Introduction

In this case, you have been tasked to trade three stocks and two ETFs. Your goal is to make as much money as you can, trading against other competitors and the bots that already exist on the exchange.

This case involves the stocks **APT** (a large-cap stock), **DLR** (a mid-cap stock) and **MKJ** (a small-cap stock). ETF **AKAV** consists of 1 share of each of the 3 stocks, and ETF **AKIM** is an ETF which tracks the inverse of the daily movement of **AKAV**. Note that AKIM cannot be created or redeemed, but rebalances at the end of every trading day.

The case is structured as a series of successive rounds. Each round consists of 10 days, and each day is 90 seconds long. Your positions hold over from day-to-day, and reset at the end of each round.

APT is a traditional large-cap stock which releases earnings. You will receive their quarterly earnings as a structured news message 2 times per day (30 and 60 seconds into the round). Based on a constant P/E ratio and the released earnings, you should calculate the new price of the stock.

DLR is a publicly traded construction firm specializing in advanced infrastructure. There is a petition to build high speed rail from NYC to Chicago, and if it receives over 100,000 signatories, they will receive a contract from the US government which will value their stock at 100/share, and at the end of the 10 days if they don't receive the requisite signatures, their stock will be valued at 0 (and the company goes into bankruptcy). DLR will release 5 structured news events every day (at 15, 30, 45, 60, 75 seconds) along with the total number of new signatures which were received. Based on the probability of DLR receiving 100,000 signatures, you will be able to determine a fair price for the stock based on the number of signatures and number of rounds left. Note that the number of signatories between each news event is drawn from a lognormal distribution dependent on the previous number of signatories (the model is discussed on Ed)

MKJ is a little more cryptic, and does not receive regular structured news updates. You will receive multiple unstructured news events relating to MKJ every day, and it is up to your quantitatively-oriented models to figure out a new fair value for MKJ and market-make around it.

Education

ETFs are investment funds that are traded on stock exchanges, similar to individual stocks. They hold a diversified portfolio of assets, such as stocks, bonds, or commodities, and are designed to track the performance of a specific index or sector. In the real world, ETFs offer investors a way to gain exposure to a broad range of assets without having to buy each one individually, and they are known for their low cost.

In the context of ETFs, creation and redemption processes involve entering and unwinding swap agreements to manage the ETF's exposure to the underlying index. Here's a succinct description:

An ETF can be thought of as an agreement between parties on the exchange; one can swap (for a small fee!) between 1 share of AKAV for 1 share of APT, DLR and MKJ each. Similarly, one can make a trade in the opposite direction (once again, paying a small fee).

An inverse ETF, such as AKIM, is designed to move in the opposite direction of the underlying ETF (e.g., AKAV) on a daily basis. If AKAV falls by a certain percentage, AKIM will rise by the same percentage, and vice versa. This daily reset mechanism makes inverse ETFs useful for short-term trading but introduces a concept known as **volatility drag** (or compounding decay) over time- holding an inverse ETF is not the same as going short a stock. Volatility drag occurs because percentage gains and losses are not symmetric. Suppose AKAV starts at **100**, drops **10%** to **90**, and then rises **11.1%** to return to **100**: AKIM (at an initial price of 100) rises 10% to 110, and on day 2 drops 11.1% from 97.79. For the purposes of this case, the inverse ETF cannot be created or redeemed.

Symbology

1 AKAV- 1 APT, 1 DLR, 1 MKJ
AKIM- Daily inverse moves of AKAV.

Potential Strategies:

Provide Liquidity: Offer continuous buy (bid) and sell (ask) quotes on the exchange to trade with participants looking to take a position. Your bid quote should be less than your ask quote (why is this?). Hint: think about the difference between your bid and your ask (known as the spread) as payment for taking on risk.

Manage Risk: Monitor and manage your exposure to market movements and potential losses. Note: strategies that produce consistent profits will score higher than those with a similar expected return and higher variance.

Strategic Adaptation: Navigate a market that includes participants that are both more and less informed that you. Consider which participants you want to trade against. Consider how trades you see on the exchange (especially from what looks like smart money) should change your fair value for assets.

Market Impact: Understand how your trades may affect market prices, in terms of pushing prices up or down. Hint: think about how your market impact varies depending on the overall market liquidity.

Understand News: How will news affect the prices of the underlying assets? Understand both structured and unstructured news, and from this develop a quantitative model which encapsulates your want to buy/sell. Fundamentally, every significant movement in the stock market is driven by some amount of news, and some amount of noise.

Note that different strategies will be more effective at different points of the competition. Make sure to adapt your sub-strategies between rounds.

Round Specifications and Scoring

Rounds: The competition will consist of 2 hours of rounds, each 15 minutes long, with **increasing difficulty and increasingly weighted scoring.** Competitors are randomly assigned to an exchange each round through a round robin process to trade against a variety of other market participants. There will be a 5 minute break between rounds which will allow you to reset and recover.

There will be a settlement price for all assets at the end of each round. Each team's P&L will be calculated using these final prices and added to their cumulative total. Positions do not carry over between rounds. The settlement price for the ETFs is computed as the NAV, and everything is marked out to the mid of the last BBBO.

Difficulty will progress over the rounds, typically through opposing market makers **increasing their spreads**, **decreasing volume**, and the underlying assets becoming more volatile. Market makers in later rounds will be much quicker to respond to news than those in early rounds. Moreover, strategies that generate positive P&L at the start of the competition are expected to continue to generate positive P&L across rounds, but decrease over time. As a result, we want to encourage competitors to adapt as the competition progresses and edges become smaller, as later rounds become weighted more heavily.

We have a **nonlinear grading schema that converts P&L into points.** Strategies that generate consistent positive P&L are expected to do much better than strategies that are high risk/high reward in nature. Similarly, outlier results of both large positive and negative P&L will likely not excessively impact a team's total score. As such, a handful of terrible rounds will not erase a team's chance of overall success, nor will a handful of great rounds assure it.

Note that the practice round will not count towards total points.

Rules

You may take long or short positions in all assets available in a round, subject to risk limits specified below. Exceeding these risk limits will result in the rejection of your entire order.

Risk Limits

As a market maker, your firm stipulates the following risk assets across the tradable assets:

- Max Order Size
- Max Open Order (Size of unfilled order)
- Outstanding Volume (Total volume of unfilled order)
- Max Absolute Position (Sum of long and short positions)

If you exceed any of these positions, all further orders for that contract that exacerbate the risk limits will be blocked by the exchange. Similarly, if any order is rejected by limit, participants are not informed of which limit they breached. **We will release the specific risk limits in a pinned Ed post in advance of the competition. Risk limits are subject to change on the day of the competition.**

Code Submission

Competitors will however run their bots from a box provided to you on the actual day of the competition. Please make sure you know how to use VSCode and are able to SSH into a virtual box- should questions arise, we will be there to answer them.

Miscellaneous Tips

In order to be successful in this case (and as a market maker in general), you will need:

1. A market making algorithm that uses the predicted "fair value" to make profitable trades:
    - There will be some "smart" and "dumb" money bots on the exchange. Which bots should you want to trade against? Which bots should inform your future expectations of price/settlement price?
    - Is it always reasonable to quote symmetrically (in size and/or price) about your predicted fair price?
    - What modifications (if any) should you make in the way you trade if the fair price predicted by your model deviates from the mid-price of the market? What if only one side of your quotes gets filled?
    - When would it be justified to "cross the spread" to take a position?
    - Do you want to hold your positions to settlement? Does this expose you to additional risk?
    - Do you want to pay to get out of risk?
2. ETF market making is a delicate task.

- How can you identify arbitrage opportunities in ETF pricing in terms of redemption and creation?
    - Make sure to factor in redemption/creation costs!

- Should you always take both sides of the arbitrage opportunity?
    - **Hint: When the ETF and equity prices don't align, it's more likely that the ETF is mispriced.**
        - If you're willing to take on more variance, it may be the case that the arb exists because the ETF is mispriced and the equity is fair, so if you do trade the arb, the trade on equity may have been bad.
- When and why would one decide to swap short?

3. Trading earnings is a difficult task. If you receive information before the rest of the market does, where will you be willing to buy and sell? Does iti always make sense to post offers at the 'new price' or somewhere in between?

<u>Questions</u>

For questions regarding Case 1, please post in the UChicago Trading Competition Ed in the "case1" folder. We will regularly check for new messages.