Team ID: 52

Team name: Team 50

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Link to project on github: https://github.com/Sagi-N/SCML-OneShot-Agent

OneShot Agent Report

The agent tries to maximize its revenues by constantly keeping track on the average sell price and average buy price it has so far, and setting the acceptable buy prices and sell prices respectively – Always trying to sell at a price higher than the average buy price and trying to buy at a price lower than the average sell price.

Sell negotiations logic

The agent is acting according to the following logic on **sell deals** (This section assumes the agent is a first level or mid level agent):

1. At the initialization stage of each step the agent initializes its ***secured sells*** and ***Average item sell price*** parameters to 0 (Meaning, it has not sold any product yet)
2. At the ***Propose*** call back:
    a. At the **first** ***Propose*** callback of each step, the agent checks whether it is a first level agent (That is supposed to have exogenous input contracts). If it is – it initializes the ***amount of secured buys*** it has and the ***average buy price*** according to the exogenous input contracts data
    b. The agent checks what ***quantity*** it needs to sell. The agent holds a ***Buy/Sell gap*** parameter that enables it, in certain circumstances, to allow selling more items than it has already secured in buys, taking the risk of a ***shortfall penalty***, assuming it will be able to buy additional products to fill the gap. In the competition the ***Buy/Sell gap*** parameter is set to "5", meaning at any stage the agent is allowed to commit on no more than 5 items to sell in addition to the ***quantity*** it already has in its ***secured buys***. The agent uses the following logic when calculating the ***quantity*** it needs to sell:
        i. In case the agent is a first level agent – The ***quantity*** it has to sell is the amount of ***secured buys*** (From exogenous contracts) minus the amount of ***secured sells*** (amount of sell items already agreed upon in closed negotiations). Note: In that case, the agent cannot get more input products than the ***quantity*** it already got through the exogenous contracts, therefore in that case it does not allow a ***Buy/Sell gap*** (Gap=0), meaning it does not allow selling more than the secured buys, and cannot get a ***shortfall penalty***.

ii. <u>In case the agent is a mid level agent</u> – The ***quantity*** it has to sell is the amount of ***secured buys*** (From exogenous contracts) minus the amount of ***secured sells*** (amount of sell items already agreed upon in closed negotiations) plus the ***Buy/Sell gap*** parameter. For example: Assuming the agent already secured buying 4 products and selling 2 products and assuming the ***Buy/Sell gap*** is set to "5", the agent will set its sell needs ***quantity*** to 7 allowing to commit on a total ***quantity*** of 9 sold items at this stage.

c. The agent calculates its ***minimal acceptable sell price*** for each item, the calculation is based on a logic that will allow the agent to sell items only at a price that guarantees an overall revenue when calculating the total income from sell deals minus the total expense from buy deals plus production costs. The agent calculates the ***minimal acceptable sell price*** using the following formula:
   i. ***Average Item Cost*** = ***Average Item Buy Price*** + ***Production cost*** (The average cost of an item that the agent has is the average buy price of the item plus the production cost)
   ii. ***Total allowed quantity to sell*** = ***Secured Sells*** * ***quantity*** (The ***quantity*** is the one that was calculated at the previous section – 2/b)
   iii. ***Total expected cost*** = ***Total allowed quantity to sell*** * ***Average Item Cost***
   iv. ***Total Income so far*** = ***Average item sell price*** * ***secured sells*** (The amount of income already secured from closed sell negotiations)
   v. ***Total income needed from current negotiation*** = ***Total expected cost*** – ***Total Income so far*** (The agent assumes that the current quantity will be sold and calculates the gap between the total cost including the current quantity and the revenues it already got from sold items)
   vi. ***Minimal profitable sell price = Total income needed from current negotiation*** / ***quantity***
   vii. The calculated ***Minimal profitable sell price*** represents the minimal sell price that the agent will be willing to accept at the end of the negotiation. However, during negotiation cycles the agent will propose a decreasing ***minimal acceptable sell price*** each cycle, until getting to the ***minimal profitable sell price*** at the last cycle.
   viii. The ***minimal acceptable sell price*** is set between the ***max allowed negotiation price*** and the ***minimal profitable sell price***. The exact value of ***minimal acceptable sell price*** is calculated each cycle in a decreasing order starting from ***max allowed negotiation price*** in the first cycle and ending at ***minimal profitable sell price*** in the one before last cycle. The exact formula is:
      1. ***Descending threshold*** = ((***max cycles*** – ***cur cycle*** – 1) / (***max cycles*** – 1)) ^ 0.4
      2. ***minimal acceptable sell price*** = ***minimal profitable sell price*** + ***Descending threshold*** * (***max allowed negotiation price*** - ***minimal profitable sell price***)
   ix. In case the last negotiation cycle is reached, the agent will try to get rid of its entire stock and will propose it at the minimal allowed price, even if that price is lower than the ***minimal profitable sell price***. The agent does that in order to avoid ***disposal penalty***.

   d. Ultimately at each cycle the agent proposes the calculated ***quantity*** and the calculated ***minimal acceptable sell price***
3. At the ***Respond*** call back:
   a. The agent rejects offers that require a larger ***quantity*** than the ***quantity*** that the agent is willing to sell (Taking into account the ***Buy/Sell gap*** as explained earlier)
   b. Assuming the ***quantity*** is acceptable, the agent checks the suggested ***unit price***
      i. The agent calculates the ***minimal acceptable sell price*** exactly as explained earlier
      ii. In case the suggested price is greater than the ***minimal acceptable sell price*** – the offer is accepted
      iii. In case the suggested price is close to the ***maximal allowed price*** (0.9 * ***Max allowed price***) – the offer is accepted even if the suggested price is lower than ***minimal acceptable sell price***. This decision assumes that if the suggested price is close to the maximal allowed price, it is better to close the deal at such a good price than trying to get a better price at the risk of losing the deal.
      iv. In any other case the offer is rejected and a counter offer will be made in the next negotiation cycle
4. When a deal is closed, the agent updates its ***secured sells*** parameter and its ***Average item sell price*** parameter, both are used for calculating the desired quantity and item price in subsequent negotiations

Buy negotiations logic

The agent is acting according to the following logic on **buy deals** (This section assumes the agent is a last level or mid level agent):

1. At the initialization stage of each step the agent initializes its ***secured buys*** and ***Average item sell price*** parameters to 0 (Meaning, it has not sold any product yet)
2. At the ***Propose*** call back:
   a. At the **first** ***Propose*** callback of each step, the agent checks whether it is a last level agent (That is supposed to have exogenous output contracts). If it is – it initializes the ***amount of secured sells*** it has and the ***average sell price*** according to the exogenous input contracts data
   b. The agent checks what ***quantity*** it needs to buy. The agent holds a ***Max items in stock*** parameter that enables it, in certain circumstances, to allow buying more items than it has already secured in sells, taking the risk of a ***disposal penalty***, assuming it will be able to sell additional products and get rid of its stock. In the competition the ***Max items in stock*** parameter is set to "2", meaning at any stage the agent is allowed to commit on no more than 2 items to buy in addition to the ***quantity*** it already has in its ***secured sells***. The agent uses the following logic when calculating the ***quantity*** it needs to buy:
      i. In case the agent is a last level agent – The ***quantity*** it has to buy is the amount of ***secured sells*** (From exogenous contracts) minus the amount of ***secured buys*** (amount of buy items already agreed upon in closed

negotiations). Note: In that case, the agent cannot sell more items than the ***quantity*** it already got through the exogenous contracts, therefore in that case it does not allow items in stock (***Max items in stock***=0), meaning it does not allow buying more than the secured sells, and cannot get a ***disposal penalty***.

ii. In case the agent is a mid level agent – The ***quantity*** it has to buy is the amount of ***secured sells*** (From exogenous contracts) minus the amount of ***secured buys*** (amount of buy items already agreed upon in closed negotiations) plus the ***Max items in stock*** parameter. For example: Assuming the agent already secured buying 4 products and selling 3 products and assuming the ***Max items in stock*** is set to "2", the agent will set its buy needs ***quantity*** to 1 allowing to commit on a total ***quantity*** of 1 buy items at this stage.

c. The agent calculates its ***maximal acceptable buy price*** for each item
   i. In case the agent has more secured sells than secured buys
      1. In that case the agent is currently obliged to sell more than it has actually secured
      2. The agent will set a ***maximal item buy price*** that will still enable it to profit taking into account the average price of items that were already bought and their production costs:
         Max profitable item buy price = ***Average item sell price*** – ***Production cost***
      3. The ***maximal acceptable buy price*** is set between the ***min allowed negotiation price*** and the ***max profitable item buy price***. The exact value of ***max profitable item buy price*** is calculated each cycle in a decreasing order starting from ***min allowed negotiation price*** in the first cycle and ending at ***max profitable item buy price*** in the one before last cycle. The exact formula is:
         a. ***Descending threshold*** = ((***max cycles*** – ***cur cycle*** – 1) / (***max cycles*** – 1)) ^ 0.4
         b. ***maximal acceptable buy price*** = ***max profitable item buy price*** - ***Descending threshold*** * (***max profitable item buy price - min allowed negotiation price***)
   ii. In case the agent has more secured buys than secured sells or as equal
      1. In that case the agent has currently secured more items than it is currently obliged to sell. In that case the agent will only buy new items in a price lower than the average price of items it has already bought
         a. The preliminary price in which the agent is willing to buy the first items is set as the maximal price that will still enable it to profit. Since that agent still has not bought any items, it has to rely on the trading price of the output product and its production cost:
            max profitable item buy price = ***Output product trading price*** – ***Production cost***
         b. If the agent has already bought some items it sets the maximal price it is willing to buy new items as the average price of items

already bought: ***max profitable item buy price*** = ***Average item buy price***

2. The agent sets ***maximal acceptable buy price*** according to the following formula:
   maximal acceptable buy price = ***max profitable item buy price*** - ***Descending threshold*** * (***max profitable item buy price - min allowed negotiation price***)

d. Ultimately at each cycle the agent proposes the calculated ***quantity*** and the calculated ***maximal acceptable buy price***

3. At the ***Respond*** call back:
   a. The agent rejects offers that require a larger ***quantity*** than the ***quantity*** that the agent is willing to buy (Taking into account the ***Max items in stock*** parameter as explained earlier)
   b. Assuming the ***quantity*** is acceptable, the agent checks the suggested ***unit price***
      i. The agent calculates the ***maximal acceptable buy price*** exactly as explained earlier
      ii. In case the suggested price is lower than the ***maximal acceptable buy price*** – the offer is accepted
      iii. In case the suggested price is close to the ***minimal allowed price*** (1.1 * ***Min allowed price***) – the offer is accepted even if the suggested price is higher than ***maximal acceptable buy price***. This decision assumes that if the suggested price is close to the minimal allowed price, it is better to close the deal at such a good price than trying to get a better price at the risk of losing the deal.
      iv. In any other case the offer is rejected and a counter offer will be made in the next negotiation cycle
4. When a deal is closed, the agent updates its ***secured buys*** parameter and its ***Average item buy price*** parameter, both are used for calculating the desired quantity and item price in subsequent negotiations