AgentRM for ANAC SCML OneShotTrack

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Abstract

This report provides an explanation of AgentRM for ANAC SCML OneShot Track. AgentRM is an improved BetterAgent to achieve a better agreement. AgentRM obtained a higher score than BetterAgent and other sample Agents in my experiments.

1 Negotiation Strategy

This section explains how to manage the negotiation strategy of offering strategy and acceptance strategy. AgentRM is an improved version based on BetterAgent. AgentRM will try to agree with terms that are more advantage than BetterAgent.

I use the following trading information for developing AgentRM.

q^{offer}, p^{offer} :quantity of an offer and unit price of an offer

q^{my_needs} :the quantity that AgentRM needs to sell or buy by the end of the day

$q_{neg}^{your\_needs}$:the quantity that the negotiation partner proposed just before

$p^{production}$:production cost per a product

$p^{exg\_input}, p^{exg\_output}$:the unit price of the exogenous contracts for the input and output

$p^{disposal}$:current disposal cost per material to be discarded

$p^{penalty}$:current shortfall penalty per a missing product

q^{max}, q^{min} :the maximum and minimum quantity of the negotiation issue

p^{max}, p^{min} :the maximum and minimum unit price of the negotiation issue

$p_{neg}^{maxagree}, p_{neg}^{minagree}$:the maximum and minimum unit price agreed in the past by the negotiation partner

$p^{max\_rjc\_offer}, p^{min\_rjc\_offer}$:the maximum and minimum unit price AgentRM rejected on the day

1.1 Offering Strategy

This section explains my offering strategy.

First, AgentRM offers lesser of q^{my_needs} and q^{your_needs}. This is expected to make it easier for the negotiation partner to accept my offer.

Next, AgentRM offers a more limited range of prices than BetterAgent. If it is the seller, it concedes from the slightly higher price than the previous highest agreement price with the negotiation partner to the highest price proposed on that day. If it is the buyer, it concedes from the slightly lower price than the previous lowest agreement price with the negotiation partner to the lowest price proposed on that day.

If it is the seller, the unit price of its offer p^{offer} is the following. (Note that *th* is the same exponential function as that of BetterAgent. The same applies to subsequent *th*.)

$$\begin{aligned} mx &= (p^{max} + p_{neg}^{max\_agree})/2 \\ mn &= max(p^{max\_rjc\_offer}, p^{exg\_input} + p^{production}) \\ p^{offer} &= mn + th(mx - mn) \end{aligned}$$

If it is the buyer, the unit price of its offer p^{offer} is the following.

$$\begin{aligned} mn &= (p^{max} + p_{neg}^{min\_agree})/2 \\ mx &= min(p^{min\_rjc\_offer}, p^{exg\_output} - p^{production}) \\ p^{offer} &= mx - th(mx - mn) \end{aligned}$$

The above is how to determine the unit price of an offer if the negotiation partner proposes first in a negotiation on the day. If AgentRM proposes first in a negotiation on the day, it makes a more bullish offer on price. This purpose is to prevent the signing of contracts with excessive quantities. Due to the order of proposals and responses in a negotiation step, when it makes an offer, the offer cannot take into account whether other

offers made in the same negotiation step were accepted or rejected.

$$\begin{aligned} mx &= p^{max} \\ mn &= \{p^{exg\_input} + p^{production} + p^{disposal}(q^{my\_needs} - q^{offer})/q^{offer} + p^{max}\}/2 \\ p^{offer} &= mn + th(mx - mn) \end{aligned}$$

If it is the buyer, the unit price of its offer p^{offer} is the following.

$$\begin{aligned} mn &= 0.9(p^{max} + p_{neg}^{min\_agree})/2 \\ mx &= 0.9p^{min\_rjc\_offer} \\ p^{offer} &= mx - th(mx - mn) \end{aligned}$$

1.2 Acceptance Strategy

This section explains my acceptance strategy.

First, as for the quantity, AgentRM can only accept q^{my_needs} or less.

Next, as for unit the price, AgentRM will take a strategy similar to the offer strategy. If it is the seller, it concedes from the slightly higher price than the previous highest agreement price with the negotiation partner to the highest price proposed on that day for the lowest unit price accepted. If it is the buyer, it concedes from the slightly lower price than the previous lowest agreement price with the negotiation partner to the lowest price proposed on that day for the highest unit price accepted.

If it is the seller, the unit price of the acceptable offer p^{offer} satisfies the following.

$$\begin{aligned} mx &= (p^{max} + p_{neg}^{max\_agree})/2 \\ mn &= max(p^{max\_rjc\_offer}, p^{exg\_input} + p^{production}) \\ p^{offer} - mn &\geq th(mx - mn) \end{aligned}$$

If it is the buyer, the unit price of the acceptable offer p^{offer} satisfies the following.

$$\begin{aligned} mn &= (p^{max} + p_{neg}^{min\_agree})/2 \\ mx &= min(p^{min\_rjc\_offer}, p^{exg\_output} - p^{production}) \\ mx - p^{offer} &\geq th(mx - mn) \end{aligned}$$

If the negotiation partner proposes first in a negotiation on the day, if only one negotiation remains and it is the final negotiation step on the day, AgentRM changes the

conditions of acceptance of the offer because no negotiation remains after that.

If it is the seller and the quantity of the partner's offer q^{offer} is more than q^{my_needs}, the acceptable offer satisfies the following.

$$-(p^{offer} - p^{production})q^{my\_needs} + p^{penalty}(q^{offer} - q^{my\_needs}) < p^{disposal}q^{my\_needs}$$

If it is the seller and the quantity of the partner's offer q^{offer} is less than q^{my_needs}, the acceptable offer satisfies the following.

$$p^{offer} + p^{disposal} > p^{production}$$

If it is the buyer and the quantity of the partner's offer q^{offer} is more than q^{my_needs}, the acceptable offer satisfies the following.

$$p^{offer}q^{offer} + p^{disposal}(q^{offer} - q^{my\_needs}) - p^{exg\_output}q^{my\_needs} < p^{penalty}q^{my\_needs}$$

If it is the buyer and the quantity of the partner's offer q^{offer} is less than q^{my_needs}, the acceptable offer satisfies the following.

$$p^{exg\_output} + p^{penalty} > p^{offer}$$

2 Evaluation

To evaluate AgentRM, I tested AgentRM in 30 simulations against BetterAgent, AdaptiveAgent, LearningAgent and SyncAgent. Each simulation runs for 50 days.
The results are shown in Table 1.

Table 1: Agents Scores

Agent Type	mean	std	min	25%	50%	75%	max
AgentRM	1.180	0.179	0.714	1.102	1.178	1.259	1.519
AdaptiveAgent	1.120	0.181	0.702	1.020	1.126	1.220	1.533
BetterAgent	1.013	0.222	0.399	0.858	1.084	1.169	1.414
LearningAgent	1.058	0.198	0.607	0.943	1.048	1.192	1.413
SyncAgent	0.685	0.139	0.346	0.594	0.711	0.769	0.962

As Table 1 shows, the mean and median scores of AgentRM were higher than those of any other agents.