RIT SBL Package Overview

The RIT simulation-based-learning (SBL) package integrates analytical, behavioural and judgement skills using a market simulator and decision cases that replicate the relevant real-world setting; allowing participants to learn from mistakes and, in so doing, adapt and improve their decision-making strategies.

The SBL package has three components:

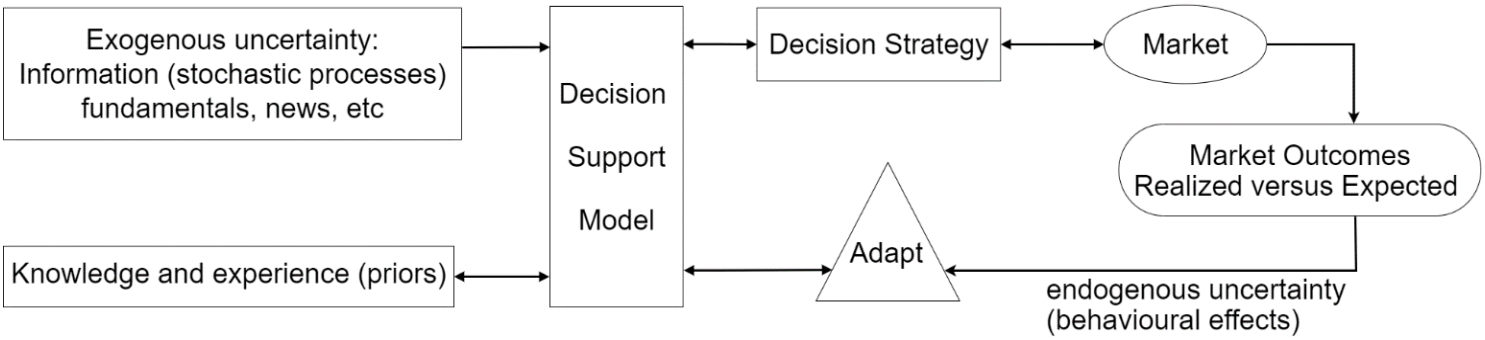
- Forty-six **RIT Decision Cases** which focus on specific decision tasks associated with financial securities, market dynamics, and investment or risk management strategies. The cases are designed to be run on the RIT Market Simulator platform using multiple iterations which implement a range of potential scenarios. Participants explore and practice strategies that achieve the desired objective. The cases sequence from introductory (generally one source of risk) to capstone cases for which the decision maker must manage several, potentially correlated, risks.
- Case-specific start-up **RIT Decision-Support Templates** which model the relevant theory and link to the simulated market(s) to guide decisions and derive best practice outcomes. Those models include RTD and/or API links to the order-driven market(s) in real time – both to pull information from the market(s) into one's decision model and (optionally) to direct decisions automatically back into the market(s). Both VBA and REST APIs are available allowing users to use the programming language of their choice to model, message, and submit decisions to the simulated market. For example, the REST API supports the increased usage of Python and other programming languages.
- The **RIT Market Simulator**: an electronic exchange (order-driven market) which allows users to transact financial securities with each other on a real-time basis. This **order-matching platform** links participants, aggregates decisions, and provides immediate feedback allowing participants to revise/adapt their orders.

The **RIT Decision Cases** and associated **RIT Decision-Support Templates** develop probabilistic modelling and decision-making skills, applying those skills to the types of decisions that practitioners must make, including for trading, investments, portfolio, and risk management (e.g., managing liquidity, interest rate, credit, VaR, crash, variance, and model risks).

Students use their decision-support models to derive and submit their decisions to the market(s). The market(s) aggregate participants' decisions (and the AI order flow) providing immediate feedback on the outcome of the participants' strategies. This feedback allows them to adapt their strategies after each iteration and, in so doing, derive a robust strategy that works well across a range of potential outcomes. In effect, the RIT Decision Cases are designed to apply theory in a setting in which participants learn how to make good decisions when faced with uncertainty about outcomes. Since, in most cases, participants are not exogenous (price takers), the results generated by millisecond market clearing can also reflect endogenous (behavioral) uncertainty generated by the participants' decisions.

Using interactive simulations to develop and practice decision-making skills is analogous to the simulators used for training in aviation and health professions. Decision errors in aviation and surgery are easy to identify and are catastrophic. Due to model & parameter uncertainty, it is more difficult to disentangle skill versus luck associated with decisions in social sciences. Nevertheless, with appropriately designed cases, the simulation approach is ideal for learning about and managing the risks and opportunities associated with financial securities and inherent in trading, investment, and risk management strategies.

Typical structure of a SBL RIT Decision Case:



Pedagogical motivation for SBL and the associated learning objectives using the RIT package are available **here**.

RIT Decision Cases for Simulation-Based Learning

Grouped by Topic with Authors

Contents

1. Fixed Income

a) Fixed Income security pricing, characteristics of bonds, interest rate risk

i. Fixed Income 1 - Treasury Bills (*Mak, McCurdy*)

The first fixed income case illustrates how to calculate the fair value (present value of future cash flows) of a risk-free treasury bill when interest rates are known. Trading is based on identifying a mispriced treasury bill.

ii. Fixed Income 2 - Coupon Bonds (*Mak, McCurdy*)

The second Fixed Income case introduces a yield curve and government coupon bonds (nominally risk free). Students trading the bond learn about coupon payments, accrued interest, dirty and clean prices.

iii. Fixed Income 3 - Interest Rate Risk (*Mak, McCurdy*)

Fixed income 3 builds on the previous fixed income cases by adding interest rate risk.

b) Default risk

i. Fixed Income 4 - Default Risk (*Mak, McCurdy*)

The fourth fixed income case presents students with risky corporate bonds with a chance to default and requires them to price the bonds accordingly. An arbitrage condition exists where students can build a portfolio of bonds with known default risk.

c) Yield measures and the term structure of Interest rates

i. Fixed Income 5 - Yield Curve (*McCurdy, Salerno*)

The fifth fixed income case challenges students' understanding of bond pricing based on news and benchmark interest rates derived from 4 non-tradable government zero-coupon bonds. Students have to price 3 tradable government coupon bonds based on the benchmark rates and news. The news, which will be released throughout the case, may have an impact on the benchmark rates, and thus on the fair prices of the tradable coupon bonds.

d) Credit Risk

i. Fixed Income 6 – Credit Risk (*Kang, Salerno, McCurdy*)

The sixth fixed income case challenges students' understanding of credit risk and it introduces them both to a structural model (Merton's model) and to the Altman Z-score which is often used to predict potential changes to a company's credit ratings based on distress measures.

e) Fixed Income Capstone

i. Fixed Income 7 – Fixed Income Capstone Case (*Kang, Salerno, McCurdy*)

The seventh (capstone) fixed income case combines features of the previous six cases in the fixed income sequence.

2. Price Discovery

a) Price discovery in equity markets with asymmetric information

i. Price Discovery 0 - Price Discovery (*Mak, McCurdy*)

The Price Discovery 0 case demonstrates the concept of informational efficiency as students attempt to determine the fair price for a takeover bid. Students have asymmetric information, which is updated over time, but there is no aggregate uncertainty.

ii. Price Discovery 1 - IPO Pricing (*Mak, McCurdy*)

The Price Discovery 1 builds on the Price Discovery 0 (PD0) case to demonstrate the concept of informational efficiency as students attempt to determine the fair price for a newly issued stock. As it happens in PD0, students have asymmetric information which is updated over time but there is no aggregate uncertainty.

iii. Price Discovery 2 - Asymmetric Information (*Mak, McCurdy*)

The Price Discovery 2 case also demonstrates informational efficiency by giving students private price estimates and confidence intervals associated with those forecasts. The fair value of the equity is based on the intersection of all students' information.

3. Equity Valuation

a) Valuation

i. Equity Valuation 1 - Relative PE Valuation (*Mak, McCurdy*)

The first equity valuation case introduces students to basic equity valuation by applying a fixed P/E ratio to the realized earnings of a company to determine the associated stock valuation. Trading is based on identifying mispriced stocks according to that relative valuation criterion.

ii. Equity Valuation 2 - DDM Valuation (*Mak, McCurdy*)

The second equity valuation case requires students to use the Gordon Dividend Discount Model to value the equity traded in the case. Students must model annual EPS, dividends, and the appropriate discount rate in order to derive a valuation for the company.

iii. Equity Valuation 3 – DCF Modeling (*McCurdy, Salerno*)

The third equity valuation case requires students to develop a DCF model to value a company and then identify and exploit mispricing opportunities in the market.

b) Mergers & Acquisitions

i) Merger & Acquisitions 1 - Takeover Arbitrage (*Mak, McCurdy*)

The first mergers & acquisitions case requires students to calculate the arbitrage-free price of a company that has received a takeover offer. The probability of the deal succeeding is dynamically updated through time and students must value the security based on the probability weighted outcomes.

4. Portfolio Management

a) Diversification, portfolio choice for long-horizon objectives using Monte Carlo

i. Portfolio Management 1 – Diversification (*Mak, McCurdy*)

The Portfolio Management 1 case requires students to invest funds for retirement across a diversified portfolio of ETFs. They can use a provided Monte-Carlo simulation tool to evaluate the potential distributions, returns, and risks associated with different portfolio weights; and then allocate their funds accordingly.

ii. Portfolio Management 2 – Rebalancing (*Mak, McCurdy*)

The second portfolio management case is similar to the PM1 case, except it allows students to rebalance their portfolio intermittently. These rebalancing points present students with the opportunity to enhance (or destroy) value by making wise risk and reward-based decisions.

b) Performance metrics and portfolio optimization

i. Portfolio Management 3 – Optimization (*Kang, Salerno, McCurdy*)

The third portfolio management case introduces students to portfolio optimization involved in maximizing performance measures, in this case the Sharpe Ratio. They will have to find the efficient frontier of the investment opportunity set and the tangency portfolio and will be allowed to rebalance their portfolios every 5 years. A tutorial document is available for this case and will show the students how to perform the analysis using Excel.

c) Portfolio choice subject to regulatory capital adequacy requirement *

i. Value-at-Risk (*Mak, McCurdy, Salerno*)

This case challenges students to manage their equity portfolios (allocating funds to three different ETFs in response to analysts' forecasts) while at the same time managing their VaR exposure. Exceeding their CRO's potential loss limit will result in fines that will reduce their overall portfolio performance. An Excel file is provided to instructors and can be used to compute and graph the fines, portfolio returns, and total returns for each participant.

* This VaR case is also included in the list of Risk Management cases below.

5. Derivative Pricing

a) Futures Contracts/Prices

i. Futures 1 - Equity Index Futures (*Mak, McCurdy*)

The first futures case is designed to introduce students to financial futures that track an index. Students can take long, or short, positions based on their view on whether the market as a whole is going to rise or fall in response to news releases.

ii. Futures 2 - Cost-of-Carry (Contango) (*Mak, McCurdy*)

The second futures case facilitates learning about how futures contracts are priced based on the cost-of-carry. The case uses the contango relationship between physical crude and crude futures and provides arbitrage opportunities when the spread is sufficiently wide.

iii. Commodities 1 - Crude Oil Futures (*Mak, McCurdy*)

The first commodities case allows students to profit from trading crude oil futures based on their assessment of the price impact of news releases. This is standard directional trading (in a futures market) based on relevant news that might affect the underlying.

iv. Commodities 2 - NG Futures (*Mak, McCurdy*)

Commodities 2 expands on the previous commodities case by providing students with a quantitative model that they can use to estimate the price shocks caused by forecasted supply and demand differentials for Natural Gas (NG). Students trade NG futures to profit from their price forecasts for the underlying NG. This is a detailed news trading case for which seasonals associated with geographic location and time of the year are also important.

b) Forward Contracts/Prices

i. Foreign Exchange Trading 1 - Covered Interest Rate Parity (*Mak, McCurdy, Salerno*)

The first FX case introduces students to covered interest rate parity. Participants have to find arbitrage opportunities by observing the relationship between interest rates and the spot and forward currency values of two countries.

c) Options Contracts/Prices

i. Options 1 - Puts and Calls (*Mak, McCurdy*)

The first options case introduces students to call and put options. They can practice understanding payoffs and identifying mispriced options.

ii. Options 2 - Options Strategies (*Mak, McCurdy*)

The second options case introduces students to 'Options Strategies' and requires them to build long and short straddles, strangles, condors and butterflies.

iii. Options 3 - Trading Volatility (*Kang, Salerno, McCurdy*)

The third options case introduces students to using options strategies to speculate on the volatility of the underlying. Students should seek out mispriced options (using put-call parity) and evaluate the volatility smile to determine which options positions can be used to exploit differentials between the option-implied and realized volatilities.

6. Risk Management

a) Hedging using Futures Contracts

i. Hedging 1 - Hedging with Futures (*Mak, McCurdy*)

The first hedging case requires using index futures to hedge positions in a basket of equities, introducing the concepts of portfolio beta, tracking error, and hedging costs.

b) Hedging using Options Contracts (Portfolio Insurance and Tail Risk)

i. Hedging 2 - Portfolio Insurance *(Mak, McCurdy)*

The second hedging case allows students to use various put or call options across multiple months to hedge their position in a single stock. The students use this portfolio insurance strategy to protect their underlying equity position from downside or risk.

ii. Hedging 2e – Hedging Tail Risk (*McCurdy*)

This case extends the H2 case by introducing additional further out-of-the money options strike prices. This extension facilitates focusing on how to choose option strike prices that correspond to specific quantiles of the return distribution of the underlying security, enabling hedging various measures of tail risk.

c) Delta-Neutral Hedging

i. Hedging 3 - Delta-Neutral Hedging (*Mak, McCurdy*)

Hedging 3 requires the students to act as a financial institution who is buying/selling blocks of options for individual equities from their clients. When trades are made, students are then responsible for hedging their position and remaining relatively 'delta neutral'.

d) Agricultural Crop Hedging: introducing production and price risk

i. Agricultural Hedging 1 - Price and Production Risk (*Mak, McCurdy*)

The agricultural hedging case allows students to manage risks associated with wheat crops. Students must forecast yields (production level) based on news about factors that affect crop yield and use domestic or international wheat futures contracts to hedge their price risk. While international contracts are more liquid than domestic, they involve FX risk and have different delivery options. Students must decide whether they wish to use a hedge that tracks well due to liquidity but is cash-settled or a perfectly correlated domestic hedge at a higher cost; and then evaluate their performance.

ii. Agricultural Hedging 2 – Grain Merchandiser (*Kang, McCurdy*)

The second agricultural hedging case requires students to assume a role as a grain (canola) merchandiser. Students can explore the implications of storage costs and features of futures and spot contracts using different hedge ratios.

e) Equity Risk Management: VaR based on regulatory capital adequacy requirement.*

i. Value-at-Risk (*Mak, McCurdy, Salerno*)

This case challenges students to manage their equity portfolios (allocating funds to three different ETFs in response to analysts' forecasts) while at the same time managing their VaR exposure. Exceeding their CRO's potential loss limit will result in fines that will reduce their overall portfolio performance.

- This VaR case is also included in the list of Portfolio Management cases above.

7. Sell-Side Roles

a) Agency Trading

i. Agency Trading 1 - VWAP Strategies (*Mak, McCurdy*)

The first agency trading case is designed to introduce order-driven markets, to order types, and to VWAP strategies. For example, one can illustrate how using limit orders instead of market orders allows the trader to capture the bid-ask spread instead of paying the bid ask spread. The market is designed to be extremely liquid so students will not be exposed to liquidity risk.

ii. Agency Trading 1v - VWAP Strategies (Kang, McCurdy)

The AT1v case extends AT1 by introducing a new intraday market volume distribution every iteration (day). This challenges participants to adapt their VWAP strategy to different intraday market volume patterns which they could experience for different securities and over time.

iii. Agency Trading 2 - Price Impact (*Mak, McCurdy*)

The second agency trading case builds on the AT1 case by adding liquidity risk. In this simulation, the market will be extremely illiquid so students should use limit orders to execute their trades at desirable prices (that is, avoid price impact). Students will also be under a time constraint and will potentially need to use some market orders in order to receive order fills in a timely manner.

b) Liability Trading

i. Liability Trading 1 - Trading as a Principal (*Mak, McCurdy*)

The first liability trading case introduces students to taking on price and liquidity risk by accepting a large block trade and requiring them to unwind the position in the open market. While closing the position, they will cause price impact due to limited (but reasonably high) liquidity in the market.

ii. Liability Trading 2 - Orders in Illiquid Markets (*Mak, McCurdy*)

The second liability trading case is considerably more difficult because it forces students to trade directly with each other in order to unwind their positions. A time constraint is also added, requiring that the trades be closed out by the middle and end of the trading session.

iii. Liability Trading 3 - Dynamic Order Arrival (*Mak, McCurdy*)

The third liability trading case is a dynamic version of the LT2 case; students will receive tender offers for two stocks at unknown intervals. They must quantify available liquidity, make a decision as to whether the premium offered by the buy-side institution is adequate given the liquidity risk, and then, if accepted, cover the accepted block trade at a profit while managing liquidity and market risk.

iv. Liability Trading 4 - Liability Trading Capstone (*Mak, McCurdy*)

The fourth liability trading case adds multiple marketplace functionality and requires students to seek best execution while weighing different commission and passive order rebate schedules.

c) Market-Making

i. Algorithmic Trading 2 - Algorithmic Market Making (*Mak, McCurdy*)

The second algorithmic trading case is considerably more difficult because it forces students to build on skills learned in the algorithmic arbitrage (ALGO1) case and motivate students to build a market-making algorithm that generates profits by capturing the bid-ask spread. As in the LT4 case, make-take fees differ across traditional and new exchanges.

ii. Algorithmic Trading 2e - Algorithmic Market Making Capstone (*Geoffrey, Kang, McCurdy*)

This case extends ALGO2 by introducing three securities with very different dynamics and make-take fees (analogous to TSX, NYSE, and a newer ATS exchange). These enhancements encourage participants to prioritize the application of their algorithmic market making across exchanges.

d) Algorithmic Smart-Order Routing

i. Algorithmic Trading 3 – Smart Order Routing (*McCurdy, Salerno*)

Given fragmented markets, managing liquidity risk by minimizing potential price impact has become even more challenging than it used to be when liquidity was focused on the traditional exchanges. In addition, it is essential to meet regulatory requirements to fill orders at the NBBO (National Best Bid and Offer) and to avoid gaming by predatory algorithms due to different latencies across exchanges. A smart algorithm is essential.

8. Arbitrage

a) Algorithmic Arbitrage

i. Algorithmic Trading 1- Algorithmic Arbitrage (*Mak, McCurdy*)

The first algorithmic trading case introduces students to algorithmic trading by providing a simple example of exploiting an arbitrage opportunity for one stock traded on two different exchanges.

b) Law of one price and arbitrage

i. Price Discovery 3 - Arbitrage Pricing (*Mak, McCurdy*)

The third price discovery case builds on the previous cases by adding a second company and an ETF. The ETF can be priced on an arbitrage-free basis using the market values of the two individual companies. Students should observe how the riskiness and distribution for the ETF is considerably different than the individually priced companies.

c) Location Arbitrage

i. Commodities 3 – Location Arbitrage (*McCurdy, Salerno*)

The Commodities Trading 3 Case will introduce students to the risks and opportunities associated with the concept of 'transportation arbitrage'. Students will be allowed to buy crude oil and transport it across different locations. In order to analyze risks and opportunities associated with their strategy, students need to forecast the price for the time at which the oil will arrive at the destination market and assess the probability of making a profit on location arbitrage trades.

d) Refinery arbitrage

i. Commodities 4 – Product Arbitrage (*McCurdy, Salerno*)

The Commodities Trading 4 Case will introduce students to the risks and opportunities associated with the concept of "production arbitrage". Students will be allowed to buy crude oil and refine it into two products, Heating Oil and RBOB Gasoline.

e) Commodities Capstone Case

i. Commodities 5 - Commodity Capstone (*Mak, McCurdy*)

The fifth commodities case requires students to 'juggle' a magnitude of arbitrage and asset pricing strategies to generate profits. Students can take positions based on fundamental views of crude oil, or they can engage in locational, product, or storage arbitrage.