OPTIBOOK

Build Algorithms To Build Markets

SLIDES: You can find accompanying slides with basic finance knowledge here.

WORKSHOP VIDEO: You can find our workshop video here.

Introduction

Join us in our mission to improve the markets! Your challenge: develop a trading algorithm to encourage growth in firms entering new markets. Your algorithm will compete against others on our simulated exchange in real time!

As a global market maker, Optiver is committed to improving access and pricing for thousands of financial products across markets worldwide. By providing this liquidity, we make it easier and more attractive for market participants to incorporate products into their investment strategies. At HackZurich, you'll discover what it's like to work at a trading company. You'll compete against other participants to write your own trading algorithm that can handle the pressure of a constantly changing market. You'll do this on our simulated exchange, Optibook, which recreates the real-life complexity of trading. The challenge presents a unique opportunity to learn and improve your trading skills using live market data in a risk-free environment. You'll walk away with a greater understanding of life at a trading company, financial markets and the ability to build your own Python trading algorithm.

Getting Started

Read the challenge first, then follow our Getting Started guide in order to get trading! You will be working with your own virtual machine that we provide you in Amazon's "Cloud9" environment (this is all on the getting started guide).

You can see current prices of the stocks as well as your own inventory on the visualizer, which you can find here.

Credentials

In order to participate, you will need credentials to Optibook. Come to our booth or ask us on our Discord channel `#03-optiver` to obtain the credentials for your team.

The Challenge

In this challenge you will see first-hand how increased trading interest in a financial product leads to lower cost for investors. To illustrate this, our challenge is centered around four stocks. Your goal is to create an algorithm that is able to trade these products successfully. Remember: your algorithms will compete against each other, that means you can also trade against each other!

Let's get started. A "dual listing" is the listing of any security on two different exchanges. That means the same instrument (i.e. a stock) is traded in two different places (e.g. in Zurich and in Amsterdam). This is a simple yet very real trading strategy that is used all over the world by professionals. In this challenge, there will be two of these dual-listings, resulting in a total of four tradable instruments. All instruments are traded in the same currency.

NOTE: The stock names are fictitious, their values are not related to real-world equivalents.

Instrument name	Type of instrument	Listing of Company
TECH_INC	Stock	Tech Inc.
TECH_INC_NEW_COUNTRY	Stock	Tech Inc.
SMALL_CHIPS	Stock	Small Chips
SMALL_CHIPS_NEW_COUNTRY	Stock	Small Chips

In the table above, you can see the two dual listings depicted. Each company has two listings traded in a different country. The first

company "Tech Inc." will have successfully expanded to this new country, where it will be very liquid. As you can see from the table, there will be one stock listed in the original country, and one stock listed in the new country (if you don't know what "liquid" means, look at the slides linked at the top of this page).

The other company called "Small Chips" has only recently set foot in the new country, and is still starting out there. It will be less liquid. Again, there will also be one stock listed in the original country, and one stock listed in the new country.

It is your job to build a successful trading strategy to provide liquidity to Small Chips. Try to make profit for yourself, and in doing so, you will make it more attractive for investors to invest in that company as more volume appears in the books and spreads get tighter. Of course, you can also trade Tech Inc. and try to do the same there, but it will be harder.

Different Market Hours

Because TECH_INC_NEW_COUNTRY and SMALL_CHIPS_NEW_COUNTRY are traded in a different country, there are different time-zones! All instruments are not always open at the same time (i.e. they are not always tradable). That means you cannot always hedge (hedging is explained in the slides linked at the top of this page).

Part 1

As a first step, try to come up with a simple strategy that detects opportunities in SMALL_CHIPS_NEW_COUNTRY's order book, and hedges the trades in the order books of SMALL_CHIPS.

How can you detect an opportunity? Suppose you can buy SMALL_CHIPS_NEW_COUNTRY for 150 and you can sell SMALL_CHIPS for 151. This looks like it's possible to make some profit with this, right? Since SMALL_CHIPS and SMALL_CHIPS_NEW_COUNTRY both represent the same company, they should be worth the same in the long run. You can sell SMALL_CHIPS for 151. However, what happens if you sell SMALL_CHIPS and then the price starts changing? If SMALL_CHIPS's price increases, you lose some money, because you sold it. If SMALL_CHIPS's price decreases, you win some money instead. You need to *hedge* your trade. You sell SMALL_CHIPS for 151 and at the same time you buy SMALL_CHIPS_NEW_COUNTRY for 150. If you do this correctly, you are immune to market moves, and you capture the 1 Euro credit. Don't take outright positions in just SMALL_CHIPS or just SMALL_CHIPS_NEW_COUNTRY. Always combine the two to reduce risk: If you buy one stock, then you have to sell the other!

Keep in mind, in the long term, the valuations of the two stocks should always be roughly equal to each other. That is how we defined it in this exercise. In the short-term, there are sometimes opportunities! It's your goal to find these. But beware, due to different market hours, the two instruments are not always tradable at the same time. So it is possible that you cannot hedge. What do you do then? One idea could be, only sell when you have a long position, and only buy when you have a short position.

For some help, look at the documentation of the Python API. The `manual.ipynb` notebook also shows some simple examples that you can use for manual interaction with the exchange.

Part 2

The more difficult challenge: Become a market-maker and try to improve the market by continuously quoting 2-sided in SMALL_CHIPS_NEW_COUNTRY's order book, and hedging your trades in SMALL_CHIPS. Use "limit" orders to quote, they will stay in the order book.

A little warning: This is not an easy challenge, and you will likely struggle at first. However, that is also why we are here to assist in any way we can, so please come to us with any questions you have. The good news is, that if you do this challenge you will dive deep into the world of financial algorithms, and you should walk away with a pretty good idea of what it means to trade algorithmically. If you enjoy difficult problems, then this should be right up your alley.

Once you can confidently quote SMALL_CHIPS_NEW_COUNTRY, you can also try your luck in SMALL_CHIPS and the TECH_INC's. Competition is tight here already, but there is still room for improvement!

A little help

To make things a little easier, we have provided two templates for you to use in your Cloud9 environment that will help you get started faster. They contain a simple implementation which connects to the exchange and does a very basic trade every 5 sec.

Improving the markets

When multiple people are competing in the same order book with their quotes, you will see that the spreads start to tighten. More competition means better prices! Our shared goal is to make the spread in 'SMALL_CHIPS_NEW_COUNTRY' as tight as possible.

Compete with each other and see the improvement!

You can judge the quality of the spread of the 'SMALL_CHIPS_NEW_COUNTRY' by looking at the big emoji on the visualizer.

Limits

In any trading company, risk limits are of utmost importance. Real markets are constantly changing: you need to be aware of what can happen and what impact that has on your portfolio. Having a high risk exposure may work well in the short-term, but can be devastating for long-term sustainability.

We also take these risk limits very seriously in Optibook. Your algorithm is not allowed to cross a few pre-predefined limits.

1. Total position (positive or negative) per instrument cannot go over 500
2. You are not allowed to have total orders outstanding for over 800 lots per instrument
3. You are only allowed to send 25 updates (inserts/deletes/amends) to the market per second
4. You are only allowed to have a combined "hedged" position (SMALL_CHIPS vs SMALL_CHIPS_NEW_COUNTRY or TECH_INC vs TECH_INC_NEW_COUNTRY) of 100. This means that your position in SMALL_CHIPS_NEW_COUNTRY must be: `-100 <= SMALL_CHIPS + SMALL_CHIPS_NEW_COUNTRY <= 100` (this applies to both companies). This is a soft limit, meaning that it is allowed to breach this limit for up to six seconds. After these six seconds you must be within limits again!

If you breach limit (1), (2) or (3), your algorithm automatically gets disconnected and your outstanding orders will be pulled. You should then reconnect, but if you start your algorithm again, you might well breach again. Perhaps you want to manually reduce your position or change some settings.

Breaching limit (4) does not disconnect your algorithm. Instead, it will automatically reduce your position to within limits. However, it does this at a cost! In order not to breach this, make sure to always properly hedge your trades. If you buy one listing, sell the other listing and vice versa.

Can you alter your algorithm to account for all of these automatically?

Judging Criteria & Prizes

Prize

There is one iPhone 13 awaiting each member of the winning team.

Judging Criteria

You will be able to practice and play around until 9 AM local time on Sunday. At 9 AM local time, we will reset the Optibook, your positions and your PnL, and from then on the real competition begins.

In order to participate in the competition you will need to:

- Submit your code (.py file) to the HackZurich competition website before 9 AM local time on Sunday
- Submit a couple of paragraphs about the trading ideas behind your code before 9 AM local time on Sunday. Be sure to include your team number in your submission!
- Be ready to participate in the final competition at 9 AM local time on Sunday! After the reset, we will run a 20 minute competition. It is your responsibility to start your algorithm after the reset. During the competition we will be communicating on Discord.

When judging a submission, we will look at it from the angle of how it would behave over a larger amount of time. Your PnL during the 20 minute competition is important, but it is not the only thing we look at. Your algorithm needs to be resilient to some extent and should not be profitable due to a short-term strategy which does not pan out in the long term.

Here are some concrete points we will look at:

- We will look at the strategy you've come up with as a whole. Your PnL is important, but this is definitely not everything.
- What ideas did you have and how well were you able to implement them? A lot of the time, the difficulty lies in turning theory into practice, and we want to reward teams that have done this well.
- How are you dealing with risk? Are you taking a lot of risk or are you more risk-averse? Are you aware of the risks you are taking as well?

- How novel is your strategy? How resilient is it to different market conditions, and how does it hold up when markets get very busy?
- We will take the structure of your code into account as well.

Contact optibook@optiver.com for any questions