RITC 2024 Notes

https://inside.rotman.utoronto.ca/financelab/competition/getting-started-ritc/
Code: private Github repo, contact one of us
Participants: Nolan Lu, Vanessa Quan, Joshua Lim, Oliver Zhou
Emails: nolan8152@gmail.com
oliverzhou77@gmail.com
joshlim01@gmail.com

General Notes:

- Aside form understanding the case, the team really need to first spend time on understanding how the RIT REST API works to pull data to help you make decision making tools / algorithms. Ideally, all members should learn know to code using Python. The API is pretty well made and you can pull a lot of information to be used via python.
- Great to have a faculty advisor from Sauder or CS who worked in finance.
- Good to have 1 person with Finance background on the team.
- Ideally 5-6 people instead of only 4.
- Don't take aggressive speculative positions and be consistent will probably be enough to help you score above 50% percentile. We took some very aggressive position that didnt make sense half way through the competition when we realized we cant make top 10, which in hindsight is a bad idea. Consistency > taking big risk.
- Also being consistent across all cases is better than being realy good in one case and being really bad in the other.
- To do really well in this competition (top 10), need to spend some additional time and repeatedly test your strategy/ understand the case.
- A great event to talk to prestige finance programs and their directors around the world, a lot from financial engineering / quant finance programs (Berkely, Baruch, Princeton, CMU, Columbia)

1. Funding
- Engineering PAF fund: https://experience.apsc.ubc.ca/paf
    - See application docs in folder
    - Apply for funding for each engineering student in team (covers part of travel/accommodation/conference fee, $1200 for 2 members in 2024)
    - Deadline end of January

- Sauder Funds: CCF from CUS. No set deadline. Apply anytime and apply ASAP. ~500 per person.
- UGO Experience Grants: Application is a bit extensive but there are 2 deadlines and the one for the second term is around the end of January.
- Walter Gage Memorial Fund: 2000 max fund

2. Electricity
a. Producer

General strategy:

- Basically the same strategy as commodities, never sold forwards unless price was good or had large inventory (since forwards are generally cheaper)
- Main difference from commodities is that you can't hold positions into new round (which is very easy to get fined for) and the fines are very high. Make sure you can offload all your inventory (if price is terrible, still take the loss because the penalty is much higher)
- As soon as new round starts, immediately set several limit orders with max price. Some players use market orders and you will get filled if you're fast enough
- Watch your open orders though because if all get filled, you may have negative position that you need to buy back (cancel orders as necessary)

b. Distributer

Two choices I can buy: Forward, Spot-Day X. Communicate with producers, so they would give you the cost of producing electricity. Calculate the Consumer Quantity demanded from the news. It's normally very accurate. Make sure you don't long or short too many forwards(otherwise, you get fined heavily) Instead, meet the Consumer Quantity demanded first, which may require 30 forwards(leave it there), and buy around 10 more forwards when it's cheap. Trade the extra 10 forwards in the forward market. If these 10 extra have a negative unrealized PNL, unload 5, leave 5 of them in the spot market and trade over there.

DON'T take too many risks. You may see you can short for 100000% return, but the contracts are limited, For example, you see the ask is $0.1, there might only be 1 contract on the market. May end up with a short position of 20 contracts (you get fined)

ALWAYS have 0 inventory at the end of each day.   ($2-3 mm is good, **don't get fined**)

c. Trader
3. Commodity
- Difficult to practice without a lot of people so just make sure you know how to calculate costs, use your assets, manage your positions to AVOID FINES.
- In theory, there should be communication between all three roles as each person has different info

a. Producer

Basic strategy: use forward prices to decide if oil prices will be high the next round. If expect high price, produce maximum amount. Otherwise, produce half of max amount. Likely will lose money but in case price is good, have inventory to sell. Production prices are generally low and any losses are generally covered by good rounds.

During game:

- Always have a limit sell open at 100. Sometimes, other players use market order and if by luck you are at top of ladder, you get filled
- If prices < 10 or trending down, likely over supply. Sell all inventory immediately as towards the end of the round, there will be no buyers
- If prices > 50 or trending up, likely under supply, price will keep going up and hit MAXIMUM of 100. To reduce risk, can offload as price increases (e.g., sell 20% at 80, 40% at 90, 40% at 100)

Other:

- Limit for oil position was 300 but I could not figure out how to go over 100 without getting fined…
- If you can avoid fines, nearly impossible to go negative as a producer

b. Refiner

Buy Crude Oil from Producers—-rent refineries (New and Old) which have a high cost& buy carbon credits— convert the Crude oil(CO) into Heating Oil and RBOB Gasoline— sell it in the market

Make sure to stop leasing the new refinery when not in use. Otherwise, make use of every second,(don't stop producing), also make sure you have enough Crude Oil units and Carbon Credits to produce after finishing the last round of production.

DON'T use Old Refinery unless you want to unload your CO and Credit the very last round. It's very expensive with low efficiency.(CONSERVATIVE Thought)

Strategies: In the beginning, Don't buy CO from producers at the beginning, since they are overpriced. Instead, use your initial units to produce first and wait for around ⅔ of the producing cycle to buy CO from producers. Then keep refining.

When CO is low, buy them to have some storage, ALWAYS have a storage of CO around 8 and Carbon Credits of around 8. So you are ready to refine anytime.

At the very last 120 seconds, produce with New Refinery, since producers want to unload their storage of CO. Your cost to produce is cheaper now. After producing, sell them to make the last profit.

Asset: N-REFINERY
Description: New Refinery to Process Crude Oil
Capacity (Barrels): 4,000
Cost: $120,000 per 5 trading days
Conversion Period: 3.5 trading days

Asset: O-REFINERY
Description: Old Refinery to Process Crude Oil
Capacity (Barrels): 8,000
Cost: $360,000 per 5 trading days
Conversion Period: 4.5 trading days

MOST important thing, read the news and communicate with teammate about the expected price of heating oil, so traders know what to long and what to short. Also good for you if you want to make pnl from rising HO prices. (I used brain calculation lol. Better to have an algo extracting the news info and calculating)

$$P_{HO} = E_{HO} + \frac{\Delta_{HO}}{\sigma_{HO}}$$

Where;
P_{HO} is the final close-out price for Heating Oil;
E_{HO} is the expected price for Heating Oil;
Δ_{HO} is the expected weekly temperature change;
σ_{HO} is the standard deviation of the temperature change.

Expected weekly temperature change = Expected weekly temperature – Realized weekly temperature

Things I wish I can improve: automate the calculation of producing the RBOB and HO

Overall, pretty good, I saw UOBC-2 (refiner) consistently on the leading board.($2-3mm each round)

c. Trader
- **CL is not shortable. So if you want to take tender offers to Sell CL, make sure you load up on enough CL beforehand or else it doesn't get filled!!!!!!! In the actual competition, tenders to sell is often just free money (prices trade around 20 while tenders is around 90).**
- Communication with Disttributor is crucial as they have receive info on target prices.

4. Volatility

- **You should do this with CODE!!!!!!!!** Order submission can be done with coding. Hence, Python is the best tool to be used. **100% recommend to do this entirely**

algorithmically. We did not realize we can algo this and felt it was very painful to trader / delta hedge, and in the end over half the contestant did it with algo! Doing it with code makes much more sense when you have to trade all these options, and it opens the door for a lot more strategies.

- The team should understand Greeks specifically with Delta, Vega, and Gamma. The case requires you to delta hedge so you have to know how that works with stock and with options (note that, delta changes is very spontaneous when you have option positions and almost impossible to be done by reacting manually, hence more reasons to do this with algo).
- **Our Strategy:** whenever news comes out, buy/sell straddles (you double down on volatility but you limit the delta exposure by long/ short call puts at the same time). For straddles to be meaningful, you should buy ATM option, staddles or else you are not really delta neutral (Example: buy ATM straddle means you are delta neutral cause Call delta is 0.5 and put delta is -0.5. However, if you do this with a really OTM call, for example, you will just be doing this with a in-the-money put if you enter into a straddle… so Very negative delta exposures with that straddles). After we do this, we use algo to do a dynamic delta hedge on a portfolio level.
- **Execution:** Use Blackscholes to calculate fair price options given volatility data (you have all other info, note that drift is not really important as they are embedded in the underlying price as mentioned by Jose). Whenever news comes out you can see that options are under / overpriced with under Black-schole. Vol increase often means buy and decrease means sell. The art and the science are how you do this with so many options.
- **Volatility Data:** We used the latest data outputted by the news. Sometimes data is a range (expectation of volatility) and we took the average middle point. Might be a better way to do this but you need to write an algorithm that extracts the vol number to plug into your Black-Scholes equation.

  There are two types of volatility news: Expectation of next period (which is a range not a expect figure) and the actual volatility for the period. In hindsight, it might be hinting that the expectation is telling you what implied vol is (trading vega) while the actual volatility is realized vol (trading gamma). Might be worth exploring.

- **Other Strategies:** Technically our strategy is long vega and we disregard gama, which we are also directionally long/short… We know that other teams (Baruch for example) are simply buying Gamma only. Doing this is computationally extensive, and most importantly there's 1Millions ways to do it (how do you determine a buy/sell decision with margin? How many positions do you enter? Do you hedge delta with stock or option? Do you compare fair price vs mid-price or bid/ask??). The team will need to understand greeks very well to know how to implement these strategies. The art and science here are the little details, so really test your strategy to see if it works, and understand that in the actual competition your algo might not work.

  Note that, under the blackscholes framework, you can easily calculate the greeks (Delta, vega, gamam) as there are closed formed solutions for these in very straightforward formulas.

- **Delta Hedging:** You are required to delta hedge and it is indeed expensive penalties if you don't. We used a dynamic hedging strategy using portfolio-level delta hedging via underlying stock. We can choose to customize what kind of delta exposure we want before it starts delta hedge (see script as we have a delta limit we technically

can stay within. However, if you write your strategies perfectly, technically you want your delta to be ~ zero all the time, so not sure if it is useful to purposely leave a margin at all.

We also heard that a smart way to hedge delta is not using stocks (costly/dynamic might mean high transaction cost), but with **low vega options.** So your vol is not affected but you still have a meaningful delta exposure to help you hedge. This makes a lot of sense but requires some thinning as you have an option limit.

- Luck: Luck is very important. Waterloo's code went down completely during the competition, and they simply tried to buy/sell underlying stock within the delta limit. They placed 1 higher above us (LOL). Luck is important there and maybe manual trading does work better sometimes when your code goes bust. A lot of team's code just went bust completely in the actual competition and their strategies no longer worked.
- GOOD LUCK!!! Feel free to contact Nolan Lu and Oliver Zhou for Questions

5. ETF

Basic strategy: If tender offer is SELLing to you, check that price is lower than bid. After we accept offer, our position will be positive, and we will need to sell it at bid price. Thus, to profit, offer should be lower than bid. Similarly, if tender offer is BUYing from you, check price is higher than ask.

 sell<bid, buy>ask

Check direction: prices seem to trend and are not completely random. If stock is trending upward, tender offer to SELL is better as we expect bid to rise. If stock is trending downward

Volatility: if stock was highly volatile, would increase margin between offer and market price required for me to enter the trade

Quantity: Personal strategy was to offload position over time, especially if market was moving in ideal direction so you get better prices over time while somewhat reducing risk. Only bought/sold big positions if the losses were huge and my PnL chart was dying.

RITC app: for each asset, make a widget for market buy and market sell in quantities of 10000 and 1000. This way you can get out of any position this way without adjusting the numbers (thanks Oliver).

General tips:

- 20+ seconds to accept an offer. Unless there is huge margin between tender offer and market price at time of offer, take your time to check market direction
- Market becomes much more volatile with more players, leave more margin
- ~200k each round is a very good score for 2024 game
- Fines for taking directional bets. You can trade after tenders, this just means you can't enter an opposite direction (if you have positive inventory, can sell any time. But if you sell so much that you get negative inventory, or if you start with 0 inventory and enter a position, you will be fined)

Strategy heard from other teams: no matter the offer, take it and offload it immediately. Reasoning being that offers are generally well priced (not actually the case. Possibly at time of offer, but by the time the offer expires, that might not be true) .

6. Algo - CAPM

The CAPM (Capital Asset Pricing Model) is used to determine the expected return of an asset based on its risk relative to the market. In RITC, this model can be applied for asset valuation and identifying arbitrage opportunities. The CAPM equation is:

$E(R_i) = R_f + \beta_i(E(R_m) - R_f)$

where:

- $E(R_i)$ = expected return on the asset
- R_f = risk-free rate
- β_i = asset's beta (measure of volatility relative to the market)
- $E(R_m)$ = expected market return

Strategy:

1. **Risk Management**: Use CAPM to gauge whether a security is priced fairly based on its expected return versus its risk. This can help avoid taking unnecessarily risky positions in highly volatile securities unless there is an arbitrage or clear risk premium.
2. **Estimating Beta**: To use CAPM effectively, you'll need to calculate the beta of each asset in real-time. Beta can be estimated by regressing historical price data of the asset against a market index or by using rolling averages over a certain time period.
3. **Arbitrage Opportunities**: Compare the expected returns from CAPM to the actual market prices. If the CAPM suggests that an asset is undervalued, you can take a long position. If it's overvalued, consider shorting the asset. Combine this with volatility indicators and news updates to refine decisions.
4. **Dynamic Hedging**: Since RITC involves dynamic markets, regularly adjust your CAPM inputs (market returns and risk-free rates) based on new data and news feeds. The CAPM's simplicity makes it ideal for quick, algorithmic recalculations to update price predictions.
5. **Market Context**: CAPM is useful for slower-moving markets where pricing inefficiencies occur due to delayed reactions to new information. In cases of sudden news or high volatility, CAPM-based strategies should be supplemented with more responsive, volatility-driven models (e.g., Black-Scholes for options).

Implementation:

- Use Python to automate CAPM calculations, pulling real-time data for asset prices, market indices, and interest rates.
- Beta estimation can be updated using a rolling window of price data, and expected market returns can be taken from index movements or forecasted data.
- Cross-check CAPM outputs with real-time market movements and other predictive models to decide on trades (especially in cases of discrepancies between CAPM expected returns and actual prices).

Considerations:

- **Limitations**: CAPM assumes a linear relationship between market and asset returns, which may not hold in the highly volatile environment of RITC. Also, it doesn't account for the possibility of structural shifts in market risk or sudden shocks.

- **Alternative Models**: Consider supplementing CAPM with multifactor models like Fama-French for deeper analysis, especially if assets have strong size, value, or momentum characteristics.

7. Algo - Market Making

Basic strategy: there were three main components of the strategy that ran in three separate threads but only two were used in competition

1. Tender offers: if big enough margin between tender offer price and market price, take offer and unroll the position over the course of 10s
2. Arbitrage: detect if there was arbitrage between the ETFs and composite stocks. In theory, you should use the converter to make riskless profit but that takes time. Thus, we went with short the overpriced, buy the underpriced asset and wait until the prices align again. Don't know how this would have done in real competition.
3. Market making: set bid ask slightly narrower than the market bid ask, adjusting the center we set our bid ask around depending on the current position we hold (if we are long the stock, adjust bid and ask lower so more likely that ask will be hit and we our position gets balanced out).

Tips for next year because this algo did not work well at all

1. Tender offers
   a. Find a better way to sell off the position. PnL chart showed huge spike up when we took tender offers but by the time we sold everything off, profit may be close to zero. This is possibly because tender offer quantities are relatively big so we flooded the market and lowered the price of the stock too much.
   b. Building inventory: Jose mentioned that we can build up an inventory over time when the prices are more desirable so when the offer comes, we are well prepared to take it. Worth considering
   c. Instead of selling off the position immediately, we can take more directional bets and only sell if, for example, we hit a stop loss. Directional bets earn a lot more than market making or arbitrage.
      i. Market is very volatile so it can suddenly drop down, hit your stop loss, and jump back to continue trending upwards. Consider using an average of

price or something similar that prevents this from happening.

2. Arbitrage
    a. Possibly worth looking into. Time it takes to use converter stopped us from the strategy of identifying arbitrage -> entering positions -> manually getting out of position. However, converters might be a good way to get out of positions and manage loss/risk.

3. Market making
    a. I set the spread too big during competition. There were some orders in the ladder that didn't get filled that we could have taken
    b. Quantity: submitted orders for 30000 shares at a time which is not big enough to make any substantial profit. Can consider setting multiple bid prices with different quantities (similar to grid trading).
    c. Theoretical market price was simply calculated as the average of the bid and ask at top of ladder. Can consider using a volume weighted average over multiple bid/ask prices.
    d. Bid and ask were adjusted slightly depending on the inventory we currently hold. Can also adjust based on volatility, market direction, volume imbalance, etc.

4. Other
    a. I don't think RITC charges you for cancelled orders… you get rebate if limit orders get filled; however, trading fees are pretty negligible
    b. ~200k is a good (top 10) PnL