



Rotman School of Management
UNIVERSITY OF TORONTO

Rotman
INTERACTIVE TRADER



FLOW TRADERS



S&P GLOBAL
MARKET INTELLIGENCE



WORLDQUANT



Rotman
MASTER OF FINANCIAL
RISK MANAGEMENT

Rotman

INTERNATIONAL TRADING COMPETITION 2018
15TH YEAR ANNIVERSARY

CASE PACKAGE

Table of Contents

| | Content Titles | Pages |
|---|-------------------------------------|-------|
| ● | About RITC | 3 |
| ● | Important Information | 4 |
| ● | Case Summaries | 7 |
| ● | Social Outcry Case | 9 |
| ● | BP Commodities Case | 12 |
| ● | Fixed Income Case | 19 |
| ● | S&P Global Quantitative Outcry Case | 29 |
| ● | MATLAB Volatility Trading Case | 35 |
| ● | Flow Traders ETF Case | 39 |
| ● | Schonfeld Algorithmic Trading Case | 43 |

About RITC

A WARM WELCOME FROM THE ROTMAN COMMUNITY

The Rotman International Trading Competition (RITC) is a one-of-a-kind event hosted annually at the Rotman School of Management, University of Toronto, located in one of North America's largest financial centres. RITC, now in its 15th anniversary, is the world's largest simulated market challenge, bringing together teams of students and their faculty representing over 50 top universities across the world. Unlike remote electronic trading competitions, RITC offers students, faculty, and sponsors the invaluable experience of engaging in a stimulating face-to-face interaction, encouraged by our unique conference format.

The competition is predominantly structured around the Rotman Interactive Trader (RIT) platform, an electronic exchange that matches buyers and sellers in an order-driven market on which we run trading cases. The cases simulate potential scenarios for risks and opportunities with a focus on specific investment, portfolio or risk management objectives. Participants will be challenged to handle a wide range of market scenarios.

This case package provides an overview of the content of the 2018 Rotman International Trading Competition. Each case has been specifically tailored to cover topics taught in university level classes and real-life trading situations. We are thrilled to present to you the 15th edition of RITC, and we hope you will enjoy your experience at RITC 2018!



SEE YOU IN TORONTO!



Important Information

PRACTICE SERVERS

Practice servers will be made available starting from January 26th. We will introduce the actual cases in a staggered manner - not all cases will be available on January 26th. Further information on release dates can be found below and more information will be posted as it becomes available on the RITC website.

| Case Name | Release date |
|------------------------------------|--|
| Flow Traders ETF Case | Friday, January 26 th by 11:59pm EST |
| BP Commodities Case | Monday, January 29 th by 11:59pm EST |
| MATLAB Volatility Trading Case | Tuesday, January 30 th by 11:59pm EST |
| Fixed Income Case | Wednesday, January 31 st by 11:59pm EST |
| Schonfeld Algorithmic Trading Case | Wednesday, January 31 st by 11:59pm EST |

Practice servers will operate 24 hours a day, 7 days a week until 11:00pm EST Thursday, February 22nd. Information on how to download and install the RIT v2.0 Client is available on the RITC website: <http://rit.rotman.utoronto.ca/software.asp>.

The following table details the server address and ports available for RITC practice environments:

| Case Name | Server Address | Port |
|---|-----------------------------|-------|
| Flow Traders ETF Case | flserver.rotman.utoronto.ca | 16510 |
| BP Commodities Case | flserver.rotman.utoronto.ca | 16520 |
| MATLAB Volatility Trading Case | flserver.rotman.utoronto.ca | 16530 |
| Fixed Income Case | flserver.rotman.utoronto.ca | 16540 |
| Schonfeld Algorithmic Trading Case Server 1 | flserver.rotman.utoronto.ca | 16550 |
| Schonfeld Algorithmic Trading Case Server 2 | flserver.rotman.utoronto.ca | 16560 |
| Schonfeld Algorithmic Trading Case Server 3 | flserver.rotman.utoronto.ca | 16570 |
| Schonfeld Algorithmic Trading Case Server 4 | flserver.rotman.utoronto.ca | 16580 |

To login to any server port, you can type in any username and password and it will automatically create an account if it does not exist. If you have forgotten your password, or the username appears to be taken, simply choose a new username and password to create a new account.

Multiple server ports have been provided for the Schonfeld Algorithmic Trading Case to allow teams to trade in either populated or unpopulated environments. For example, if you are testing your algorithm and there are seven other algorithms running, you may want to move to a different port where there is less trading.

Please note that each case structure in practice and in the competition will be the same while market dynamics may be different depending on the participants' behaviour. Price paths will be different during the competition. In addition, market parameters during the competition may be adjusted to better account for over 100 live traders.

The BP Commodities Case, MATLAB Volatility Trading Case, and Fixed Income Case will be updated with multiple server files that include different sets of news and price paths on February 7th by 11:59pm EST. A server file with a different set of news and price paths will be randomly selected to run every time the case iteration is over on the practice server. The Flow Traders ETF Case and the Schonfeld Algorithmic Trading Case will have new, randomized sets of security paths each time they are run on the practice server.

We will be running two "special" practice sessions for the BP Commodities Case. All teams are invited to connect at the same time: the first one is on Tuesday, February 6th at 10:00am EST; the second one is on Friday, February 9th at 2:00pm EST. Teams wishing to participate in these practice sessions are encouraged to connect to the appropriate port for the BP Commodities Case at the above mentioned times. Additionally, all teams are invited to connect at the same time to trade all competition cases for two additional practice sessions: the first one is on Monday, February 12th at 5:00pm EST; the second one is on Thursday, February 15th at 5:00PM EST.

ADDITIONAL SUPPORT FILES

The following support files will be provided on the RITC website

(<http://ritc.rotman.utoronto.ca/casefiles.asp?n=1>):

- The "Performance Evaluation Tool" for the Flow Traders ETF Case will be released on January 26th.
- The "Penalties Computation Tool" for the MATLAB Volatility Trading Case will be released on January 30th.
- The Schonfeld Algorithmic Trading Case Base Algorithm and other relevant support will be released on January 31st.
- A tutorial for the Social and S&P Global Quantitative Outcry Case will be released on February 9th.

Other documents may be posted and, if so, participants will be notified via email.

SCORING AND RANKING METHODOLOGY

The Scoring and Ranking Methodology document will be released prior to the start of the competition on the RITC website. An announcement will be sent out to participants when the document is available.

COMPETITION SCHEDULE

This schedule is subject to change prior to the competition. Participants can check on the RITC website for the most up-to-date schedule. Each participant will also receive a personalized schedule when s/he arrives at the competition.

TEAM SCHEDULE

Participants must submit a team-schedule by Saturday, February 10th at 11:59pm EST. This schedule will specify which team members will participate in certain RITC events and will specify each team member's role in the BP Commodities Case. It is the team's responsibility to organize and schedule appropriately so that conflicts (for example, simultaneously trading 2 cases) are avoided. Schedules submitted by Saturday, February 10th are considered final and substitutions following that date will not be permitted except under extreme circumstances. Further instructions on how to submit your team schedule will be sent via email.

COMPETITION WAIVERS

Each participant is required to sign a competition waiver prior to his/her participation at RITC. These will be e-mailed to you (to be signed and returned via email by Saturday, February 10th).

QUESTIONS

Please send any case-related questions to ritc@rotman.utoronto.ca. To ensure the fair dissemination of information, responses to your questions will be posted online for all participants to see under the FAQ section of the website.

Case Summaries

SOCIAL OUTCRY

The opening event of the competition gives participants the first opportunity to make their first impression with sponsors, faculty members, and other teams in this fun start to the Rotman International Trading Competition. Each participant has the opportunity to trade against experienced professionals from the industry, trying to make his/her case against the professors, and showcasing his/her outcry skills by making fast and loud trading decisions.

BP COMMODITIES CASE

The BP Commodities Case challenges the ability of participants to trade in a closed supply and demand market for crude oil. Natural crude oil production and its consumption will form the framework for participants to engage in direct trade to meet each other's objectives. The case will test each participant's ability to understand sophisticated market dynamics and optimally perform his/her role, while stressing teamwork and communication. The case will involve crude oil production, refinement, storage, as well as the sale of its synthesized physical products.

FIXED INCOME CASE

The Fixed Income Case will challenge participants to manage a bond portfolio and generate profits by taking advantage of any mispricing of bonds due to changes in the zero-coupon rates and/or credit spreads. This will require participants to accurately understand various types of news and evaluate their impact on the yield curve, credit ratings, and bond prices. Participants will then use the risk-free zero-coupon rates to price risk-free treasury bonds. They will also use the yield curve and the Altman Z-Score model to forecast potential changes to companies' credit rating to price the risky corporate bonds.

S&P GLOBAL QUANTITATIVE OUTCRY CASE

The S&P Global Quantitative Outcry case challenges participants to apply their understanding of macroeconomics to determine the effect of news releases on the world economy as captured by the Rotman Index ("RT100 Index"). The RT100 Index is a composite index reflective of changes in global political, economic, and market conditions. Participants will be required to interpret both quantitative and qualitative news, analyze the impact of the news on the RT100 index, and react by trading futures contracts on the index.

MATLAB VOLATILITY TRADING CASE

The MATLAB Volatility Trading Case gives participants the opportunity to generate profits by implementing options strategies to trade volatility. The underlying asset of the options is a non-dividend paying Exchange Traded Fund ("ETF") called RTM that tracks a major stock index. Participants will be able to trade shares of the ETF and 1-month call/put options at 10 different strike prices. Information including the ETF price, option prices, and news releases will be provided. Participants are encouraged to use the provided information to identify mispricing opportunities and construct options trading strategies accordingly.

FLOW TRADERS ETF CASE

The Flow Traders ETF Case challenges participants to put their critical thinking and analytical abilities to the test in an environment that requires them to evaluate the liquidity risk associated with different tender offers. Participants will be faced with multiple tender offers throughout the case. This will require participants to make rapid judgments on the profitability and subsequent acceptance and execution, or rejection, of each offer. Profits can be generated by taking advantage of price differentials between market prices and prices offered in the private tenders. Once any tender has been accepted, participants should aim to efficiently close out the large positions to maximize returns.

SCHONFELD ALGORITHMIC TRADING CASE

The Schonfeld Algorithmic Trading Case is designed to challenge participants' programming skills in developing algorithms using MATLAB or Excel VBA to automate trading strategies and react to changing market conditions. Throughout the case, these algorithms will submit orders to capitalize on any arbitrage opportunities and working private tender offers. Due to the high-frequency nature of the case, participants are encouraged to develop algorithms that can adapt to rapid changes in market dynamics.

Social Outcry Case

OVERVIEW

The objective of the Social Outcry Case is to allow participants to interact (“break the ice”) and to recognize how far financial markets have evolved technologically. The Social Outcry will be an exciting way for participants, professors and sponsors to interact with one another as well as a great preparation for the Quantitative Outcry. Participants will be ranked based on their profits at the end of the case. Participants’ performance in the Social Outcry Case will not count towards their final scoring of RITC.

DESCRIPTION

Each participant will start the session with a neutral futures position. Participants are allowed to go long (buy) or go short (sell). All trades will be settled at the closing spot price.

MARKET DYNAMICS

Participants will trade futures contracts on an index, the RT100. The futures price will be determined by the market’s transactions while the spot price will follow a stochastic path subject to influence from qualitative news announcements that will be displayed on a screen. News announcements will be displayed one at a time, and each news release will have an uncertain length and effect. Favourable news will result in an increase in the spot price while unfavourable news will cause a decrease in the spot price. These reactions may occur instantly or with lags. Participants are expected to trade based on their interpretation of the news and on their expectations of market reactions.

TRADING LIMITS AND TRANSACTION COSTS

There are no trading commissions for the Social Outcry Case. Participants are allowed to trade a maximum of 5 contracts per trade/ticket. The contract multiplier of RT100 futures is \$10. There are no limits to the net position that participants can have.

RULES AND RESPONSIBILITIES

The following rules apply throughout the Social Outcry Case:

- Market agents are RITC staff members at the front of the outcry pit collecting tickets.
- Once parties have verbally committed to a trade, they are required to transact.
- All tickets must be filled out completely and legibly, and verified by both parties. Illegible tickets will be ignored by the market agents!
- Both transacting parties are responsible for making sure that the white portion of the ticket is received by the market agent. The transaction will **not** be processed if the white

portion is not submitted or is damaged. Both trading parties must walk the ticket up to the market agent for the ticket to be accepted.

- Only the white portion of the ticket will be accepted by the market agent; trading receipts (pink and yellow portions) are for the participants' records only.
- RITC staff reserve the right to break any unreasonable trades.
- Any breaches of the above stated rules and responsibilities are to be reported to the market agent or floor governors immediately.
- All communications must be done in English.

POSITION CLOSE-OUT AND CASE SCORING

Each person's trades will be settled at the close of trading based on the final spot price. The ranking is based on the total profit and loss (P&L) from the trading session. There are no commissions or fines in the Social Outcry Case.

Example:

Throughout the trading session, one participant has made the following trades:

Buy 2 contracts @ 998

Sell 5 contracts @ 1007

Buy 1 contract @ 1004

The market closed out @ 1000. The P&L for the participant is then calculated as follows:

2 long contracts @ 998

$P\&L: (1000 - 998) * 2 * \$10 = \$40$

5 short contracts @ 1007

$P\&L: (1000 - 1007) * (-5) * \$10 = \$350$

1 long contract @ 1004

$P\&L: (1000 - 1004) * 1 * \$10 = -\$40$

The participant has made a total P&L of \$350.

COMPLETE TRANSACTION AND OUTCRY LANGUAGE EXAMPLE

To find the market, participants simply yell "What's the market". If someone wants to make the market on the bid side, s/he can answer "bid 50" meaning s/he wants to buy at a price ending with 50 (e.g. 950 or 1050), whichever is closest to the last trade. If someone wants to make the market on the ask side, s/he will yell "at 51" meaning s/he wants to sell at a price ending with 51 (e.g. 951 or 1051), whichever is closest to the last price. Note that so far, no quantity has been declared, only two digits are required when calling the bid or ask. To complete a trade, someone willing to take

the market price can simply say “bought two” to the person selling. The seller’s response must then be: “sold two” (or any other quantity below 2, but not 0, at the seller’s discretion). After the seller and the buyer fill out the trade ticket and submit the white part to the ticket taker, the trade is complete. Please note that the “market maker” (participant announcing the price) gets to decide the quantity traded up to a maximum of the quantity requested by the “market taker” (participant taking the price).

A complete transaction could run as follows:

| | |
|-----------------------------|---|
| Trader 1 | “What’s the market?” |
| Trader 2 | “bid 70, at 72” or “70 at 72”, (bid 1070, ask 1072, this trader wants to buy and sell) |
| Trader 3 | “at 71” (the new market is 1070 to 1071) |
| Trader 1 to Trader 3 | “Bought 5” (he/she wants to buy 5 contracts at 1071) |
| Trader 3 to Trader 1 | “Sold 3” (Although trader 1 wanted to buy 5 contracts, trader 3 only wants to sell 3 contracts so trader 1 must accept the three contracts). |
| Trader 1 or Trader 3 | S/he fills out the trade ticket with initials from both trader 1 and trader 3. The white portion of the ticket is submitted to the market agent by both traders (both traders walk the ticket up to the front of the trading floor to the market agent). Trader 1 (Buyer) keeps the yellow portion of the ticket and trader 3 (Seller) keeps the pink portion of the ticket. |

There will be a brief outcry tutorial and demonstration before the Social Outcry on the first day of the competition.



BP Commodities Case

OVERVIEW

The BP Commodities Case challenges the ability of participants to trade in a closed supply and demand market for crude oil. Natural crude oil production and its consumption will form the framework for participants to engage in direct trade to meet each other's objectives. The case will test each participant's ability to understand sophisticated market dynamics and optimally perform his/her role, while stressing teamwork and communication. The case will involve crude oil production, refinement, storage, as well as the sale of its synthesized physical products.

DESCRIPTION

The BP Commodities Case will comprise of 2 heats with 4 team members competing together for the assigned heat (i.e. half of the teams will compete in the first heat and half in the second heat). Each heat will consist of four 16-minute independent sub-heats, each representing two months, or 40 trading days. Each sub-heat will involve six tradable securities and five assets. Trading from Excel using the Rotman API will be disabled. Real time data (RTD) links will be enabled.

| Parameter | Value |
|-----------------------------|----------------------------|
| Number of trading sub-heats | 4 |
| Trading time per sub-heat | 16 minutes (960 seconds) |
| Calendar time per sub-heat | 2 months (40 trading days) |
| Maximum order size | 5 contracts |
| Mark-to-market frequency | Daily (24 seconds) |

TEAM ROLES

In this case, each team member will have 1 of 3 specific roles:

1. Producer
2. Refiner
3. Trader

Each team will have 1 producer, 1 refiner, and 2 traders. The team will determine the position of each member.

Example:

The team ROTMAN will have 4 trader-IDs (ROTMAN-1, ROTMAN-2, ROTMAN-3, ROTMAN-4), and roles have been assigned according to the list below.

| Trader-ID | Role |
|-----------------------|----------|
| ROTMAN-1 | Producer |
| ROTMAN-2 | Refiner |
| ROTMAN-3 and ROTMAN-4 | Trader |

Please remember to submit each member's role in the team schedule by **Saturday, February 10th, at 11:59pm EST** as specified in the "Important Information" section above. If a team misses this deadline, the roles will be randomly assigned by competition staff.

Producer

The producer owns oil rigs that produce both Light and Heavy Crude Oil and also owns storage facilities for each type of oil. The average production of each type of Crude Oil is about 2,000 barrels per day, or 10,000 barrels per week (excluding weekends). Oil is produced at a base cost of \$35/barrel for Light Crude Oil and \$30/barrel for Heavy Crude Oil. Production costs and quantities for both Light and Heavy Crude Oil can fluctuate because of external factors. The producer can expect to receive all of his/her weekly production of Light and Heavy Crude Oil at the beginning of each week, but there may be unexpected delays in the delivery to the storage facility. Producers will receive news detailing delivery delays, production quantity variance, and production cost shocks.

Producers start with an initial endowment of both types of Crude Oil and will have a total storage capacity of 20,000 barrels for Light Crude Oil and 20,000 barrels for Heavy Crude Oil. It is important to note that producers cannot mix Light and Heavy Oil in their storage tanks: each storage tank can only be used for the specified type of Crude Oil. Additionally, a producer cannot shut down the production of any of his/her oil rigs. In the event that a producer exceeds the storage limit, he or she will be forced to lease additional storage for the remainder of the simulation at an expensive distressed storage cost. Distressed storage costs are the same for both Heavy and Light Crude Oil storage tanks; however, since the two types of Crude Oil are stored separately, distressed storage costs are applied independently.

Refiner

Each refiner has access to three separate facilities: a refinery that refines only Light Crude Oil, a refinery that refines only Heavy Crude Oil, and one that refines both Light and Heavy Crude Oil simultaneously. For every 5 barrels of Light Crude Oil, the Light Refinery (L-Refinery) will produce

3 barrels of RBOB Gasoline and 2 barrels of Heating Oil (5-3-2) at a production cost of \$25/barrel. For every 5 barrels of Heavy Crude Oil, the Heavy Refinery (H-Refinery) will produce 2 barrels of RBOB Gasoline and 3 barrels of Heating Oil (5-2-3) at a production cost of \$35/barrel. For every 1 barrel of Light Crude Oil and 1 barrel of Heavy Crude Oil, the Light and Heavy Refinery (L/H Refinery) will produce 1 barrel of RBOB Gasoline and 1 barrel of Heating Oil (2-1-1) at a production cost of \$30/barrel. RBOB Gasoline and Heating Oil are traded in gallons, where **one barrel equals 42 gallons**. All three refineries will have a refinery time of 108 seconds and a refinery lease time of 120 seconds. However, the lease function will be disabled when the remaining time in the sub-heat is less than 108 seconds.

Refiners will receive news impacting the prices of RBOB Gasoline and Heating Oil in the future, and will have to evaluate the impacts of these news items in order to decide which refinery, if any, is profitable to operate.

The RBOB Gasoline price will be mainly affected by news items related to market demand. These news items will need to be evaluated by refiners in order to determine their impact and how the future RBOB Gasoline price will change.

The primary driver of Heating Oil prices will be fluctuations in temperature, since demand for Heating Oil will increase as expected temperatures fall. Hence, the price impact of changes in temperature will be estimated based on the simplified equation below:

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

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.

$$\begin{aligned} & \text{Expected weekly temperature change} \\ &= \text{Expected weekly temperature} - \text{Realized weekly temperature} \end{aligned}$$

The expected price for Heating Oil will start at \$2.50/gallon. Information regarding the weather will be released on a weekly basis through news items. Furthermore, it is possible for Heating Oil prices to be affected by external shocks affecting market demand and supply. These external shocks must be evaluated by refiners in order to determine their impact and estimate future Heating Oil prices.

Refiners will need to accurately determine the profitability of running their refineries by evaluating the prices of their inputs (Light and/or Heavy Crude Oil) as well as their future outputs (Heating Oil and RBOB Gasoline).

Refiners start with an initial endowment of 5,000 barrels of Light Crude Oil and 5,000 barrels of Heavy Crude Oil and will have a total storage capacity of 20,000 barrels for each oil type. Heating Oil and RBOB Gasoline do not require storage.

Traders

Traders have access to Light and Heavy Crude Oil markets as well as Heating Oil and RBOB Gasoline futures markets. During the trading period, traders will receive institutional orders from overseas clients who wish to buy or sell Light and Heavy Crude Oil. Traders act as the “shock absorber” for the market. They balance the supply and demand, and help markets achieve equilibrium by naturally filling up their storage tanks when crude prices are very low and by selling them back to the market when prices are relatively high for each type of Crude Oil.

MARKET DYNAMICS

Producers, Traders, and Refiners will be able to trade the securities according to the table below.

| Commodities | | | | |
|-------------|------------------------------------|----------------|---------------------------------|-----------|
| Securities | Description | Contract Size | Accessibility | Shortable |
| CL-L | Light Crude Oil Spot | 1,000 Barrels | Producer, Refiner, Trader | No |
| CL-H | Heavy Crude Oil Spot | 1,000 Barrels | Producer, Refiner, Trader | No |
| HO-2F | Month 2 futures contract for HO | 42,000 Gallons | Trader | Yes |
| RB-2F | Month 2 futures contract for RB | 42,000 Gallons | Trader | Yes |
| RB | RBOB Gasoline | 42,000 Gallons | Refiner | No |
| HO | Heating Oil | 42,000 Gallons | Refiner | No |

Participants will be able to utilize the following assets, which are required for storing and refining physical crude products.

| Assets | Description | Capacity (Barrels) | Cost | Conversion Period |
|--------------|---|--------------------|------------------------------|-------------------|
| CL-L STORAGE | Storage for Light Crude Oil | 10,000 | Free* | N/A |
| CL-H STORAGE | Storage for Heavy Crude Oil | 10,000 | Free* | N/A |
| L-Refinery | Refinery Designed to Process Light Crude Oil Only | 10,000 | \$250,000 per 5 trading days | 4.5 trading days |
| H-Refinery | Refinery Designed to Process Heavy Crude Oil Only | 10,000 | \$350,000 per 5 trading days | 4.5 trading days |
| L/H-Refinery | Refinery Designed to Process a Combination of Light and Heavy Crude Oil | 10,000 | \$300,000 per 5 trading days | 4.5 trading days |

*All starting endowments of storage are free. Subsequent storage leased (due to overproduction) will be charged at a lease price of \$500,000 per storage unit, which can hold up to 10,000 barrels.

Industry-specific news will be released to participants based on their roles. Producers will receive expected production reports of their oil rigs (which are subject to changes throughout the simulation). Actual production may be different from the forecast, in which case producers will be informed of the quantity shock in the next expected production report. Producers will also be subject to shocks influencing the production price of crude and the time at which production is delivered. Refiners will receive information on the downstream RBOB Gasoline and Heating Oil markets, and they must use this information to forecast future prices. Traders will receive "The International Tender Report" which describes the expected institutional orders activity.

The interaction between different market participants (producer, refiner, and traders) within each team, including their profit maximization objectives, is what will largely influence the overall profits of each team. Therefore, participants should optimize the dynamics of each role.

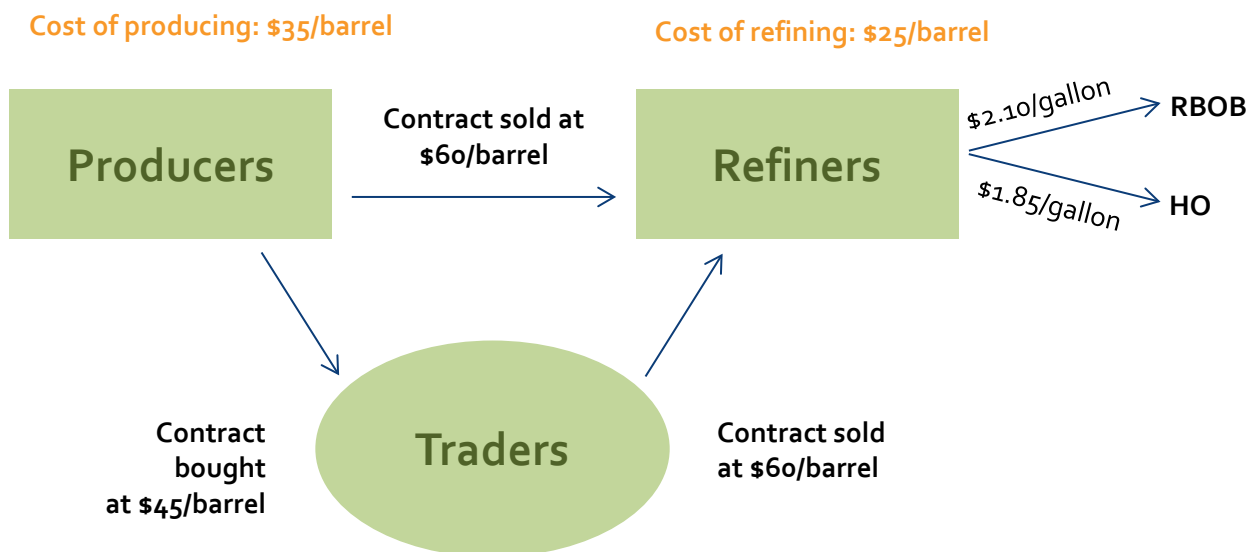
The following is a simplified example of the case:

Assume that RBOB and HO are currently trading at \$2.10/gallon and \$1.85/gallon respectively. Those outputs can be obtained using the Light Refinery, giving a Light Crude refined value of \$2.00/gallon. If you convert this value into barrels: $42,000 \times \$2/\text{gallon} = \$84,000$ per 1,000 barrels, or \$84/barrel. Refiners have bought ten contracts, agreeing to buy 5,000 barrels of Light Crude Oil from the producers and 5,000 barrels of Light Crude Oil from traders at a price of \$60/barrel. In this

scenario, refiners choose to operate only the Light Refinery. Traders initially bought Light Crude from producers at a spot price of \$45/barrel.

Profit generated by each team member (per barrel):

- Producers: Price per contract - cost of producing oil per barrel = \$60 - \$35 = \$25
- Refiners: Value of refined oil - cost of buying and refining oil = \$84.00 - (\$60 + \$25) = -\$1.00
- Traders: Price of contract sold - spot price of oil bought = \$60 - \$45 = \$15



TRADING/POSITION LIMITS AND TRANSACTION COSTS

Each participant will be subject to trading/position limits. Separate limits will be maintained for Light and Heavy Crude Oil (CRUDE) and RBOB/HO Products (PRODUCT). Trading limits will be strictly enforced and participants will not be able to exceed them by trading. However, production and refining assets can and will cause limit breaches if they are not managed properly, resulting in a penalty of \$25,000 per contract over gross and/or net limit.

The maximum trade size will be 5 contracts, restricting the volume of the contracts transacted per trade to 5.

POSITION CLOSE OUT

All futures positions will be marked-to-market every 24 seconds with any profits and losses reflected in the traders' cash balance by the mark-to-market operation.

Each security position, except Light and Heavy Crude Oil, will be closed out at the last traded price. Light Crude Oil will be closed out at \$50/barrel and Heavy Crude Oil will be closed at \$40/barrel regardless of the market price.

KEY OBJECTIVES

Objective 1

Design a model to calculate the effect of news releases on the prices of Crude Oil, Heating Oil and RBOB Gasoline. Using information gathered from news releases and trading data, track the supply and demand of oil throughout the simulation to determine optimal storage usage and trading strategies.

Objective 2

Maximize profits as a team of producers, refiners, and traders by communicating private news information with each other.

Note: Since this simulation requires a large number of participants in order to establish supply/demand, practice sessions for this case will be organized and held at specified times. After organized practice sessions are completed, cases will be run iteratively for model calibration purposes ("trading skillfully" cannot be practiced unless there are 20+ users online).

Fixed Income Case

OVERVIEW

The Fixed Income Case will challenge participants to manage a bond portfolio and generate profits by taking advantage of any mispricing of bonds due to changes in the zero-coupon rates and/or credit spreads. This will require participants to accurately understand various types of news and evaluate their impact on the yield curve, credit ratings, and bond prices. Participants will then use the risk-free zero-coupon rates to price risk-free treasury bonds. They will also use the yield curve and the Altman Z-Score model to forecast potential changes to companies' credit rating to price the risky corporate bonds.

DESCRIPTION

The Fixed Income Case will comprise of 2 heats in which 2 team members will be allocated to complete in each heat. Each participant may compete in only one of the 2 heats. A total of 4 team members will compete in the overall case. Each heat will consist of 5 independent sub-heats, with 6 tradable securities for each sub-heat. Individual sub-heats will span approximately 10 minutes, representing one calendar year. Trading from Excel using the Rotman API will be disabled. Real Time Data (RTD) links will be enabled.

| Parameter | Value |
|-----------------------------|--|
| Number of trading sub-heats | 5 |
| Trading time per sub-heat | Approximately 10 minutes (624 seconds) |
| Calendar time per sub-heat | One calendar year (52 weeks) |
| Number of periods | 2 |
| Compounding interval | One week (12 seconds) |

This case assumes that participants are working as fixed income traders. During the case, news will be released and participants will be able to trade treasury and corporate bonds based on their understanding of news impacts.

SECURITIES

The case will start at the beginning of the year ($t = 0$). There will be four non-tradable zero-coupon bonds issued by the government with the following maturity periods.

| Securities | Maturity Periods |
|-------------------|-------------------------|
| ZCY ₁ | One year from $t = 0$ |
| ZCY ₂ | Two years from $t = 0$ |
| ZCY ₅ | Five years from $t = 0$ |
| ZCY ₁₀ | Ten years from $t = 0$ |

The annualized yields to maturity for the above zero-coupon bonds will be quoted and will be available as zero-coupon benchmark rates for the pricing of both the treasury bonds and the corporate bonds. These benchmark rates may be used to generate the zero-coupon yield curve. They should be considered to be exogenous and risk-free.

There will be a total of six tradable fixed income securities: three treasury bonds with different maturity dates and three corporate bonds with the same maturity date. Detailed information on the tradable securities is presented below:

Treasury bonds

| Securities | Maturity date | Coupon rate | Face Value |
|-------------------------------|-------------------------|-------------------------|------------|
| GovtBondY₂ | Two years from $t = 0$ | 5% (paid semi-annually) | 100 |
| GovtBondY₅ | Five years from $t = 0$ | 5% (paid semi-annually) | 100 |
| GovtBondY₁₀ | Ten years from $t = 0$ | 5% (paid semi-annually) | 100 |

Corporate bonds

| | CorpBondA | CorpBondB | CorpBondC |
|--|-------------------------|-------------------------|-------------------------|
| Issuer | Ackroyd Shipping | Bergman Telecom | Cartwright Industries |
| Credit Rating at the Beginning | A | A | A |
| Face Value (D) | 100 | 100 | 100 |
| Coupon | 5% (paid semi-annually) | 5% (paid semi-annually) | 5% (paid semi-annually) |
| Maturity (T) | Ten years from $t = 0$ | Ten years from $t = 0$ | Ten years from $t = 0$ |
| Total Asset Value (<i>in 100 millions</i>) | 120 | 90 | 170 |
| Total Debt Value (<i>in 100 millions</i>) | 35 | 70 | 120 |
| Market Value of Equity (<i>in 100 millions</i>) | 90 | 50 | 75 |
| Sales (<i>in 100 millions</i>) | 40 | 80 | 150 |
| EBIT (Earnings Before Interest and Taxes) (<i>in 100 millions</i>) | 15 | 25 | 65 |
| Retained Earnings (<i>in 100 millions</i>) | 5 | 15 | 30 |
| Working Capital (<i>in 100 millions</i>) | 10 | 40 | 25 |

VALUATION: TREASURY BONDS

Valuation of a bond requires the calculation of the present value of the future cash flows: the periodic coupon payments and the face value. Summing the present values of the cash flows, participants will be able to calculate the fair price of the treasury bonds as shown below:

$$\text{Treasury Bond Price}_0 = \frac{C}{(1 + y_{6m})} + \frac{C}{(1 + y_{\text{year } 1})} + \dots + \frac{C}{(1 + y_{\text{year } n})} + \frac{M}{(1 + y_{\text{year } n})}$$

Where, $\text{Treasury Bond Price}_0$ is the price of the Treasury bond at $\text{time} = 0$

C = coupon payment

M = face value

y_t = discount rate for the cash flow paid in t

t = calendar periods for when the cash flows are paid (e.g. 6 month, year 1, ... , year 10)

When valuing treasury bonds, participants can use linear interpolation to derive the discount rates for the different cash flows' maturities from the zero-coupon curve. Therefore, y_t is equal to r_t , which is the appropriate risk-free zero-coupon rate for the period t .

For example, consider the zero-coupon (benchmark) rates provided below:

| Securities | Annualized YTM |
|-------------------|----------------|
| ZCY ₁ | 2.00% |
| ZCY ₂ | 3.00% |
| ZCY ₅ | 4.50% |
| ZCY ₁₀ | 5.00% |

The interpolated zero-coupon rate for the bond that matures three years from now (e.g. ZCY₃) would be 3.50% [=3.00% + (three years – two years) / (five years – two years)*(4.50%-3.00%)]. The interpolated zero-coupon rate for the bond that matures four years from now would be 4.00% and so forth. Assuming that the overnight rate is zero, the interpolated zero-coupon rate for the six-month mark of this year would be 1.00%.

Using the table above, at the start of the case with 52 weeks remaining, the discount rate for the cash flow paid for this year end will be equal to 2.00% [= (1+2.00%)^(52/52)-1]. At tick 132, when there are 41 weeks remaining until the coupon payment for the year end, the discount rate for the cash flow paid at the end of this year will be approximately 1.5736% [= (1+2.00%)^(41/52)-1]. Given the interpolated 6-month zero-coupon rate of 1%, the discount rate for the coupon to be paid at the end of June this year would be 0.2874%.

The following table provides details on the present value, at tick 132, for each of the cash flows associated with GovtBondY2, a coupon-paying government bond that matures in two years from

the beginning of the case. Note that, at tick 132, the fair value price for GovtBondY2 will be \$104.60.

| Date of payment | Weeks remaining before payment | Annualized YTM zero-coupon rate | Discount rates | Cash Flows | PV of Cash Flows |
|-----------------|--------------------------------|---------------------------------|----------------|------------|------------------|
| June, Year 1 | 15 | 1.00% | 0.2874% | \$2.50 | \$2.49 |
| Dec, Year 1 | 41 | 2.00% | 1.5736% | \$2.50 | \$2.46 |
| June, Year 2 | 67 | 2.50% | 3.2327% | \$2.50 | \$2.42 |
| Dec, Year 2 | 93 | 3.00% | 5.4287% | \$102.50 | \$97.22 |
| | | | | | \$104.60 |

If a participant wished to purchase this bond, s/he would have to pay \$1,046 (= \$104.60 * 10). Between two coupon payment periods, the buyer needs to pay the seller accrued interest¹ in addition to the 'clean' price of the bond. Accrued interest is calculated using the following formula:

$$\text{Accrued Interest} = C * \frac{\text{Ticks between settlement and last coupon payment}}{\text{Total ticks in payment period}}$$

Where, C = coupon payment, and $Ticks$ refer to seconds in the case.

For example, if a participant purchased the bond described in the table above 132 seconds after the start of the case for \$103.54 (clean price), the accrued interest would be \$1.06 [= (132/312) * \$2.5]. The 'dirty' price of the bond is obtained as the sum of the accrued interest and the clean price.

The total amount that the trader will pay per bond is the dirty price, in this case, \$103.54 + \$1.06 = \$104.60. The transaction log will display two entries for every purchase or sale of a bond: the transaction amount (clean price * quantity) and the accrued interest amount. Please note that the participant paid the fair price for the bond, but there might be occasions where the bond is mispriced, making it more attractive for a trader seeking extra returns.

For valuing corporate bonds, the same valuation will be applied. However, credit spreads will need to be added to the zero-coupon rates in order to account for the credit risk of the corporate bonds. The calculations of the credit spreads are explained in the Market Dynamics section below.

¹ Accrued interest is the fraction of the coupon payment that the original holder has earned prior to the settlement of the bond.

VALUATION: CORPORATE BONDS

An analogous method will be applied for valuation of the corporate bonds. However, credit spreads will need to be added to the zero-coupon rates in order to determine a cash flow discount rate that accounts for the credit risk of the corporate bonds.

There will be a credit rating agency that issues credit ratings corresponding to specific credit spreads. The credit spreads from the table below are the spreads associated with the probability of default between year t and year $t+1$, evaluated at year t ($s_{t,t,t+1}$). The credit rating agency will release updated credit ratings for the three corporate bonds on a quarterly basis. The credit spreads by the rating agency at the beginning of the case are provided below:

| Rating Agency Credit Ratings | |
|------------------------------|---------------------------------|
| Rating | Credit Spread ($s_{t,t,t+1}$) |
| AAA | 0.25% |
| AA+ | 0.30% |
| AA | 0.35% |
| AA- | 0.40% |
| A+ | 0.45% |
| A | 0.50% |
| A- | 0.60% |
| BBB+ | 0.90% |
| BBB | 1.15% |
| BBB- | 1.50% |
| BB+ | 1.90% |
| BB | 2.50% |
| BB- | 3.20% |
| B+ | 4.00% |

In equilibrium, the implied yield to maturity (y_t) is equal to $r_t + s_t$ (risk-free rate plus credit spread). Therefore, the pricing formula for corporate bonds is:

$$\text{Corporate Bond Price}_0 = \frac{C}{(1 + y_{6m})} + \frac{C}{(1 + y_{year\ 1})} + \dots + \frac{C}{(1 + y_{year\ 10})} + \frac{M}{(1 + y_{year\ 10})}$$

Where, $\text{Corporate Bond Price}_0$ = price of the corporate bond at $time = 0$

C = coupon payment

M = face value

$y_t = r_t + s_t$

r_t = the appropriate risk-free rate for the period t

s_t = the appropriate credit spread for the period t

t = calendar periods for when the cash flows are paid (e.g. 6 month, year 1, ..., year 10)

In order to calculate the appropriate credit spread for each period t , it is necessary to first calculate the credit spreads for subsequent years using the credit spreads from the table above, which are the spreads associated with the probability of default within one year. Therefore, the following formula should be applied to calculate the credit spreads for subsequent years²:

$$s_{0,t,t+1} = s_{0,t-1,t} + s_{t,t,t+1} * (1 - s_{0,t-1,t})$$

Where,

$s_{0,t,t+1}$ = credit spreads that should be applied for discounting cash flows paid between year t and year $t + 1$, evaluated at the current time ($t = 0$),

$s_{0,t-1,t}$ = credit spreads that are applied for discounting cash flows paid between year $t - 1$ and t , evaluated at the current time ($t = 0$), and

$s_{t,t,t+1}$ = credit spreads that should be applied for discounting cash flows paid between year t and year $t + 1$, evaluated at year t

This means that the credit spreads that should be applied for discounting cash flows paid between year t and year $t + 1$ are equal to the credit spreads that are applied for discounting cash flows paid between year $t - 1$ and year t (evaluated at year 0) plus the probability that the company defaults between year t and year $t + 1$ (evaluated at year t) multiplied by the probability that the company survives until year t .

For example, let's assume that there is a corporate bond with an "A" credit rating that has a credit spread of 0.50% for the first year ($s_{0,0,1}=0.50\%$). This means that the probability of default within one year is 0.50% and that 0.50% should be added to the risk-free rate in order to be used as a discount rate to calculate the present values of all cash flows paid between year 0 and year 1, evaluated at time 0.

From the equation above, the credit spread between year 1 and year 2, evaluated at the current time ($t = 0$), should be equal to the credit spread between year 0 and year 1 plus the probability that the company defaults between year 1 and year 2 (evaluated at year 1) multiplied by the probability that the company survives until year 1. The probability that the company defaults between year 1 and year 2, evaluated at year 1, should be equal to $s_{1,1,2} = s_{0,0,1} = 0.50\%$ which is the probability of default within one year from time $= t$. Therefore, the credit spread that should be applied for discounting cash flows paid between year 1 and 2 equals to $0.50\% + 0.50\% * (1 - 0.50\%) = 0.998\%$.

The credit spread between year 2 and year 3, evaluated at the current time ($t = 0$), should be equal to the credit spread for year 1 and year 2 plus the probability that the company defaults within a year from year 2 multiplied by the probability that the company survives until year 2. The probability that the company defaults within a year from year 2 should be equal to $s_{2,2,3} = s_{0,0,1} =$

² For simplicity, this case assumes that the credit spread is equal to the probability of default.

0.50%. Therefore, the credit spread that should be applied for discounting cash flows paid between year 2 and year 3 will be $0.998\% + 0.50\% * (1 - 0.998\%) \sim 1.493\%$.

The same calculation steps can be applied to compute the credit spreads for subsequent years.

Now that the credit spreads for subsequent years are calculated, let's apply them to the appropriate credit spread for the period t (which is s_t from the bond pricing equation above) with the following example to come up with discount rates for corporate bonds. Let's assume that we observe the following zero-coupon rates:

| Securities | Annualized YTM |
|------------|----------------|
| ZCY1 | 2.00% |
| ZCY2 | 3.00% |

At the start of the case with 52 weeks remaining, the discount rate for the cash flow paid for this year end for a corporate bond with an "A" credit rating with a credit spread of 0.50% will be equal to 2.50% $[=\{(1+2.00\%)^{(52/52)}-1\}+0.50\%*(52/52)]^3$.

At tick 132, when there are 41 weeks remaining until the coupon payment for the year end, the discount rate for the cash flow paid at the end of this year will be approximately 1.97% $[=\{(1+2.00\%)^{(41/52)}-1\}+0.50\%*(41/52)]$. Given the interpolated 6-month zero-coupon rate of 1%, the discount rate for the coupon to be paid at the end of 6 month this year would be approximately 0.43%.

The following table provides details on the present value, at tick 132, for each cash flow amount up to two years for a corporate bond with an "A" credit rating with a credit spread of 0.50%.

| Date of payment | Weeks remaining before payment | Annualized YTM zero-coupon rate | Credit spreads | Discount rates | Cash Flows | PV of Cash Flows |
|-----------------|--------------------------------|---------------------------------|----------------|----------------|------------|------------------|
| June, Year 1 | 15 | 1.00% | 0.14% | 0.43% | \$2.50 | \$2.49 |
| Dec, Year 1 | 41 | 2.00% | 0.39% | 1.97% | \$2.50 | \$2.45 |
| June, Year 2 | 67 | 2.50% | 1.29% | 4.52% | \$2.50 | \$2.39 |
| Dec, Year 2 | 93 | 3.00% | 1.78% | 7.21% | \$2.50 | \$2.33 |

...

³ In order to match the weekly compounding interval for risk-free rates, the changes of credit spreads will also be applied on a weekly basis in the case.

As a fixed income trader, you understand that each firm's financial stability affects its credit rating. Therefore, your team has implemented the Altman Z-Score model to evaluate a potential change of the credit rating for each company. The detailed information for Altman Z-Score is shown below:

$$\text{Altman Z-Score} = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.99X_5$$

Where,

X_1 is Working Capital/Total Assets,

X_2 is Retained Earnings/Total Assets,

X_3 is EBIT/Total assets,

X_4 is Market Value of Equity/Total Debt, and

X_5 is Sales/Total Debt

Based on the Z-Score, the company can be classified into one of three different categories below:

If $Z > 2.99$, there is a low probability of bankruptcy ("Safe" Zone).

If $1.81 < Z \leq 2.99$, there is a moderate probability of bankruptcy ("Grey" Zone).

If $Z \leq 1.81$, there is a high probability of bankruptcy ("Distress" Zone).

Since credit rating agencies only release updated credit ratings on a quarterly basis, you are expected to use the Altman Z-Score model to immediately apply any changes of the company's financial performance to its potential credit rating changes.

MARKET DYNAMICS AND NEWS RELEASE

Each participant will begin with an endowment of \$10,000,000.00 CAD and interests will not be earned on cash amounts held in the participant's accounts.

Various types of news items will be distributed throughout the case. There will be news items that may affect the slope, level, and/or the curvature of the zero-coupon curve, resulting in price changes of both treasury bonds and corporate bonds. Some news items may be only related to credit spreads, only affecting the valuation of corporate bonds. Participants are expected to identify relevant news items, evaluate their impacts, and execute appropriate strategies.

News impacts are not likely to be reflected immediately, allowing participants to trade bonds based on their assessment of news items. For example, if a participant receives news items that affect the benchmark rates, s/he can buy and/or sell treasury and corporate bonds according to his or her expectation of future movements of the zero-coupon curves. Once news impacts are properly reflected onto the zero-coupon curve, the fair price of bonds will also change accordingly. As a result, if participants correctly interpret the news, they can make profits by trading the (mispriced) bonds.

There will be news items that may result in the change of credit spreads or may be related to a particular company, only affecting the variables for the Altman Z-Score model and resulting in a change of the company's credit rating. Participants will need to estimate its change on the state of the company's financial health across the Altman Z-Score categories (e.g. "Safe", "Grey", and "Distress") which may result in the change of each company's credit rating and execute transactions accordingly.

Participants will be naturally exposed to the change of the zero-coupon rates if they trade corporate bonds. If participants wish to trade corporate bonds only to take a view on the potential change of the credit rating, they are suggested to trade treasury bonds in an opposite direction to hedge the exposure to the change of the zero-coupon rates.

TRADING/POSITION LIMITS AND TRANSACTION COSTS

Each participant will be subject to gross and net trading/position limits. The gross limit reflects the sum of the absolute values of the long and short positions across all securities, while the net limit reflects the sum of long and short positions such that short positions negate any long positions. Trading/position limits will be strictly enforced and participants will not be able to exceed them.

A commission of 2 cents per contract (each contract is written for 10 bonds) is charged on every transaction. The maximum order size will be 500 contracts per order.

POSITION CLOSE-OUT

Any non-zero position in the tradable bonds will result in coupon receipts or payouts at the end of the first period. All the non-zero positions at the end of the second period will be settled at the last traded price and the coupon receipts or payouts.

KEY OBJECTIVES

Objective 1

Build a pricing model for both treasury bonds and corporate bonds using the zero-coupon rates and the credit ratings. Participants can analyze news items and determine how they will affect the slope, level, and/or the curvature of the zero-coupon curve, resulting in price changes of both treasury bonds and corporate bonds. Participants should be able to choose to trade treasury bonds and/or corporate bonds, depending on whether to speculate on the change of the zero-coupon rates, credit rating changes, or both.

Objective 2

Implement the changes of each company's financial performance into participants' credit risk model that incorporates the Altman Z-Score model to identify potential credit rating change. Because of the lagged release for credit rating updates by credit rating agencies, participants should be able to identify and exploit mispricing opportunities to generate profits.

Objective 3

Manage exposure to market risk. In order to minimize their bond portfolios' exposure to market risk, participants are encouraged to take positions in more than one bond to reduce losses associated with idiosyncratic risks of each bond.

S&P GLOBAL MARKET INTELLIGENCE

S&P Global Quantitative Outcry Case

OVERVIEW

The S&P Global Quantitative Outcry case challenges participants to apply their understanding of macroeconomics to determine the effect of news releases on the world economy as captured by the Rotman Index ("RT100"). The RT100 Index is a composite index reflective of global political, economic, and market conditions. Participants will be required to interpret and react to both quantitative and qualitative news releases based on their analysis of the news' impact on the index by trading futures.

DESCRIPTION

There will be 2 heats with 4 team members competing for the entire heat. The 4 team members will comprise of 2 analysts and 2 traders who will rotate positions for the second heat. Team members acting as traders in the first heat must act as analysts in the second heat and vice versa. Each heat will last 30 minutes and represent six months of calendar time. Traders will be trading futures contracts on the RT100 Index.

| Parameter | Value |
|-------------------------|-----------------------|
| Number of trading heats | 2 |
| Trading time per heat | 30 minutes |
| Calendar time per heat | 6 months (2 quarters) |

The Fleck Atrium in the Rotman Building will serve as the trading pit for traders, while analysts will share a desktop in the Rotman Finance Lab. Analysts will have access to detailed news releases, while traders in the pit will have access only to news headlines. It will be the role of the analyst to quantify the impact of news releases on the RT100 Index, while traders will be required to react and trade according to the analysts' instructions.

As analysts and traders will be on separate floors, it is essential for teams to develop non-verbal communication strategies. **Electronic devices are not permitted during this case.**

MARKET DYNAMICS

The value of the RT100 Index is determined by the quarterly GDP growth, in billions, of the following 6 economies: **Canada, the United States, Brazil, Japan, Germany and South Africa**. Each country's GDP contributes to a percentage of the RT100 Index.

The initial level of RT100 is 1,000 at $t=0$. The RT100 Index is quoted in units and the futures contracts are written on the RT100 Index. The contract multiplier for RT100 futures is \$10. Therefore, 1 futures contract is worth $\$10 \times \text{RT100 Index}$. If the RT100 Index is at 995 and a trader owns 1 future contract, his/her position will be worth \$9,950 ($= \10×995).

Economic statistics for each of the countries are collected and released throughout the case, and will determine the exact trading level of the RT100 Index at the midpoint and at the end of the trading period (15 minutes and 30 minutes of the simulation, equivalent to 3 months and 6 months in calendar time). There is no exchange rate risk (all values are expressed in the same currency).

The value of the RT100 Index at $t=15$ minutes is calculated by the following formula:

$$RT100_{\text{Value at } t=15} = 1000 + \text{Canada}_{(\text{Actual Q1 GDP} - \text{Previous Q1 GDP})} + \text{USA}_{(\text{Actual Q1 GDP} - \text{Previous Q1 GDP})} \dots \\ + \text{South Africa}_{(\text{Actual Q1 GDP} - \text{Previous Q1 GDP})}$$

In other words, every \$1 billion of actual year-over-year GDP increase will cause a 1 point increase in the RT100 Index. Consequently, every \$1 billion of actual GDP shortfall will cause a 1 point decrease in the RT100 Index.

The quarterly GDP for each country is comprised of aggregate production in three independent sectors: Manufactured Goods, Services, and Raw Materials. At the beginning of the outcry case, estimates for the aggregate quarterly GDP of each country and sector will be released. Throughout the quarter, news releases will provide estimates and information that will allow analysts to construct expectations for each country and each sector.

The following is a sample series of data for Q1 Canada:

- Canadian Q1 GDP last year was \$100 billion. This year in Q1, the market expects manufactured goods of \$30 billion, services of \$60 billion, and raw materials of \$10 billion.
- General workers protest hits Canada manufacturing sector, causing minor production delays.
- Strong global commodities prices lift raw materials output across the globe by as much as 10%.
- New policies cause \$7 billion increase in services spending.
- RELEASE – Canadian Manufacturing for Q1: \$28 billion
- RELEASE – Canadian Services for Q1: \$67 billion
- RELEASE – Canadian Raw Materials for Q1: \$11 billion

The sum of the independent sectors, and thus the resulting Q1 Canadian GDP, is \$106 billion. This is \$6 billion above last year's Q1 GDP of \$100 billion and would cause the RT100 Index to increase by 6 points. This, in addition to the effects of the other 5 countries, will determine the RT100 Index at the 15-minute mark (and then at the 30-minute mark).

TRADERS' ROLES

Traders are responsible to interpret the signals from the analysts located in the Rotman Finance Lab and to trade the RT100 index. Traders will have to find other teams who are willing to act as counterparties to complete their trades. Traders are also responsible for keeping track of their position and communicating it to analysts.

ANALYSTS' ROLES

Analysts are responsible for interpreting the detailed news they receive on the RIT and communicating their findings to the traders in the Fleck Atrium. Analysts are also responsible for submitting analyst estimate forms (refer to the Cash Bonuses section for more details) and making spot trades.

Spot Trades

In addition to the transactions executed by traders in the Fleck Atrium, analysts in the Rotman Finance Lab are allowed to make up to 2 spot trades per heat, with a maximum of 50 contracts in each trade. The spot trades will be executed at the current spot price of the RT100 Index posted on the screen. The spot contract has a contract multiplier of \$10. Therefore, if an analyst owns 1 spot contract when the RT100 Index is at 1,023, his/her position will be worth \$10,230 ($= \$10 \times 1,023$).

The spot trades allow each team to have an opportunity to close out their positions in a timely manner. Moreover, since the futures market will be driven by trader activity, while the spot market is based on the actual economic indicators realized, there may be arbitrage profit opportunities arising from inefficiencies in the two markets (the actual market and the spot market). These trades are added to the aggregate futures position of the team. The soft and hard trading restriction limits discussed below also apply to trades made by analysts in the Rotman Finance Lab.

CASH BONUSES

Analyst Estimates

Throughout the trading heat, analysts will be required to submit a point estimate of where they believe the RT100 Index will settle at the 15 and 30 minute marks. These estimates are due by the 10 and 25 minute marks, respectively (i.e. 5 minutes before the end of the quarter). These time limits will be tracked solely based on the trading software. Participants should refrain from using external devices (online timers, cell phones, watches, etc.) to track the time limits. Analysts will be

graded based on their prediction accuracy and bonus cash will be allocated to the teams with the most accurate estimate.

Counterparties

At the end of trading, all submitted tickets will be reviewed and each team will be given a counterparty score based on the number of different trading counterparties they transacted with throughout the trading session. Teams will be awarded bonus cash based on the number of different counterparties with which they transacted.

Bonus Cash Calculations

Each team will be ranked based on its performance and split into quintiles for each of the 2 bonus calculations. The top quintile for each bonus pool will be assigned a 5% bonus, the second 4%, and so on until the last quintile, which is assigned a 1% bonus. The 2 last placed teams are assigned a 0% bonus. Bonuses are never negative, and they are applied at the end of the heat based on the team's absolute performance throughout the heat.

TRADING LIMITS AND TRANSACTION COSTS

Each team has a starting position of 0 contracts, a soft trading limit of 200 contracts, and a fixed hard trading limit of 500 contracts on their net positions. On a best-efforts basis, each team will be notified as it approaches its soft and hard limits. If a team exceeds its soft limit, it will be charged a fine proportional to how much they exceed the soft limit. The amount by which a team exceeds the initial soft limit of 200 will become their new soft limit. The fine per contract above the soft limit is \$50.

For instance, if Team A's net position is at 220, they will be charged a fine of $\$50 \times 20 = \$1,000$ (they have exceeded their soft limit of 200 by 20 contracts). For Team A, 220 is now the new soft limit. As long as Team A's position remains below 220, there will be no additional fines. If Team A bought more and had a new net position of 280, then they would be charged an additional fine of $\$50 \times 60 = \$3,000$ which is the difference between the new net position and new soft limit. If a team does not exceed its soft limit, it will not be charged any fines.

Any team that exceeds the hard limit of 500 will be automatically disqualified from the outcry. They will be given a rank equal to that of last place for that sub-heat. In addition, there is a zero tolerance policy with regards to electronic communication. Any trader or analyst seen by an RITC staff member using or holding a cell phone or any other electronic device during the trading heats will be immediately disqualified. RITC staff will be positioned throughout the pit and the trading lab to monitor this.

Each transaction on futures has a **maximum volume of 20 contracts** per trade. Once again, analysts in the Rotman Finance Lab are allowed to make up to 2 spot trades during each heat, with up to 50 contracts in each trade.

Each contract will be charged a brokerage commission of \$1 per contract.

POSITION CLOSE-OUT

Each team's position will be settled at the end of the trading session by closing out their remaining positions at the final spot price.

TRADING P&L CALCULATION EXAMPLE

Trading P&L will be calculated in a similar fashion to the Social Outcry Case (with the addition of trading fines as described below). Trading P&L will then be modified by all bonuses (Analyst Estimates and Counterparties).

The following is an example of a P&L calculation:

- Bought 5 RT100 Index futures at 1,000
- Sold 5 RT100 Index spot contracts at 1,100

The team is ranked at the top quintile for the bonus pool of Analyst Estimates and the third quintile for Counterparties

$$\begin{aligned}
 \textit{Profit Before Bonuses} &= (1,100 - 1,000) \times \$10 \times 5 - \$1^4 \times 10 \\
 &= \$4,990 \\
 \textit{Bonuses} &= |\$4,990| \times 5\% + |\$4,990| \times 3\% \\
 &= \$399.20 \\
 \textit{Total P\&L} &= \$4,990.00 + \$399.20 \\
 &= \$5,389.20
 \end{aligned}$$

The following is an example when a trader has a negative P&L:

- Bought 5 RT100 Index futures at 1,000
- Sold 5 RT100 Index spot contracts at 900
- The team is ranked at the top quintile for the bonus pool of Analyst Estimates and the third quintile for Counterparties

$$\begin{aligned}
 \textit{Profit Before Bonuses} &= (900 - 1000) \times \$10 \times 5 - \$1 \times 10 \\
 &= -\$5,010 \\
 \textit{Bonuses} &= |-\$5,010| \times 5\% + |-\$5,010| \times 3\% \\
 &= \$400.80 \\
 \textit{Total P\&L} &= -\$5,010.00 + \$400.80 \\
 &= -\$4,609.20
 \end{aligned}$$

⁴ Brokerage commission of \$1 per contract traded – explained in Trading Limits and Transaction Costs – there have been 10 contracts traded in this example, 5 to buy and 5 to sell.

KEY OBJECTIVES

Objective 1

Traders can generate profits by interpreting news headlines and going long on positive news and short on negative news. Traders are also encouraged to trade with as many different counterparties to capitalize on the bonus structure.

Objective 2

Analysts should track news releases and attempt to accurately estimate the value of the RT100 Index in order to develop a profitable trading strategy and communicate it efficiently to the traders. Additionally, the analyst should submit their index estimates in a timely manner and develop effective communication methods with the traders to quickly communicate trading strategies.



MATLAB Volatility Trading Case

OVERVIEW

The MATLAB Volatility Trading Case gives participants the opportunity to generate profits by implementing options strategies to trade volatility. The underlying asset of the options is a non-dividend paying Exchange Traded Fund (ETF) called RTM that tracks a major stock index. Participants will be able to trade shares of the ETF and 1-month call/put options at 10 different strike prices. Information including the ETF price, option prices, and news releases will be provided. Participants are encouraged to use the provided information to identify mispricing opportunities and construct options trading strategies accordingly.

DESCRIPTION

There will be 2 heats and teams will allocate 2 team members for each heat. Each participant may compete in only one of the 2 heats. Each heat will consist of 5 independent sub-heats, with each sub-heat representing one month of calendar time.

| Parameter | Value |
|-----------------------------|---------------------------|
| Number of trading sub-heats | 5 |
| Trading time per sub-heat | 600 seconds (10 minutes) |
| Calendar time per sub-heat | 1 month (20 trading days) |

News will be released during each sub-heat. **Real Time Data (RTD) links will be enabled for both Excel and MATLAB, and submitting orders using Excel API or MATLAB will also be enabled.**

MARKET DYNAMICS

Participants will be able to trade RTM and 20 separate options contracts on RTM. All options are European, so early exercise is not allowed.

Starting Option Prices

| Call Price | Call Ticker | Strike Price | Put Ticker | Put Price |
|------------|-------------|--------------|------------|-----------|
| \$5.04 | RTM45C | 45 | RTM45P | \$0.04 |
| \$4.09 | RTM46C | 46 | RTM46P | \$0.09 |
| \$3.20 | RTM47C | 47 | RTM47P | \$0.20 |
| \$2.40 | RTM48C | 48 | RTM48P | \$0.40 |

| | | | | |
|--------|--------|----|--------|--------|
| \$1.71 | RTM49C | 49 | RTM49P | \$0.71 |
| \$1.15 | RTM50C | 50 | RTM50P | 1.15 |
| \$0.73 | RTM51C | 51 | RTM51P | \$1.73 |
| \$0.44 | RTM52C | 52 | RTM52P | \$2.44 |
| \$0.24 | RTM53C | 53 | RTM53P | \$3.24 |
| \$0.13 | RTM54C | 54 | RTM54P | \$4.13 |

All securities are priced by a very large market-maker who will always quote a bid-ask spread of 2 cents (i.e. \$49.99*\$50.01 for the RTM, or \$4.08*\$4.10 for the RTM46C). The bids and asks are for an infinite quantity (there are no liquidity constraints in this case).

The price of RTM is a random-walk and the path is generated using the following process:

$$P_{RTM,t} = P_{RTM,t-1} * (1 + r_t) \text{ where } r_t \sim N(0, \sigma_t)$$

The price of the stock is based on the previous price multiplied by a return that is drawn from a normal distribution with a mean of zero and standard deviation (volatility) of $\sigma_t = 20\%$ (on an annualized basis).

The trading period is divided into 4 weeks, with $t = 1 \dots 150$ being week one, $t = 151 \dots 300$ being week two, and so on. At the beginning of each week, the volatility value (σ_t) will shift, and the new value will be provided to participants. In addition, at the middle of each week (e.g. $t = 75$) an analyst estimate of next week's volatility value will be announced.

The observed and tradable prices of the options will be based on a computerized market-maker posting bids and offers for all options. The market maker will price the options using the Black-Scholes model. It is important to note that the case assumes a risk-free rate of 0%. The volatility forecasts made by the market maker are uninformed and therefore will not always accurately reflect the future volatility of RTM. Mispricing will occur, creating trading opportunities for market participants. These opportunities could be between specific options with respect to other options, specific options with respect to the underlying, or all options with respect to the underlying.

The focus of this case is on trading volatility without being exposed to price changes of the underlying security, RTM. Participants are therefore asked to manage their portfolio's delta exposure. Recognizing the transactions costs and impracticality of perfect delta hedging (i.e. keeping the portfolio's delta at zero at all times), the RITC scoring committee will allow the portfolio's delta to be different from zero but it requires it to stay between $-delta\ limit$ and $+delta\ limit$. Please note that *delta limit* is an integer number greater than 1,000 that will be announced at the beginning of the case via a news release in the RIT. For example, the following news could be released: "The delta limit for this sub-heat is 5,000". According to that news, any

participant that has a portfolio's delta greater than 5,000 will be penalized according to the penalties explained below.

For every second that a participant exceeds the limit ($\pm \text{delta limit}$), s/he will be charged a penalty according to the following formula:

$$\text{Penalty at second } t = \begin{cases} (|\Delta_{p,t}| - |\text{delta limit}|) \times 0.005 & \text{if } |\Delta_{p,t}| > |\text{delta limit}| \\ 0 & \text{if } |\Delta_{p,t}| \leq |\text{delta limit}| \end{cases}$$

Where, $\Delta_{p,t}$ is the portfolio's delta at time t

Penalties will be applied at the end of each sub-heat and **will not be included** in the P&L calculation in RIT. Participants will be provided with an Excel tool⁵, the "Penalties Computation Tool", that will allow them to calculate the penalties using their results from the practice server.

Sample News Release Schedule

| Time | Week | Release |
|------|--------|---|
| 1 | Week 1 | The realized volatility of RTM for this week will be 20% |
| 75 | Week 1 | The realized volatility of RTM for next week will be between 27-30% |
| 150 | Week 2 | The realized volatility of RTM for this week will be 29% |
| ... | ... | ... |
| 450 | Week 4 | The realized volatility of RTM for this week will be 26% |

TRADING LIMITS AND TRANSACTIONS COSTS

Each participant will be subject to gross and net trading limits specific to the security type as specified below. The gross trading limit reflects the sum of the absolute values of the long and short positions across all securities; while the net trading limit reflects the sum of long and short positions such that short positions negate any long positions. Trading limits will be enforced and participants will not be able to exceed them.

| Security Type | Gross Limit | Net Limit |
|---------------|-----------------|-----------------|
| RTM ETF | 50,000 Shares | 50,000 Shares |
| RTM Options | 2,500 Contracts | 1,000 Contracts |

The maximum trade size will be 10,000 shares for RTM and 100 contracts for RTM options, restricting the volume of shares and contracts transacted per trade to 10,000 and 100 respectively.

⁵ The "Penalties Computation Tool" will be released on January 30th.

Transaction fees will be set at \$0.02 per share traded for RTM and \$2.00 per contract traded for RTM options. As with standard options markets, each contract represents 100 shares (purchasing 1 option contract for \$0.35 will actually cost \$35 plus a \$2 commission, and will settle based on the exercise value of 100 shares).

POSITION CLOSE-OUT

Any outstanding position in RTM will be closed at the end of trading based on the last-traded price. There are no liquidity constraints for either the options or RTM. All options will be cash-settled based on the following:

$$\text{Call Option Payout} = \max\{0, S - K\}$$

$$\text{Put Option Payout} = \max\{0, K - S\}$$

Where,

S is the last price of RTM;

K is the strike price of the option.

KEY OBJECTIVES

Objective 1

Build a model to forecast the future volatility of the underlying ETF based on known information and given forecast ranges. Participants should use this model with an options pricing model to determine whether the market prices for options are overvalued or undervalued. They should then trade the specific options accordingly.

Objective 2

Use Greeks to calculate the portfolio exposure and hedge the position to reduce the risk of the portfolio while profiting from volatility differentials across options.

Objective 3

Participants should also seek arbitrage opportunities across different options.

FLOW TRADERS

Flow Traders ETF Case

OVERVIEW

The Flow Traders ETF Case challenges participants to put their critical thinking and analytical abilities to the test in an environment that requires them to evaluate the liquidity risk associated with different tender offers. Participants will be faced with multiple tender offers throughout the case. This will require participants to make rapid judgments on the profitability and subsequent execution, or rejection, of each offer. Profits can be generated by taking advantage of price differentials between market prices and prices offered in the private tenders. Once any tender has been accepted, participants should aim to efficiently close out the large positions to maximize returns.

DESCRIPTION

There will be 2 heats and teams will allocate 2 team members for each heat. Each participant may compete in only one of the 2 heats. A total of 4 team members will compete in the overall case. Each heat will consist of five 10 minute sub-heats. Each sub-heat will be independently traded and will represent one month of calendar time. Each sub-heat will have a unique objective and could involve up to 4 ETFs with different volatility and liquidity characteristics.

| Parameter | Value |
|-----------------------------|---------------------------|
| Number of trading sub-heats | 5 |
| Trading time per sub heat | 600 seconds (10 minutes) |
| Calendar time per sub heat | 1 month (20 trading days) |

Tender offers will be generated by computerized traders and distributed at random intervals to random participants. Participants must subsequently evaluate the profitability of these tenders when accepting or bidding on them. Trading from Excel using Rotman API will be disabled. Real Time Data (RTD) links will be enabled.

MARKET DYNAMICS

There are five sub-heats per heat, each with unique market dynamics and parameters. Potential parameter changes include factors such as spread of tender orders, liquidity, and volatility. Market dynamics and parameter details regarding each sub-heat will be distributed prior to the beginning of the trading period, allowing participants to formulate trading strategies. An example of sub-heat details for a sub-heat with two ETFs, RITC and COMP, is shown below.

| | RITC | COMP |
|---------------------------|-----------------|-----------------|
| Starting Price | \$10 | \$25 |
| Commission/ETF | \$0.01 | \$0.02 |
| Max Order Size | 10,000 | 15,000 |
| Trading Limit (Gross/Net) | 250,000/150,000 | 250,000/150,000 |
| Liquidity | High | Medium |
| Volatility | Medium | High |
| Tender Frequency | Medium | Low |
| Tender Offer Window | 30 seconds | 15 seconds |

During each sub-heat, participants will occasionally receive one of three different types of tender offers: private tenders, competitive auctions, and winner-take-all tenders. Tender offers are generated by the server and randomly distributed to random participants at different times. Each participant will get the same number of tender offers with variations in price and quantity. No trading commission will be paid on tenders.

Private Tenders are routed to individual participants and are offers to purchase or sell a fixed volume of ETFs at a fixed price. The tender price is influenced by the current market price.

Competitive Auction offers are sent to all participants at the same time. Participants will be required to determine a competitive, yet profitable, price to submit for a given volume of ETF from the auction. Any participant that submits an order that is better than the base-line reserve price (hidden from participants) will automatically have their orders filled, regardless of other participants' bids or offers. If accepted, the transactions will occur at the price that the participant submitted.

Winner-take-all Tenders request participants to submit bids or offers to buy or sell a fixed volume of ETFs. After all prices have been received, the tender is awarded to the participant with the single highest bid or single lowest offer. The winning price, however, must meet a base-line reserve price (hidden from participants). If no bid or offer meets the reserve price, then the trade will not be awarded to anyone (i.e. if all participants bid \$2.00 for a \$10.00 reserve price ETF, nobody will win).

CALCULATION OF THE PROFIT OR LOSS OF TRADERS

The prices generated by the RIT for this case follow a random walk process using a return drawn from a normal distribution with a mean of zero. That is, at any point in the simulation, the probability that the price will go up is equal to the probability that the price will go down. This means that participants cannot predict the future price of the ETFs without “taking a bet”. Therefore, the RITC scoring committee will consider trading ETFs for reasons other than reducing the exposure associated with accepting a tender offer to be equivalent to speculating (taking a bet) on the price movement. These types of trades will be marked as “speculative trades”.

Participants will have time to think about the offer before they choose to accept it or decline it. For example, one may receive a tender offer at time $t = 0$ and will have until $t = 30$ to decide whether to accept. Any trades made by a participant during this time without accepting the tender offer will be considered as “front-running”⁶ since the participant had the advance knowledge of a pending institutional order. The RITC scoring committee will mark these trades as “front-running trades”.

This case is designed to only reward the participants for identifying, accepting, and closing out⁷ tender offer positions at a profit, while managing liquidity risk and execution risk. Any other strategy will not be considered. In particular, the total profit of each participant⁸ will be categorized into two parts: “profits from tender offers” and “profit from speculation”; the latter category includes the profits that are a result of speculative trades and/or front-running trades.

Profits from tenders are the profits (or losses) gained from efficiently closing out the position from accepted tenders into the market. Profits from speculation are profits (or losses) generated through trades that are not associated with tenders (speculative trades or front-running trades). An “Adjusted P&L” will be calculated based on the following formula:

$$\text{Adjusted P\&L} = \text{Profit From Tenders} + \text{Min}(0, \text{Profit From Speculation})$$

Participants will be **ranked and scored** based on their *Adjusted P&L*.

For example, consider a participant who has made \$10,000 from tenders and \$50,000 from speculation, the total profit is \$60,000 ($= \$10,000 + \$50,000$) but the *Adjusted P&L* will only be \$10,000 [$= \$10,000 + \text{min}(0, \$50,000)$]. Another example, consider a participant who has made \$35,000 from tenders and lost \$20,000 from speculation (*Profit From Speculation* =

⁶ Front-running is the unethical and illegal practice of trading a security for your own account while taking advantage of the information contained in the pending orders from your institutional clients.

⁷ “Closing out” a position means that a participant is executing a trade that is the opposite of the current position in order to eliminate the exposure.

⁸ Total profit of each participant is the profit (or loss) that you can observe in the RIT at the end of a sub-heat/iteration.

–\$20,000); the total profit is \$15,000 ($\$35,000 - \$20,000$) and it is the same as the *Adjusted P&L* [$\$15,000 = \$35,000 + \min(0, -\$20,000)$]. From the last example, please note that any losses from speculation will still be considered and therefore, negatively affect your *Adjusted P&L*.

The *Adjusted P&L* will be calculated by the RITC Scoring Committee at the end each sub-heat and it will **not be included** in the P&L calculation in RIT. However, participants will be provided with an Excel tool⁹, the “Performance Evaluation Tool”, that will allow them to calculate the *Adjusted P&L*.

TRADING LIMITS AND TRANSACTION COSTS

Each participant will be subject to gross and net trading limits to be specified in the case description distributed prior to the trading period. The gross trading limit reflects the sum of the absolute values of the long and short positions across all ETFs, while the net trading limit reflects the sum of long and short positions such that short positions negate any long positions. Trading limits will be strictly enforced and participants will not be able to exceed them.

The maximum order size and commissions will be specified in the case description distributed prior to the trading period. See the table above for an example.

POSITION CLOSE-OUT

Any open position will be closed out at the end of each sub-heat based on the last traded price. This includes any long or short position open in any security. Computerized market makers will increase the liquidity in the market towards the end of trading to ensure the closing price cannot be manipulated.

KEY OBJECTIVE

Evaluate the profitability of tender offers by analyzing the market liquidity. Participants will accept the tenders that will generate positive profits while rejecting the others. Submit competitive, yet profitable, bids and offers on above reserve and winner-take-all tenders to maximize potential profits while managing liquidity and market risk. There is a chance that the market may move away from your transactions prices, so maintaining large short or long positions may result in losses. Use a combination of limit, market orders and marketable limit orders to mitigate any liquidity and price risks from holding open positions.

⁹ The “Performance Evaluation Tool” will be uploaded on the RITC website on January 26th.



Schonfeld Algorithmic Trading Case

OVERVIEW

The Schonfeld Algorithmic Trading Case is designed to challenge participants' programming skills since they are required to develop algorithms using MATLAB and/or Excel VBA to automate trading strategies and react to changing market conditions. Throughout the case, these algorithms will submit orders to profit from arbitrage opportunities and private tender offers. Because of the high-frequency nature of the case, participants are encouraged to develop algorithms that can adapt to rapid changes in market dynamics.

DESCRIPTION

There will be 4 heats with 1 team member competing in each heat. Any team member may represent the team in any one or all of the heats. Please note that as the Schonfeld Algorithmic Trading Case will run simultaneously with the other RITC cases, teams are responsible for submitting a "Team Schedule" that ensures their Algo trader will be free to trade in the allotted time. For more information on the "Team Schedule", please see the "Important Information" section above. Each heat will consist of three 5-minute sub-heats representing one month of trading. Each team will be trading with up to 14 additional teams at a time.

| Parameter | Value |
|-----------------------------|------------------------------------|
| Number of trading heats | 4 preliminary heats + 1 final heat |
| Number of trading sub-heats | 3 |
| Trading time per sub-heat | 300 seconds (5 minutes) |
| Calendar time per sub-heat | 3 months of trading |

All trades must be executed by a trading algorithm. Participants will not be allowed to trade through the RIT Client once the sub-heat begins. However, participants are allowed to use and modify their MATLAB or Excel VBA algorithms in response to prevailing market conditions and competition from the algorithms of other teams. In addition, they will have 2 minutes in between each sub-heat to alter their algorithms. A base template algorithm will be provided to participants and can be directly modified for use in the competition. However, participants are encouraged to create their own algorithms using MATLAB or Excel VBA. It is strongly suggested that all teams

have a working version of their algorithm available on a USB or storage device. Internet connection will not be provided for the workstations available for the Schonfeld Algorithmic Trading Case.

MARKET DYNAMICS

This case involves five securities with the following details.

| Ticker | CAD | USD | BULL | BEAR | RITC |
|-------------------------------------|-----------|-----------|--------|--------|--------|
| Security type | Currency | Currency | Stock | Stock | ETF |
| Quote currency | CAD | CAD | CAD | CAD | USD |
| Starting Price | n/a | n/a | \$10 | \$15 | \$25 |
| Fee/share (Market orders) | n/a | n/a | \$0.02 | \$0.02 | \$0.02 |
| Rebate/share (Limit/Passive orders) | n/a | n/a | \$0.01 | \$0.01 | \$0.01 |
| Max order size | 2,500,000 | 2,500,000 | 10,000 | 10,000 | 10,000 |

The base currency in this case will be CAD. Therefore, USD will be quoted in a direct exchange rate as the number of CAD required to buy 1 USD.

Participants will be able to trade two stocks denominated in CAD and one ETF denominated in USD with varying levels of volatility and liquidity. This dynamic exposes participants to the basics of market microstructure in the context of algorithmic trading. In equilibrium, the ETF pricing will reflect the following sum of the two stocks traded, subject to periodic shocks to its price.

$$RITC_{USD} * USD = BULL_{CAD} + BEAR_{CAD}$$

Participants will also receive private tender offers for the ETF. Since the decision time for the ETF is very short, participants should build an algorithm to evaluate the profitability of a tender offer to make a decision to accept it or not. Once a tender offer is accepted, a participant's algorithm should also unwind the positions at a profit while managing the market price impact of trades.

In addition, there will be two converters¹⁰ available to facilitate a conversion between the underlying stocks and the ETF. Participants should consider using these converters as an alternative approach to manage the liquidity risk associated with submitting orders directly to the market. Please note that these converters can only be used by human traders: you will be able to use them from the RIT Client manually but your algorithm will not be able to use them automatically through the API.

¹⁰ The two converters are available from the "Assets" tab from RIT Client.

| Converters | Description | Convert From | Convert To | Cost |
|----------------|-------------------------------------|---|---|-----------------|
| ETF-Creation | ETF creation from underlying stocks | 10,000 BULL stocks and 10,000 BEAR stocks | 10,000 units of RITC | \$1,500 USD/use |
| ETF-Redemption | ETF redemption to underlying stocks | 10,000 units of RITC | 10,000 BULL stocks and 10,000 BEAR stocks | \$1,500 USD/use |

TRADING/POSITION LIMITS AND TRANSACTION COSTS

Each trader will be subject to gross and net trading/position limits during trading in each sub-heat. The gross limit reflects the sum of the absolute values of the long and short positions across all securities, and the net limit reflects the sum of long and short positions such that short positions negate any long positions. Trading limits will be strictly enforced and participants will not be able to exceed them by trading. However, ETF converters can and will cause limit breaches if they are not managed properly, resulting in a penalty of \$0.50 per position over gross and/or net limit.

Each position in the stocks will be counted towards trading/position limits with a multiplier of one, while each position in the ETF will be counted with a multiplier of two (i.e. if you long 100 shares of any stocks, your gross and the net limits will increase by 100. If you long 100 positions of RITC, your gross and net limits will increase by 200 (100 positions * multiplier of two)). The maximum trade size will be 10,000 shares per order for stocks and 10,000 shares per order for the ETF. Transaction fees will be set at \$0.02 per share for each stock and the ETF on all market orders filled. Subsequently, a rebate of \$0.01 per share for each stock and the ETF will be provided for all submitted limit orders that are filled.

POSITION CLOSE-OUT

Any non-zero position of stocks will be closed out at the end of trading based on the last traded price while the ETF will be closed out at the fair value of the sum of both stocks converted to CAD.

KEY OBJECTIVES

Objective 1

Create a model using the provided template to identify the profitability of private tender offers and execute trades accordingly while managing liquidity risk and market risk. Consider utilizing ETF-Creation and ETF-Redemption converters as an alternative approach to mitigate the liquidity risk when working a private tender offer.

Objective 2

Build a trading algorithm that identifies arbitrage opportunities between underlying stocks and the ETF. Consider trading CAD and USD in order to hedge the currency exchange rate exposure.