# README

This README file serves as a guide for executing the code related to Section 4.3.2 of the paper. Specifically, it explains how to solve the CIOP for the UFL game.

## 1 License

The license of Gurobi 10.0.3 can be downloaded at the official website of Gurobi: https://www.gurobi.com/.

## 2 Summary of the Functions

1. *function [output_args] = StartfunctionUFL (m, n, option)*

This function is the main function, including four options, each of which calls a different function.

2. *function [c, f, c1, mn, data] = GenerateUFL (m, n)*

This function is used to randomly generate four groups of UFL instances with different sizes of $M$ and $N$, as described in Section 4.3.2 of the paper. Our 100 UFL instances are generated using this function. Since random instances have already been generated, you can directly access them in the data folder.

3. *function [v1, u1, obj1, objboundUFL, timeUFL, result] = NetworkGurobi (m,n,c,f)*

This function constructs a network for a UFL problem and calculates its optimal solution, denoted by $(x^*, z^*)$, and its optimal value, denoted by $v^*$, using Gurobi 10.0.3.

4. *function [AdjustmentCostTotalPer, DiffNumberPer, cfinal, ufinal, ffinal, vfinal, FVAL] = In-*

*vCostAdjUFL (m, n, dataread)*

This function is used to solve the CIOP for the UFL game, where $[l, u] = [v^*, v^*]$. For each group of UFL instances with the same size, we solve the CIOP for the UFL game to obtain the optimal cost adjustment using the solution algorithm illustrated in Section 4.2 of the paper. As detailed in Section 1.2 of the paper, the inverse optimization problem is an *inverse optimal solution problem.*

5. *function [AdjustmentCostTotalPer, DiffNumberPer, cfinal, ufinal, ffinal, vfinal, FVAL] = InvCostAdjUFLRange (m, n, dataread)*

This function is used to solve the CIOP for the UFL game, where $[l, u] = [0.95v^*, 1.05v^*]$. As detailed in Section 1.2 of the paper, the inverse optimization problem encompasses both an *inverse optimal solution problem* and an *inverse optimal value problem.*

6. *function [table4, table5] = FinalResultUFL*

This function is used to compute statistical metrics for the results of 100 instances, including column $U$, column $DV\%$, column $DN\%$, and column $T$, which are the results presented in Table 4 and Table 5 in the paper.

# 3 Code Instructions

To run the code smoothly and correctly, please set the variables in the file "UFL\src\ StartfunctionUFL.m" as described below. Matlab 2023a and Gurobi 10.0.3 are recommended.

*1. set parameters: $m$ and $n$.*

Note that in the instances we generate, $m = n$: where $m$ represents the number of facilities, and $n$ represents the number of customers.

*2. set parameter: option.*

*option* $= 1$ is to generate and save random instances and compute the optimal solution by GUROBI;

*option* $= 2$ is to generate instances to compute the CIOP for UFL game;

$option = 3$ is to generate instances to compute the CIOP for UFL game with range;

$option = 4$ is to compute statistical metrics for the results of 100 instances (set $m = n = 0$).