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Streamlining Warehouse Operations: Optimizing Transportation Costs through Advanced Manufacturing Unit Conversion System

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Abstract:

Globalization has led to remarkable market growth, but it also presents fickleness due to changing consumer preferences. Quantitative models and mathematical tools crucial in transportation problems, to minimize costs and meet people need in certain areas. Transportation problem widely used for decision making tool in engineering, business management and many other fields. In this project, we have performed cost minimization for transportation problem of "Highway sweets and confectionary" Company, a well-known company for selling their sweets, pastries and cakes, dry foods in different regions from their 3 factories to different destinations. In order to address the transportation problem in Bangladesh, this model will be quite efficient as it is one of the most common manufactured food business models of Bangladesh. Here we employ Vogel's approximation in order to get feasible solution for the reducing their cost. Here we also apply the MODI method to get optimal solution which will indicate we can further minimize the cost after applying the Vogel's approximation.

Introduction

Effective warehouse operations have become a key factor of an organization's success in the dynamic world of modern commerce. E-commerce's explosive expansion, the internationalization of supply chains, and rising customer expectations have all served to highlight the need for efficient and affordable warehousing methods. Given its significant impact on overall operational costs and environmental sustainability, optimizing transportation costs stands out as a key concern among the many difficulties faced by warehouse managers.

This study proposes a ground-breaking strategy by integrating an Advanced Manufacturing Unit Conversion System (AMUCS) to handle the complex interactions between warehouse operations and transportation expenses. The adoption of cutting-edge technologies has become crucial as businesses work to reduce their carbon impact and increase profitability. The AMUCS represents a paradigm shift in the way goods are produced, raw materials are processed, and warehouse inventory is maintained.

The main goal of this study is to clarify the AMUCS's potential to reduce transportation costs, not just as a stand-alone solution but also as an essential component of an all-encompassing warehouse optimization plan. This study aims to give a thorough framework for adopting the AMUCS to achieve improved operational efficiency, shorter lead times, and eventually cost reductions by combining concepts from manufacturing, logistics, and supply chain management. The research will examine the present difficulties warehouses confront with regard to transportation costs in the parts that follow, as well as the theoretical foundations of the AMUCS and case studies that demonstrate its effective application in warehouse operations. The study will also examine the environmental and economic ramifications of the suggested strategy, providing insights into the broader ramifications for businesses and society. Organizations must adopt cutting-edge tactics that not only improve their operations but also correspond with sustainable practices as the intersection of manufacturing, logistics, and technology continues to develop. This study aims to provide important insights that can reshape traditional approaches to cost-efficient warehousing while fostering a more environmentally conscious supply chain environment by exploring the unexplored territory of integrating an Advanced Manufacturing Unit Conversion System into warehouse operations.

Literature review

Transportation Problems and Optimization Techniques (References 1, 2, and 3):

summarizing the key concepts from the provided references that discuss transportation problems and optimization techniques and highlights common challenges in transportation management, such as route optimization, vehicle assignment, and cost minimization. Discussing the approaches suggested in the literature to address these challenges, including mathematical modeling and heuristic methods.

Integration of Advanced Manufacturing in Supply Chain Operations (Reference 4):

Introduces the study that explores the integration of advanced manufacturing techniques into supply chain operations. Then shows how advanced manufacturing can lead to improved efficiency, reduced waste, and cost savings. Emphasizes the potential benefits of applying these principles to warehouse operations to optimize transportation and reduce costs.

Real-world Implementation and Case Study (Reference 5):

Discussion of the practical insights gained from the case study, including strategies employed and outcomes achieved. Relate the lessons from the case study to the context of streamlining warehouse operations and optimizing transportation costs.

Operations Research and Optimization Models (Reference 6):

Introducing the book "Introduction to Operations Research" by Hiller and Lieberman. Discussion on the relevance of operations research techniques in solving complex optimization problems. Highlights the potential application of operations research methodologies in developing an Advanced Manufacturing Unit Conversion System for warehouse operations.

Vogel's Approximation Method for Transportation Problems (Reference 3):

Explaining Vogel's Approximation Method and its role in solving transportation problems. Discussion on how this method can contribute to optimizing transportation routes and reducing costs in warehouse operations

Methodology:

2.1 Mathematical Formulation of Transportation Problem

Let *Xij* = quantity of product supplied,

Cij = cost of transportation of unit quantity from th *i* source to th *j* destination,

ai = amount of quantity of the product available at *ith* source and *bj* = amount required in *jth* destination,

The objective is to minimize the total cost of transportation which is formulated as:

$$\text{minimize} \quad Z = \sum_{i=1}^{m} \sum_{j=1}^{n} C_{ij} X_{ij} \qquad \text{.........(1)}$$

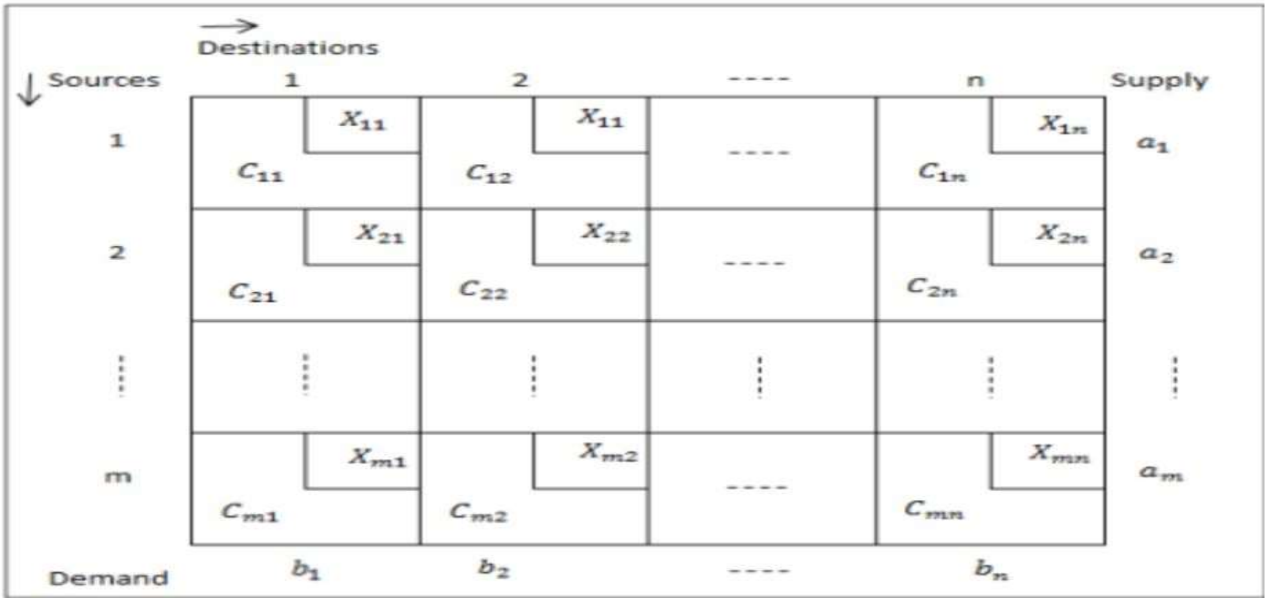
$$\text{subject to} \quad \sum_{j=1}^{n} X_{ij} = a_i , \quad i = 1, 2, \ldots\ldots, m \qquad \text{.........(2)}$$

$$\sum_{i=1}^{m} X_{ij} = b_j , \quad j = 1, 2, \ldots\ldots., n \qquad \text{.........(3)}$$

$$X_{ij} \geq 0, \quad \forall i, j$$

Text, letter
Description automatically

A necessary and sufficient condition for the existence of a feasible solution for the transportation problem is that the total supply is equal to the total demand which is an indication of making the problem a balanced transportation problem although the problem canbe an unbalanced transportation problem. The tabular form of transportation problem is given below:



Sources ↓ / Destinations →	1	2	----	n	Supply
1	C_{11} X_{11}	C_{12} X_{11}	----	C_{1n} X_{1n}	a_1
2	C_{21} X_{21}	C_{22} X_{22}	----	C_{2n} X_{2n}	a_2
⋮	⋮	⋮	⋮	⋮	⋮
m	C_{m1} X_{m1}	C_{m2} X_{m2}	----	C_{mn} X_{mn}	a_m
Demand	b_1	b_2	----	b_n	

2.2 Balanced Transportation Problem's Solution

The solution procedure has two steps where we get the feasible solution from Vogel's approximation using MATLAB code from first step and then we get the optimum solution usingsimplex of MODI Method.

2.1 Basic Feasible Solution

Any solution $X_{ij} \geq 0$ is said to be a feasible solution of a transportation problem if it satisfies the constraints. The feasible solution is said to be basic feasible solution if the number of non- negative allocations is equal to *(m + n -1)* while satisfying all requirements.

There are 3 ways to get the feasible solution and they are: North-west corner method, Vogel's approximation, Russel's approximation. We have used Vogel's approximation method as it gives the feasible solution which is close to 80% of the optimal solution.

2.2 Vogel's approximation

Vogel's approximation goes to one more level of detailing by computing the penalty associatedwith non-allocation at the minimum cost. In terms of computational requirement, Vogel take more time as this method gives superior starting basic feasible solution. It is an iterative procedure where in each step we have to find the penalties for each available row and columnby taking least cost and second least cost. Then take their difference. Then identify maximum penalty and identify the row and column with maximum penalty and assign the corresponding cell's minimum. If two or more column has same maximum penalty, then we can choose any one among them. If the assignment on previous satisfy the supply at origin, delete the corresponding row. If it satisfies the demand at that destination, delete the corresponding column. Finally, stop the procedure if supply at each origin is zero that means every supply is exhausted or same for the demand also. If this procedure does not affect this, do the same procedure from start.

For getting the feasible solution using Vogel's approximation method, we have used MATLAB software where we have made a code on that to put the input and get the feasible solution.

2.3 Optimal Solution

The feasible solution from the Vogel's approximation will be optimal if it further minimizes the transportation cost. Then check whether the number of allocated cells is exactly equal to $m+ n -1$, where m and n are number of rows and columns respectively. If the initial basic feasible solution is not basic, then there exists a loop. We have used modified distribution method (MODI) or U-V method to get the optimal solution.

2.4 Modified Distribution Method (MODI) or U-V method

MODI method is convenient to use this method while solving large problems where number ofrows and columns are very large. It requires the inclusion of some sets of numbers $u1, u2,\dots,um$ and $v1,v2,\dots.,vn$ which helps to determine the penalty costs. The steps for getting optimum solution for this is given below;

Step 1: Assign ui and vj for $i=1-m$ and $j=1-n$ in the upper and right corner of the transportation table respectively.

Step 2: Put $u1$=0 and get the other values of ui and vj using $Cij = ui + vj$

Step 3: The penalties obtained by using formula of $Pij= Cij- vj- uI$

Step 4: If all penalty costs are negative or zero then it indicates optimal solution. If not, then allocate θ to the cell having most positive P.

Step 5: Starting from the selected cell make one closed loop and alternately assign + and - sign.
Step 6: Look for the maximum possible increment in the value of ' ' which is minimum amongst the (+) sign unit cost.

Step 7: Now adding and subtracting Cij's by value of θ where there is (-) and (+) sign respectively.
Step 8: Repeat the all procedure in this method until optimum solution is arrived.

3. Problem description and formulation

We have taken the data of three factories of Highway sweets and confectionary at Lalkhan Bazar, Cheraghi Pahar and Agrabad producing sweets, pastry and cakes. They all produce every type of products and the profit per unit weight for each type of product are almost same. Thesefactories deliver products to six distribution centers. They supply the products with two types ofvehicles depending on the distance. The shorter distance vehicle can carry average 90 Kg of products. Mileage per liter patrol for the vehicle is 20 Km. Petrol price is 130 tk/liter. On the other hand, the longer distance (greater than 40 Km) vehicle can carry average 130 kg of product and the mileage per liter diesel for this vehicle is also 20 Km. Diesel price is 90tk/liter.

Distance from Lalkhan Bazar factory to destination 1,2,3,4,5,6 are 15.55 Km, 13.5 Km,17.65 Km, 11.425 Km and 67 Km respectively. Distance from Cheraghi Pahar factory for the same destinations are 22.85 Km, 24.925 Km, 20.77 Km, 23.9 Km and 18.7 Km. Finally, the distancefrom Agrabad to destination 4,5,6 are 108.33 Km, 101 Km and 7.27 Km. Calculating this Dataapproximate cost per kg product are given in the below table

	Cost per kg product						Supply
	Destination1	Destination2	Destination3	Destination4	Destination5	Destination6	
Lalkhan Bazar	1.125	0.975	1.275	0.825	2.325	-	600
Cheragi Pahar	1.65	1.8	1.5	1.725	1.35	-	795
Agrabad	-	-	-	3.75	3.5	0.525	430
Minimum Demand	180	285	230	350	345	260	
Requested	230	350	270	-	410	290	In Units of kg

Daily minimum demand and maximum requested number of products for six distribution centers are given in the bottom portion of the table and daily production from three factory aregiven in the right most column of the table. The production manager wants to deliver all the daily productions from three factories to the six distribution centers in such a way as to at least meet the minimum needs of each distribution center while minimizing the total cost for transportation.

Solution:

We've used MATLAB to find a feasible solution using Vogel's approximation. The MATLAB code is given below

```
M=10000;

Cost=[1.125 1.125 .975 .975 1.275 1.275 .825 .825 2.325 2.325 M M;1.65 1.65 1.8 1.8 1.5 1.5
1.725 1.725 1.35 1.35 M M;M M M M M M 3.75 3.75 3.5 3.5 .525 .525;M 0 M 0 M 0 M 0 M 0 M 0
M 0 ];

Supply_col=[600 795 430 250]';

Demands_row=[180 50 285 65 230 40 350 175 345 65 260 30];

C_start=Cost;

C=C_start;

m=size(C,1);

n=size(C,2);

a=Supply_col;

b=Demands_row;

X=zeros(m,n);

stop=0;

while stop==0

    for i=1:m

        for j=1:n

            if a(i,1)==0

                C(i,j)=max(C(:,j));
```

```
        end
        if b(1,j)==0
            C(i,j)=max(C(i,:));
        end
    end
end
C_sort_col=sort(C,1);
C_sort_row=sort(C,2);
Diff_customer=abs(C_sort_col(1,:)-C_sort_col(2,:));
diff_supplier=abs(C_sort_row(:,1)-C_sort_row(:,2));
for i=1:m
    if a(i,1)==0
        diff_supplier(i,1)=0;
    end
end
for j=1:n
    if b(1,j)==0
        Diff_customer(1,j)=0;
    end
end
Max_Diff_customer=max(Diff_customer);
Max_Diff_supplier=max(diff_supplier);
Customer_nr=find(Diff_customer==max(Max_Diff_customer,Max_Diff_supplier));
Supplier_nr=find(diff_supplier==max(Max_Diff_customer,Max_Diff_supplier));
if isempty(Customer_nr)==0
   Supplier_nr_=find(C(:,Customer_nr(1))==min(C(:,Customer_nr(1))));
   X(Supplier_nr_(1),Customer_nr(1))=min(a(Supplier_nr_(1),1),b(1,Customer_nr(1)));
```

```
    a(Supplier_nr_(1),1)=a(Supplier_nr_(1),1)-X(Supplier_nr_(1),Customer_nr(1));
    b(1,Customer_nr(1))=b(1,Customer_nr(1))-X(Supplier_nr_(1),Customer_nr(1));
    Supplier_nr=[];
end
if isempty(Supplier_nr)==0
    Customer_nr_=find(C(Supplier_nr(1),:)==min(C(Supplier_nr(1),:)));
    X(Supplier_nr(1),Customer_nr_(1))=min(a(Supplier_nr(1),1),b(1,Customer_nr_(1)));
    a(Supplier_nr(1),1)=a(Supplier_nr(1),1)-X(Supplier_nr(1),Customer_nr_(1));
    b(1,Customer_nr_(1))=b(1,Customer_nr_(1))-X(Supplier_nr(1),Customer_nr_(1));
end
%Stop condition:
a1=a>0;
b1=b>0;
if sum(a1)==1
    stop=1;
    for j=1:n
        if b(j)>0
            X(a1==1,j)=b(j);
        end
    end
end
if sum(b1)==1
    stop=1;
    for i=1:m
        if a(i)>0
            X(i,b1==1)=a(i);
        end
```

```
        end
    end
end
Solution=X;
Minimized_Cost=sum(sum(C_start.*X))
```

Hence,

Using MATLAB, we get from Vogel's method,

Initial Basic Feasible Solution (BVS) =2388.8

And, the final table,

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	Supply
S1	1.12	1.12	0.98(24	0.98	1.27	1.27	0.82(35	0.82(5)	2.33	2.33	10,000	10,000	600
S2	1.65(140)	1.65	1.8(40)	1.8	1.5(230)	1.5	1.72	1.72	1.35(345)	1.35	10,000	10,000	795
S3	10,000	10,000	10,000	10,000	10,000	10,000	3.75	3.75(140)	3.50	3.50	0.52(260)	0.52(30)	430
S4	10,000	0(50)	0	0(65)	10,000	0(40)	10,000	0(30)	10,000	0(65)	10,000	0	250
Demand	180	50	285	65	230	40	350	175	345	65	260	30	

MODI method:

Substituting, $u4$=0, we

get1.$c42=u4+v2$

⇒v2=c42-u4

⇒v2=0-0

⇒v2=0

2.c44=u4+v4

⇒v4=c44-u4

⇒v4=0-0

⇒v4=0

3.c46=u4+v6

$\Rightarrow v6=c46-u4$

$\Rightarrow v6=0-0$

$\Rightarrow v6=0$

4.$c48=u4+v8$

$\Rightarrow v8=c48-u4$

$\Rightarrow v8=0-0=0$

5.$c18=u1+v8$

$\Rightarrow u1=c18-v8$

$\Rightarrow u1=0.82-0$

$\Rightarrow u1=0.82$

6.$c13=u1+v3$

$\Rightarrow v3=c13-u1$

$\Rightarrow v3=0.98-0.82$

$\Rightarrow v3=0.15$

7.$c23=u2+v3$
$\Rightarrow u2=c23-v3$

$\Rightarrow u2=1.8-0.15$

$\Rightarrow u2=1.65$

8.$c21=u2+v1$

$\Rightarrow v1=c21-u2$

$\Rightarrow v1=1.65-1.65$

$\Rightarrow v1=0$

9.$c25=u2+v5$

$\Rightarrow v5=c25-u2$

$\Rightarrow v5=1.5-1.65$

$\Rightarrow v5=-0.15$

10.$c29=u2+v9$

$\Rightarrow v9=c29-u2$

$\Rightarrow v9=1.35-1.65$

$\Rightarrow v9=-0.3$

11.$c17=u1+v7$

$\Rightarrow v7=c17-u1$

$\Rightarrow v7=0.82-0.82$

$\Rightarrow v7=0$

12.$c38=u3+v8$

$\Rightarrow u3=c38-v8$

$\Rightarrow u3=3.75-0$
$\Rightarrow u3=3.75$

13.$c311=u3+v11$

$\Rightarrow v11=c311-u3$

$\Rightarrow v11=0.52-3.75$
$\Rightarrow v11=-3.22$

14.$c312=u3+v12$

$\Rightarrow v12=c312-u3$

$\Rightarrow v12=0.52-3.75$

$\Rightarrow v12=-3.22$

15.$c410=u4+v10$

$\Rightarrow v10=c410-u4$

$\Rightarrow v10=0-0$

$\Rightarrow v10=0$

Let, $dij=cij-(ui+vj)$

1.$d11=c11-(u1+v1)=1.12-(0.82+0)=0.3$
2.$d12=c12-(u1+v2)=1.12-(0.82+0)=0.3$
3.$d14=c14-(u1+v4)=0.98-(0.82+0)=0.15$

4.d15=c15-(u1+v5)=1.27-(0.82-0.15)=0.6

5.d16=c16-(u1+v6)=1.27-(0.82+0)=0.45

6.d19=c19-(u1+v9)=2.33-(0.82-0.3)=1.8
7.d110=c110-(u1+v10)=2.33-(0.82+0)=1.5
8.d111=c111-(u1+v11)=10000-(0.82- 3.22)=10002.4
9.d112=c112-(u1+v12)=10000-(0.82- 3.22)=10002.4

10.d22=c22-(u2+v2)=1.65-(1.65+0)=0
11.d24=c24-(u2+v4)=1.8-(1.65+0)=0.15

12.d26=c26-(u2+v6)=1.5-(1.65+0)=-0.15
13.d27=c27-(u2+v7)=1.72-(1.65+0)=0.08

14.d28=c28-(u2+v8)=1.72-(1.65+0)=0.08
15.d210=c210-(u2+v10)=1.35-(1.65+0)=- 0.3

16.d211=c211-(u2+v11)=10000-(1.65- 3.22)=10001.58
17.d212=c212-(u2+v12)=10000-(1.65- 3.22)=10001.5
18.d31=c31-(u3+v1)=10000- (3.75+0)=9996.25
19.d32=c32-(u3+v2)=10000- (3.75+0)=9996.25
20.d33=c33-(u3+v3)=10000- (3.75+0.15)=9996.1

21.d34=c34-(u3+v4)=10000- (3.75+0)=9996.25
22.d35=c35-(u3+v5)=10000-(3.75- 0.15)=9996.4
23.d36=c36-(u3+v6)=10000- (3.75+0)=9996.25

24.d37=c37-(u3+v7)=3.75-(3.75+0)=0

25.d39=c39-(u3+v9)=3.5-(3.75-0.3)=0.05
26.d310=c310-(u3+v10)=3.5-(3.75+0)=- 0.25
27.d41=c41-(u4+v1)=10000-(0+0)=10000
28.d43=c43-(u4+v3)=10000- (0+0.15)=9999.85

29.d45=c45-(u4+v5)=10000-(0- 0.15)=10000.15
30.d47=c47-(u4+v7)=10000-(0+0)=10000
31.d49=c49-(u4+v9)=10000-(0- 0.3)=10000.3
32.d411=c411-(u4+v11)=10000-(0- 3.22)=10003.22
33.d412=c412-(u4+v12)=0-(0-3.22)=3.22

	D1	D2	D3	D4	D5	D6	D7	D 8	D9	D 10	D11	D12	Supply	*ui*

S1	1.12 [0.3]	1.12 [0.3]	0.98 (245)	0.98 [0.15]	1.27 [0.6]	1.27 [0.45]	0.82 (350)	0.82 (5)	2.33 [1.8]	2.33 [1.5]	10000 [10002.4]	10000 [10002.4]	600	0.82
S2	1.65 (180)	1.65 [0]	1.8 (40)	1.8 [0.15]	1.5 (230)	1.5 [-0.15]	1.72 [.08]	1.72 [.08]	1.35 (345)	1.35 [-.3]	10000 [10001.58]	10000 [10001.58]	795	1.65
S3	10000 [9996.25]	10000 [9996.25]	10000 [9996.1]	10000 [9996.25]	10000 [9996.4]	10000 [9996.25]	3.75 [0]	3.75 (140)	3.5 [0.05]	3.5 [-0.25]	.52 (260)	.52 (30)	430	3.75
S4	10000 (10000)	0 (50)	10000 [9999.85]	0 (65)	10000 [10000.15]	0 (40)	10000 [10000]	0 (30)	10000 [10000.3]	0 (65)	10000 [10003.22]	0 [3.22]	250	0
Demand	180	50	285	65	230	40	350	175	345	65	260	30		
vj	0	0	0.15	0	0.15	0	0	0	0.3	0	-3.22	-3.22		

As some, *dij*<0, so, the solution is not optimum.

Now, the minimum negative value from all *dij* = *d210* = [-0.3] and we draw a closed path from *S2D10*. Closed path is *S2D10→S2D3→S1D3→S1D8→S4D8→S4D10*.Here, the minimum value of BV is 5. So, the even number members add the value and the odd number members deduct the value.Here, counting starts from 0 at *S2D10.* After add and deduct the value, the table is

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	Supply
S1	1.12	1.12	0.98(250	0.98	1.27	1.27	0.82(350)	0.82	2.33	2.33	10000	10000	600
S2	1.65(180	1.65	1.8	1.8(45)	1.5(230)	1.5	1.72	1.72	1.35(345)	1.35(5)	10000	10000	795
S3	10000	10000	10000	10000	10000	10000	3.75	3.75(140	3.5	3.5	0.52(260	0.52(30)	430
S4	10000	0(50)	10000	0(65)	10000	0(40)	10000	0(35)	10000	0(60)	10000	0	250
Demand	180	50	285	65	230	40	350	175	345	65	260	30	

After iteration 5 all $dij \geq 0$. So, this solution is the final optimal solution

Result:

The final optimization table is

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	Supply
S1	1.12	1.12	0.98(285)	0.98	1.27	1.27	0.82(315	0.82	2.33	2.33	10000	10000	600
S2	1.65(180	1.65	1.8	1.8	1.5(230)	1.5(40)	1.72	1.72	1.35(28	1.35(65)	10000	10000	795
S3	10000	10000	10000	10000	10000	10000	3.75(35)	3.75(4	3.5(65)	3.5	0.52(260)	0.52(30)	430
S4	10000	0(50)	10000	0(65)	10000	0	10000	0(135)	10000	0	10000	0	250
Demand	180	50	285	65	230	40	350	175	345	65	260	30	

So, the minimum transportation cost is=0.98*285+0.82*315+1.65*180+1.5*230+1.5*40+1.35*280+1.35*65+3.75*35+3.75*40+3.5*65+0.52*260+0.52*30+0*50+0*65+0*135

=2364.9 ≈ 2365

So, the minimum transportation cost per day is almost 2365 taka

Discussion:

In this research, we've tried to find out the minimization of transportation cost of Tasty Treat using Vogel's approximation. We used MATLAB for finding a feasible solution. After finding theBFS, we used MODI method to find out the optimal solution.

In the final optimal table, every source is indicated as *Sj* and every column indicates demand sectors. Every two sectors indicate one demand sector.

We deal with this unbalance problem using dummy source which is unreal source indicated as *S4*. So, we must count the supply amount exclude the dummy source.

From the final table, we've got the optimum solution. Excluding dummy source, we've seen that we have to supply 180 kg products to destination 1, 285 kg products to destination 2, 270kg products to destination 3, 390 kg to destination 4, 410 kg to destination 5 and 290 kg to destination 6.

Here, the sources are Lalkhan Bazar, Cheragi Pahar, Agrabad. From Lalkhan source, we've to supply 600 kg products and distribute those among destination 2 (285 kg) and 4 (315 kg).

On the other side, from Cheragi Pahar source, we must distribute 795 kg products among destination 1 (180 kg), 3 (270 kg) and 5 (345 kg).

Again, the last source Agrabad supplies 430 kg products distributed among destination 4 (75 kg), 5 (65 kg) and 6 (290 kg).

We've used Vogel's approximation which gives better result than Northwest corner rule forfinding optimum solution. Sometimes this approximation gives better result than Russel's approximation.

According to Vogel's approximation and MODI method, in our research, the minimum transportation cost is 2365 taka each day

Conclusion:

This study offers a limited survey of a company's transportation cost-minimization issue. The methodological framework and findings provide valuable insights to production manager and policymakers to decide on beneficial action regarding the transportation issues. This research has several limitations. This study was only based on transportation related costs and constrains. However, there can be additional constrains that have an impact on the final decision. However, final decision is expected to be very close to the findings of this study.

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