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Heuristic Method in Solving Optimization Problems of Online Shopping in Indonesia

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Abstract: The development of online business in Indonesia is very rapid, this indicates the era of utilization of information technology has begun to be recognized existence. Shopping online has become one of the most common activities, done by millions of users every day. The variety of available orders makes it increasingly dificult to get the most out of all the stores. This research on the optimization of online shopping has grown rapidly. The focus of this research generally is to determine the optimum cost of product cost and product delivery issues. For that purpose the issue is of online shopping optimization. The existence of the solution of the optimum cost is shown by analyzing Linear Integer Programming by using heuristic algorithm method MinMin algorithm and Celluler processing Algorithm to optimize the problem of online shopping.
Keywords: Heuristic, optimization, Online shopping, Cellular processing Algorithm, MinMin Algorithm

I. INTRODUCTION

Shopping online or commonly called e-commerce more and more in Indonesia this is due to the development of the internet. Easy access to the internet either via wifi or gadget devices facilitate the public to access information about a product or service that was searched in addition to the incessant promotion conducted by e-commerce companies in ordering goods or services by ordering various kinds of facilities for the community.

Optimization is a way used to search for all possible real values of an objective function. The search process can be done by listing one by one the possible values or by developing a search algorithm. Later after the discovery of all these possibilities, choose which one is best. In other words, the optimization looks for the maximum or minimum value depending on the issue being discussed.

Heuristic methods can be used to find solutions of optimization problems, but do not guarantee always result in optimal solutions. In principle, heuristic methods are used to find the best solution possible within a given time range. The number of online store offers that are available so much make it dificult to get the best amongst all the stores. The prices in each online store have a standard price for the product. However, the total price may change due to different delivery times, different profits etc. Customers are interested in minimizing total product and delivery costs.

II. LITERATURE REVIEW

In a previous study, a specialization of ISOP has been conducted with sensitive discounted prices (Blazewicz et al 2014a, 2014b) and a dual discount function both for price discount and delivery (Blazewicz et al., 2016). Wojciechowski and Musial (2010) first de_ned the heuristic algorithm. Internet shopping optimization issues (ISOP) (Musial, 2012) which was discovered about the description of computational experiments for ISOP problems and the results appear when shopping customers want to buy products in one online store for a minimum fee, taking into account also the shipping costs associated with the store where one or more products are purchased. The most interesting (and most complicated) specialization of ISOP is what's called online shopping with price-sensitive discount issues presented by Blazewicz et al. (2014). For each online store, the standard price for the product is known, as well as the increased total standard functionality and shipping rates. Optimization pricing can benefit customers. Moreover, we can show positive things as aspects of the information search stage much easier (Rose and Samouel, 2009). Furthermore, (Cheung et al. 2005) suggests that Internet subscribers are under the influence of many factors while shopping online (both internal and external).

The notation used in this research is:

M : The set of stores
N : The product set
m : Number of stores
n : Number of products
a : The store indicator

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b : The product indicator
N_a : The number of product sets available from store a
d_a : The delivery price of all products from the store a
c_{ab} : Price of product b in store a
x_{ab} : 0-1 indicator of product usage b in store a
y_a : 0-1 usage indicators in store a
X = $(X_1,\ldots\ldots,X_m)$: The order of product selection from store 1 ...., m
F(X) : Sum of product costs and delivery costs
δ(x) : 0-1 indicator function for x = 0 and x > 0
X^* : optimal sequence of selection of products
F* : Optimal (minimum) total cost

III. PROBLEMS REVIEW

This study analyzes the problem of online shopping optimization, where the problem of this online shopping is minimizing product price in store a and shipping price in store a. In the case, the buyers look at the number of product set N = (1,……, n) to buy in store m. There is an abundance of supply of Na product, c_{ab} part cost of product b 2 $\in N_a$, and delivery costs and there is a set of products to delivery from store to buyer where in store a, a = 1,……….,m. It is assumed that $c_{ab} = \infty$ If b $\subseteq$ N_a. The problem set in choosing the product X = $(X_1,\ldots,X_m)$, called the selected product where $X_a \bigcup_{a=1}^{m} N_a$, a = 1,…., m, X_a = N and the total price of the product and the shipping price minimized as : F(X) : = $\sum_{a=1}^{m}(\delta(|X_a)d_a + \sum_{b\in X_a} c_{ab})$. Where $(|X_a)$ denotes the cardinality of the multiset X_a, and δ (x) = 0 if x = 0 and δ (x) = ∞ if x > 0.

IV. INTEGER LINEAR PROGRAMMING

The x_{ab} variable is binary indicating product b is purchased from store a, ya is binary variable if the list of products is purchased from store a.

$$\min \sum_{a=1}^{m}\sum_{b=1}^{n} c_{ab}x_{ab} + \sum_{a=1}^{m} d_a y_a \quad (1)$$

$$x_{a,b} \in \{0,1\}, \forall a \in M, \forall b \in N \quad (2)$$

$$y_a \in \{0,1\}, \forall a \in M \quad (3)$$

$$\sum_{a=1}^{m}\sum_{b=1}^{n} x_{ab} = n \quad (4)$$

$$\sum_{a=1}^{m} x_{ab} = 1, \forall b \in N \quad (5)$$

$$ny_a - \sum_{b=1}^{n} x_{ab} \geq 0, \forall a \in M \quad (6)$$

In this ILP, the objective function is shown in (1), which is the total cost of purchasing a shopping list from the selected store, including postage, subject to the following constraints (4) making sure that the number of products purchased equals the number of products on the shopping list, while constraint (5) ensures that only one product of each type is selected; constraint (6) ensures that y_a variable takes a value 1 when the product is purchased from store a. It can be seen that this model of integer, where the decision variable xab and ya is the integer value. In addition the objective function and the constraint function are linear model.

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V. HEURISTIC METHOD

In this heuristic method there are several heuristic approaches to solve ISOP. This method I propose includes variants of the MinMin algorithm with Local search stage (MinMin) and cellular processing algorithm as follows:

A. MinMin algorithms and Varians

The MinMin algorithm has been well known in the _eld of scheduling presented by (Freund et al. 1998, Diaz et al. 2014, Nesmachnow et al. 2013) describes a task scheduling algorithm, with each task being assigned to a resource. It is divided into two phases:

The first phase is to set / calculate all the expected expected completion

times for each task and resource: the dimension matrix t x n

During the second phase, all tasks are scheduled, based on the minimum turnaround time.

At each step of the algorithm, tasks with a minimum completion time are assigned to the appropriate resources and removed from the remaining task list.

1) MinMin Algorithm

A general solution using the MinMin Algorithm Lopez-loces et al. (2016)

a) *Input:* N_a: Number of product inventory set in each store

N: Shopping list.

M: List of Shops.

b) *Output :* $X = (X_1, \ldots\ldots, X_m)$: Sequence of selection of products.

(F : sum of product costs and delivery costs)

i) $X = (X_1 = \phi, \ldots\ldots, X_m = \phi)$
ii) while $N \neq \phi$ do
iii) min $=\infty$
iv) for all $a \in M$ do
v) for all $b \in N$ do
vi) Product b is determined to X_a
vii) if F(X) < min then
viii) min = F(X)
ix) b' = b
x) end i
xi) remove b from X
xii) end fo
xiii) end for
xiv) Product b' is determin inShop a to X
xv) Remove Product b' from N and product b' from N_a
xvi) end whil
xvii) return X

2) Local Search Algorithm

Improves a solution to its local optimum in the search space. Lopez-loces et al. (2016)

a) Input: X_{old} : $(X_{old1}, \ldots., X_{oldm})$: Sequence of selection of products to improve.

N_a: Multiset of available products per shop.

b) Output : $X = (X_1, \ldots.., X_m)$: Improve sequence of selection of products.

(F : sum of product costs and delivery costs)

i) add products b and cost = $c_{ab} + d_a$ from X_{olda} to
ii) sort V by cost in ascending orde
iii) $X = X_{ol}$
iv) oldTotalCost = F(X

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v) for all b ∈ V do
vi) Remove Product b from X_a
vii) for all a ∈ M do
viii) Product b is determined to X_a
ix) if F(X) < oldTotalCost then
x) oldTotalCost = F(X
xi) . a' =
xii) end if
xiii) Remove Product b from X_a
xiv) end fo
xv) Product b is determined inShop a' to X_a
xvi) end for
xvii) return X

B. Cellular Processing Algorithm

Cellular computing is described by Sipper (1999) a philosophy design algorithm based on three interrelated principles. The principle of simplicity dictates that the processing cell ideally performs a very simple task only takes a little time. Furthermore, the principle of parallelism propagates many individual cells to solve a task. The third is the principle of locality, which states that, given the high number of cells, communication between all is impractical, therefore local communication between neighboring cells is preferred. This paradigm is perfect for use in computing or data centers, as it utilizes the large number of processors available.

1) MinMin+Local Search algorithm.

Generates an initial solution using the MinMin algorithm that is improved by a Local search method Lopez-loces et al. (2016)

a) Input: N_a : Multiset of available products per shop.
N : Shopping list.
M : List of shops.
b) Output: X = (X_1,….,X_m) : Sequence of selection of products
(minMin : MinMin heuristic in Algorithm 1)
(localSearch :Local Search in Algorithm 1)

i) X = minMin (N_a;N;M)
ii) X = localsearch (X;N_a)
iii) return
iv) improv + +
v) end i
vi) end while
vii) X = localSearch (bestX,N_a
viii) return bestX

Communication in this case is indicated by all solutions with all cells after complete iteration.

III. CONCLUSION

Integer Linear Programming Modeling with MinMin and Varian Heuristic Algorithm Methods, Celullar processing Algorithm is applicable for conditions where buyers want to minimize product price costs and minimize the cost of shipping products from the best online stores. With minimal shipping costs greatly beneficial buyers and make it easier for buyers to choose the best store from several online stores available.

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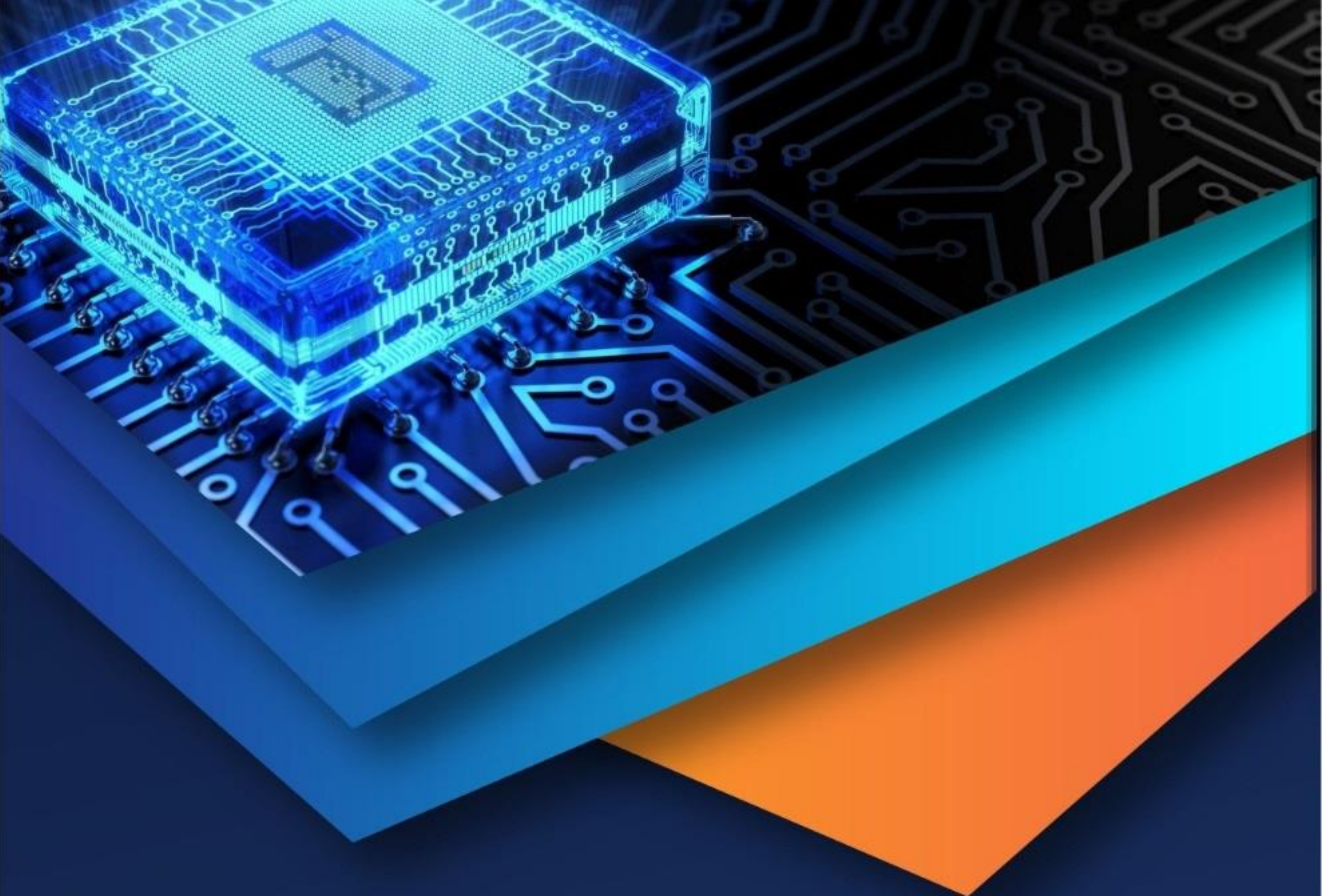

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