Oct 28th, 9:00 AM - Oct 30th, 5:00 PM

Application of Dijkstra Alegorithm to Define the Lower Price in the Distribution Network of Suppling

Bukurie Imeri Jusufi
University for Business and Technology, bukurie.jusufi@ubt-uni.net

Azir Jusufi
University for Business and Technology, azir.jusufi@ubt-uni.net

Xhevair Beqiri
University of Tetova, xhevair.beqiri@unite.edu.mk

APPLICATION OF DIJKSTRA ALEGORITHM TO DEFINE THE LOWER PRICE IN THE DISTRIBUTION NETWORK OF SUPPLING

Bukurie Imeri Jusufi[1], Azir Jusufi[2], Xhevair Beqiri[3]

[1,2] UBT – Higher Education Institution, Lagjja Kalabria, 10000 p.n.,
Prishtine, Kosovo
[3] University of Tetova, Departament of Mathematics, Macedonia
{bukurie.jusufi[1], azir.jusufi[2]}@ubt-uni.net
xhevair.beqiri@unite.edu.mk[3]

Abstract. In this paper-work beside the review of theories of graphs , Dijkstra alegorithm for finding the shortest way , here we can present the application of Dijkstra alegorithm how to find the lowest price of the supplying for a costumer in the network distributions, presented with an example. Considering that from manufacturer to the last costumer the price variates, we ask: from whom distributions we can supply the same product and pay the lower price but the quality will be same?

Keywords: Graph, weight , algorithm, distributor, minimal price.

1. Introduction

1.1. The meaning of price. Distribution and the types of distribution

The price present quantity of money which are given to pay the product. The price is an element of the marketing mix which <<produce incomes>> the other elements <<produce costs >>.
Sales price could be defined based in the purchase price, (oriented in the cost). But to define the sales price must be considered many factors , and considerate these as inner factors : *cost, 4P (product,the price, promotion place), demand and market , competition , mediator , the state etc.* Recently 4P, now is explained like 5P, as the fifth component of the marketing mix are the people . But in this paper-work we can present the distribution way according from the lower price to the last consumer .
Considering that the distribution is a element of the marketing mix and has the obligation :

- To create a contact with the consumer;
- To sale the product and
- To observe the product from factory to the consummator (Logistic)

But the way of the distribution could be done in many ways , it means that there exist many ways of distributions.

Level I KD

Producer – consumer

0- Level I KD

Producer – retail seller - consumer

1- Level I KD

Producer – majority seller – retail seller - consumer
Level I KD
Producer – majority seller - commercial agent – retail seller - consumer.
In the paper-work we will present examples of the level two of the distribution.

1.2. Reasons for the application of the ways of distribution

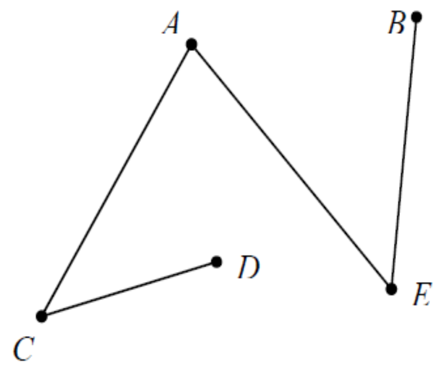
If we analyze which are the reasons that why in practice are used the ways of the distributions they are many but we can count the most important of them: *Many producer have missing of fond; The sale to the final consumer obligate the producers to mediate also for additional, the producer who can create their own distribution network, in many cases considerate that more favorable is that those money should be invested in their main activity (production) , the usage of the mediator may reduce the expenses of distribution (price of lower supplying we will explain further in the paper-work using theory of graph – Dijkstra alegorithm).*
Considering the reasons of the distribution we can define some of the important functions which are : exploring , transferring, taking a risk , promotion , contact adaptation , negotiation.
But which of the following ways of the distribution will be followed, depends on many factors :

- Properties of the factory, properties of the competition, properties of the product , properties of the consumer etc..

1.3. Knowledge of the graph

Definition : We define graph as doubles G=(V(G),E(G)), where V(G) the finite set none empty and the elements of this set are called the vertex and E(G) is a finite set of unordered different doubles of elements V(G) which's are called side .

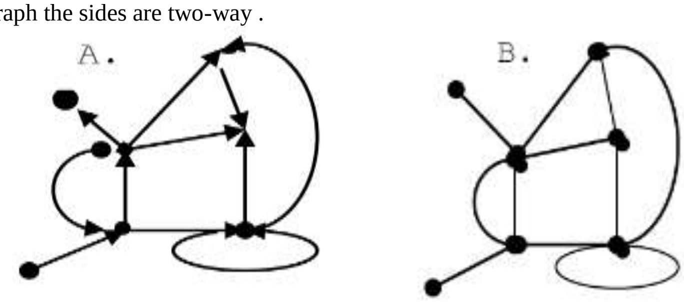
V(G) –Are called the set of vertex,
E(G) – Are called the set of the side .



Fg.1 Graph G

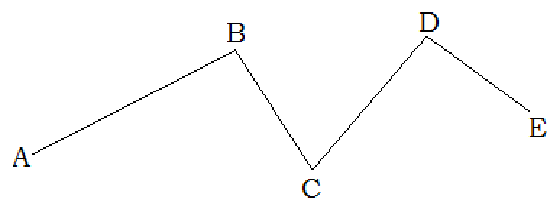
Graph G consists the set V(G) = {A, B, C, D, E} and set
E(G) = {AC, AE, CD, BE}.
Side of the form (Ai, Ai) is called loop . The graph where the set E of the side is an empty set is empty graph.
We say that the vertices v and w of the graph G are adjacent if there exists the side vw which unites that vertex. In this case vertices v and w are incidents with that side (belong to that side).
Related , two different sides e and f are adjancent if they have common vertex .
The scale of the vertex v of the graph G is number of the incidents side with v. Symbolically we mark it with deg v. With definition , the loop in v contributes 2 times (but not once) in the scale v, therefore we considered deg v=2
Vertex with the scale 0 is isolate vertex and the vertex with scale 1 is the end of the vertex .

Oriented graph is odd where each side is oriented from the beginning to the end point . . Whereas in the none oriented graph the sides are two-way .



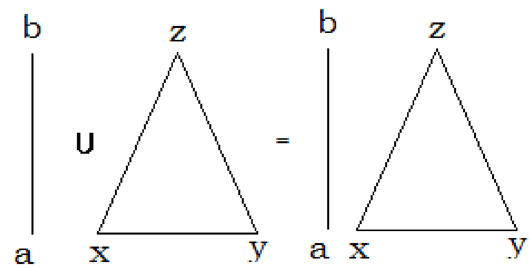
A. Oriented graph B. Not oriented graph

Path is defined as the chain of the sides among themselves which are connected for example.



Let there be graph $G_1=(V_1,E_1)$ and $G_2=(V_2,E_2)$, where $V_1 \cap V_2 = \varnothing$. $G_1 \cup G_2 = (V_1 \cup V_2, E_1 \cup E_2)$ is defined as the *union* of the graph G_1 and G_2.

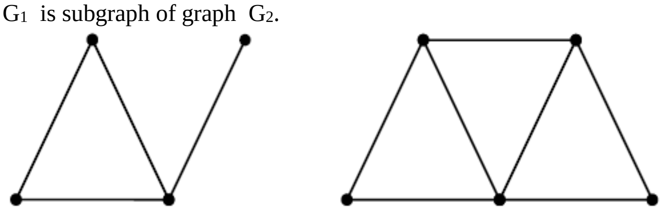
Example 1. If for graph G_1 we have $V_1=\{a,b\}$ and $E_1=\{ab\}$, while for graph G_2 we have $V_2=\{x,y,z\}$ and $E_2=\{xy,yz,xz\}$.



Connected graph is define if there is not a possibility to explain it like a union of two graphs, otherwise is defined not connected .

Graph $H=(V(H),E(H))$ is defined as subgraph of the graph $G=(V(G),(E(G))$, if $V(H) \subseteq V(G)$ and $E(H) \subseteq E(G)$.

For example the graph G_1 is subgraph of graph G_2.



G_1 G_2

1.4. The graph with weight

Definition . *Graph with weight* G^W is G, the side of this are accompanied with any none negative real number, so the exist the function of weight $W : E(G) \to R_0^+$.

w(e)- is the weight of the side $e \in E(G)$.

For the subgraph H of the graph G^W, the number $W(H)=\sum_{e\in E(H)} w(e)$ is defined as the total weight of the subgraph H.

Otherwise , if H is a path (u,v) in G^W, where $u,v\in V(G^W)$, then the number $d(u,v)=\min\{W(P)\mid P \text{ is a path from vertex u to the vertex v}\}$ is defined as minimal distance with weight under the vertex u and v.

1.5. Problem of the shortest path. Dijkstra alegorithm

Let G be the connected graph with the function weight $W:E(G)\to R_0^+$. We need to find d(u,v) i.e. minimal weight under the vertex u and v to the graph G. This problem is solved by Dijkstra algorithm . With agreement we take w(uv)= ∞ , if uv $\notin E(G)$.

Dijkstra Algorithm

Dijkstra Algorithm is very important to find the shortest path . While using the alegorith we mark *l*(v) the "current " distance from u_0 to v. This value is the upper bound of the distance from u_0 to v which will decrease along the alegorithm .Dijkstra Algorithm is :

Step 1: For $l(u_0)=0, l(v)=\infty$, for each $u_0\neq v\in V(G)$. Therefore , $S_0=\{u_0\}$ for *i*=0.

Step 2. Calculate $l(v)=\min\{l(v), l(u_i)+w(u_i v)\}$, for each $v\in \overline{S_i}$. Then calculate $\min_{v\in\bar{S}_i}\{l(v)\}=d(u_0,u_{i+1})$

Where u_{i+1} is vertex of $\overline{S_i}$ where we find this minimum. In this way we take $S_{i+1}=S_i\cup\{u_{i+1}\}$.

Step 3: If we have i=|V|-1, then the algorithm ends and if i<|V|-1, then we take i for i+1 and we return to the second step.

Example 2. Let G^W be a graph. To calculate the minimal distance between vertex u_0 and u_5.

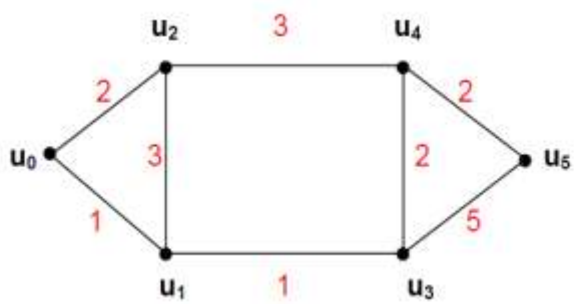


Fig.2 Graph G^W

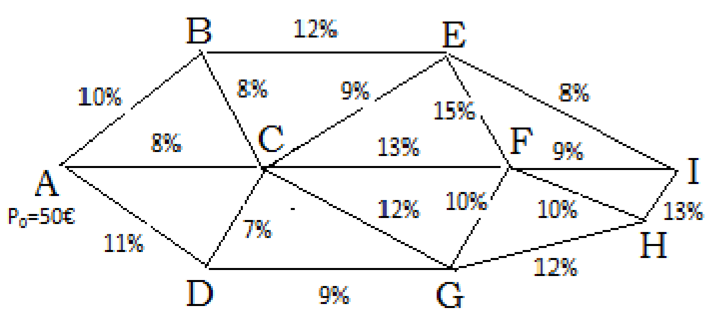
Solution : Initial conditions $l(u_0)=0, l(u_1)=l(u_2)=l(u_3)=l(u_4)=l(u_5)=\infty$

We take $S_0=\{u_0\}$. Then we calculate $l(u_1)=\min\{\infty, l(u_0)+w(u_0u_1)\}=\min\{\infty, 0+1\}=1$

And in analog way we have $l(u_2)=2, l(u_3)=\infty, l(u_4)=\infty, l(u_5)=\infty$.

We remark that $l(u_1)=d(u_0,u_1)=1$. Then we take $S_1=\{u_0,u_1\}$.
Then ,we calculate $l(u_2)=\min\{2,l(u_1)+w(u_1u_2)\}=\min\{1,1+3\}=2$ and in same way we have $l(u_3)=2, l(u_4)=\infty, l(u_5)=\infty$. In this way we have $l(u_2)=d(u_0,u_2)=2$. For $S_2=\{u_0,u_1,u_2\}$.
Then calculate, $l(u_3)=\min\{2,l(u_2)+w(u_2u_3)\}=\min\{2,2+\infty\}=2$ and in same way we have $l(u_4)=5, l(u_5)=\infty$. Now we have $l(u_3)=d(u_0,u_3)=2$. We take $S_3=\{u_0,u_1,u_2,u_3\}$.
Then calculate $l(u_4)=\min\{5,l(u_3)+w(u_3u_4)\}=\min\{5,2+2\}=4$ and in same way we have $l(u_5)=7$. Now $l(u_4)=d(u_0,u_4)=4$. We place $S_4=\{u_0,u_1,u_2,u_3,u_4\}$.
We conclude that , $l(u_5)=\min\{7,l(u_4)+w(u_4u_5)\}=\min\{7,4+2\}=6.$ So , $l(u_5)=d(u_0,u_5)=6$.

Example 3. (Application of Dijkstra alegorithm to decide the lowest price). The factory A presents in the market the product with price 50€ for units . The list of the distributors to this product is given like in the figure. Each distributor calculates additional costs for each units of the product to include its margin and this affects tp the price with p% (respectively like in the figure). Is needed to be found the minimal price with which the distributor will supply the **I** costumer , so the way which gives the lowest price.



Solution: This problem could be solved with Dijiksta algorithm.

0) Initial conditions

$$l(A)=p_0=50,\quad l(B)=l(C)=l(D)=l(E)=l(F)=l(G)=l(H)=l(I)=\infty$$

We take $S_0=\{A\}$.

1) Then calculate:

$$l(B)=\min\{\infty,l(A)+w(AB)\}=\min\{\infty,50+5\}=55\text{, where } w(AB)=50\cdot\frac{10}{100}=5;$$

$l(C)=\min\{\infty, l(A)+w(AC)\}=\min\{\infty,50+4\}=54$, where $w(AC)=50\cdot\frac{8}{100}=4$;

$l(D)=\min\{\infty, l(A)+w(AD)\}=\min\{\infty,50+5{,}5\}=55{,}5$, where $w(AC)=50\cdot\frac{11}{100}=5{,}5$.

And in this way , we have $l(E)=l(F)=l(G)=l(H)=l(I)=\infty$.

We remark that $l(C)=p_C=54$. We take $S_1=\{A,C\}$.

2) We fix $l(C)=p_C=54$. Following, we calculate :

$l(E)=\min\{l(E), l(C)+w(CE)\}=\min\{\infty,54+4{,}86\}=58{,}86$, where $w(CE)=54\cdot\frac{9}{100}=4{,}86$;

$l(F)=\min\{l(F), l(C)+w(CF)\}=\min\{\infty,54+7{,}02\}=61{,}02$, where $w(CF)=54\cdot\frac{13}{100}=7{,}02$;

$l(G)=\min\{l(G), l(C)+w(CG)\}=\min\{\infty,54+6{,}48\}=60{,}48$, where $w(CG)=54\cdot\frac{12}{100}=6{,}48$.

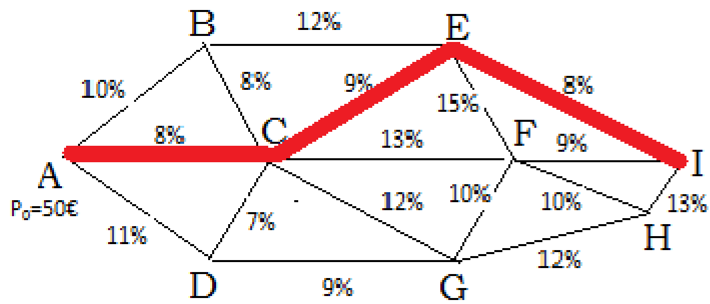
and in the same way we have $l(H)=l(I)=\infty$ .So , we fix $l(E)=p_E=58{,}86$ and we take $S_2=\{A,C,E\}$.

Remark: If we calculate l(*E*) through B, then
$l(E)=\min\{l(E), l(B)+w(BE)\}=\min\{\infty,55+6{,}6\}=61{,}6$, where $w(BE)=55\cdot\frac{12}{100}=6{,}6$

3) We fiix $l(E)=p_E=58{,}86$. Now , we calculate
$l(I)=\min\{l(I), l(E)+w(EI)\}=\min\{\infty,58{,}86+4{,}7088\}=63{,}5688$, where $w(EI)=58{,}86\cdot\frac{8}{100}=4{,}7088$ and

$l(F)=\min\{l(F), l(E)+w(EF)\}=\min\{61{,}02, 58{,}86+8{,}829\}=61{,}02$, where $w(EF)=58{,}86\cdot\frac{15}{100}=8{,}829$.

Now we fix $l(I)=p_I=63{,}5688$ and we take $S_3=\{A,C,E,I\}$. So



References:

1. Keijo Ruohonen, GRAPH THEORY, 2013
2. Seifedine Kadry, Ayman Abdallah, Chibli Joumaa, On The Optimization of Dijkstra's Algorithm, 2012
3. Pimploi Tirastittam, Phutthiwat Waiyawuththanapoom, Public Transport Planning System by Dijkstra Algorithm: Case Study Bangkok Metropolitan Area, 2014
4. NEIL H . BORDEN, The Concept of the Marketing Mix, 1984
5. Marilyn A. Stone, John Desmond, FUNDAMENTALS OF MARKETING, 2007