Correction to: Optimal Location for Renewable Gas Production and Distribution Facilities: Resource Planning and Management

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In the "A Numerical Illustration" section, the mathematical expression in matrix format were mistakenly presented. The correct form are as follows:

5.4 A numerical illustration

Assume a small region with four zip codes grows three kinds of residues. For simplicity, let the fixed building cost C^f and variable building cost C_n^v be 0 each because they are just constants in the model. For ease of computation, let us assume that two anaerobic reactors and two condensers are to be located so that the liquefied SYNGAS are delivered in three locations in the region. The information are listed as follows: total number of types of residues, $K = 3$; total number of zip codes in the region, $Z = 4$; total number of reactors to be built, $N = 2$; total number of condensers to be built, $M = 2$; total number of delivery points, $L = 3$.

Let the availability of residue k in the hub in zip code z be $\mathbf{A} = [A_{zk}] = \begin{bmatrix} 3.4 & 2.5 & 2.2 \\ 2.3 & 4.5 & 3.3 \\ 2.7 & 3.6 & 2.3 \\ 4.7 & 5.0 & 4.9 \end{bmatrix}$ (truck-load) and the unit cost

for hiring a worker, $C^w = 10$ (dollar /person/truck-load). The unit transportation cost for moving residue k from the hub

in zip code z to the reactor be $\mathbf{C}^t = [C_{zk}^t] = \begin{bmatrix} 3.3 & 4.1 & 3.7 \\ 3.3 & 3.3 & 4.0 \\ 4.7 & 4.7 & 3.8 \\ 4.2 & 4.2 & 3.1 \end{bmatrix}$

(dollar/truck-load/mile). The feedstock cost of residue k supplied from the hub in zip code z to the reactor is $\mathbf{C}^r = [C_{zk}^r]$

$= \begin{bmatrix} 100 & 104 & 122 \\ 139 & 120 & 146 \\ 141 & 113 & 109 \\ 144 & 140 & 113 \end{bmatrix}$ (dollar/truck-load). The unit cost of pipe-

line from the reactor n to condenser m , $\mathbf{C}^p = [C_{nm}^p] = \begin{bmatrix} 3.39 & 4.23 \\ 3.50 & 3.95 \end{bmatrix}$ (dollar/mile). The unit transportation cost for

liquefied carbon product from condenser m to delivery point l , $\mathbf{C}^d = [C_{ml}^d] = \begin{bmatrix} 3.70 & 4.17 & 4.83 \\ 4.66 & 4.10 & 3.57 \end{bmatrix}$ (dollar/truck-load/mile).

The pipeline cost between reactors is $C_{1,2}^b = 3.76$ (dollar/mile). The demand of residues k at the n th reactor is given

as $\mathbf{D} = [D_{kn}] = \begin{bmatrix} 6 & 8 \\ 6 & 8 \\ 7 & 6 \end{bmatrix}$ (truck-load) and the unit workforce

requirements for collecting residue k , $\mathbf{w} = [w_k] = \begin{bmatrix} 3 \\ 5 \\ 4 \end{bmatrix}$ (per-

sons/truck-load). Total workforce availability at the n th reactor, $\mathbf{W} = [W_n] = \begin{bmatrix} 96 \\ 96 \end{bmatrix}$ (persons). Percent of residue to be unaccounted for due to natural loss or unavailability, $\beta = 0.05$.

The coordinate of the hub in zip code z , $[(x_1^h, y_1^h), (x_2^h, y_2^h), (x_3^h, y_3^h), (x_4^h, y_4^h)] = [(56.88, 16.22), (46.94, 79.43), (1.19, 31.12), (33.71, 52.85)]$. The coordinate of the delivery points l , $[(x_1^p, y_1^p), (x_2^p, y_2^p), (x_3^p, y_3^p)] = [(116.56, 165.41), (160.20, 168.92), (126.30, 174.82)]$.

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From the above data, the allocation sub-problem can be written in the form of (4). Applying one iteration of Algorithm C (ASA) yields:

Step C-1: Let $\bar{\mathbf{r}}_1 = \bar{\mathbf{r}}_2 = \frac{1}{2} \sum_{z=1}^3 \mathbf{h}_z = \begin{bmatrix} 69.36 \\ 89.81 \end{bmatrix}$ and $\bar{\mathbf{s}}_1 = \bar{\mathbf{s}}_2 =$

$\bar{\mathbf{r}}_1 + \frac{1}{3} \sum_{l=1}^3 \mathbf{p}_l = \begin{bmatrix} 203.71 \\ 259.52 \end{bmatrix}$ be the initial location vectors

for the reactors and condensers. TC_{opt} is set to $+\infty$.

Step C-2: Algorithm B (B&B method) is applied to find

the optimal allocation $\bar{\alpha}^1 = \begin{bmatrix} 3 & 0 & 0 \\ 2 & 4 & 3 \\ 0 & 0 & 0 \\ 1 & 2 & 4 \end{bmatrix}$, $\bar{\alpha}^2 = \begin{bmatrix} 3 & 0 & 0 \\ 2 & 4 & 3 \\ 0 & 0 & 0 \\ 3 & 4 & 4 \end{bmatrix}$, $\bar{\gamma} =$

$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ and $\bar{\rho} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \end{bmatrix}$ based on $\bar{\mathbf{r}}$ and $\bar{\mathbf{s}}$. Obtain the objective value as $\bar{TC} = \$16,061.53$

Step C-3: Algorithm A yields the locations $\tilde{\mathbf{r}}_1 = \begin{pmatrix} 40.49 \\ 63.83 \end{pmatrix}$, $\tilde{\mathbf{r}}_2 = \begin{bmatrix} 33.71 \\ 52.85 \end{bmatrix}$, $\tilde{\mathbf{s}}_1 = \begin{bmatrix} 115.77 \\ 160.17 \end{bmatrix}$, $\tilde{\mathbf{s}}_2 = \begin{bmatrix} 115.72 \\ 160.13 \end{bmatrix}$ based on allocations $\bar{\alpha}^n$, $\bar{\gamma}$ and $\bar{\rho}$. Hence, the incumbent total cost as $TC = \$10,787.69$.

Step C-4: Because $TC < TC_{opt}$, then $TC_{opt} = TC = \$10,787.69$, $\alpha_{opt}^n = \bar{\alpha}^n$ for $n = 1, \dots, N$, $\gamma_{opt} = \bar{\gamma}$ and $\rho_{opt} = \bar{\rho}$, $\mathbf{r}_{opt} = \tilde{\mathbf{r}}$ and $\mathbf{s}_{opt} = \tilde{\mathbf{s}}$.

Step C-5: Because $|\bar{TC} - \tilde{TC}| = 5273.8 > \text{set precision} = 0.1$, then $\bar{\mathbf{r}}_1 = \tilde{\mathbf{r}}_1 = \begin{pmatrix} 40.49 \\ 63.83 \end{pmatrix}$, $\bar{\mathbf{r}}_2 = \tilde{\mathbf{r}}_2 = \begin{bmatrix} 33.71 \\ 52.85 \end{bmatrix}$, $\bar{\mathbf{s}}_1 = \tilde{\mathbf{s}}_1 = \begin{bmatrix} 115.77 \\ 160.17 \end{bmatrix}$, $\bar{\mathbf{s}}_2 = \tilde{\mathbf{s}}_2 = \begin{bmatrix} 115.72 \\ 160.13 \end{bmatrix}$ and go to Step C-2.

A complete iteration shows how the computational procedure works using Algorithm B and C. The final outcome of the solution and the suboptimal solutions are in the most recent values of the variables from the $|\bar{TC} - \tilde{TC}| < \text{set precision}$ and updates to $\alpha_{opt}^n = \bar{\alpha}^n$ for $n = 1, \dots, N$, $\gamma_{opt} = \bar{\gamma}$ and $\rho_{opt} = \bar{\rho}$, $\mathbf{r}_{opt} = \tilde{\mathbf{r}}$ and $\mathbf{s}_{opt} = \tilde{\mathbf{s}}$.

We propose an algorithm for the MINLP in (1) by alternatively searching minima for two sets of decoupled sub-problems. A small instance illustrates the algorithm step by step. We present more numerical examples in the next section to test the efficiency of the algorithm.

The original article has been corrected.

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