














Rotman INTERNATIONAL **TRADING** COMPETITION **2016**

Table of Contents

	Pages
 About RITC	3
 Important Information	4
 Case Summaries	6
 Social Outcry Case	8
 BP Commodities Case	11
 Credit Risk Case	17
 Quantitative Outcry Case	26
 S&P Capital IQ Equity Valuation Case	31
 Sales & Trader Case	35
 MathWorks Algorithmic Trading Case	38
 Appendix	41

About RITC

A WARM WELCOME FROM THE ROTMAN COMMUNITY

The Rotman International Trading Competition 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 cities. This world's largest 3-day simulated market challenge brings teams of students and their faculty advisors representing approximately 50 top universities across the world. Despite the technological improvements and continued shift towards remote electronic trading, the event continues to draw enthusiastic interest. Our participants and sponsors demonstrate that they value the face-to-face interaction encouraged by our conference format.

The competition is predominantly structured around the Rotman Interactive Trader 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 relevant investment, portfolio or risk management objectives. Participants will be challenged to handle a wide range of market scenarios.

The following case package provides an overview of the content presented at the 2016 Rotman International Trading Competition. Each case has been specifically tailored to topics taught in university level classes and real-life trading situations. We hope you enjoy your experience at the competition.



SEE YOU IN TORONTO!



Important Information

PRACTICE SERVERS

Practice servers will be made available starting from January 29th. We will introduce the actual cases in a staggered manner - not all cases will be available on January 29th. Further information on release dates can be found below and more information will be posted on the RITC website.

Case	Release date
Sales & Trader Case	Friday, January 29 th – 11:59pm EST
S&P Capital IQ Equity Valuation Case	Friday, January 29 th – 11:59pm EST
MathWorks Algorithmic Trading Case	Monday, February 1 st – 11:59pm EST
BP Commodities Case	Wednesday, February 3 rd – 11:59pm EST
Credit Risk Case	Friday, February 5 th – 11:59pm EST

Practice servers will operate 24 hours a day 7 days a week until 11:00pm EST Thursday, February 18th. 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 IP and ports available for RITC practice environments:

Case Name	Server IP	Port
Sales & Trader Case	flserver.rotman.utoronto.ca	14960
BP Commodities Case	flserver.rotman.utoronto.ca	14970
S&P Capital IQ Equity Valuation Case	flserver.rotman.utoronto.ca	14980
Credit Risk Case	flserver.rotman.utoronto.ca	14990
MathWorks Algorithmic Trading Case Server 1	flserver.rotman.utoronto.ca	16500
MathWorks Algorithmic Trading Case Server 2	flserver.rotman.utoronto.ca	16510
MathWorks Algorithmic Trading Case Server 3	flserver.rotman.utoronto.ca	16520
MathWorks Algorithmic Trading Case Server 4	flserver.rotman.utoronto.ca	16530

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 MathWorks 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 7 other algorithms running, you may want to move to a different port where there is less trading.

Please note that the market dynamics in practice and in the competition cases will be the same. 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 S&P Capital IQ Case will be updated with a different set of news on February 10th at 7:00pm EST. The BP Commodities Case will be updated with a different set of news on February 10th at 6:00pm EST. We will be running two “special” practice sessions for BP where all teams are invited to connect at the same time: the first one is on February 8th at 5:00pm EST; the second one is on February 10th at 6:00pm 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. The Credit Risk Case will be updated with a different set of news on February 12th at 7:00pm EST.

At each update, a new case file with different news items and price paths will be uploaded and will continue to run until the next update. The Sales & Trader Case and the MathWorks Algorithmic Trading Case have no news drivers but comprise new, randomized sets of security paths each time they are run.

ADDITIONAL SUPPORT FILES

Additional support files including the MathWorks Algorithmic Trading Case Base Algorithm and other relevant support and documentation files will be provided on the RITC website (<http://ritc.rotman.utoronto.ca/casefiles.asp?n=1>).

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 Wednesday, 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 Wednesday, 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 Wednesday, February 10th).

Case Summaries

SOCIAL OUTCRY

The opening event of the competition gives participants the first opportunity to make an impression on the sponsors, faculty members, and other teams in this fun introduction to the Rotman International Trading Competition. Each participant is trading 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 the participants to interact with one another 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 individual's ability to understand sophisticated market dynamics and optimally perform his/her role, while stressing teamwork and communication within the team. The case will involve crude oil production, refinement, storage, as well as the sale of its synthesized physical products.

CREDIT RISK CASE

The Credit Risk Case challenges participants to build and apply a credit risk model in a simulation where corporate bonds are traded. Participants will use both a Structural Model and the Altman Z-Score to predict potential changes to the companies' credit ratings. Periodic news updates will require participants to make appropriate adjustments to the assumptions in their models and rebalance their portfolios accordingly. This case will test participants' ability to develop a credit risk model, assess the impact of news releases on credit risk, and execute trading strategies accordingly to profit from mispricing opportunities.

QUANTITATIVE OUTCRY CASE

The Quantitative Outcry Case allows participants to apply their understanding of macroeconomics to determine the effect news releases will have on the global economy as captured by the Rotman Index (RT100). The RT100 Index is a composite index reflective of the world's political, economic, and market conditions of four distinct countries. Traders and analysts will be required to work together to interpret, react to, and communicate to both quantitative and qualitative news released when trading futures written on the RT100 Index based on their analysis of the news' impact on the index.

S&P CAPITAL IQ EQUITY VALUATION CASE

The S&P Capital IQ Equity Valuation Case will test the participants' ability to apply a discounted cash flow (DCF) model in an equity trading simulation. The fundamental/fair price adjustments will be driven by news items that will change the financial model's assumptions. With four companies in the public utility, IT outsourcing, medical imaging, and railway servicing industries, news updates will be both varied and interrelated. The case will test each participant's understanding of equity valuation, ability to assess impacts on valuation, and capitalize on equity mispricing.

SALES & TRADER CASE

The Sales & Trader 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 requiring participants to make rapid judgments on the profitability and subsequent execution of these offers. Profits can be generated by taking advantage of price premiums and discounts associated with the large tender offers compared to the market, and market-making opportunities.

MATHWORKS ALGORITHMIC TRADING CASE

The MathWorks Algorithmic Trading Case is designed to challenge participants' programming skills since they are required to develop algorithms using MATLAB or Excel VBA to automate the market-making process and react to changing market conditions. Throughout the case, these algorithms will submit orders to create and unwind positions. In addition, teams should attempt to maximize profits from the bid-ask spread and any arbitrage opportunities that may arise. Due to the high-frequency nature of the case, participants will have to develop algorithms to adapt to changes in market dynamics.

Social Outcry Case

OVERVIEW

The objective of the Social Outcry Case is to allow competition participants to interact (“to break the ice”) and to understand the progression of market technology. This segment of the competition will not count towards the final scoring of RITC. 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 Net Liquidation Value at the end of the case.

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 the ticker. One news announcement will be displayed 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. Each participant is expected to trade based on how s/he interprets the news and his/her anticipation of the market reaction.

TRADING LIMITS AND TRANSACTION COSTS

There are no trading commissions for the Social Outcry Case. Participants are only 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 with no portion of the ticket left blank. 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. 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) are for the team’s 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 have to 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 P/L (profit/loss) from the trading session.

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

There are no commissions or fines in the Social Outcry.

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

COMPLETE TRANSACTION AND SOCIAL 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. 1050 or 1150), 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. 1051 or 1151) 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.

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). Trader 1 (Buyer) keeps the yellow portion of the ticket and trader 3 (Seller) keeps the pink (red) portion of the ticket.

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



BP Commodities Case

OVERVIEW

The BP Commodities Case challenges the ability of the participants to interact with one another 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 individual'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 participant 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 **Wednesday, February 10th** as specified in the "Important Information" section above. If a team misses this deadline, the roles will be randomly assigned between the team members by competition staff.

Producer

The producer owns oil rigs that produce both Light and Heavy Crude Oil. The average production of each type of Crude Oil is about 2,000 barrels per day, or 10,000 barrels per week (neglecting 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 due to external factors. The producer can expect to receive all of his or her weekly production of Light and Heavy Crude Oil at the beginning of each week, but there may be unexpected delays in delivery to the storage facility. Producers will be given 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 and 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 they 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) and will cost \$25/barrel to run. 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) and will cost \$35/barrel to run. 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) and will cost \$30/barrel to run. Heating Oil (HO) and RBOB Gasoline 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 is less than 108 seconds.

Refiners will be given news impacting the prices of Heating Oil and RBOB Gasoline in the future and will have to evaluate the impact of these items in order to decide which refinery, if any, is profitable to operate. 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 weekly temperature change, and

σ_{HO} is the standard deviation of the temperature change

Weekly temperature change = Expected weekly temperature – Realized weekly temperature

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 Heating Oil prices will 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.

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.

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 selling them back to the market when prices are relatively high for each type of Crude Oil.

Traders are limited to at most 2 units of storage (20,000 barrels) for each Light and Heavy Crude at a time.

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
HO	Heating Oil	42,000 Gallons	Refiner	No
RB	RBOB Gasoline	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 price of \$500,000 per unit.

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 Heating Oil and RBOB Gasoline markets which they must use to forecast future prices. Traders will receive "The International Tender Report" which describes the expected institutional orders activity.

The interaction between different market participants, including their maximization objectives and teamwork, is what will largely influence the overall profits of each team. Thus, participants have to optimize the dynamics of each role.

The following is a simplified example of the case:

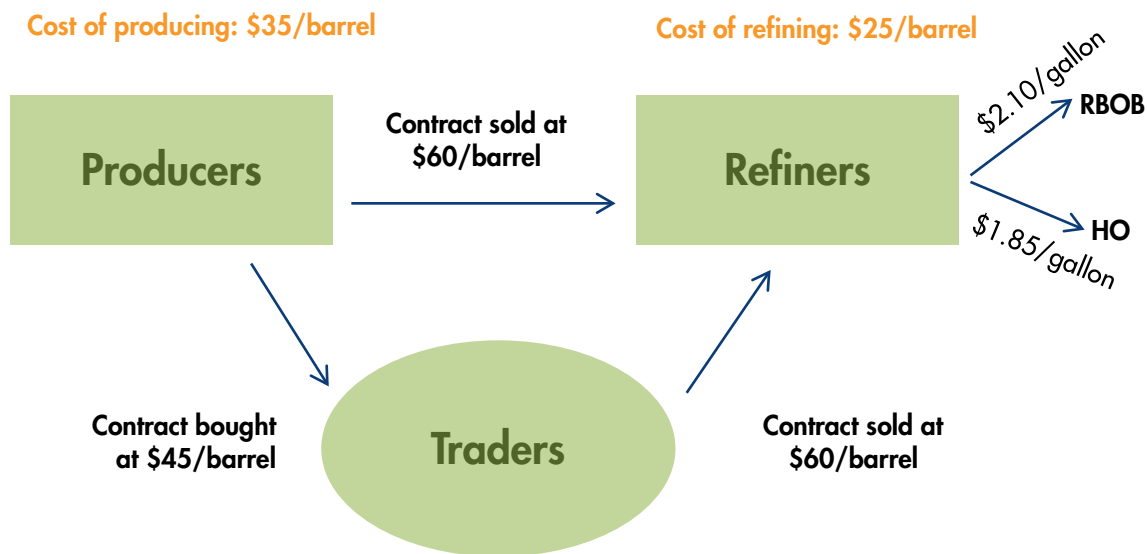
Assume RBOB and HO are currently trading at \$2.10/gallon and \$1.85/gallon respectively, which will be obtained using the Light Refinery, giving a Light Crude refined value of \$2/gallon. If you convert this value into barrels: $42,000 * \$2/\text{gallon} = \$84,000$ per 1,000 barrels, or \$84.00/barrel. 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 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 LIMITS AND TRANSACTION COSTS

Each participant will be subject to trading limits and position constraints. Separate limits will be maintained for Light and Heavy Crude Oil (CRUDE) and HO/RBOB Products (PRODUCT). Position limits

will be strictly enforced and traders 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.

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 per 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 and sharing 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.)

Credit Risk Case

OVERVIEW

The Credit Risk Case challenges participants to build and apply a credit risk model in a simulation where corporate bonds are traded. Participants will use both a Structural Model and the Altman Z-Score to predict potential changes to the companies' credit ratings. Periodic news updates will require participants to make appropriate adjustments to the assumptions in their models and rebalance their portfolios accordingly. This case will test participants' ability to develop a credit risk model, assess the impact of news releases on credit risk, and execute trading strategies accordingly to profit from mispricing opportunities.

DESCRIPTION

The Credit Risk Case will comprise 2 heats each with 4 sub-heats. In each heat, 2 team members will be competing together. Each sub-heat will span 16 minutes, representing two calendar years. Each heat will involve 5 tradable securities. 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 calendar years (4 weeks per month, 12 months in a year – total of 48 weeks in a year)
Compounding interval	1 week (10 seconds)
Maximum order size	500 contracts

This case assumes that participants are working at a fixed income trading desk as a junior analyst. Participants are strongly suggested to build a credit risk model according to the information presented in the "Market Dynamics" section below. Two models will be introduced, the "Structural Model" and the "Altman Z-Score Model". The Structural Model will be used to calculate the implied credit spreads for the bonds, while the Altman Z-Score Model can be used to determine the Z-Score and associated financial solvency category of the company. With the use of the two models, participants will be able to calculate the probabilities of a rating upgrade/downgrade and the fair price for the bonds. Then they will be able to implement a trading strategy and profit from mispricing opportunities.

News items will be periodically released during the case, which may have an impact on the variables used in the two models. As these variables change, the implied credit spread or the Altman Z-Score may change, changing the likelihood of a rating upgrade/downgrade. Participants will then have to adjust their trading strategies and portfolio positions. For more details about the variables used in the models and the news releases, please see the "Market Dynamics" and "News Releases" sections, respectively.

MARKET DYNAMICS

There are five tradable zero-coupon corporate bonds that are issued by non-dividend paying public companies. All of these bonds have the same credit ratings at the beginning of the case. The characteristics of the bonds are found in the table below.

	BondA	BondB	BondC	BondD	BondE
Face Value	100	100	100	100	100
Coupon	0	0	0	0	0
Maturity	5 years from now	5 years from now	5 years from now	5 years from now	5 years from now
Credit Rating	A	A	A	A	A
Issuer Info	Anderson Shipping	Barbell Gaming Technologies	Cataran Industries	Dysol Solutions Company	Evolution Entertainment
Volatility of Company's Assets	36%	35%	54%	35%	46%
Total Asset Value <i>(in 100 millions)</i>	100	185	130	80	140
Total Debt Value <i>(in 100 millions)</i>	60	110	35	50	55
Market Value of Equity <i>(in 100 millions)</i>	40	75	95	30	85
Sales (at $t=0$) <i>(in 100 millions)</i>	100	160	35	60	60
EBIT (Earnings Before Interest and Taxes) <i>(in 100 millions)</i>	20	60	10	40	35
Retained Earnings <i>(in 100 millions)</i>	15	30	5	10	25
Working Capital <i>(in 100 millions)</i>	40	20	10	10	20

There is a risk free rate r and a table provided by the credit rating agency with credit spreads (s_r) that correspond to each rating. Bonds will be priced such that the implied yield to maturity (y) is equal to $r + s_r$ (risk free rate plus credit spread), where T is the time to maturity:

$$P_0 = \frac{100}{(1+y)^T} = \frac{100}{(1+r+s_r)^T}$$

Table of the credit ratings

Rating	Credit Spread (s_r)
AAA	0.50%
AA+	1.00%
AA	1.50%
AA-	2.00%
A+	2.50%
A	3.00%
A-	3.50%
BBB+	4.00%
BBB	4.50%
BBB-	5.00%
BB+	5.50%
BB	6.00%
BB-	6.50%
B+	7.00%

The credit rating agency will be releasing the updated credit ratings for each company on a quarterly basis. A company can be upgraded or downgraded by the credit rating agency only by one notch. For example, if a company has a current rating of A, its rating will be A+ in case of upgrade and A- in case of downgrade.

The senior fixed income fund managers understand that the change of the financial situation of a company will not be reflected immediately by these ratings since they are only updated quarterly. Therefore, they have suggested that you can also calculate an implied credit spread (s_m) using real-time market data through a Structural Model, as explained in the following subsection.

Structural Model

The company's liabilities are composed of two parts: equity and debt. The equity does not receive dividends and the debt is in the form of a zero coupon bond with face value D and maturity T . If at time T , the value of the assets is greater than the value of the debt, the company will pay its debt. If instead the value of the assets, A , is smaller than the value of the debt, the company will go bankrupt. Bondholders will receive the value of the assets and the shareholders will not receive anything.

Conceptually, this means that the equity portion of a company can be modelled as a European call option written on the value of the assets (A) with a strike price equal to the face value of the debt (D). Therefore, Black-Scholes can be used to model the value of the equity, leading to the following model¹ for the implied credit spread: let L be the measure for the company's leverage and defined as:

$$L = \frac{\text{current value of debt}}{\text{current value of assets}} = \frac{D e^{-rT}}{A_0}$$

¹ The model presented is known in the literature as the Merton Model and is a type of structural model.

Where,

D is the face value of debt

r is the risk free rate

T is the time to maturity

A_0 is the current value of assets at the present time

The implied credit spread is then calculated as:

$$s_m = -\frac{\ln\left(N(d_2) + \frac{N(-d_1)}{L}\right)}{T}$$

Where,

$$d_1 = \frac{-\ln(L)}{\sigma_A \sqrt{T}} + \frac{1}{2} \sigma_A \sqrt{T}$$

$$d_2 = d_1 - \sigma_A \sqrt{T}.$$

T is the time to maturity of the zero-coupon bond in years.

σ_A is the volatility of the company's assets.

$N(x)$ is the standard normal cumulative distribution function of x .

For further details, including a formal derivation of the Structural Model, please see the Appendix to the Credit Risk Case.

Altman Z-Score Model

In addition, your fund managers suggest that you also consider the Altman Z-Score to understand the financial healthiness of the companies. The Altman Z-Score is calculated as follows:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.99X_5$$

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

X_5 is Sales/Total Debt

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

- If $Z > 2.99$, there is a low probability of bankruptcy ("Safe" Zone).
- If $1.81 < Z < 2.99$, there is a moderate probability of bankruptcy ("Grey" Zone).
- If $Z < 1.81$, there is a high probability of bankruptcy ("Distress" Zone).

Evaluating the Probability of Credit Rating Downgrade/Upgrade

Your trading analysts have come up with the following table, which predicts the probability of a rating upgrade/downgrade. The rows of the table are based on the difference between the Structural Model implied credit spread (s_m) and the credit spread associated with the current credit rating (s_r) while the columns are based on the categories found using the Altman Z-Score Model.

Difference ($s_m - s_r$)	Probability of Downgrade			Probability of Upgrade		
	Safe	Grey	Distressed	Safe	Grey	Distressed
$s_m - s_r < -2\%$	0.0%	0.0%	0.0%	75.0%	65.0%	55.0%
$-2.0\% \leq s_m - s_r < -1.5\%$	0.0%	0.0%	0.0%	65.0%	55.0%	45.0%
$-1.5\% \leq s_m - s_r < -1.0\%$	0.0%	0.0%	0.0%	55.0%	45.0%	35.0%
$-1.0\% \leq s_m - s_r < -0.5\%$	0.0%	0.0%	0.0%	45.0%	35.0%	25.0%
$-0.5\% \leq s_m - s_r < 0.0\%$	25.0%	35.0%	45.0%	40.0%	30.0%	20.0%
$0.0\% \leq s_m - s_r < 0.5\%$	35.0%	45.0%	55.0%	35.0%	25.0%	15.0%
$0.5\% \leq s_m - s_r < 1.0\%$	45.0%	55.0%	65.0%	0.0%	0.0%	0.0%
$1.0\% \leq s_m - s_r < 1.5\%$	55.0%	65.0%	75.0%	0.0%	0.0%	0.0%
$1.5\% \leq s_m - s_r < 2.0\%$	65.0%	75.0%	85.0%	0.0%	0.0%	0.0%
$s_m - s_r \geq 2.0\%$	75.0%	85.0%	95.0%	0.0%	0.0%	0.0%

These probabilities should be used to find the expected credit spread as shown in the formula below:

$$E(s) = p_u \cdot s_r^u + p_d \cdot s_r^d + (1 - p_u - p_d) \cdot s_r$$

Where,

p_u and p_d are, respectively, the probability of a rating upgrade and the probability of a rating downgrade.

s_r^u is the credit spread used for the company in case of upgrade according to the Table of the credit ratings.

s_r^d is the credit spread used for the company in case of downgrade according to the Table of the credit ratings.

s_r is the current credit spread according to the Table of credit ratings.

This expected credit spread should then be used to calculate the fair value for the zero-coupon bond. Traders are expected to compare this fair value to the market value and make appropriate trading decisions.

NEWS RELEASE

News items will be released every quarter. They will affect the variables within the Structural Model and the Altman Z-Score Model. Participants should be able to identify relevant news, assess their impact, and execute appropriate trading strategies.

A sample news release affecting the Structural Model is:

“Company C takes on an additional \$1B of debt financing for their share repurchase program”

This will increase the level of total debt of Company C by \$1 billion, which will directly increase the company's leverage (L). This in turn increases the implied credit spread (s_m) in the Structural Model through the variables d_1 and d_2 .

The Structural Model should be updated to determine the impact on the difference between the implied credit spread (s_m) and the credit spread given by the credit rating agency (s_r). For example, if the initial difference between the two credit spreads ($s_m - s_r$) was 0.40%, the impact of this news may move the difference to 0.90%. Looking at the upgrade/downgrade table, if the company is in the “Safe” zone, the probability of downgrade will increase from 35% to 45% and the probability of upgrade will decrease from 35% to 0%.

Note that the increase in total debt from this example will also affect the Altman Z-Score Model through variables X_4 (Market Value of Equity/Total Debt) and X_5 (Sales/Total Debt). A detailed explanation of effects on the Altman Z-Score Model is given below.

A sample news release impacting the Altman Z-Score Model is:

“Major weather conditions reduce demand for Company E's products, decreasing the company's revenue by \$500M”

In this case, the news item decreases the sales of Company E by \$500M, which decreases X_5 (Sales/Total Debt) in the Altman Z-Score Model. Hence, the Altman Z-Score decreases for Company E, which in turn could move the state of the company's financial solvency from either the “Safe” zone to the “Grey” zone or from the “Grey” zone to the “Distress” Zone. For example, assume that Company E is initially in “Safe” zone with a difference between s_m and s_r of 0.00%. If the news release changes the Altman Z-Score Model for Company E so that the company moves from “Safe” zone to “Grey” zone, then the probability of downgrade changes from 35% to 45% and the probability of upgrade changes from 35% to 25%.

TRADING LIMITS AND TRANSACTION COSTS

Each participant will be subject to gross and net trading limits. 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 strictly enforced and participants will not be able to exceed them.

The maximum order size will be 500 bonds, and transaction fees will be set to 2 cents per bond.

POSITION CLOSE-OUT

Any open position will be closed out at the end of each sub-hour based on the price of the bond using the credit spread provided by the credit rating agency. This includes any long or short position open in any security.

KEY OBJECTIVES

Objective 1:

Build a credit risk model that incorporates both the Structural Model and the Altman Z-Score Model to find the expected credit spread and fair value for the zero-coupon bonds. By understanding the variables that drive the credit risk models, participants should be able to identify and exploit mispricing opportunities to generate profits.

Objective 2:

Analyze the impact of news releases on the relevant variables of the model. News items will affect one or more parameters in the Structural Model and/or the Altman Z-Score Model, and consequently the probability of a credit rating change. Traders should update their credit risk models to reflect these changes and rebalance their portfolios accordingly.

Objective 3:

Manage exposure to market risk. 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.

APPENDIX

The company's liabilities are composed of the following two parts: equity and debt. The equity does not receive dividends and the debt is in the form of a zero coupon bond with face value equal to D and maturity at time T .

If at time T , the value of the assets, A , is greater than the value of the debt, the company will pay its debt. If at time T , the value of the assets, A , is smaller than the value of the debt, the company will go bankrupt. Bondholders will receive the value of the assets and the shareholders will not receive anything. The company cannot go bankrupt before time T .

Formalizing this description: the value of the assets is assumed to follow a geometric Brownian motion described by the following equation:

$$dA = \mu_A A dt + \sigma_A A dW$$

Where,

μ_A is the drift of the assets. It is assumed to be equal to zero in the credit risk case.

σ_A is the volatility of the assets

dW is a standard Wiener process

The value of the assets at time t is equal to

$$A_t = A_0 \exp \left\{ \left(\mu_A - \frac{\sigma_A^2}{2} \right) t + \sigma_A^2 \sqrt{t} W_t \right\}$$

Where,

$W_t \sim N(0, t)$.

The expectation of A_t is:

$$E(A_t) = A_0 \exp(\mu_A t)$$

At time T , the value of the equity will be:

$$E_T = \max[A_T - D, 0]$$

The above shows that the value of the equity looks like the payoff of a (European) call option written on the value of the assets (A) with a strike price equal to the face value of the debt (D). Using Black-Scholes:

$$E_0 = A_0 N(d_1) - D e^{-rT} N(d_2)$$

With

$$d_1 = \frac{\ln \left(\frac{A_0 e^{rT}}{D} \right)}{\sigma_A \sqrt{T}} + \frac{1}{2} \sigma_A \sqrt{T}$$

$$d_2 = d_1 - \sigma_A \sqrt{T}$$

Where r is the risk-free rate.

Let L be a measure of the leverage used by the company and defined as:

$$L = \frac{\text{current value of debt}}{\text{current value of assets}} = \frac{D e^{-rT}}{A_0}$$

Then we can write the current value of the Equity as:

$$E_0 = A_0[N(d_1) - LN(d_2)] \quad \text{equation \#1}$$

Where,

$$d_1 = \frac{-\ln(L)}{\sigma_A \sqrt{T}} + \frac{1}{2} \sigma_A \sqrt{T}$$

$$d_2 = d_1 - \sigma_A \sqrt{T}.$$

The current value of the debt (at time zero) is equal to:

$$B_0 = A_0 - E_0$$

Substituting E_0 from the equation #1 we have:

$$B_0 = A_0[N(-d_1) + LN(d_2)]$$

The current value of debt B_0 can also be expressed by discounting the face value at the implied yield to maturity (y):

$$B_0 = D e^{-yT} = D e^{-rT} e^{(r-y)T} = A_0 L e^{(r-y)T}$$

It follows that:

$$A_0 L e^{(r-y)T} = A_0[N(-d_1) + LN(d_2)]$$

Therefore the implied yield to maturity (y) can be calculated as:

$$y = r - \frac{\ln\left(N(d_2) + \frac{N(-d_1)}{L}\right)}{T}$$

Then the implied credit spread (s_m) is calculated as:

$$s_m = y - r = -\frac{\ln\left(N(d_2) + \frac{N(-d_1)}{L}\right)}{T}$$

Quantitative Outcry Case

OVERVIEW

The 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 in trading futures written on the RT100 Index based on their analysis of the news' impact on the index.

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 representing 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 the traders, while the analysts will share a desktop in the Rotman Finance Lab. Analysts will have access to detailed news releases, while traders in the pit will only have access 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 will be essential 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 4 economies: **Canada, the United States, the United Kingdom, and China**. Economic statistics for each of the countries are collected and released throughout the trading session, 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 real calendar time). There is no exchange rate risk (all values are expressed in the same currency). The value of the RT100 Index is calculated by the following formula:

$$\begin{aligned}
 RT100_{\text{Value at } t=15} &= 1000 + \text{Canada}_{(\text{Actual Q1 GDP} - \text{Previous Q1 GDP})} + \dots \\
 &+ \text{China}_{(\text{Actual Q1 GDP} - \text{Previous Q1 GDP})}
 \end{aligned}$$

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 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*RT100 Index. If the RT100 Index is at 995 and a trader buys 1 future contract, his/her position will be worth \$9,950 (= \$10*995).

Analysts are allowed to make up to 2 spot trades per heat. It is assumed that a spot contract exists and is written on the RT100 Index with a contract multiplier of \$10. Therefore, if an analyst sells 1 spot contract when the RT100 Index is at 1,023, his/her position will be worth \$10,230 (= \$10*1,023).

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 sees 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 3 countries, will determine the RT100 Index at the 15 minute mark (and then the 30 minute mark).

In addition to the transactions executed by the traders in the Fleck Atrium, analysts in the Rotman Finance Lab are allowed to make up to 2 spot trades during each 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. These 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 due to inefficiencies in the two markets. These trades are added to the aggregate futures position of the team.

Traders are responsible for keeping track of their position and communicating it to analysts. The soft and hard trading restriction limits discussed below will 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 P&L

Trading P&L will be calculated in a similar fashion as 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
- Profit Before Bonuses = $(1100 - 1000) * 5 - 1^2 * 5 = \$4,995$
- Bonuses = $| \$4,995 | * 5\% + | \$4,995 | * 3\% = \$399.60$
- Total P&L = $\$4,995 + \$399.60 = \$5,394.60$

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

- Bought 5 RT100 Index futures at 1,000

² Brokerage commission – explained in Trading Limits and Transaction Costs

- 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
- Profit Before Bonuses = $(900-1000)*\$10*5-\$1*5 = -\$5,005$
- Bonuses = $|-\$5,005|*5\% + |-\$5,005|*3\% = \$400.40$
- Total P&L = $-\$5,005 + \$400.40 = -\$4,604.60$

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 $\$50*20 = \$1,000$ (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 $\$50*60 = \$3,000$ 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 futures contract has a **maximum volume of 20 contracts** per trade. Once more, 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.

KEY OBJECTIVES

Objective 1:

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

Objective 2:

The analyst should track news releases and attempt to accurately estimate the value of the RT100 Index in order to develop a profitable trading strategy and deliver it 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.



S&P Capital IQ Equity Valuation Case

OVERVIEW

The S&P Capital IQ Equity Valuation Case will test the participants' ability to apply a discounted cash flow (DCF) model in an equity trading simulation. The fundamental/fair price adjustments will be driven by news items that will change the financial model's assumptions. With four companies in the public utility, IT outsourcing, medical imaging, and railway servicing industries, news updates will be both varied and interrelated. The case will test each participant's understanding of equity valuation, ability to assess impacts on valuation, and capitalize on equity mispricing.

DESCRIPTION

The S&P Capital IQ Equity Valuation Case will comprise 2 heats, each with 3 sub-heats. In each heat, 2 team members will be competing together. Each sub-heat will span 20 minutes, representing 2 fiscal quarters. Each heat will involve 4 tradable securities. Trading from Excel using the Rotman API will be disabled. Real Time Data (RTD) links will be enabled.

Parameter	Value
Number of trading heats	2
Number of trading sub-heats	3
Trading time per sub-heat	20 minutes (1,200 seconds)
Calendar time per sub-heat	2 fiscal quarters

Participants are expected to use a valuation model to determine the fair prices of the 4 companies. In order to come up with a complete valuation model to trade the case, participants must begin with the "S&P Capital IQ Equity Valuation Case Starting Template" spreadsheet and follow step-by-step instructions in the posted "S&P Capital IQ Equity Valuation Case Model Tutorial" document. The starting template and the tutorial document, as well as individual company briefs and assumptions will be provided in separate files on the RITC website as soon as the first practice case of the S&P Capital IQ Equity Valuation Case becomes available. Further, qualitative details necessary to analyze the news items can be found in the "S&P Capital IQ Equity Valuation Case Company Profiles" document.

A PDF copy of the completed solution to the valuation model will be released Wednesday, February 3rd 2016 on the RITC website. Participants are highly recommended to cross-check their valuation models with the posted PDF copy of the completed valuation model in order to ensure that they have the correct

model for the case. Please note that only the PDF copy of the completed solution to the valuation model will be released (i.e. the spreadsheet of the completed valuation model will NOT be released).

An introductory level of corporate finance knowledge is recommended for building the valuation model. However, because the model is standardized for all teams, please do not add line items or add/remove columns/rows. Even though certain calculations might be shown differently in other pieces of literature (online, valuation books, etc.), for the purposes of consistency, please only refer to the instructions provided in the tutorial document.

Please note that clarification of case content will be provided to all teams if deemed necessary. To ensure fairness, answers to all questions will be posted on our website.

MARKET DYNAMICS

By the end of the case, the final price for all companies will be closed out at their respective fair prices, which are calculated according to the complete valuation model. However, there could be instances of mispricing during the trading simulation. The news items released throughout the case will have an impact on the assumption(s) on one or more companies. Due to the new information, the fair value of each company will change and the participant will need to determine if the spread between the market price and the fair value calculated from the valuation model is sufficient enough to justify an investment. Despite a robust financial model, the participant will be exposed to the risk that new information released before the end of the case could move the fair value in an unfavorable direction.

NEWS RELEASES

News items are modelled after real world press releases and articles that contain relevant information to value the companies. In order to interpret the news properly, it is **strongly recommended** that at least two team members carefully analyze the S&P Capital IQ Equity Valuation Case Company Profiles provided on the RITC website under casefiles. Without a comprehensive understanding of the S&P Capital IQ Equity Valuation Case Company Profiles, it will be challenging to identify the parameters that need to be updated in the valuation model (which is explained in the S&P Capital IQ Equity Valuation Case Model Tutorial).

Some news will have a direct and precise impact on the variables that are driving the financial model. An example would be:

“Meanwhile, the extensive damage done to the underground servers necessitated a complete replacement of numerous cables. The replacement cost will be \$450mm split evenly between this year and next year. Company A will also incur a \$230mm asset write-down next year.”

The valuation model should be updated to take into account this change in capital expenditure assumptions in Year 0 and Year 1 as well as the asset write-down charge in Year 1.

Some news will require more judgment from participants. In these cases, the precise effect of the news will be unknown but the direction of the effect should be clear. Participants will need to arrive at their own expectations regarding the change in the parameter discussed by the news. An example would be:

“Company A’s Q2 earnings were in line with Street estimates and analysts’ consensus is that the company’s cost of goods sold % sales will decrease between 1.00 to 5.00 percentage points.”

Note that a change in percentage points refers to an absolute change. For example, if the cost of goods sold % sales was 50%, and it decreases by 5 “percentage points”, the margin assumption decreases to 45%.

In this case, the company is expected to decrease the cost of goods sold % sales over the next 5 years but the precise decrease is unknown. Participants will need to formulate their own opinions, based on the content of the news, qualitative factors described in the company profiles, and update their models accordingly. In the example provided above, the decrease in cost of goods sold % sales could be assumed to be distributed as a continuous uniform distribution. Therefore, one could expect the margin to decrease by 3 percentage points, which is the mean of the distribution. Alternatively, one could be risk averse and assume that the decrease will be only 1.00%, that is, the bottom of the range (1.00% - 5.00%). The specific value in this type of news will be confirmed in a later news item.

TRADING LIMITS AND TRANSACTION COSTS

Each participant will be subject to gross and net trading limits. 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 strictly enforced and participants will not be able to exceed them.

The maximum order size will be 10,000 shares, restricting the volume of shares transacted per trade to 10,000. Transaction fees will be set to 2 cents per share.

POSITION CLOSE-OUT

Any open position will be closed out at the end of each sub-heat based on the company’s fair price, which is calculated according to the complete valuation model. This includes any long or short position open in any security.

KEY OBJECTIVES

Objective 1:

Fully link each company's three financial statements to accurately project the company's future free cash flows for the next 5 years. Note that all the cells in the operating model must be linked to the "News Adjusted Figures" in the Excel file as opposed to the initial assumptions.

Objective 2:

Gain a strong understanding of the key drivers influencing the company's share price and its sensitivity to changes in the parameters of the 3-statement operating model and DCF model.

Objective 3:

Maximize profits as a team of traders by reacting to news headlines that potentially may exploit arbitrage opportunities.

Sales & Trader Case

OVERVIEW

The Sales & Trader 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 requiring participants to make rapid judgments on the profitability and subsequent execution of these offers. Profits can be generated by taking advantage of pricing premiums and discounts of the large tender offers compared to the market, and market-making opportunities.

DESCRIPTION

In this case, there will be 2 heats of the case and teams will allocate 2 team members for each heat. Each participant may only participate in 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, with each sub-heat to be independently traded and representing one month of calendar time. Each sub-heat will have a unique objective and could involve up to 4 securities 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 enabled³.

MARKET DYNAMICS

There are five sub-heats per heat, each with unique market dynamics and parameters ranging from changes in the spread of tender orders to the liquidity and volatility of various stocks. Details regarding each sub-heat will be distributed prior to the beginning of the trading period, allowing participants to formulate trading strategies.

³ Note: RTD links are not enabled for tender offers.

An example of sub-heat details is shown below.

	RITC	COMP
Starting Price	\$10	\$25
Commission/share	\$0.01	\$0.02
Max order size	25,000	25,000
Trading Limit (Gross/Net)	250,000/250,00	250,000/250,000
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 participants at different times. Each participant will get the same number of tender offers with variations in price and quantity.

Private tenders are routed to individual participants and are offers to purchase or sell a fixed volume of stock at a fixed price. The tender price is influenced by the same pre-generated path that the liquidity participants follow in an attempt to drive the market price towards that path. No trading commission will be paid on private tenders.

Competitive auction offers will be sent to every participant at the same time. Participants will be required to determine a competitive, yet profitable, price to submit for a given volume of stock 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 order filled, regardless of other participants' bids or offers. If accepted, the fills 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 stock. 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 may not be awarded to anyone (i.e. if all participants bid \$2.00 for a \$10 stock, nobody will win).

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 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 strictly enforced and participants will not be able to exceed them.

The maximum order size will be 25,000 shares, restricting the volume of shares transacted per trade to 25,000. Transaction fees will be specified in the case description distributed prior to the trading period.

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 OBJECTIVES

Objective 1:

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 in order to manage liquidity risk and maximize potential profits.

Objective 2:

Limit market risk by managing open positions. Maintaining large short or long positions may result in the market moving away from your transaction price, resulting in losses. Use a combination of limit, market orders and marketable limit orders to mitigate any liquidity and price risks from holding open positions.

Objective 3:

Generate profits by market making in order to capture the bid-ask spread. Develop trading strategies based on the case descriptions to be distributed prior to the trading period in order to customize profitable trading strategies to each sub-heat.



MathWorks Algorithmic Trading Case

OVERVIEW

The MathWorks Algorithmic Trading Case is designed to challenge participants' programming skills since they are required to develop algorithms using MATLAB or Excel VBA to automate the market-making process and react to changing market conditions. Throughout the case, these algorithms will submit orders to create and unwind positions. In addition, teams should attempt to maximize profits from the bid-ask spread and any arbitrage opportunities that may arise. Due to the high-frequency nature of the case, participants will have to develop algorithms to adapt to 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. Each heat will consist of three 5-minute sub-heats representing one day of trading. Each team will be trading with up to 14 additional teams at a time.

Parameter Value	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	1 day of trading

All trades must be automatically executed by a trading algorithm. Participants will not be allowed to trade through the RIT Client once the case begins. However, participants are allowed to and encouraged to use and modify their MATLAB or Excel VBA algorithm in response to prevailing market conditions and competition from the algorithms of other teams. In addition, they will have 3 minutes in between each sub-heat to alter their algorithm. A base template algorithm will be provided for participants and can be directly modified for use in the competition. Alternatively, participants can create their own algorithm 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 trading the MathWorks Algorithm Trading Case.

MARKET DYNAMICS

This case will involve 3 stocks and 1 ETF with varying levels of volatility and liquidity. This dynamic exposes participants to the basics of market microstructure in the context of algorithmic trading. Participants can manage the market price impact of trades and automate market making operations by dividing larger volume orders into smaller trades and submitting pairs of trades electronically. The ETF

pricing will reflect the following weighted sum of the 3 stocks traded, subject to periodic shocks to its price.

$$HUNY = 2 \cdot POOH + TIGR + EYOR$$

Each participant will be able to trade 4 securities of which the details are shown below.

Ticker	POOH	TIGR	EYOR	HUNY
Starting Price	\$20	\$20	\$20	\$80
Fee/share (Market orders)	\$0.01	\$0.01	\$0.01	\$0.02
Rebate/share (Limit/Passive orders)	\$0.005	\$0.005	\$0.005	\$0.015
Max order size	10,000	10,000	10,000	5,000
Annualized volatility	27%	34%	12%	15%
Liquidity	Medium	Medium	Low	High
Type	Stock	Stock	Stock	ETF

Participants will be given endowments during each sub-heat following the schedule below. An endowment with $0 \pm 2,000$ will therefore be any amount between -2,000 and 2,000 shares. Note that these endowments are priced at the market price at each endowment time (i.e. the market prices of each security at tick 75, 150, or 225).

Tick of Endowment	POOH	TIGR	EYOR	HUNY
75	-	$-3,000 \pm 2,000$	$8,000 \pm 2,000$	$-3,000 \pm 2,000$
150	$-2,000 \pm 1,000$	$10,000 \pm 2,000$	$-2,500 \pm 2,000$	-
225	$3,000 \pm 2,000$	-	$4,000 \pm 2,000$	$2,000 \pm 1,000$

There will be no information provided that will allow teams to predict the future price or direction of any security. While unwinding their positions, teams may choose to simultaneously have their algorithm automatically generate and execute orders on other securities. A fee-rebate structure will be instituted to compensate participants for the addition of liquidity through limit orders. As such, participants will have the opportunity to generate returns by market making.

Participants will be penalized for having an open position at the end of any individual sub-heat. This penalty will be levied against the final Net Liquidation Value for that sub-heat. The calculation for the penalty is as follows:

$$\text{Penalty for Stocks A} = (\# \text{ of shares open of Stock A} * \$0.50)$$

Please be aware that this penalty applies to each of the securities separately which emphasizes the importance of closing out your position across all securities. Furthermore, although RIT automatically closes out your position at the conclusion of the case, this is not considered a valid closeout by the participant. Any positions closed out by RIT are considered to be an open position at the close.

TRADING LIMITS AND TRANSACTION COSTS

Time of Sub-heat (tick)	0 ~ 240	240 ~ 299	300
Gross/Net	200,000/50,000	100,000/50,000	100,000/0

Each participant will be subject to gross and net trading limits which will change over each sub-heat. The gross trading limit reflects the sum of the absolute values of the long and short positions across all securities and 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. Each position in stock will be counted towards trading limits with a multiplier of 1, while each position in the ETF will be counted with a multiplier of 4 (i.e. if you long 100 shares of any stocks, your gross and the net trading limits will increase by 100. If you long 100 positions of HUNY, your gross and net trading limits will increase by 400 (100 positions * multiplier of 4).

The maximum trade size will be 10,000 shares for stocks and 5,000 shares for the ETF, restricting the volume of shares transacted per trade to 10,000 shares for stocks and 5,000 shares for the ETF. Transaction fees will be set at \$0.01 per share for stocks and \$0.02 per share for the ETF on all market orders filled. Subsequently, a rebate of \$0.005 per share for stocks and \$0.015 per share for the ETF will be given for all submitted limit orders that are filled. Due to this rebate structure, it is possible for a participant to be profitable after buying and selling a security at the same price, provided that the participant uses limit orders.

POSITION CLOSE-OUT

Any non-zero position in either stock will be closed out at the end of trading based on the last traded price. It is strongly suggested that participants close out their positions prior to the end of trading period as open positions will be subject to the penalty described above.

KEY OBJECTIVES

Objective 1:

Edit the template provided and optimize the trading parameters such that the algorithm efficiently balances a) trading frequently and large positions while b) minimizing price risk. Successful algorithms manage to transact large amounts of shares while keeping their position (and risk) very small.

Objective 2:

Consider rewriting and redesigning the algorithm using your own logic. Since the same template is being provided to all participants, there is a limitation on your ability to differentiate yourself by simply modifying the base template.

Appendix

Supplementary files will be released prior to the competition as they become available. Announcements will be made on the RITC website when these files are released.

Please refer to the RITC website for more information on the release dates for cases. The website will be updated periodically to reflect estimated upload dates.

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.

Information regarding BP Practice sessions will be updated on the RITC website at a later date. In addition, emails to each team with notification of practice sessions will be sent.

Good luck and see you in Toronto!