Ap-
pendix
?
??

$\mathbf{x}_u Minimize\ \ F_u(\mathbf{x}_u, \mathbf{x}_l) = F_1(\mathbf{x}_{u1}) + F_2(\mathbf{x}_{l1}) + F_3(\mathbf{x}_{u2}, \mathbf{x}_{l2})$
$\mathbf{x}_l Minimize\ \ f_l(\mathbf{x}_u, \mathbf{x}_l) = f_1(\mathbf{x}_{u1}, \mathbf{x}_{u2}) + f_2(\mathbf{x}_{l1}) + f_3(\mathbf{x}_{u2}, \mathbf{x}_{l2}),$
$where\ \ \mathbf{x}_u = (\mathbf{x}_{u1}, \mathbf{x}_{u2}),\ \ and\ \ \mathbf{x}_l = (\mathbf{x}_{l1}, \mathbf{x}_{l2})$

(1)

F_1
F_2
F_3
f_1
f_2
f_3
$|\mathbf{x}_{u1}| = p$
$|\mathbf{x}_{u2}| = r$
$|\mathbf{x}_{l1}| = q$
$|\mathbf{x}_{l2}| = r$
$|\mathbf{x}_{l1}| = q+s$
??
co-
op-
er-
a-
tive

$F_1 = \sum_{i=1}^{p} x_{u1i}^2$
$F_2 = \sum_{i=1}^{q} x_{l1i}^2$
$F_3 = \sum_{j=1}^{r} x_{u2i}^2 + \sum_{i=1}^{r} (x_{u2i} - tanx_{l2i})^2$
$f_1 = \sum_{i=1}^{p} x_{u1i}^2$
$f_2 = \sum_{i=1}^{q} x_{l1i}^2$
$f_3 = \sum_{i=1}^{r} (x_{u2i} - tanx_{l2i})^2$

(2)

$x_{u1i} \in [-5, 10], \forall i \in 1, 2 \ldots, p$
$x_{u2i} \in [-5, 10], \forall i \in 1, 2 \ldots, r$
$x_{l1i} \in [-5, 10], \forall i \in 1, 2 \ldots, q$
$x_{l2i} \in (\frac{-\pi}{2}, \frac{\pi}{2}), \forall i \in 1, 2 \ldots, r$

(3)

??

$F_1 = \sum_{i=1}^{p} x_{u1i}^2$
$F_2 = -\sum_{i=1}^{q} x_{l1i}^2$
$F_3 = \sum_{j=1}^{r} x_{u2i}^2 - \sum_{i=1}^{r} (x_{u2i} - logx_{l2i})^2$
$f_1 = \sum_{i=1}^{p} x_{u1i}^2$
$f_2 = \sum_{i=1}^{q} x_{l1i}^2$
$f_3 = \sum_{i=1}^{r} (x_{u2i} - logx_{l2i})^2$

(4)

$x_{u1i} \in [-5, 10], \forall i \in 1, 2 \ldots, p$
$x_{u2i} \in [-5, 1], \forall i \in 1, 2 \ldots, r$
$x_{l1i} \in [-5, 10], \forall i \in 1, 2 \ldots, q$
$x_{l2i} \in (0, e], \forall i \in 1, 2 \ldots, r$

(5)

??

$F_1 = \sum_{i=1}^{p} x_{u1i}^2$
$F_2 = \sum_{i=1}^{q} x_{l1i}^2$
$F_3 = \sum_{j=1}^{r} x_{u2i}^2 - \sum_{i=1}^{r} (x_{u2i} + tanx_{l2i})^2$
$f_1 = \sum_{i=1}^{p} x_{u1i}^2$
$f_2 = q + \sum_{i=1}^{q} (x_{l1i}^2 - cos2\pi x_{l1i})$
$f_3 = \sum_{i=1}^{r} (x_{u2i} - tanx_{l2i})^2$

(6)

$x_{u1i} \in [-5, 10], \forall i \in 1, 2 \ldots, p$
$x_{u2i} \in [-5, 10], \forall i \in 1, 2 \ldots, r$
$x_{l1i} \in [-5, 10], \forall i \in 1, 2 \ldots, q$
$x_{l2i} \in (\frac{-\pi}{2}, \frac{\pi}{2}), \forall i \in 1, 2 \ldots, r$

(7)

??

$F_1 = \sum_{i=1}^{p} x_{u1i}^2$
$F_2 = -\sum_{i=1}^{q} x_{l1i}^2$
$F_3 = \sum_{j=1}^{r} x_{u2i}^2 - \sum_{i=1}^{r} (|x_{u2i}| - log(1 + x_{l2i}))^2$
$f_1 = \sum_{i=1}^{p} x_{u1i}^2$
$f_2 = q + \sum_{i=1}^{q} (x_{l1i}^2 - cos2\pi x_{l1i})$