be 2 if it is entered on the route. For the initial plan, all the values of the column will be 2.

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P10	5.8	1.2	03	2.3	4.0	9.7	8.7	0.0	9.9	1	390
	P9	14.8	11.3	6.8	12.1	6.8	7.8	12.9	5.7	1	180
		P8	6.0	2.2	9.1	2.7	4.0	7.8	3.7	0	220
			P7	1.5	4.2	0.8	1.4	5.4	7.8	1	210
				P6	0.0	2.1	1.1	6.4	12.7	1	270
					P5	8.8	10.8	5	4,4	1	230
						P4	19,9	8,8	12,1	1	290
							P3	0,7	9,8	0	200
								P2	6,5	1	170
									P1	0	180
										у	Total transporting

Of the elements of the matrix of achievements, the largest (19,9) is selected. This indicates the routes ((P_3, P_4) that will give the greatest success when combined. Thus, two pendulum routes $P_0 - P_3 - P_0$ and $P_0 - P_4 - P_0$ are combined, J and the distribution route P_3 and P_4 is formed. in the column of the matrix of achievements and the values of the rows are changed from 2 to 1. The volume of Transportation on the distribution route will be $Q_3 + Q_4$ =200+290=490 tons. In the first plan of use of cars, each pendulum was allocated one car on the route.

For this is P_3 we determine the greatest win value in the column (P_4 except for the row). P_5 after, P_3 The achievement in the column of the row is equal to 10,8 which is the largest. So, P_5 it is necessary to enter the address in the formed distribution route. In this we form the following route:

$$P_0 - P_5 - P_3 - P_4 - P_0$$

Cargo transportation on this route $Q_5 + Q_3 + Q_4$ =230+200+290=720 will be. P_3 we change the value of the row J from I to 0 the column, because this punches has become internal punches on the route, P_5 which the value of which we change from 2 to 1 and continue until all shipments шу тартибда ҳамма юклар манзилига етказилгунча давом этирилади. in the same order are delivered to the address. By following the steps described above, we determine the following 2-and 3-distribution route:

2-route: $P_0 - P_{10} - P_8 - P_9 - P_0$

Cargo transportation on this Route $Q_{10} + Q_8 + Q_9$ =390+220+180=790 t.

3-route:

$P_0 - P_7 - P_1 - P_6 - P_2 - P_0$

The volume of Transportation on the specified route

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$Q_7 + Q_1 + Q_6 + Q_2$ =210+270+180+140=800 t. will be. So, it is necessary to allocate one car with a load of 800 units for transportation. The optimal scheme of delivery of goods to the address is shown in Figure 5.

5-picture. Optimal scheme of delivery of cargo to the address

The total cargo delivery time when transportation is completed on pendulum routes can be found as follows.

$L_{етк}^{ум1} = 2\sum_{j\in(1-10)} l_{oj}$ =2(12,7+10,8+11,0+13,0+9,2+6,4+3,1+6,0+10,2+5,0)=174,8 км.

Let’s calculate these all routes amount of result :

I for route:

$L_{етк}^{1} = l_{05} + l_{53} + l_{34} + l_{40} = 9{,}2 + 9{,}4 + 4{,}1 + 13 = 35{,}7$ km;

II for route:

$L_{етк}^{2} = l_{010} + l_{108} + l_{89} + l_{90} = 5 + 9{,}8 + 1{,}4 + 10{,}2 = 26{,}4$ km;

III for route:

$L_{етк}^{3} = l_{07} + l_{71} + l_{16} + l_{62} + l_{20} = 3{,}1 + 3{,}1 + 6{,}4 + 10{,}8 + 10{,}8 = 34{,}2$ km.

And so, the time of delivering of entire cargo,

$L_{етк}^{ум} = L_{етк}^{1} + L_{етк}^{2} + L_{етк}^{3} = 35{,}7 + 26{,}4 + 34{,}2 = 96{,}3$ km.

Conclusion

Reduction of the distance of cargo delivery on structured rational routes compared to the initial option

$\Delta L_{етк} = L_{етк}^{ум1} + L_{етк}^{ум2} = 174{,}8 - 96{,}3 = 78{,}5$ consists of them.

This means that the Clark-Wright algorithm allows you to formulate optimal routes, attach to them vehicles and regulate the restriction of drivers on working time, the load capacity of vehicles. This saves transportation costs on the basis of effective management of transportation services, reduces the harmful effects of harmful emissions by vehicles on the environment.

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