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## **WELCOME**

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On behalf of the University of Chicago and the UChicago Careers in Business: Financial Markets (UCIB: FM) program, we are pleased to welcome you to the 3rd Annual UChicago Midwest Trading Competition! We are thrilled to have such a great turnout for this year's event. Thank you to the UCIB: FM students, the Chicago Innovation Exchange (CIE), and most importantly, our corporate sponsors for making this competition a reality.

This trading competition is powered by OptionsCity Freeway™ and we want to recognize the countless hours OptionsCity Software has dedicated to making this event possible. Throughout the event, you'll have ample opportunities to meet members of OptionsCity as well as our other sponsoring companies: DRW Trading, IMC Financial Markets, Optiver Trading, Belvedere Trading, BP, CME Group & CME Group Foundation, Wolverine Trading, TransMarket Group, SBB Research Group, Spot Trading, Flow Traders, Eurex, and 3Red Group.

The event will kick off on Friday, April 10th at the Willis Tower with a networking reception sponsored by IMC Financial Markets from 6:30-8:30pm. The trading competition starts at 8:00am on Saturday, April 11th at the Chicago Innovation Exchange (CIE)—near the University of Chicago campus in Hyde Park—and will conclude with an awards ceremony that same evening. The focus of this event will be algorithmic trading, with cases this year covering the following themes – *Options Market-Making, Pairs Trading, and Index Tracking*. Each algorithmic case will require preparation before competition day. In addition to these cases, BP will also conduct a Crude Oil Trading Simulation. **This simulation requires no preparation in advance of the competition and will be scored independently of the other three cases.** The Crude Oil Trading Simulation will also offer a separate cash prize for the winning team. Aside from the educational value, we hope this event will bring together like minded students from across the country, provide a networking platform for our sponsors, and showcase the robust financial markets industry in the city of Chicago.

The remainder of this packet includes materials relevant to the trading cases, a tentative schedule of events, and other logistical information. We recommend you prepare your algorithms well in advance, and as a reminder, **each team must bring at least one laptop to the competition on Saturday.** Please contact Jesse Meyer at [jameyer@uchicago.edu](mailto:jameyer@uchicago.edu) if you have any questions regarding the competition.

Best regards,

Jesse Meyer  
Program Director, UChicago Careers in Business: Financial Markets

Kim Picciola  
Associate Director, UChicago Careers in Business

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## **SCHEDULE OF EVENTS**

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### **Friday, April 10**

6:30PM – 8:30PM

#### **Networking Reception hosted by IMC Financial Markets**

Willis Tower – 233 South Wacker Drive, Suite 4300

*Drinks and appetizers will be served. Photo ID required for check-in at security desk in the main lobby before proceeding to the 43<sup>rd</sup> floor. Business casual attire.*

### **Saturday, April 11**

7:30AM

#### **Shuttle Bus Departure**

W Chicago-City Center – 172 West Adams Street

8:00AM

#### **Trading Competition Check-in**

Chicago Innovation Exchange (CIE) – 1452 East 53<sup>rd</sup> Street

*Breakfast and networking. Photo ID required for check-in. Formal business attire.*

8:45AM – 9:15AM

#### **Keynote Address**

*Optiver Trading*

9:15AM – 9:30AM

#### **OptionsCity Software Presentation**

*Ben Sandmann, Director of Engineering*

9:30AM – 10:30AM

#### **Case 1: Options Market-Making**

10:30AM – 10:45AM

*Break and Networking*

10:45AM – 11:15AM

#### **Firm Presentation – DRW Trading**

11:15AM – 12:15PM

#### **Case 2: Pairs Trading**

12:15PM – 1:45PM

#### **Lunch & Panel Discussion**

*OptionsCity, DRW Trading, IMC Financial Markets, Optiver Trading*

1:45PM – 2:15PM

#### **Firm Presentation – IMC Financial Markets**

2:15PM – 2:30PM

*Break and Networking*

2:30PM – 3:30PM

#### **Case 3: Index Tracking**

3:30PM – 4:30PM

#### **BP Crude Oil Trading Simulation**

4:30PM – 6:30PM

#### **Awards Ceremony**

*Cocktails and hors d'oeuvres will be served.*

*Note: DRW Trading will treat the winning team(s) to dinner Saturday evening. Please make appropriate travel arrangements. Participants must be present at awards ceremony to claim prize money.*

**\*\*\* All sessions are required for participants \*\*\***

## PARTICIPANTS

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We are pleased to announce that over 90 students will participate in this year's competition. The following institutions will be represented:

- Massachusetts Institute of Technology
- Northwestern University
- New York University
- Carnegie Mellon University
- California Institute of Technology
- University of Iowa
- Baruch College
- Dartmouth College
- University of Chicago
- University of Illinois-Champaign-Urbana
- University of Maryland

## AWARDS

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Awards will be announced during the closing ceremony on Saturday evening. Cash prizes will be awarded to the winning team of each individual case and the top three overall winners based on a weighted-average score. Additionally, there will be a separate cash prize for BP's Crude Oil Trading Simulation. **In addition to cash prizes, DRW Trading will treat the winning team(s) to dinner Saturday evening after the awards ceremony.** Please be sure to make arrangements to be in Chicago through Saturday night to enjoy the city and potentially have the opportunity as a winning team to attend an exclusive dinner with DRW Trading.

## ATTIRE

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Business casual attire is requested for the event at IMC Financial Markets on Friday evening. Business formal attire is expected for the competition on Saturday. Jeans, gym shoes, tee shirts, or casual clothing are not permitted for any events. Thank you!

# LOGISTICS

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Friday, April 10

**IMC Financial Markets  
Willis Tower – 233 South Wacker Drive, Suite 4300**

The Willis Tower is within walking distance of the W Hotel.  
Photo ID required for check-in. Business casual attire.

Saturday, April 11

**Chicago Innovation Exchange (CIE)  
1452 East 53rd Street**

The trading competition venue is near the UChicago main campus in Hyde Park (approximately 20 minutes from downtown Chicago). The entrance is located on 53<sup>rd</sup> street just west of the Five Guys restaurant. Enter through the double doors and head up to the 2<sup>nd</sup> floor. Photo ID required. Business formal attire.

## Parking

The following parking options are available at the CIE:

- **Harper Court Garage**, located between 52<sup>nd</sup> and 53<sup>rd</sup> on South Lake Park Avenue. The garage entrance is on the west side of Lake Park Avenue, north of 53rd Street and is now accessible to both northbound and southbound traffic.
- **Hyatt Place Chicago-South Garage**, located at 5225 S. Harper Ave. This is a valet only underground garage for \$35 a day.
- **Hyatt General Public Lot**, immediately west of the Hyatt Hotel.
- **Street Parking**, There is limited free street parking northwest of the CIE.

## Hotel

A block of rooms have been reserved at the W Chicago-City Center, 172 W. Adams St, Chicago, IL 60603. Please click on the following link to make a reservation: [The University of Chicago Room Block](#). As mentioned above, the W Chicago-City Center is within walking distance of the Willis Tower.

## Airport Information

### *Chicago Midway Airport*

For those flying out of Midway Airport, there are ample cabs near the CIE. Alternatively, teams can take the #55 Bus westbound to Midway Airport. For those heading back to the W Chicago-City Center prior to departing, teams can take the shuttle back to the W Chicago-City Center and then take the Orange Line directly to Midway Airport.

### *Chicago O'Hare International Airport*

For those flying out of O'Hare Airport, teams can take the shuttle back to the W Chicago-City Center and take the Blue Line directly to the airport. Alternatively, teams can take a cab to O'Hare.

Questions regarding logistics should be sent to Jesse Meyer – [jameyer@uchicago.edu](mailto:jameyer@uchicago.edu).

# OPTIONSCITY FREEWAY™ SYSTEM REQUIREMENTS

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- Windows OS Preferred
- 1-2 GB Ram
- 1 GB Hard Drive Space
- Internet Connectivity
- Java 7 Runtime (Cannot be Java 6)
- Modern CPU (e.g., Pentium 4+)
- Wireless Network Card
- Modern Graphics Card

## Technical & General Support

- For technical and development questions or support, each team will have access to a forum at [forum.optionscity.com](http://forum.optionscity.com).
  - Teams will receive an email from OptionsCity Software with login/password.
  - An email address will be provided in the forum for questions with sensitive/"secret sauce" information.
  - Please check the forum on a regular basis. Many of your questions may already be answered on the forum.
  - Forum requests will be responded to as quickly as possible. Teams should not expect immediate responses, but can expect to hear back within 12 hours.
- A Dropbox account has been created and will contain all up-to-date files for your reference. Teams will receive an email with a link to the Dropbox account.
  - Please check the Dropbox on a regular basis.
  - For your reference, we have created a basic "OnRamp Tutorial" and a "Getting Started with the Code" document explaining how to load the code dependencies and some sample implementations into common development software.
- All of the code getting started and sample code can be checked out via GitHub. If your team is unfamiliar with using GIT, a competition.zip file containing the source code will be included within the dropbox folder as well. We recommend using GitHub, however, so that if any code updates are made, your team can easily update these. The URL is listed below, but all information on how to get bootstrapped with the sample code will be described in the Getting Started guide on dropbox as well.
  - <https://github.com/hanzhiw/2015UChicagoTradingCompetition.git>
- Along with the Dropbox resources, we have **created a video** to help you get started with Freeway™ and testing your code. Please be sure to click on the link below and watch the video:
  - [UChicago Midwest Trading Competition 2015 Training Video](#)

## Case Preparation Tips

We have provided you with a substantial amount of information and resources to get started. A good order for approaching the various documents is to read:

- (1) The Individual Cases – See Below
- (2) Getting Started with the Code – [Dropbox Link](#)
- (3) OnRamp/Freeway™ Video – [UChicago Midwest Trading Competition 2015 Training Video](#)
- (4) OnRamp Tutorial – [Dropbox Link](#)

# CASE 1: OPTIONS MARKET-MAKING

## Introduction

This case tests the team's ability to adapt to changing volatility conditions and manage risk while continually making markets in multiple options on the same underlying product.

Each team will be competing in its *own* market in which it is the *sole* market-maker, and will be required to at all times post limit orders of quantity one *both* buy and sell options at each of five strikes. At evenly spaced time-intervals, a broker will submit a single immediate-or-cancel order of quantity one, which may be either a buy or a sell order at any of the five strikes. If the broker's order hits or lifts one of the market-maker's limit orders, a trade will occur. The market-maker will *only* know the broker's quote when a trade takes place. When you receive a non-marketable quote or two, you should probably widen the spread to search for a current price level. The market-maker will have the opportunity to adjust her markets before the next broker order.

The underlying will not move over the course of the competition, nor will the time-to-expiration interest rate change. The changes in the prices offered by the broker will be primarily determined by the volatility parameter,  $\sigma_t^{(b)}$ , in the Black-Scholes formula, which will be generated from a stochastic process. The main tasks of each team's algorithm will be to attempt to track  $\sigma_t^{(b)}$  and adjust its quotes accordingly to make profit while managing inventory risk.

This case will consist of three rounds with 100 broker orders each. Teams will have time between rounds to make changes to their parameters used in the algorithms if they choose.

## The Broker Orders

Each broker order will be randomly generated from the distribution described below. Each order is a triple  $O_t = (price_t, strike_t, direction_t)$ , i.e.,  $(\omega, 90, -1)$  would mean a broker order to *sell* the 90 strike at  $\omega$ . The underlying price is fixed at  $X = 100$ , the five available strikes are  $\{80, 90, 100, 110, 120\}$ , interest rate is fixed at  $r = 0.01$ , time-to-expiration is fixed at  $L = 1$ , and the distributions of the elements of  $O_t$  are:

$$direction \stackrel{iid}{\sim} Uniform(\{-1, 1\})$$

$$strike \stackrel{iid}{\sim} Uniform(\{80, 90, 100, 110, 120\})$$

$$price_t = BlackScholes^{call}(X, strike_t, r, L, \sigma_t^{(b)}) \cdot e_t \cdot \epsilon_t$$

where  $e_t$  reflects the 5% edge the broker is willing to give to the market-maker and  $e_t = 1.05$  or  $0.95$  in the case of a broker buy or sell order, respectively.  $\epsilon_t$  serves as the noise parameter drawn from  $N(1, 0.05^2)$ .  $\{\sigma_t^{(b)}\}_1^T$  is a set of discrete draws from a geometric Brownian motion with zero drift, volatility 0.05, and initial value of 0.3.

In each round, all teams will face the same realization of the broker order process.

## Penalty

To prevent excessive risk-taking, teams will be required to adhere to vega limits throughout all rounds of the case.

The vega limit will be 5 times the calculated vega of the 100-strike option with  $\sigma = 0.3$ . You will be charged one hundred dollars times the amount by which your position vega exceeds the vega limit. Note that although the vega limit is fixed, your position vega is calculated based on the current true  $\sigma_t^{(b)}$  which you have to track. Further, the penalty will continue to apply until your position vega is below the limit.

## Scoring

Participants' scores in each round of the case will be determined based on  $PnL$  and any penalties incurred, where  $PnL$  is defined to include profits and losses from closed positions, as well as profits and losses from any open positions at the end of the round marked to  $price_{100}$  of that round.

The weighting of the scores from each round to calculate the final score of the case will be announced prior to the start of the competition.

## Case Objects & Interface

The following Java class objects are implemented in the utility package and should be used in your program based on the interface defined below:

```
public static class Quote {  
    public Quote(double bid, double offer)  
}  
  
public static class QuoteList {  
    public QuoteList(Quote quoteEighty, Quote quoteNinety,  
                    Quote quoteHundred, Quote quoteHundredTen, quoteHundredTwenty)  
}
```

You will be writing implementations in Java for the following methods:

```
public QuoteList getCurrentQuotes();
```

The implementation of this method should be ready to provide current market quotes at any point in time. Broker request submitted at each time interval will cause this method to be called. The name of the `Quote` variable within `QuoteList` indicates the strike. Therefore, please provide your price with the correct corresponding `Quote` object.

The brokers orders will be compared to the quotes returned from the above method and any trades will be notified through the following two functions.

```
public void newFill(int strike, int direction, double price);  
public void noBrokerFills();
```

If the `QuoteList` object returned in `getCurrentQuotes` matches against any broker orders, the `newFill` method will be invoked with trade details. The `strike` argument indicates which option was filled. Definition of `direction` will stay consistent as before in reference to the broker, i.e., -1 would be mean that you have *bought* one lot with a broker *sell* order.

If the `QuoteList` object returned in `getCurrentQuotes` does not result in a trade, the `noBrokerFills` method will be invoked so that your implementation can make any necessary adjustments.

Any penalty incurred will be announced through the following function.

```
public void penaltyNotice(double amount);
```

The `amount` argument reflects the monetary amount of the penalty that the participants have incurred in that particular round.

In addition, we have also provided you with the Black-Scholes option pricing function and vega calculation function in `OptionsMathUtils.java`:

```
public static double theoValue(double strike, double vol)
public static double calculateVega(double strike, double vol).
```

## CASE 2: PAIRS TRADING

### Introduction

This case examines how an understanding of the relationship between securities can be used to attain profits when prices deviate from the equilibrium.

Each team will be allowed to trade a portfolio of stocks in each round of the case. Your algorithm should be able to identify the profitable trading pairs within the portfolio of securities, discover the underlying relationship and profit from it, and manage your exposure to secure the profit before the deviation reverts.

The case will consist of three rounds with 1,000 ticks each. (1) The first round will consist of only two securities with a pre-established relationship. Your job is to study it and profit from any deviations from its equilibrium. (2) In the second round, there will be three tradable securities so your job extends to being able to identify the *one* trading pair (and the third security, which has no meaningful relationship with the other two) and profit from it. (3) The third round will have five tradable securities available with *two* distinct trading pairs for your algorithm to tackle. Hence, you should also be aware of the trading opportunity between the two trading pairs from the last round.

Securities	HURON	SUPERIOR	MICHIGAN	ONTARIO	ERIE
Starting Price for Round 1	100	100	-	-	-
Starting Price for Round 2	100	100	100	-	-
Starting Price for Round 3	100	100	100	100	100

### Addtional Details

To discourage running an algorithm that only trades one particular security instead of attempting to discover a profitable pair, data for each individual security will be generated from a process where the expected returns are 0.

In addition, you must maintain a net zero position at all times. Hence, when you buy a security, you must simultaneously sell another security in the same amount (and vice versa).

An absolute position limit (the sum of the absolute value of all of your open positions) will also be enforced. That is, if you have a long position of HURON of 10 lots and a short position of SUPERIOR of 10 lots, your absolute position will be 20. This constraint means your algorithm should allocate your exposure to where it thinks the most profitable trades will lie. The absolute position limit for Round 1 will be 40, Round 2 with 60 and Round 3 with 100.

There will be a \$1 fixed bid-ask spread around the price of each security throughout the entire competition, so the starting bid ask price for all securities will be 99.5, 100.5, respectively.

Participants will be given sample data generated from our algorithm to test run their program, but we may change the parameters used on the competition day. You will be provided with adequate capital at the

beginning of each round to establish positions within the limits set forth above. Positions and *PnL* are not carried over between rounds. Any open positions will be liquidated at the closing price of each security at the end of each round. Teams will have time between rounds to make changes to their parameters used in their algorithm if they choose.

## Scoring

Participants' scores in each round of the case will be determined based on *PnL*, where *PnL* is defined to include profits and losses from closed positions, as well as profits and losses from any open positions at the end of the round marked to the closing price of each security of that round.

The weighting of the scores from each round to calculate the final score of the case will be announced prior to the start of the competition.

## Case Objects & Interface

The following Java class objects are implemented in the util package and should be used in your program based on the interface defined:

```
public enum Ticker {  
    HURON, SUPERIOR, MICHIGAN, ONTARIO, ERIE  
}  
  
public static class Quote {  
    public Quote(Ticker ticker, double bid, double ask)  
}  
  
public enum OrderState {  
    DEFAULT, FILLED, REJECTED  
}  
  
public static class Order {  
    public Order(Ticker ticker, int quantity, OrderState state)  
}
```

Within `PairsUtil.java`, the following helper function is available to you:

```
public static Order[] initiateOrders(Ticker[] symbols)
```

Your program needs to expose the following functions:

```
public void currentSymbols(Ticker[] symbols);
```

This method will be called at the beginning of each round and an array of Tickers used for that round will be passed down to you through the argument. You should use `initiateOrders(Ticker[] symbols)` provided in the util to initiate the array of orders that will be returned to the system.

```
public Order[] priceUpdate(Quote[] quotes);
```

This method is called when new quotes for the stocks are distributed. New price information will be passed on via the quotes array argument. Your implementation should return an array of orders indicating your actions for each of the stocks using the `quantity` variable of the `order` object. 1 for buy, -1 for sell and 0 for inaction.

```
public void ordersConfirmation(Order[] orders);
```

This method is invoked to confirm the orders you submitted were filled. The same array of `order` that you submit to the system is returned to you with the updated `OrderState`. If the order is rejected, you should check your position/limit.

Note that although you can always expect the order of the tickers in `Quote[]` to be  
HURON, SUPERIOR for Round 1,  
HURON, SUPERIOR, MICHIGAN for Round 2 and  
HURON, SUPERIOR, MICHIGAN, ONTARIO, ERIE for Round 3,

please double check the Ticker before you proceed with your algorithm and in your `Order[]`, please return them in the SAME order as the `Quote[]`.

## CASE 3: INDEX TRACKING

### Introduction

Consider a **cap-weighted** index comprised of 30 stocks (UC30). You are the manager of a fund aimed at mimicking the returns of the index. However, due to the constantly changing regulatory environment, you are never allowed to trade or hold all 30 of the stocks at any one time.

Your goal is to have your fund track the returns of the index as closely as possible, while trading only the legally permissible stocks and being subject to transaction costs.

### Data

The case will run for 1,000 ticks (days) over 3 rounds. At the start of each round, and at every tick thereafter, participants will be provided with the prices of all 30 stocks as well as the value of the index. Participants' algorithms will take this data and return their desired portfolio weights. The platform will adjust their portfolio weights and calculate transaction costs accordingly.

Occasionally (approximately once every 50 ticks), announcements will be made regarding the tradability of non-tradability of certain stocks. The new regulations will kick in 20 ticks after they're announced, so participants should adjust their positions accordingly before the new laws apply. Holding positions in stocks that are no longer allowed to be traded will lead to penalties. Note that it will be possible for multiple announcements to occur in a short period (though not multiple in the same tick  $t$ ).

To assist participants in designing their portfolio-tracking algorithm, teams will be provided with 10,000 ticks of historical data comprising of all 30 stocks prices and the index value for each period. Teams will also be provided with the true weights for the indices. Competition data will be drawn from the same distribution as the historical data.

The underlying true index weights and the distribution of underlying stocks will differ across all 3 rounds. (Think of each case as a completely different index of completely different stocks.) Hence, participants will be provided with three separate sets of historical data, and should tweak their algorithms accordingly for each round.

The index will be calculated as the following:

$$INDEX_t = k \sum_{i=1}^{30} \varphi_i S_{i,t}$$

where  $S_{i,t}$  is the price of stock  $i$  at time  $t$ , and  $\varphi_i$  is the number of outstanding shares of the stock, and  $k$  is some constant. While you won't be getting  $\varphi_i$ . Note that  $\varphi_i$  and  $k$  are constant for all time  $t$ , and the  $k\varphi_i$  corresponds to the true index weights mentioned above.

## Penalty & Transaction Costs

Transaction costs apply when a trade is made in either direction, i.e. whenever the portfolio weight for any stock is modified from period-to-period. These will be incurred per-period. The transaction cost function is defined as the following:

$$TCOST(\Delta_{i,t}) = \exp(|\Delta_{i,t}|) - 1$$

where  $\Delta_{i,t}$  is the change in portfolio weight of stock  $i$  at time  $t$ . For example, if the portfolio weight for stock A changes from 0.05 to 0.06,  $\Delta_{i,t} = 0.01$ . Transaction costs are summed over all periods and all stocks.

Penalties for holding onto a stock that is no longer tradable will be calculated as follows:

$$PENALTY(w_{i,t}) = \begin{cases} 0 & \text{if stock } i \text{ is tradable at time } t \\ \exp(|Cw_{i,t}|) & \text{otherwise} \end{cases}$$

where  $w_{i,t}$  is the portfolio weight of stock  $i$  at time  $t$ , and  $C$  is a very, very large constant. E.g.  $w_{i,t} = 0.05$  means 5% of the portfolio is allocated to stock  $i$ .

## Scoring

Teams will be scored on the following formula (summed over 3 rounds):

$$\text{Score} = \sum_{t=1}^{1000} (r_{I,t} - r_{P,t})^2 - \text{TOTAL TCOST} - \text{TOTAL PENALTIES}$$

where  $r_{I,t}$  is the 1-period log-return of the Index between time  $t$  and time  $t - 1$ , and  $r_{P,t}$  is the 1-period log-return of your portfolio between time  $t$  and time  $t - 1$ . In other words,

$$r_{I,t} = \log \frac{\text{INDEX}_t}{\text{INDEX}_{t-1}}$$
$$r_{P,t} = \log \frac{\text{PORTFOLIO}_t}{\text{PORTFOLIO}_{t-1}}$$

## 5. CASE OBJECTS & INTERFACE

Teams will have to implement the following methods for this case:

```
double[] InitializePosition(double[] underlyingPrices, double indexValue,
                            double[] trueProductWeights, boolean[] tradables)
```

This method will be invoked at the beginning of each round for participants to initialize their positions (no transaction costs for establishing initial positions).

The argument `underlyingPrices` contains information for the starting prices of the 30 assets at the start of the case and `indexValue` is the value of the index at the start of the case. `trueWeights` is an array of doubles representing the true weights of the portfolio that the index is based on, and sums to 1. `tradables` is an array of booleans, indicating what stocks are tradable at the start. The implementation should return an array of doubles corresponding to the portfolio weights that must sum to 1.

```
public double[] updatePosition(int currentTime, double[] underlyingPrices,
                               double indexValue);
```

This method is called every period and participants will get updates of the prices and index values from the previous day, and return their *desired* positions for the day. Transaction costs are calculated accordingly. Arguments contain information for the prices of assets and index value at time `currentTime`. The implementation should return an array corresponding to the portfolio weights that must sum to 1.

```
public void regulationAnnouncement(int currentTime, int timeTakeEffect,  
                                    boolean[] tradableProducts);
```

Participants are informed about what stocks are tradable/untradable through this method, taking effect 20 ticks later. This method is called before `updatePosition` for the same period `currentTime`. The boolean array `tradableProducts` contains information about whether the stock is tradable or not at time `timeTakeEffect`. Note that

```
timeTakeEffect = currentTime + 20
```

always.

```
public void penaltyNotification(int currentTime, boolean[] tradableProducts);
```

This method is called when the system detects that you have incurred a penalty by holding an illegal position (i.e. non-zero weight in a nontradable product). `currentTime` is the time period when the violation occurred, and `tradableProducts` has the latest information of what is tradable. Use this method primarily for testing and logging purposes.

## APPENDIX

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### Dropbox Resources Overview

The Dropbox folder ([Dropbox Link](#)) sent out to each team will serve as the central location for all resources related to the trading competition.

The section below will go over the initial documents found in the folder and how they may be useful. As the competition approaches, however, additional resources may be added to provide advanced details or address any questions that arise while teams are developing their implementations.

- **Getting Started with the Code** - This guide will walk each team through checking out the code from any repositories, importing them into an IDE, and uploading the code to OnRamp for testing.
- **Java Security Configuration** - Java 7 & 8 can be very protective when launching via the web on certain platforms. You may encounter an error or have trouble launching the application properly. This guide should address any common problems on most operating systems competitors will likely be using
- **OnRamp Tutorial** - This guide walks the end user through various components within OnRamp, the name of the user interface for Freeway. This user interface will be the gateway to the platform for all teams and will also serve as the primary mechanism for uploading your code, testing, and verifying results. While each team doesn't need to know the platform in detail, it's important that they have a basic understanding.
- **Advanced User Guide** - This document might be confusing to read until after team members have worked with the system for one to two weeks. Once competitors start to have a basic understanding of the coding requirements and have created simple working implementations, reading this document will give them a good overview of how to make use of variables or the IDB interface. These two topics are essential if teams want to build dynamic algorithms that can be tweaked on competition day or persist data between rounds.
- **Competition.zip** - This contains the same code that is in the GitHub repo. It is uploaded here in case teams have issues checking out from GitHub or using GIT in general.



3Red is a proprietary trading startup headquartered in the Chicago Loop, with a presence in New York. We're committed to leveraging technology and math to implement competitive trading strategies while managing risk and responding to dynamic market conditions.

Technology and quantitative ingenuity are at our core.

We hire extremely bright, talented, and motivated individuals to collaborate with each other and compete in the world's financial markets. Our team has extensive, global experience in a wide variety of asset classes, risk management, and simple and complex technologies. Dedicated Technologists create all of our trading architecture, risk management systems, and software in-house. Algorithmic Traders extract information from a ton of data and leverage mathematical modeling to build automated trading algorithms.



Belvedere Trading is a leading proprietary trading firm based in Chicago, Illinois that develops and maintains proprietary, high performance trading software. Our Technology Department is an innovative environment where our Software Engineers continually develop and optimize our trading platform. We pride ourselves in our ownership of projects, diverse technology experience, and our great relationship between our Technology and Trading groups.

### **Our Culture**

We believe that great ideas can come from anywhere and anyone so we encourage all of our employees to take a passionate interest in promoting, within the team environment, those solutions they feel strongly about. Through this open exchange of ideas, experienced and novice team members alike grow professionally.

Belvedere employees work hard, and are appreciated first and foremost for their contributions to the firm and each other. We believe in the absence of barriers to communication and the maintenance of our small company culture.

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### **Careers**

Belvedere Trading combines training programs, a support network and sophisticated theoretical models with the collective trading experience of its partners and employees to produce an ideal environment for creating successful traders. Belvedere is always looking for exceptionally talented individuals that have a strong desire to succeed in the fast paced trading industry. We believe that the continued success of our firm depends upon the ongoing education of our employees, the perpetual integration of our cutting edge technology, and the implementation of our unique trading strategies. Visit [www.belvederetrading.com/careers](http://www.belvederetrading.com/careers) for more information.



BP is a leader in the Global Energy Trading Market. We trade a varied range of products including oil, natural gas, liquefied natural gas, currencies, metals and financials derivatives.

Experience realism and pressure of a world-class trading organization by participating in our trading simulation for prizes.

- Manage your positions and determine your trading strategy
- Compete in a fast-paced real-time market against your peers
- Use state of the art technology

Come join us and learn how BP positions itself in the commodities trading space and where we extract value for our business. The game will bring to life some of the decisions we face every day.

Learn. Trade. Win.



As the world's leading and most diverse derivatives marketplace, CME Group ([www.cmegroup.com](http://www.cmegroup.com)) is where the world comes to manage risk. CME Group exchanges offer the widest range of global benchmark products across all major asset classes, including futures and options based on [interest rates](#), [equity indexes](#), [foreign exchange](#), [energy](#), [agricultural commodities](#), [metals](#), [weather](#) and [real estate](#). CME Group brings buyers and sellers together through its [CME Globex®](#) electronic trading platform and its trading facilities in New York and Chicago. CME Group also operates [CME Clearing](#), one of the world's leading central counterparty clearing providers, which offers clearing and settlement services across asset classes for exchange-traded contracts and over-the-counter derivatives transactions. These products and services ensure that businesses everywhere can substantially mitigate counterparty credit risk.

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[info@cmegroup.com](mailto:info@cmegroup.com) | [www.cmegroup.com](http://www.cmegroup.com)



CME Group Foundation's mission is to enhance economic opportunity by supporting academic initiatives and activities that:

- promote research, teaching and learning in financial markets, futures and derivatives;
- promote the education of disadvantaged children and youth; and
- promote the health and education of young children.

The Foundation's current priorities for grants in the higher education area are:

- 1) Preparation of Undergraduate and Graduate Students for Careers in Financial Services
  - we believe that undergraduate and graduate students preparing for careers in financial services industries need a deep understanding of the futures and derivatives field and its uses in risk management.
- 2) Academic Research on Futures and Derivatives Policy Issues – to encourage such research, the Foundation provides grant support to professors and CME Group data related to the research.

<http://www.cmegroupfoundation.org/>



DRW Trading Group (DRW) is a principal trading organization. This means that all of our trading is for our own account and risk, and all of our methods, systems and applications are solely for our own use. Unlike hedge funds, brokerage firms and banks, DRW has no customers, clients, investors or third party funds. Our trading spans a wide range of asset classes, instruments, geographies and trading venues, with a focus on trading listed, centrally-cleared instruments.

Founded in 1992, our mission is to empower a team of exceptional individuals to identify and capture trading opportunities in the global markets by leveraging and integrating technology, risk management and quantitative research. With that spirit, DRW has embraced the integration of trading and technology by devoting extensive time, capital and resources to develop fast, precise and reliable infrastructure and applications.

DRW's strategies and methods vary. For example, certain of our operations focus on liquidity provision, while others interact with the markets as liquidity takers. Furthermore, certain of our operations are heavily dependent on technology while others involve interactions with markets in more traditional ways. This has resulted in our business being diversified as to strategies, asset classes, instruments and geographical presence. DRW focuses on finding liquid, centrally-cleared instruments, thus eliminating the counterparty exposure associated with OTC/bilateral trading. DRW is an active participant on exchanges in the United States and Europe, including the Chicago Mercantile Exchange, the Chicago Board of Trade, the New York Mercantile Exchange, the Intercontinental Exchange, Eurex, LIFFE and several other exchanges and trading venues.

Our philosophy on building technology is to be pragmatic, lean and business-focused. We are technology-agnostic and empower our teams to choose the right tools for the job. We have a playful, collaborative culture, favoring healthy and public debate while actively discouraging politics and finger pointing. We value talented people who are passionate about their craft and continuous learning. DRW offers various opportunities for personal and career growth with in-house training, conferences, seminars and outside speakers.



Eurex Exchange, a member of Eurex Group, is one of the world's leading derivatives exchanges. A broad range of products, including equity index futures, a growing number of commodity derivatives and some of the world's most liquid fixed income products tradable on one single platform provide our customers with new opportunities. Our innovative and reliable technology gives around 430 members and 8,300 traders in 31 countries worldwide access to our products and services. We also deliver ground-breaking clearing services through Eurex Clearing, Europe's largest CCP for securities and derivatives transactions.

# FLOW ■ TRADERS

Innovative, fiercely competitive and backed by cutting-edge technology, Flow Traders is one of the leading proprietary trading houses worldwide. Awarded ETF Market Maker Europe & Asia, Flow Traders monitors international stock markets, instantly identifies fleeting price differences between related financial products, and seizes upon those opportunities through intelligent electronic trading processes. In order to maximize our performance and facilitate our international growth, Flow Traders heavily invests in our employees. The backbone of our success is the collection of creative doers, thinkers, and above all, believers who form our team.



IMC is a leading market maker, active on over 100 exchanges, platforms and pools of liquidity around the world. Founded in Amsterdam in 1989, IMC was among the first to value the importance of technology and innovation in the evolution of trading. As we invested we grew, from 2 to 400. Today we operate globally – across time zones and continents as one company with one trading platform.

While we value the contribution of each individual, we know we work better together. That is why our traders, developers, and technologists team up. We hire smart people from diverse backgrounds, cultures, and nationalities and given them freedom and responsibility to develop to their full potential. At IMC, the best idea wins. That's what's driven the innovation that has put us at the forefront of our industry. And it's what we believe will keep us there as a great and creative place to work.



OptionsCity Software powers the trading, risk management and analytics needs of professional futures and options traders, market-makers and financial institutions worldwide. OptionsCity's diverse suite of powerful tools includes Metro, its flagship electronic trading and market-making platform, and Freeway, a multi-asset automated trading engine designed to build, test, and deploy algorithms with micro-second execution. OptionsCity is a certified Independent Software Vendor on leading global derivative exchanges and markets. For more information, please visit [www.optionscity.com](http://www.optionscity.com).



Optiver is an international and innovative global market maker. We deal with highly-automated electronic market making activities in a wide variety of products including derivatives and stocks. With offices in Amsterdam, Chicago and Sydney, we employ over 750 talented individuals from over 30 nationalities and trade in more than 20 countries, across five continents, 24 hours a day. Located in Chicago with 160 of those talented individuals, Optiver US LLC is registered with the SEC as a broker-dealer and participates in trading on various U.S. securities and commodities exchanges. Founded in 1986, Optiver has been profitable every year of its existence.



SBB Research Group is an early-stage investment management and research firm utilizing sophisticated and responsible strategies to manage assets totaling more than \$100 million. While protecting principal and reducing portfolio volatility, we apply tested techniques to ensure our investments are maximizing their potential.

"I am committed to investing responsibly, seeking returns while protecting principal. My team and I strive to employ our current strategies as effectively as possible while researching new approaches that can complement our present operations."

-Sam

Barnett

The culture at SBB Research Group fosters intense collaboration between metrics-driven individuals from diverse engineering and research backgrounds. Team members share topical expertise while engaging in independent research and continuous professional development. Our team of engineers implements and refines concepts, often inspired by academic communities, into full-fledged algorithmic models. Active positions result from data-driven constructs and careful evaluation. Our models are subject to constant scrutiny to achieve optimal performance. Our continued success is chiefly attributed to the implementation of quantitative analytics and continuous improvement in our models.

SBB Research Group was recently featured in Hedge Fund Alert: "More Growth Seen for Quant Shop." Forbes highlighted Sam's accomplishments in this year's 2014 30 Under 30: Finance.

## Careers

Our engineers have the opportunity to design, develop, and improve applications that support operations, financial modeling, trading, and portfolio management. Team members share topical expertise while engaging in independent research and continuous professional development. Our small size allows for a truly collaborative environment and promotes entrepreneurial spirit. Exploration of new ideas is encouraged and professional growth is unlimited.

SBB Research Group is currently seeking candidates for full time and internship positions. Visit [www.sbbrg.com](http://www.sbbrg.com) to apply.



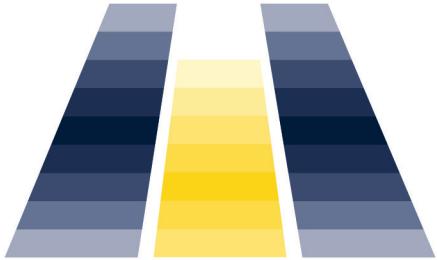
# Spot

Spot Trading is a Chicago proprietary trading firm active in multiple markets including cash, options, futures, and other derivatives. We have grown from a team of 5 individuals in 1999 to over 100 professionals working in technology, equity research, quantitative and trading jobs. We proudly distinguish ourselves through our world class trading technology, our innovative trading model, and a collaborative culture.

Since its establishment in 1999 by Rob Merrilees, Spot Trading has expanded in reach, accomplishment and size. Today, we deploy capital to multiple strategies across options, equities and futures, utilizing an industry-leading platform for algorithmic trading. We are proud of our history as a Chicago trading firm, and the opportunities we have provided to individuals seeking jobs in the trading industry.



TransMarket Group LLC (TMG) is a global quantitative proprietary trading and technology company. Since our founding in 1980, we have earned an international reputation for successful trading based on technological innovation, scrupulous risk management, and most importantly- the intellect and work ethic of our team. We provide substantial liquidity on the world's major derivative exchanges, market-making in a wide variety of asset classes and financial instruments in both developed and developing economies.



# wolverine

Founded in 1994, the Wolverine companies comprise a number of diversified financial institutions specializing in proprietary trading, asset management, order execution services, and technology solutions. We are recognized as a market leader in derivatives valuation, trading, and value-added order execution across global equity, options, and futures markets. With a focus on innovation, achievement, and integrity, we take pride in serving the interests of both our clients and colleagues. The Wolverine companies are headquartered in Chicago with offices in New York and San Francisco and a proprietary trading affiliate office located in London.