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RESEARCH ARTICLE | DECEMBER 28 2023

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AIP Conf. Proc. 2913, 030011 (2023)
https://doi.org/10.1063/5.0171989

Sensitivity Analysis of Layout Model of Improved Dynamic Spectrum and Traffic Management in Internet Financing Scheme on Selfish Customer DSL-LTE Multiple QoS

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Abstract. The speed and completeness of the information provided by the internet is an attraction and a basic need for internet customers. Internet Service Providers (ISP) must provide a better quality of service or QoS and different to customers at a minimum cost. This service must be improved by using the variables Fair Network Traffic Management *and* Selfish customer. C-RAN is a centralized radio access network connected to a cellular antenna to process signals and transmit them to the core network. Determining and modeling C-RAN can be done by inserting a schema model for measuring internet network customer satisfaction with optimization of bandwidth consumption. Testing the sensitivity analysis can determine the optimal parameters that are solved with the help of Lingo 13.0 software. This study aims to analyze the sensitivity of the selfish customers and fair network models combined into the C-RAN model to the internet network scheme model on consumption bandwidth. This research data is secondary data obtained from the server of the Sriwijaya State Polytechnic building in Palembang. The results obtained from this study in a C-RAN model is then obtained with the optimal solution by using local server data shows better results compared the previous research without dealing with utility function by determining the initial consumption (Q^N) and the maximum bandwidth consumption (P_0). Then, if the analysis of the model is explored in depth using sensitivity analysis, it is found that if the variable is infinity, the increase or decrease is not fixed and can change, while a variable with a value of 0.000 means that the increase or decrease is fixed, then the values cannot be changed.

INTRODUCTION

Nowadays, technology is developing rapidly. One of them is the internet, the internet is a human need in meeting information needs. The internet has been used in various circles, from children to adults. Every year internet customers are growing and every year it creates an internet culture. In optimization problems [1,2], the internet becomes a connecting network that connects customers with one another. To connect customers with each other, the internet has an Internet Service Provider or ISP [3] as a service provider that requires a Transmission Control (TCP) [4] or Internet Protocol (IP) [5]. The internet network is a combination of two or more networks that exchange data with each other.

In the previous research, we analyzed the network scheme of the Cloud Radio Access Network (C-RAN) [6] and ,formulated a new model plan that involved Fair Network Traffic Management [7-11] and selfish customers [12,13] that

Sriwijaya International Conference on Basic and Applied Sciences 2021
AIP Conf. Proc. 2913, 030011-1–030011-10; https://doi.org/10.1063/5.0171989
Published by AIP Publishing. 978-0-7354-4775-2/$30.00

could work under the cloud of a wireless network[14-16] where C-RAN is a centralized radio access [17-19] network, the equipment used is connected to a cellular antenna to process the signal and transmit it to the core network.

It is a necessity to analyze the selfish customers network scheme focussed on customers' satisfaction toward the internet usage by formulation new dynamical models that can work in wireless cloud. Selfish customers in traffic management is aimed to maximize the Quality of Experience (QoE) [20,21] focussed on service, customers' experience sourced from telecommunication companies. The International Telecommunication Union (ITU) defines QoE as the receptions of all applications or services as subjective perspectives [16, 22] of the customers.

Then, this study aims to analyze the sensitivity of the selfish customers models combined into the C-RAN [6] model in an optimized manner as Mixed Integer Nonlinear Programming (MINLP) [1] involving Path loss of Remote Radio Heads (RRH) and channel gain of RRH the LINGO application using the internet network scheme model for bandwidth consumption. It is not quite common step to conduct for examining the post optimality [23-25] of nonlinear programming [23] due to model's complexity. But it is urgent to be discussed if involving the validation of the model designed. It is a necessity to examine the pattern of model designed after finding the solution to check whether the post optimality still hold in certain solution range without affecting the objective function value.

METHOD

Data used in this study is secondary data obtained from the Sriwijaya State Polytechnic building server in Palembang within one month with the start point starting in March 2020 and the end point in April 2020.

Variables-variables used in this study are as follows:

a) P_0 (bandwidth) as a constant and
b) Q^N (initial usage of bandwidth) as a variable

The data Analysis used in this study in sensitivity analysis using Lingo software with the following stages:

1. Describe hotspot data traffic
2. Process data into two categories, during peak hours (07.00-17.00) and during off-peak hours (19.00-05.00)
3. Define the variables and parameters used in the model of selfish customers for bandwidth consumption on the network.
4. Apply the summed data into model of selfish customer C-RAN
5. Analyze the sensitivity of the results that have been carried out to model using LINGO 13.0

RESULT AND DISCUSSION

Parameters and variables defined are as presented in Table 1 and Table 2, respectively, as follows.

TABLE 1. Parameter for Selfish Customers Model

Parameter	Definitions
P_0	Bandwidth
φ_{eff}	Efficiency of power amplifier
Q_c^R	Circuit bandwidth
Q_{bz}	Bandwidth consumption from fronthaul link
η_{R}	Upper bound of QoS
η_{ER}	Lower Bound of QoS
δ_0	Predefined limit
$Q_{\max}^{\mathrm{R}}$	Maximum switching bandwidth
Q_n	Initial usage of bandwidth
T	Time spent in this model
π	Phi
β	Chemical parameter value
$w_n^R = \bar{X}_n$	the path loss n of remote radio heads (RRH)
$z_{i,k}^R$	*i* channel gain of RRH
e	Logarithmic base
d	Energy bandwidth consumption of the device when connected
η	Battery consumption per unit distance
n	Coefficient of propagation

TABLE 2. Variables for Selfish Customers Model

Variable	Definitions
$\zeta(T)$	Battery usage rate
E	Device energy
Ω	The utility function is based on the throughput received and consumed by the battery
C_{jb} and E_{jb}	Represents the value of throughput and energy consumed by customers
w_1 and w_2	Weight value
$a_{n,k}$	Resource Block (RB) allocation indicator having 0 or 1 value.

Data used for Selfish model obtained from local server data is displayed in Table 3 as follows, based on C-RAN model.

TABLE 3. Parameter values

Parameter	Value (kpbs)	Parameter	Value (kpbs)	Parameter	Value (kpbs)
$w_1^R = \bar{X}_1$	9106.064	z_{52}^R	5457.227	P_0	5000
$w_2^R = \bar{X}_2$	2935.127	z_{61}^R	1269.256	φ_{eff}	500
$w_3^R = X_n$	30.002	z_{62}^R	8315.611	Q_c^R	4500
$w_4^R = \bar{Y}_1$	291.441	z_{13}^R	5963.413	Q_{bz}	4000
$w_5^R = \bar{Y}_2$	241.112	z_{23}^R	75180.04	η_R	128
$w_6^R = Y_n$	19.988	z_{33}^R	23152.535	η_{ER}	64
z_{11}^R	6478.525	z_{44}^R	6222.305	δ_0	4500
z_{12}^R	7640.178	z_{45}^R	1347.486	Q_{max}^R	500
z_{21}^R	3829.665	z_{46}^R	5763.497	Q_n	150
z_{22}^R	5779.399	z_{54}^R	3581.486	T	2 hours
z_{31}^R	11468.578	z_{55}^R	51418.161	π	3.14
z_{32}^R	4778.478	z_{56}^R	1560.931	β	0.5
z_{41}^R	10176.931	z_{64}^R	23739.706	e	2.71
z_{42}^R	7179.032	z_{65}^R	1360.317	d	10,240
z_{51}^R	5331.473	z_{66}^R	1518.298	η	6 hours
				n	2.71

Then the design of model are stated as follows

Model of Selfish Customers

$$\Omega = \frac{[\sum_j C_{jb}]^{w1} + [\sum_j E_{jb}]^{w2}}{\sum_j C_{jb} + \sum_j E_{jb}}$$

Subject to

$$\sum_j E_{jb} \leq P_b, j = \{1, 2\}$$

In this model, P_b shows the probability value and j shows the users or customers, a and b are limited to the value of j= 1,2 and b = 1,2

To obtain the value of E_{jb} , need to find the value of $\zeta(\mathrm{T}) = \frac{\pi^2}{3\beta^2} e^{-\beta^2 T}$ and $E_j = \zeta(T) + \eta\, d_j^i$

To obtain $\zeta(T)$, then, calculate $\zeta(T) = \frac{\pi^2}{3\beta^2} e^{-\beta^2 T} = \frac{(3.14)^2}{3(0.5)^2} (2.71)^{(-0.5)^2(2)}$

$= 13.14613\ (1.64620)$

$= 21.64115$

From the value of $\zeta(T)$ it is obtained 21.64115, then E_j can be calculated as follows.

$E_j = \zeta(\mathrm{T}) + \eta\, d_j^i = 21.64115 + 6\ (10.240)^{2.71} = 4.4262 \times 10^{11}$

In selfish customers model, $E_j = E_{jb}$

Then the Improved C-RAN for selfish customer will be

$$\text{Max } = \frac{\sum_{i=1}^{3+3}\sum_{k=1}^{2} a_{i,k}P_0\, log_2(1+\sigma_{i,k}q_{i,k})}{\varphi_{eff}\sum_{i=1}^{3+3}\sum_{k=1}^{2} a_{i,k}q_{i,k}+Q_c^R+Q_{bz}} + \frac{\left[\sum_j C_{jb}\right]^{w1} + \left[\sum_j E_{jb}\right]^{w2}}{\sum_j C_{jb} + \sum_j E_{jb}}$$

Subject to

$$\sum_{n=1}^{N+M} a_{n,k} = 1,\;\; a_{n,k} \in \{0,1\}, k = 2$$

$$\sum_{n=1}^{N} C_{n,k} \geq \eta_{\mathrm{R}},\;\;\; k \in \Omega_1$$

$$\sum_{n=N+1}^{N+M} C_{n,k} \geq \eta_{\mathrm{ER}},\qquad k \in \Omega_2$$

$$\sum_{n=N}^{N+M} a_{n,k}p_{n,k}d_k^{R2M}h_k^{\mathrm{R2}M} \leq \delta_0\,,\;\; k \in \Omega_{\mathrm{II}}$$

$$\sum_{n=1}^{N+M}\sum_{k=1}^{K} a_{n,k}p_{n,k} \leq P_{max}^R\,,\;\;\; p_{n,k} \geq 0$$

$$\sum_i E_{ij} \;\leq\; P_j \qquad , i = \{1,2,\ldots,n\}$$

with

$$C_{n,k} = a_{n,k}B_0 \log_2\left(1 + \sigma_{n,k}p_{n,k}\right)$$

$$\sigma_{n,k} = \begin{cases} \dfrac{d_n^R h_{n,k}^R}{B_0 N_0}, & k \in \Omega_1 \\ \dfrac{d_n^R h_{n,k}^R}{(P^M d_n^M h_{n,k}^M + B_0 N_0)}, & k \in \Omega_2 \end{cases}$$

In LINGO code, it is can be stated as follows.

$$\max = ((a_{11} * p * @logb((1 + (((w_1^r * z_{11}^r)/(p * i)) * q_{11})),2)) + (a_{12} * p * @logb((1 + (((w_1^r * z_{12}^r)/(p * i)) * q_{12})),2)) + (a_{21} * p * @logb((1 + (((w_2^r * z_{21}^r)/(p * i)) * q_{21})),2)) + (a_{22} * p * @logb((1 + (((w_2^r * z_{22}^r)/(p * i)) * q_{22})),2)) + (a_{31} * p * @logb((1 + (((w_3^r * z_{31}^r)/(p * i)) * q_{31})),2)) + (a_{32} * p * @logb((1 + (((w_3^r * z_{32}^r)/(p * i)) * q_{32})),2)) (a_{41} * p * @logb((1 + (((w_4^r * z_{41}^r)/(p * i)) * q_{41})),2)) + (a_{42} * p * @logb((1 + (((w_4^r * z_{42}^r)/(p * i)) * q_{42})),2)) + (a_{51} * p * @logb((1 + (((w_5^r * z_{51}^r)/(p * i)) * q_{51})),2)) + (a_{52} * p * @logb((1 + (((w_5^r * z_{52}^r)/(p * i)) * q_{52})),2)) + (a_{61} * p * @logb((1 + (((w_6^r * z_{61}^r)/(p * i)) * q_{61})),2)) + (a_{62} * p * @logb((1 + (((w_6^r * z_{62}^r)/(p * i)) * q_{62})),2)) + (x_1 + x_2 + x_3)^2)$$

$$/$$

$$(phi * (((a_{11} * q_{11}) + (q_c + q_{bz})) + ((a_{12} * q_{12}) + (q_c + q_{bz})) + ((a_{21} * q_{21}) + (q_c + q_{bz})) + ((a_{22} * q_{22}) + (q_c + q_{bz}) + ((a_{31} * q_{31}) + (q_c + q_{bz})) + ((a_{32} * q_{32}) + (q_c + q_{bz})) + ((a_{41} * q_{41}) + (q_c + q_{bz})) + ((a_{42} * q_{42}) + (q_c + q_{bz})) + ((a_{51} * q_{51}) + (q_c + q_{bz})) + ((a_{52} * q_{52}) + (q_c + q_{bz})) + ((a_{61} * q_{61}) + (q_c + q_{bz})) + ((a_{62} * q_{62}) + (q_c + q_{bz}))) + 3 * ((x_1{}^2) + (x_2{}^2) + (x_3{}^2)));$$

$x_1 \geq cb;$
$x_2 \geq cb;$
$x_3 \geq cb;$
$a_{11} + a_{21} + a_{31} + a_{41} + a_{51} + a_{61} = 1;$
$a_{12} + a_{22} + a_{32} + a_{42} + a_{52} + a_{62} = 1;$

$$(a_{11} * p * @logb((1 + (((w_1^r * z_{11}^r)/(p * i)) * q_{11})),2)) + (a_{12} * p * @logb((1 + (((w_1^r * z_{12}^r)/(p * i)) * q_{12})),2 + (a_{13} * p * @logb((1 + (((w_1^r * z_{13}^r)/(p * i)) * q_{13})),2 \geq n_r;$$

$$(a_{21} * p * @logb((1 + (((w_2^r * z_{21}^r)/(p * i)) * q_{21})),2)) + (a_{22} * p * @logb((1 + (((w_2^r * z_{22}^r)/(p * i)) * q_{22})),2 + (a_{23} * p * @logb((1 + (((w_2^r * z_{23}^r)/(p * i)) * q_{23})),2 \geq n_r;$$

$$(a_{31} * p * @logb((1 + (((w_3^r * z_{31}^r)/(p * i)) * q_{31})),2)) + (a_{32} * p * @logb((1 + (((w_3^r * z_{32}^r)/(p * i)) * q_{32})),2 + (a_{33} * p * @logb((1 + (((w_3^r * z_{33}^r)/(p * i)) * q_{33})),2 \geq n_r;$$

$$(a_{44} * p * @logb((1 + (((w_4^r * z_{44}^r)/(p * i)) * q_{44})),2)) + (a_{45} * p * @logb((1 + (((w_4^r * z_{45}^r)/(p * i)) * q_{45})),2 + (a_{46} * p * @logb((1 + (((w_4^r * z_{46}^r)/(p * i)) * q_{46})),2 \geq n_{er};$$

$$(a_{54} * p * @logb((1 + (((w_5^r * z_{54}^r)/(p * i)) * q_{54})),2)) + (a_{55} * p * @logb((1 + (((w_5^r * z_{55}^r)/(p * i)) * q_{55})),2 + (a_{56} * p * @logb((1 + (((w_5^r * z_{56}^r)/(p * i)) * q_{56})),2 \geq n_{er};$$

$$(a_{64} * p * @logb((1 + (((w_6^r * z_{64}^r)/(p * i)) * q_{64})),2)) + (a_{65} * p * @logb((1 + (((w_6^r * z_{65}^r)/(p * i)) * q_{65})),2 + (a_{66} * p * @logb((1 + (((w_6^r * z_{66}^r)/(p * i)) * q_{66})),2 \geq n_{er};$$

$a_{31} * q_{31} * w_1^{rn} * z_1^{rn} + a_{41} * q_{41} * w_1^{rn} * z_1^{rn} + a_{51} * q_{51} * w_1^{rn} * z_1^{rn} + a_{61} * q_{61} * w_1^{rn} * z_1^{rn} \leq \delta;$
$a_{32} * q_{32} * w_2^{rn} * z_2^{rn} + a_{42} * q_{42} * w_2^{rn} * z_2^{rn} + a_{52} * q_{52} * w_2^{rn} * z_2^{rn} + a_{62} * q_{62} * w_2^{rn} * z_2^{rn} \leq \delta;$
$a_{33} * q_{33} * w_3^{rn} * z_3^{rn} + a_{43} * q_{43} * w_3^{rn} * z_3^{rn} + a_{53} * q_{53} * w_3^{rn} * z_3^{rn} + a_{63} * q_{63} * w_3^{rn} * z_3^{rn} \leq \delta$
$a_{34} * q_{34} * w_4^{rn} * z_4^{rn} + a_{44} * q_{44} * w_4^{rn} * z_4^{rn} + a_{54} * q_{54} * w_4^{rn} * z_4^{rn} + a_{64} * q_{64} * w_4^{rn} * z_4^{rn} \leq \delta;$
$a_{35} * q_{35} * w_5^{rn} * z_5^{rn} + a_{45} * q_{45} * w_5^{rn} * z_5^{rn} + a_{55} * q_{55} * w_5^{rn} * z_5^{rn} + a_{65} * q_{65} * w_5^{rn} * z_5^{rn} \leq \delta$
$a_{36} * q_{36} * w_6^{rn} * z_6^{rn} + a_{46} * q_{46} * w_6^{rn} * z_6^{rn} + a_{56} * q_{56} * w_6^{rn} * z_6^{rn} + a_{66} * q_{66} * w_6^{rn} * z_6^{rn} \leq \delta;$

$$a_{11} * q_{11} + a_{12} * q_{12} + a_{21} * q_{21} + a_{22} * q_{22} + a_{31} * q_{31} + a_{32} * q_{32} + a_{41} * q_{41} + a_{42} * q_{42} + a_{51} * q_{51} + a_{52} * q_{52} + a_{61} * q_{61} + a_{62} * q_{62} \leq q_{max};$$

$c_j = 278512.528;$
$w_1^r = 9106.064;$
$w_2^r = 2935.127;$
$w_3^r = 30.002;$
$w_4^r = 291.441;$
$w_5^r = 241.112;$
$w_6^r = 19.988;$

$z_{11}^r = 6478.525;$
$z_{12}^r = 7640.178;$
$z_{21}^r = 3829.665;$
$z_{22}^r = 5779.399;$
$z_{31}^r = 11468.578;$
$z_{32}^r = 4778.478;$
$z_{41}^r = 1176.931;$
$z_{42}^r = 7179.032;$
$z_{51}^r = 5331.473;$
$z_{52}^r = 5457.227;$
$z_{61}^r = 1269.256;$
$z_{62}^r = 8315.611;$
$z_{13}^r = 5963.413;$
$z_{23}^r = 75180.04;$
$z_{33}^r = 23152.535;$
$z_{44}^r = 6222.305;$
$z_{45}^r = 1347.486;$
$z_{46}^r = 5753.497;$
$z_{54}^r = 3581.486;$
$z_{55}^r = 51418.161;$
$z_{56}^r = 1560.931;$
$z_{64}^r = 23739.706;$
$z_{65}^r = 1360.317;$
$z_{66}^r = 1518,.98;$

$phi = 500;$
$q_c = 4500;$
$q_{bz} = 4000;$
$p = 5000;$
$\delta = 7000;$
$q_{max} = 500;$
$n_r = 128;$
$n_{er} = 68;$

$q_{11} \geq 0;$
$q_{12} \geq 0;$
$q_{13} \geq 0;$

$q_{21} \geq 0;$
$q_{22} \geq 0;$
$q_{23} \geq 0;$

$q_{31} \geq 0;$
$q_{32} \geq 0;$
$q_{33} \geq 0;$

$q_{34} \geq 0;$
$q_{35} \geq 0;$
$q_{36} \geq 0;$

$q_{41} \geq 0;$
$q_{42} \geq 0;$
$q_{43} \geq 0;$
$q_{44} \geq 0;$
$q_{45} \geq 0;$
$q_{46} \geq 0;$

$q_{51} \geq 0;$
$q_{52} \geq 0;$
$q_{53} \geq 0;$
$q_{54} \geq 0;$
$q_{55} \geq 0;$
$q_{56} \geq 0;$

$q_{61} \geq 0;$
$q_{62} \geq 0;$
$q_{63} \geq 0;$
$q_{64} \geq 0;$
$q_{65} \geq 0;$
$q_{66} \geq 0;$

Then the solution is stated as follows.
Local Optimal Solution Found
Objective Value : 1.000000
Infeasibilities : 0.000000
Total Solver Iterations : 34
Model Class : NLP

The objective value reached is IDR 1/kbps solved in 34 iterations which class of model is nonlinear programming (NLP). For example, from Table 4 , it is stated that the application of $q_{1,2}$ can be summarized as bandwidth transfer from the 1st Resource Block (RB) on the 2th Remote User Equipment (RUE) is 500. Path loss from RRH to RB for $w_1^{\mathrm{R2M}} = w_2^{\mathrm{R2M}} = w_3^{\mathrm{R2M}} = w_4^{\mathrm{R2M}} = w_5^{\mathrm{R2M}} = w_6^{\mathrm{R2M}} = 1.234568$.

TABLE 4. Decision Variables Values

Variable	Value	Variable	Value	Variable	Value
$a_{1,1}$	1.000000	$z_{2,2}^{R}$	5779.399	$a_{1,3}$	0.8257×10^{9}
p	5000.000	$q_{2,2}$	2.462319	$z_{1,3}^{R}$	0.8257×10^{9}
w_{1}^{R}	5000.000	$a_{3,1}$	0.000000	$q_{1,3}$	0.8257×10^{9}
$z_{1,1}^{R}$	6478.525	w_{3}^{R}	30.00200	$a_{2,3}$	1.234568
I	0.000000	$z_{3,1}^{R}$	11468.58	$z_{2,3}^{R}$	75180.04
$q_{1,1}$	0.49×10^{-7}	q_{31}	1.234568	$q_{2,3}$	1.234568
$q_{1,2}$	500.0000	$a_{3,2}$	0.000000	$a_{3,3}$	1.234568
$a_{2,1}$	0.000000	$z_{3,2}^{R}$	4778.478	$z_{3,3}^{R}$	23152.53
w_{2}^{R}	2935.127	$q_{3,2}$	1.234568	$q_{3,3}$	1.234568
z_{21}^{R}	3829.665	$a_{4,1}$	0.000000	$a_{4,4}$	1.234568
$q_{2,1}$	2.415436	w_{4}^{R}	291.4410	$z_{4,4}^{R}$	6222.305
$a_{2,2}$	0.000000	$z_{4,1}^{R}$	10176.93	$a_{5,4}$	1.234568
$z_{4,2}^{R}$	7179.032	$q_{4,1}$	1.234568	$z_{5,4}^{R}$	3581.486
$q_{4,2}$	1.234568	$a_{4,2}$	0.000000	w_{5}^{N}	1.234568
$a_{5,1}$	0.000000	$q_{6,2}$	1.234568	$z_{5,4}^{N}$	1.234568
w_{5}^{R}	241.1120	w_{4}^{N}	1.234568	$q_{5,4}$	1.234568
$z_{5,1}^{R}$	5331.473	$z_{4,4}^{M}$	1.234568	$a_{5,5}$	1.234568
$q_{5,1}$	1.234568	$q_{4,4}$	1.234568	$z_{5,5}^{R}$	51418.16
$a_{5,2}$	0.000000	$a_{4,5}$	1.234568	$z_{5,5}^{N}$	1.234568
$z_{5,2}^{R}$	5457.227	$z_{4,5}^{R}$	1347.486	$q_{5,5}$	1.234568
$q_{5,2}$	1.234568	$z_{4,5}^{N}$	1.234568	$a_{5,6}$	1.234568
$a_{6,1}$	0.000000	$q_{4,5}$	1.234568	$z_{5,6}^{R}$	1.234568
w_{6}^{R}	19.98800	$a_{4,6}$	1.234568	$z_{5,6}^{N}$	1.234568
$z_{6,1}^{R}$	1269.256	$z_{4,6}^{R}$	5753.497	$q_{5,6}$	1.234568
$Q_{6,1}$	1.234568	$z_{4,6}^{N}$	1.234568	$q_{5,3}$	1.234568
$a_{6,2}$	0.000000	$q_{4,6}$	1.234568	$a_{6,3}$	1.234568
$z_{6,2}^{R}$	8315.611	$z_{6,6}^{R}$	1518.298	$q_{6,3}$	1.234568
$a_{6,4}$	1.234568	$z_{6,6}^{N}$	1.234568	$a_{3,4}$	1.234568
$z_{6,4}^{R}$	23739.71	$q_{6,6}$	1.234568	$q_{3,4}$	1.234568
w_{6}^{N}	1.234568	w_{1}^{R2N}	1.234568	w_{4}^{R2N}	1.234568
$z_{6,4}^{N}$	1.234568	z_{1}^{R2N}	1.234568	z_{4}^{R2N}	1.234568
$q_{6,4}$	1.234568	δ_0	7000.000	$a_{3,5}$	1.234568
$a_{6,5}$	1.234568	w_{3}^{R2N}	1.234568	$q_{3,5}$	1.234568
$z_{6,5}^{R}$	1360.317	z_{2}^{R2N}	1.234568	w_{5}^{R2N}	1.234568
$z_{6,5}^{N}$	1.234568	w_{3}^{R2N}	1.234568	z_{5}^{R2N}	1.234568
$q_{6,5}$	1.234568	z_{3}^{R2N}	1.234568	$a_{3,6}$	1.234568
$a_{6,6}$	1.234568	$a_{4,3}$	1.234568	$q_{3,6}$	1.234568
w_{6}^{R2N}	1.234568	$q_{4,3}$	1.234568	c_j	278512.5
z_{6}^{R2N}	1.234568	$a_{5,3}$	1.234568		

The decision variables are represented in Table 4. Change a coefficient in the objective function without changing any of the optimal values of choice variables is shown in this range which the basis is unchanged is stated as follows.

1. $a_{1,1}, a_{1,2}, \ldots a_{6,2}$ are allowed to increase into ∞ without affecting the objective function value.
2. N is allowed to decease into ∞ without affecting the objective function value

If a variable in the objective is nonlinear, its value in the Current Coefficient column will be NONLINEAR. In the same way, if a row is nonlinear, the Current RHS column value will be NONLINEAR. This sensitivity analysis shows that the optimality holds for the objective function and within certain range of some decision variables.

CONCLUSION

From this research, non-linear optimization of the sensitivity analysis is more complex than linear optimization, the analyzing the sensitivity of the fair network model and selfish customers using the LINGO software, allowable increase is infinite, while the allowable decrease is 0.000 (fixed). It means that the increment of the models are allowed, while the decrement aren't. This sensitivity analysis shows that the model is validated especially for its decision variables.

Further discussion should be addressed to show how good the model designed compared to previous model stated regarding with selfish model to prove the ideal model for dealing with traffic management in C-RAN network.

ACKNOWLEDGMENT

On November 23, 2020, DIPA of the Public Service Agency of Universitas Sriwijaya 2021, SP DIPA-023.17.2.677515 /2021, supported the publishing of this article. On April 28, 2021, the Rector's Decree Number: 0010/ UN9/ SK.LP2M.PT/2021 was issued.

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