AgentSDH for ANAC2023 SCML Agent Strategy

Sadahiro Atsunaga

May 1, 2023

Tokyo University of Agriculture and Technology
sadahiro@katfuji.lab.tuat.ac.jp

1 The Design

This section describes the design of the AgentSDH in standard and collision trucks.AgentSDH inherits class $IndependentNegotiationsManager$, $SupplyDriven ProductionStrategy$, $PredictionBasedTradingStrategy$ and $SCML2020Agent$.

1.1 Negotiation Strategy

AgentSDH is based on IndependentNegotiationsManager. The utility function of AgentSDH is set to LinearUtilityFunction. LinearUtilityFunction is a function provided by NegMas.

if selling:

$$\begin{aligned} U &= LinearUtilityFunction(3, 0, 2) \\ q^{target} &= I_i/3 \\ p^{accept}_{i,output} &= \begin{cases} p^{accept}_{i-1,output} * 0.95 & \text{if no signed sales contracts} \\ p^{accept}_{i-1,output} * 1.1 & \text{else if } p^{average}_{i,output}/p^{accept}_{i-1,output} > 1.1 \\ p^{average}_{i,output} * 0.9 & \text{otherwise} \end{cases} \end{aligned}$$

if buying:

$$\begin{aligned} U &= LinearUtilityFunction(1, 0, -2) \\ q^{target} &= n_{lines}/3 \\ p^{accept}_{i,output} &= \begin{cases} p^{accept}_{i-1,input} * 1.1 & \text{if no signed buy contracts} \\ p^{accept}_{i-1,input} * 1.05 & \text{else if } p^{average}_{i,input}/p^{accept}_{i-1,input} > 0.9 \\ p^{accept}_{i-1,input} * 0.95 & \text{otherwise} \end{cases} \end{aligned}$$

$$
\begin{aligned}
U &: \text{utility function} \\
i &: \text{current step} \\
I_i &: \text{inventory at step i} \\
n_{lines} &: \text{number of production lines in the factory} \\
q^{target} &: \text{target quantity} \\
p^{accept}_{i,output} &: \text{acceptable unit price of output products} \\
p^{accept}_{i,input} &: \text{acceptable unit price of input products} \\
p^{average}_{i,output} &: \text{average unit price of output products in previously executed sales contracts} \\
p^{average}_{i,input} &: \text{average unit price of input products in previously executed buy contracts}
\end{aligned}
$$

AgentSDH's objective is to negotiate more successfully by making adjustments to ensure that the acceptable unit price is neither too high nor too low. The weight is also set so that it is not too greedy. The target quantity of each purchase contract depends on the number of lines in the factory and the target quantity each sale contract depends on the quantity of inventory.

1.2 Risk Management

AgentSDH will decide whether to sign the contract based on 'Risk Management'.

1.2.1 sale contracts

AgentSDH needs to calculate the average purchased price per unit and the average number of units purchased in previous contracts, which will be the basis for deciding whether to enter into a contract.

$$
p^{average}_{i,input} = \begin{cases} p^{catalog}_{input} & \text{if no input product bought} \\ (\sum_{a=1}^{n} p_{a,input} * q_{a,input}) / \sum_{a=1}^{n} q_{a,input} & \text{else} \end{cases}
$$

$$
\begin{aligned}
n &: \text{contracts executed in the past} \\
p^{catalog}_{input} &: \text{Input product catalog prices} \\
p_{a,input} &: \text{unit price of input product in contract 'a'} \\
q_{a,input} &: \text{quantity of input product in contract 'a'}
\end{aligned}
$$

When the agreed quantity is less than or equal to the inventory on the delivery date and satisfies the following condition, sign the contract. It avoids penalties for non-delivery.

$$
p_{a,input} > p^{average}_{i,input} + p^{cost}
$$

$$
p^{cost} : \text{cost of processing an input product into an output product}
$$

And also AgentSDH signs the contracts to generate profits.

1.2.2 purchase contracts

AgentSDH needs to calculate the average sales price per unit and the average number of units sales in previous contracts, which will be the basis for deciding whether to enter into a contract.

$$p^{average}_{i,output} = \begin{cases} p^{catalog}_{output} & \text{if no output product bought} \\ (\sum_{a=1}^{n} p_{a,input} * q_{a,output})/\sum_{a=1}^{n} q_{a,output} & \text{else} \end{cases}$$

$$q^{average}_{i,output} = \begin{cases} n_{lines} & \text{if no output product bought} \\ (\sum_{a=1}^{n} q_{a,output})/i & \text{else} \end{cases}$$

$$\begin{aligned} n &: \text{contracts executed in the past} \\ p^{catalog}_{input} &: \text{output product catalog prices} \\ p_{a,output} &: \text{unit price of output product in contract 'a'} \\ q_{a,output} &: \text{quantity of output product in contract 'a'} \\ q^{average}_{i,output} &: \text{average number of sales per day in past contracts} \end{aligned}$$

AgentSDH signs a contract to buy only when the estimated quantity of inventory at the end is less than $4 * n_{lines}$ and the delivery date is earlier than $0.9 * n_{steps}$. AgentSDH signs a contract when $q_{a,output}$ satisfies the following conditions.

$$\text{if } q_{a,output} <= q^{average}_{i,output} \text{ - inventory[t]} : p_{a,input} < p^{average}_{i,output} - p^{cost}$$
$$\text{else} : p_{a,input} < \max((p^{average}_{i,output} - p^{cost}) * 0.8, p^{average}_{i,input} * 0.8)$$

$$\begin{aligned} t &: \text{delivery date of the contract} \\ inventory[t] &: \text{Inventory at step t} \end{aligned}$$

The strategy of AgentSDH is based on not holding more inventory than the average sales volume. However, AgentSDH signs contracts when undervalued contracts come in.

1.3 Collusion Strategy

In the collusion track, AgentSDH is basically the same as the Standard track. However, only the target quantity in the negotiation strategy is changed as follows

$$q^{target} = n_{lines}/3$$

Negotiations are more successful on the collusion track when target quantities are standardized at the time of purchase and at the time of sale.

2 Evaluation

This section describes the evaluation of AgentSDH. Table 1 shows the results of the competition with MarketAwareDecentralizingAgent,DecentralizingAgent. The configuration of this competition are n_steps:100,n_configs:8 and running 24 simulations.

Table 1: The results of competing with default agents

	AgentSDH	MarketBCSE	DecentralizingAgent
Score	0.0149	-1.5576	-0.1597