



## Improved Logistics Optimization for Virtual Market using CVX Optimizer & SEDUMI Solver

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**Abstract:** The terms we hear regularly in the market is Imports and exports. Marketing is the process of selling, buying goods and gaining profits & now a day's mobile users are growing in the communication . This paper deals how to avoid mediators intervention between the sellers and the buyers by effectively utilizing the mobile. Here optimization is the process developed for performing the virtual marketing system. This system plays a vital role in identifying the particular product ordered person and delivering the product to him/her within the time. The main objective in this is purchasing the goods directly from the vendor and displaying this product in virtual market which can be accessible by every person. In order to gain the profits transportation plays a key role. For this we have optimizing the cost distance and time using Cvx optimizer with SEDUMI solver along with this we maintain the quality.

**Keywords:** Optimization, mobile, logistic ,cvx, sedumi, matlab

### I- Introduction

#### A. Virtual Market

As per the definition of Wikipedia market means “A market is any place where the sellers of a particular good or service can meet with the buyers of that goods and service where there is a potential for a transaction to take place. The buyers must have something they can offer in exchange for there to be a potential transaction [1]”. That means market is a place we people physically go and buy/sell their products. Now days every one is busy with their life no one has a time to go and buy/sell products. This decade in our India e-marketing plays a crucial role in internet business. But all of them are like mediators that means they busy products from some X costumer for some amount and they sell to some another costumer with another amount in this way he gains the profits. In this type of business mediator gains more profits compare to others. So in order to avoid this we have providing a platform here a user can buy the product or can sell the products just by placing orders with their expecting prices. Here we are not alter any prices the prices place by the user are the final rates for the product here we may rise a doubt what is the profit for us. Here we just act as delivery persons from x user to some y user for this we chare some amount in this way we gain the profit. along with this we check the quality of the product also . in this no particular buyer and no particular seller ever user has a potential buyer and potential seller . so may virtual markets are there in the world examples are ebay.com flipkart.com jabang.com all are like mediators.

#### B. Virtual Market Using Wire And Wireless Communication

Now a day's mobile plays a vital role in the communion system so for our virtual market we have provide a mobile application for using this a user can buy / sell his products in the virtual market not only a mobile application we are providing a system application also . This application contains the user registration buying /selling goods & and application for delivery boys to track the good

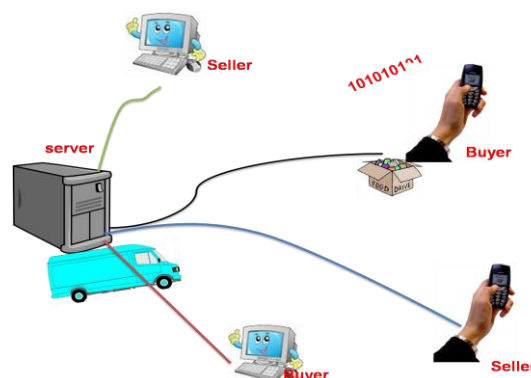


Fig1: Virtual Market Proposed System

**C. Logistic Optimization**

According to the Wikipedia definition Logistics is the management of the flow of resources between the point of origin and the point of destination in order to meet some requirements [2]. Optimization means Optimization is the selection of a best criterion from some set of available alternatives [3]. When a seller places an order and a buyer buys that product the system is decide the route to deliver the product. This is the main heart of the system because we only cost the amount for delivering the product only. For this gaining the product we must optimize the route that means by choosing which route the user will gain the the more profits. We will discuss it in the implementation section. Cost and transport system relationship is shown in the fig2.

The logistics for our market is

- Time of delivery
- Distance between the source and destination
- Mode of transport

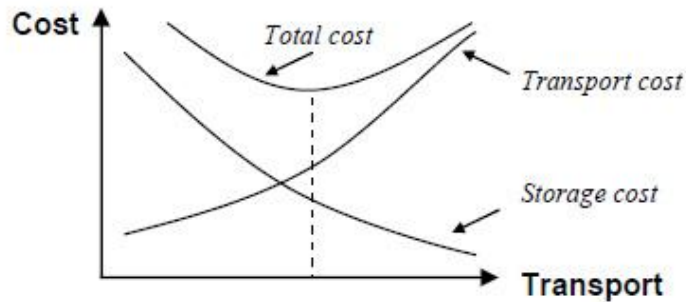


Fig2: Relation between cost and Transport

**Server design for virtual market**

The server is designed by using the java server pages (JSP) and the J2ME the server is responsible for maintaining the following information (i) customer information (ii) orders data base (iii) maintain the records of all the data of transactions.(iv) tracking the good details

The application is different for users and delivery people .For every user he must need to register then only he places the order

**II- Implementation Of Logistics**

In the previous section mention that server has a responsible for making the decision to choose the optimum route for delivering goods/ picking up goods. Server is decided to determine among the all tractions to make a route that will pick up the products in a sequence manner then the cast should be minimum. For this we have chosen the travelling salesman problem

**A. Traveling Sales man problem:**

Given a list of cities and the distances between each pair of cities, what is the shortest possible route that visits each city exactly[4] once and returns to the origin city fig[3].

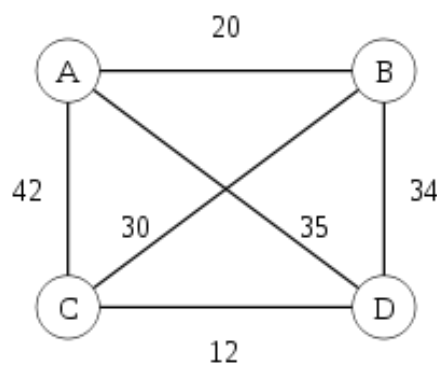


Fig3. Travelling Sales man problem

The travelling sales man problem is represented in the form of graphical representation it is show in above fig[3]. In this each node is represented a city and line between nodes represents the distance between the city's . this can be represented in the form of mathematical formula as

$$x_{ij} = \begin{cases} 1 & \text{if edge } i \\ 0 & \text{other wise} \end{cases}$$

### III- Optimization According To Distance

Solving Quadratic Assignment Problems Using Convex Quadraticprogramming Relaxations using Cvx Sedumi solver[5]

I have followed the a paper which has the same formula but they can't discussed about the cost of the delivery good [6].

#### 1) Formula 1 :

The quadratic assignment problem (QAP) may be stated as the following

$$\begin{aligned} \min \quad & \text{tr}(AXB + C)X^T \\ \text{s.t.} \quad & X \in \Pi, \end{aligned}$$

A = (aik), where aik is the flow from facility i to facility k;

B = (bjl), where bjl is the distance from location j to location l;

C = (cij), where cij is the cost of placing facility i at location

[[ Represents The n x n permutation matrices [8] & A and B matrices are the Symmetric Matrices  $A^T=A$ ,  $B^T=B$

this can be solved by using the cvx optimizer with sedumi solver this is show below

The matlab sedumi solver code shown below

```
%reading input values
disp('hi welcome to optimization');

% reads the size of matrix
% input is take the value from the console and assign to n
n=input('enter the size of the matrix');

disp('Please enter A and B matrices of same elements \n such away that matrix is symmetric')

%A= DISTANCE B=MATERIAL FLOW MATRIX C=COST MATRIX

A=input('Enter DISTANCE MATRIX which is symmetric:')
B=input('Enter FLOW MATRIX which is symmetric:')
C=input('Enter COST MATRIX which is symmetric:')

if(isequal(A,A') && isequal(B,B') && isequal(C,C'))

    [vec_A,val_A]=eig(A)
    [vec_B,val_B]=eig(B)
    X=vec_B*(vec_A)'
    % cvsx with sedumi soler code

    cvx_begin
    cvx_solver sedumi
    variable x(n)
    minimize trace((A*X*B+C)*X)
    cvx_end

else
    disp('please enter only symmertic');
end
```

#### output :

```
hi welcome to optimization
enter the size of the matrix5
Please enter A and B matrices of same elements \n such away that matrix is symmetric
Enter DISTANCE MATRIX which is symmetric:[0 2 3 4 1;2 0 1 2 2;3 1 0 5 3;4 2 5 0 4;1 2 3 4 5]
```

A =

```

0  2  3  4  1
2  0  1  2  2
3  1  0  5  3
4  2  5  0  4
1  2  3  4  5

```

Enter FLOW MATRIX which is symmetric:[0 4 3 2 1;4 0 2 1 2;3 2 0 5 3;2 1 5 0 4;1 2 3 4 5]

B =

```

0  4  3  2  1
4  0  2  1  2
3  2  0  5  3
2  1  5  0  4
1  2  3  4  5

```

Enter COST MATRIX which is symmetric:[0 2 3 4 1;2 0 1 2 2;3 1 0 5 3;4 2 5 0 4;1 2 3 4 5]

C =

```

0  2  3  4  1
2  0  1  2  2
3  1  0  5  3
4  2  5  0  4
1  2  3  4  5

```

vec\_A =

```

-0.2600 -0.7184  0.0708 -0.5303  0.3608
-0.0587  0.3185  0.9021 -0.1007  0.2669
-0.5245  0.5568 -0.3911 -0.2428  0.4504
-0.7995  0.1186 -0.1681 -0.2222  0.5187
-0.1207 -0.2417 -0.0052  0.7748  0.5715

```

val\_A =

```

-5.3319    0    0    0    0
  0 -3.5359    0    0    0
  0    0 -0.6608    0    0
  0    0    0  1.9684    0
  0    0    0    0 12.5601

```

vec\_B =

```

0.0448  0.7264 -0.1117  0.5831  0.3432
0.1363 -0.6244 -0.5067  0.4809  0.3218
-0.6920 -0.2076  0.4910  0.1298  0.4691
0.7001 -0.1058  0.5234 -0.0951  0.4645
-0.1021  0.1676 -0.4646 -0.6347  0.5855

```

val\_B =

```

-5.2034    0    0    0    0
  0 -4.3561    0    0    0
  0    0 -0.2552    0    0
  0    0    0  2.5521    0
  0    0    0    0 12.2626

```

X =

```
-0.7267  0.1609  0.4377  0.1892  0.4675
0.2383 -0.6264 -0.1928  0.1802  0.6937
0.4643  0.5295  0.2351 -0.4460  0.4999
0.1490  0.5309 -0.3985  0.7213  0.1301
0.4210 -0.1395  0.7464  0.4611 -0.1830
```

Homogeneous problem detected; solution determined analytically.

Status: Solved

Optimal value (cvx\_optval): +184.172

hi welcome to optimization

enter the size of the matrix5

Please enter A and B matrices of same elements \n such away that matrix is symmetric

Enter DISTANCE MATRIX which is symmetric:[0 2 3 4 1;2 0 1 2 2;3 1 0 5 3;4 2 5 0 4;1 2 3 4 5]

A =

```
0  2  3  4  1
2  0  1  2  2
3  1  0  5  3
4  2  5  0  4
1  2  3  4  5
```

Enter FLOW MATRIX which is symmetric:[0 2 3 4 1;2 0 1 2 2;3 1 0 5 3;4 2 5 0 4;1 2 3 4 5]

B =

```
0  2  3  4  1
2  0  1  2  2
3  1  0  5  3
4  2  5  0  4
1  2  3  4  5
```

Enter COST MATRIX which is symmetric:[0 4 3 2 1;4 0 2 1 2;3 2 0 5 3;2 1 5 0 4;1 2 3 4 5]

C =

```
0  4  3  2  1
4  0  2  1  2
3  2  0  5  3
2  1  5  0  4
1  2  3  4  5
```

vec\_A =

```
-0.2600 -0.7184  0.0708 -0.5303  0.3608
-0.0587  0.3185  0.9021 -0.1007  0.2669
-0.5245  0.5568 -0.3911 -0.2428  0.4504
0.7995  0.1186 -0.1681 -0.2222  0.5187
-0.1207 -0.2417 -0.0052  0.7748  0.5715
```

val\_A =

```
-5.3319    0    0    0    0
 0 -3.5359    0    0    0
 0    0 -0.6608    0    0
 0    0    0 1.9684    0
 0    0    0    0 12.5601
```

vec\_B =

```
-0.2600 -0.7184 0.0708 -0.5303 0.3608
-0.0587 0.3185 0.9021 -0.1007 0.2669
-0.5245 0.5568 -0.3911 -0.2428 0.4504
0.7995 0.1186 -0.1681 -0.2222 0.5187
-0.1207 -0.2417 -0.0052 0.7748 0.5715
```

val\_B =

```
-5.3319 0 0 0 0
0 -3.5359 0 0 0
0 0 -0.6608 0 0
0 0 0 1.9684 0
0 0 0 0 12.5601
```

X =

```
1.0000 -0.0000 0.0000 -0.0000 -0.0000
-0.0000 1.0000 0.0000 0.0000 0.0000
0.0000 0.0000 1.0000 0.0000 0.0000
-0.0000 0.0000 0.0000 1.0000 0.0000
-0.0000 0.0000 0.0000 0.0000 1.0000
```

**Homogeneous problem detected; solution determined analytically.**

**Status: Solved**

**Optimal value (cvx\_optval): +208**

## 2) FORMULA 2

It is well known that the Quadratic Assignment Problem (QAP) contains the symmetric traveling salesman problem (TSP) as a special case. To show this, we denote the complete graph on  $n$  vertices with edge lengths (weights)  $D_{ij} = D_{ji} > 0 (i \neq j)$ , where  $D$  is called matrix of edge lengths (weights), by  $k_n(D)$ . The TSP is to find a Hamiltonian circuit of minimum length in  $k_n(D)$ . The  $n$  vertices are often called as cities, and the Hamiltonian circuit of minimum length is the "optimal tour"

To see that TSP is a special case of QAP, let  $C$  denote the adjacency matrix.

Now the TSP problem is to be obtained from the QAP formulation (1) by setting

$$I) \quad A = \frac{1}{2}D$$

$$II) \quad C=B$$

$$C = \begin{pmatrix} 0 & 1 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 & 1 \\ 1 & 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 & 0 \end{pmatrix}$$

To see this, note that every Hamiltonian circuit in a complete graph has adjacency matrix  $XCX^T$  for some  $X \in \pi_n$ . Thus we may concisely state the TSP as

$$TSP_{opt} := \min_{X \in \pi_n} \text{trace} \left( \left( \frac{1}{2}DXC + F \right) X^T \right)$$

$F = (F_{ij})$ , where  $F_{ij}$  is the cost of placing facility  $i$  at location

The solution for the above optimization problem is as follows:

The code for this problem in Matlab is as follows:

```
%reading input values
disp('hi welcome to optimization');

% reads the size of matrix
% input is take the value from the console and assign to n
n=input('enter the size of the matrix');

disp('Please enter A and B matrices of same elements \n such away that matrix is symmetric')

%A= DISTANCE B=MATERIAL FLOW MATRIX C=COST MATRIX

A=input('Enter DISTANCE MATRIX which is symmetric:')
B=input('Enter FLOW MATRIX which is symmetric:')
F=input('Enter COST MATRIX which is symmetric:')

[vec_A,val_A]=eig(A)
[vec_B,val_B]=eig(B)
X=vec_B*(vec_A)'
for i=1:n
for j=1:n
    if B(i,j)~=0
        B(i,j)=1;
    else
        B(i,j)=0;
    end
end
end
B
C=B
D=2*A

cvx_begin
cvx_solver sedumi
variable x(n)
minimize trace((0.5*D*X*C+F)*X)
cvx_end
```

Output Of The Code is

**Homogeneous problem detected; solution determined analytically.**

**Status: Solved**

**Optimal value (cvx\_optval): +67.6394**

In the a same way we can optimize the time also

#### IV- Conclusion:

In Conclusion the optimization of the route by using the cvx optimizer with sedumi solver we can get more efficient results and it is well used for both convex ,non –convex problems . the virtual market is fully depends on the supply chain management so by including all the parameters of supply chain management we can get more efficient results

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