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THE NEW APPROACH OF BUNDLE-PRICING SCHEME MODELS BY USING BRANCH AND BOUND SOLVER

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Abstract

As the internet become important in everyday life, it is the critical task for the Internet Service Provider (ISP) to serve better service to the customers. One scheme offered is through the bundle-pricing scheme that is proved to be able to serve the types of customers. Previous stdies already begun with the models of bundle-pricing schemes that are solved by various techniques such as game theory or through the optimization problem of Lagrangian relaxation. This study attempts to solve the bundle-prcing scheme by using the branch and bound solver through LINGO 11.0 to obtain the optimal solution. The results show that by setting up certain number of users, services and number of goods to be chosen, if the service providers set the price of booking a lower then the consumer will be more interested in choosing a service with the subscription price is lower as well.

Keywords: bundle-pricing; branch and bound solver; optimal solution

1. Introduction

As the development of the technology era, human needs of the Internet today is a very important thing. Internet Service Provider are competing to provide the best Internet services to be offered to consumers.

Pricing scheme nowadays, play the role part in technological area. The providers are pushed to promote better service and the skilss to compete to others to attract the interest of the customers to subscribe to the services. ISP with the ability to buy from some operators by offering different tariffs and ability to design smart strategy will gain some customers to attract the customers (Jormakka & Sarala, 2004).

Some preliminary studies focus on pricing scheme of information goods are due to Wu et al. (2010), Indrawati et al., (2014; 2015), the optimal pricing by considering the utility function as the users' satisfaction measurement in networks (Indrawati et al., 2005; Indrawati et al., 2014) and some works focus on the pricing in multi QoS networks in wired or wireless networks proposed by Puspita et al. (2011, 2015; 2013), Irmeilyana et al., (2015; 2016). According to Gizelis, et al. (2011) the pricing schemes can be classified into broad categories consisting the flat rate and parameter based pricing schemes.

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Bundle Pricing is one way to deal with uncertainty, potential customers using the services offered by the service provider information. This technique is deemed able to cope with the diversity of the types of customers and have a good assessment of the customer. The method previously studied using mixed integer nonlinear programming models are solved using game theory strategy (Viswanathan & Anandalingam , 2005; Wu , 2008).

The decision of the providers consist of the selection of certain techniques and the price involved to maximize the objective function which is to obtain the maximum profit. The bundling scheme is proved to be powerfull in handling the competition among providers (Venkatesh & Mahajan, 2009).

This study is a breakthrough by applying new approach of bundle pricing model with branch and bound technique to produce Integer Linear Programming model and solved iteratively by using LINGO 11.0. So the contribution is basically to have new approach in solving bundle-pricing scheme by formulating into integer linear programming as a new insight in viewing the optimization of bundle-pricing scheme. The branch and solver is one of the very powerful solver that deals with the optimization problem mainly for getting the exact solutions.

2. Methods

This study used LINGO 11.0 program to obtain the optimal solution of model by formulating the model into integer linear equations. The model established by

the parameters and variables that are used to solve optimization problems. Then, the branch and bound solver of LINGO 11.0 solve the problem through some iterations until it achieves the optimal solution with the state of either local or global optimum.

3. Results and Discussion

The model begins with the setting up of the parameters and decision variables. The objective function is to maximize the reseller profit that consists of the profit obtained with the reduced cost occurs. Then the constraints shows set of the equations that limits the objective functions that mainly tell about the benefit for the customers starting with the maximization of customer surplus and the choice to make for the customer to choose to only one item of bundle.

The model established is based on Wu et al., (2008) and Viswanathan and Anandalingam (2005). Rather than by using Lagrangian relaxation, we propose the simplest way to solve the problem by using branch and bound solver through LINGO 11.0. The parameters and decison variables are exactly the same as defined in previous research, while the parameter values we add to the model is presented in Table 1.

Table 1. Our Proposed Parameter Values of The Bundle-Pricing Scheme proposed by Wu et al. (2008)

Parameter	Value
R_{11}	10000
R_{12}	10000
R_{21}	20000
R_{22}	20000
M	2000
B_1	2000
B_2	2000
i	2
j	2
k	2

Below is the program code of LINGO 11.0 to show how to find the optimal solution of the problem. We want to show how the models to be solved by taking the example of 2 users, 2 services and 2 goods to be offered. To resolve the case we need to solve by using Lingo 11.0 program . Models of Integer Linear Programming models are solved using a branch and bound iterative solver.

```
max=((p1-b1)*x11)+((p1-b1)*x21)+((p2-
b2)*x12)+((p2-b2)*x22)-(m*y1+m*y2);

s1>=(r11-p1)*y1;
s1>=(r12-p2)*y2;
s2>=(r21-p1)*y1;
s2>=(r22-p2)*y2;

s1=(r11-p1)*x11+(r12-p2)*x12;
s2=(r21-p11)*x21+(r22-p2)*x22;

(r11-p1)*x11>=0;
(r12-p2)*x12>=0;
(r21-p1)*x21>=0;
(r22-p2)*x22>=0;

r11=10000;
r12=10000;
r21=20000;
r22=20000;

x11+x12<=1;
x21+x22<=1;

x11<=y1;
x21<=y1;
x12<=y2;
x22<=y2;

s1>=0.01;
s2>=0.01;
p1>=0.01;
p2>=0.01;

m=2000;
b1=2000;
b2=2000;


@BIN(y1);
@BIN(y2);
@BIN(x11);
@BIN(x12);
@BIN(x21);
@BIN(x22);
        end
```

The optimal solutions of the cases are shown in the Table 2 dan Table 3, respectively.

Table 2. The Solver Status of The LINGO 11.0 of the Bundle-Pricing Scheme Model

Solver Status	
Model Class	ILP
State	Global Opt
Objective	14000
Infeasibility	5,45697e-012
Iterations	225
Extended Solver Status	
Solver Type	Branch and Bound
Best Objective	14000
Steps	8
Update interval	2
GMU(K)	26
ER(sec)	0

Based on Table 2 it can be seen that the case has the optimal solution with a value of 14000, the results obtained through 225 iterations and the value of infeasibility 5,45697e-012. The model is considered as integer linear programming and the global optimum is reached. The solver type shows that this case is solved by methods of Branch and Bound. GMU or Generated Memory Used shows the number of memory allocations were used of 26 K and ER or Runtime Elapsed time showed fatherly produce and finalize the model that is 0 seconds .

Table 3 shows the decision variables and the optimal solution for the model with $i = 1 , .. , 2$ and $j = 1 , .. 2$.

Table 3. The Decision Variable Values of the Scheme of Bundle-Pricing

Variable	Value
P_1	0.01
P_2	9999.990
X_{11}	0
X_{12}	0
X_{21}	1
X_{22}	1
Y_1	0
Y_2	1.
S_1	0.01
S_2	10000

Overall, by determining of parameters value R of 10000 for each consumer , and the value of B is the cost of making a bundle in j service of 2000 , the service providers will gain maximum benefit that not only benefit the service provider but on certain conditions , service users are given the opportunity to choose which classes are desired within the budget that users have. X_{11} and X_{12} are 0 due to R value that is the total price of the reservation R_{11} and R_{12} worth less than R_{21} and R_{22} of 10000 and 20000. So here, we can check that the user 2 has choices to either to choose bundle 1 good or 2 good that is why the value of user 2 is 1.

4. Conclusion

If the service providers set the price of reservation a lower value then the consumer will be more interested in choosing a service with the subscription price is lower as well.

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