



# **A Simulation-Based Approach to Learning Finance**

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**Rotman European Trading Competition Workshop**

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# Learning Goals: Preparing Students For Careers

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Practitioners need to operate in uncertain, complex, real-time environments:

- Learning goals: **develop skills in making decisions in real time** in realistic environments which make uncertainty explicit

On-going innovation is a necessity in a competitive global environment:

- Learning goals: **integrating research and practice and learning how to learn** promotes learning on the job which is a critical ingredient of innovation

Practitioners rarely have well-defined problems:

- Learning goals: go beyond cookbook approaches by designing **interactive simulations** that allow participants to experience implications of their actions and discover the main issues and optimal solutions

# Some Challenges

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## Diverse backgrounds:

- **Prior knowledge about institutional detail of markets and securities**
- **Adeptness with tools such as Excel**
- **Dealing with uncertainty in a quantitative way**

## Diverse aspirations:

- **Learning about different types of securities**
- **Learning how to identify, quantify and manage risks and opportunities**
- **Learning how to learn and find new solutions to new problems**

## Learning how to use dynamic learning strategies

- **Dealing with complexity and potential informational overload**
- **Coping with integrative exercises**
- **Allocating time to practice and make efficient use of feedback**

# Meeting the Challenges\*

## Interactive simulation methods:

- **Involve learning-by-doing which is active learning that engages participants**
- **Enhance individualized learning by allowing participants with different backgrounds to interact and learn from their own level**
- **Provide immediate feedback which contributes to a self-reinforcing cycle of learning**
- **Contribute to deep as opposed to surface learning**
- **Facilitate learning how-to-learn which promotes life-long learning**

## Critical inputs for innovation and the knowledge economy

**\*For more details see *'Meeting the challenge of innovation in management education: the case for interactive simulations'* by Woodhouse and McCurdy, 2012**

# Examples: Applications developed in the FRTL

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## 1. Rotman Interactive Trader (RIT) platform plus RIT cases

Analogous to a flight simulator

in our case learning how to make effective financial decisions in an uncertain world

<http://inside.rotman.utoronto.ca/rit>



## 2. Rotman Portfolio Manager (RPM) platform

Applying the strategies derived and tested using RIT

incorporating the institutional details involved with trading real securities

<http://rpm.rotman.utoronto.ca>



# What is the RIT (Rotman Interactive Trader) application?

- **RIT platform:** a flexible & robust order-driven market platform designed to facilitate learning objectives in innovative ways
  - For example, ANON traders may be turned on to provide liquidity – can be programmed to be informed or uninformed and can be adjusted during trading
- plus
- **RIT cases** focusing on particular learning objectives in a stochastic environment
  - Cases simulate risks and opportunities associated with securities/strategies
  - Learning objectives for each case are designed such that students can explore, learn, and practice strategies that achieve their desired goals
  - Also sequence from introductory (generally 1 source of risk) to richer cases for which the decision maker has to manage several risks
  - Real-time interface to Excel applications applying relevant finance theory --integration of research and practice
- **Note that the RIT cases are not just about trading; rather they cover wide variety of securities and objectives**
  - Learning to make effective decisions when one cannot predict outcomes with certainty

# RIT Features: RTD Links to Simulated Market

The screenshot shows an Excel spreadsheet titled "RIT2 - Trader Support - FB - Interest Rate Risk.xlsx". The formula bar for cell D17 contains the RTD formula: `=RTD("rit2.rtd","TB6M| BID")`. A red box highlights this formula, and a red line connects it to the "Bid" cell in the "Securit2.rtdy" table (row 17, column C).

**Rotman INTERACTIVE TRADER**  
**Excel Support for Fixed Income 3 - Interest Rate Risk**  
 File Version 1.0

								TB6M	TB12M		1YCP		Weeks Remaining		
									@ 6%	@ 9%	@ 6%	@ 9%			
<b>Purpose:</b>	This support file will show the valuation of the Treasury Bills and Bonds at each time point and allow you to calculate a probability weighted value 1 year bonds.														
<b>Case Data</b>															
<b>Cash:</b>	\$1,007,837.32							\$96.67	\$93.90	\$92.60	\$103.43	\$102.06	52	26	
<b>Time Remaining:</b>	235							\$96.80	\$94.02	\$92.72	\$103.37	\$102.00	51	25	
<b>Time in a Week:</b>	12							\$96.93	\$94.14	\$92.84	\$103.31	\$101.94	50	24	
<b>Weeks Remaining</b>	46							\$97.05	\$94.26	\$92.96	\$103.25	\$101.88	49	23	
<b>Current Risk Free Rate</b>	7%							\$97.18	\$94.39	\$93.08	\$103.20	\$101.82	48	22	
<b>Current Period</b>	1							\$97.30	\$94.51	\$93.20	\$103.14	\$101.76	47	21	
								\$97.43	\$94.63	\$93.32	\$103.08	\$101.71	46	20	
								\$97.56	\$94.76	\$93.44	\$103.03	\$101.65	45	19	
								\$97.69	\$94.88	\$93.57	\$102.97	\$101.59	44	18	
								\$97.81	\$95.00	\$93.69	\$102.91	\$101.53	43	17	
								\$97.94	\$95.13	\$93.81	\$102.86	\$101.47	42	16	
								\$98.07	\$95.25	\$93.93	\$102.80	\$101.42	41	15	
								\$98.19	\$95.38	\$94.05	\$102.75	\$101.36	40	14	
								\$98.32	\$95.50	\$94.18	\$102.69	\$101.30	39	13	
								\$98.45	\$95.62	\$94.30	\$102.64	\$101.24	38	12	
								\$98.58	\$95.75	\$94.42	\$102.58	\$101.19	37	11	
								\$98.71	\$95.87	\$94.54	\$102.53	\$101.13	36	10	
								\$98.84	\$96.00	\$94.67	\$102.47	\$101.07	35	9	
								\$98.96	\$96.12	\$94.79	\$102.42	\$101.02	34	8	
								\$99.09	\$96.25	\$94.91	\$102.36	\$100.96	33	7	
								\$99.22	\$96.37	\$95.04	\$102.31	\$100.90	32	6	
								\$99.35	\$96.50	\$95.16	\$102.25	\$100.85	31	5	
								\$99.48	\$96.62	\$95.29	\$102.20	\$100.79	30	4	
								\$99.61	\$96.75	\$95.41	\$102.15	\$100.74	29	3	
								\$99.74	\$96.88	\$95.53	\$102.09	\$100.68	28	2	
								\$99.87	\$97.00	\$95.66	\$102.04	\$100.63	27	1	

**Securit2.rtdy**

	Position	Bid Size	Bid	Ask	Ask Size	Volume	Weeks to Expy
TB6M	0	987	96.72	96.75	10	45734	20
TB12M	0	1133	93.2	93.25	2438	37535	46
1YCP	0	1027	102.76	102.79	144	39059	46

**Period 2 Rate Inference Table**  
 (only affects prices in period 1)

	Rate	Probability
	6%	50%
	9%	50%

**Performance Assessment**

<b>Your NLV</b>	\$1,007,837.32
<b>Risk-Free Portfolio</b>	\$1,007,837.32
<b>Excess Return (\$)</b>	\$0.00
<b>Excess Return (%)</b>	0.00%

Note: Once period 2 has begun, the rate is established so probabilities are ignored.

# RIT Features: RTD Links to Simulated Market

RIT2 - Trader Support - COM5 - Commodities Capstone.xlsx - Microsoft Excel

File Home Insert Page Layout Formulas Data Review View Developer Add-Ins Acrobat

Clipboard Alignment Number Styles

D9 =RTD("rit2.rtd",,B9,\$D\$7)

**Rotman**  
INTERACTIVE TRADER

**Excel Support Sheet Template for Commodities 5 Case (Commodities Capstone)**  
Support Sheet v1.0

Current Market Monitor								Trader Status Monitor	
	POSITION	LAST	BID SIZE	BID	ASK	ASK SIZE	VOLUME	Trader ID	
CL	0	99.82	3,000	99.31	99.33	3,000	0	Eric	
CL-1F	0	99.99	3,000	99.98	100.00	3,000	0	Eric Kang	
CL-2F	0	100.81	3,000	100.80	100.82	3,000	0	P&L	1,375

**News Monitor (Displays the Most Recent 4 News Items)**

Recent #	MONTH	News
1st	1	CL,HOPE RISES AS NEW PETROLEUM INDUSTRY BILL IS PASSED,A bill clarifying regulations on the Oil Industry in Nigeria has been passed. It is h
2nd	1	CL,WEEK 2 CL ACTUAL DRAW 2 MLN BBL VS FORECAST BUILD 1 MLN BBL,WEEK 2 CL ACTUAL DRAW 2 MLN BBL VS FORECAST BUILD 1
3rd	1	AK-CS-PIPE,PIPELINE COST FOR ALASKA TO CUSHING GOING DOWN TO \$34,000 PER LEASE.,PIPELINE COST FOR ALASKA TO CUSHING GO
4th	1	CL,WEEK 1 CL ACTUAL BUILD 9 MLN BBL VS FORECAST DRAW 1 MLN BBL,WEEK 1 CL ACTUAL BUILD 9 MLN BBL VS FORECAST DRAW 1

Crude Oil (CL) Fundamental Model					Forecasted Price			
<b>EIA Statistics Month 1</b>					<b>News Report Effects</b>			
	Actual	Expected	Differential	Net Effect	News Item	Month 1	Month 2	Starting Price
Week 1		7	8	1	0.1	1	-\$0.10	
Week 2		6	6	0	0	2	\$0.25	Month 1 EIA Report Effect
Week 3				0	0	3	\$0.06	Month 2 EIA Report Effect
Week 4				0	0	4	-\$0.50	
<b>Total</b>	<b>13</b>	<b>14</b>	<b>1</b>	<b>\$0.10</b>	<b>5</b>	<b>-\$1.00</b>		<b>Total Effects from EIA Reports</b>



# RIT Features: API from Excel to the RIT Platform

- **Allows algorithmic trading, for example:**
  - **To implement an arbitrage strategy across alternative markets**
  - **To implement a market-making strategy**
  - **Etc.**
  
- **Writing a VBA script can clarify participants' thinking about a strategy**
  
- **Running their algorithm by linking it to the relevant RIT ALGO case:**
  - **Allows testing of the algorithm design**
  - **Promotes better understanding of the relevant theory**
  - **Provides immediate feedback about the effectiveness of their strategy**
  - **Assesses competitiveness of their strategy relative to their cohort**
  - **Promotes on-going learning**

# Example from RIT ALGO1 Case

```

(Function) arb
Function arb(timerremaining)
    Dim API As RIT2.API
    Set API = New RIT2.API

    If timerremaining < 295 And timerremaining > 5 Then

        If Range("CRZY_A_BID") > Range("CRZY_M_ASK") Then
            OrderID = API.AddOrder("CRZY_M", 1000, 0, API.BUY, API.MKT)
            OrderID = API.AddOrder("CRZY_A", 1000, 0, API.SELL, API.MKT)
        End If

        If Range("CRZY_M_BID") > Range("CRZY_A_ASK") Then
            OrderID = API.AddOrder("CRZY_A", 1000, 0, API.BUY, API.MKT)
            OrderID = API.AddOrder("CRZY_M", 1000, 0, API.SELL, API.MKT)
        End If

    End If

End Function

```

	A	B	C	D	E	F	G	H	I
1		Bid	Ask		Time Remaining				
2	CRZY_A	10.15	10.16		156	<--=RTD("rit2.rtd", "TIMEREMAINING")			
3	CRZY_M	10.1	10.12						
4									
5					0	<--=ARB(E2)			
6									
7									
8									

# Some auxiliary learning facilitated by RIT cases

- **How markets work: types of markets and market microstructure details**
- **The role of market participants (market makers, buy side, etc.)**
- **How security prices get determined reflecting**
  - **Fundamentals, information & news, market structure, trader behaviour, etc.**
- **Motivations for trading (arbitrage, speculation, hedging, etc.)**
- **Learn effective trading/investment/risk management strategies by applying finance theory**
- **How participants generate liquidity, volatility, profits/losses, informational & allocative efficiency**
- **The ‘business of trading’ is not just trading but is involved with every step:**
  - **trade idea generation & structuring**
  - **executing the trade**
  - **managing the position or rebalancing; etc.**
  - **identifying, quantifying & managing risks at each step, including:**
    - **liquidity risk, market risk, interest rate risk, FX risk, model risk, operational risks, etc.**
- **Our suite of RIT cases focus on many of these issues**

# RIT2 Case Topics

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- **Our RIT 2.0 (RIT2) cases cover three broad topic areas**
  - **Market Microstructure**
  - **Asset Pricing**
  - **Portfolio and Risk Management**
  
- **For a list of cases currently available see**  
<http://inside.rotman.utoronto.ca/rit/cases/>
  
- **I will summarize some details for a few sample cases**

# Sample Market Microstructure Case: Liquidity Risk

## RIT2 LT2 – Orders in Illiquid Markets

- **Having already learned about how order-driven markets work using the agency trading cases, one can then add the issue of liquidity risk**
- **In this case, the liability desk uses the firm's capital to buy or short securities and generates profits and losses depending on the skill of the liability trader**
  - **Facilitating buy side institutions that want to accumulate or dispose of a position with expediency by offering to buy a block of shares at a premium, or sell shares at a discount, immediately, rather than waiting for a typical agency-type execution (VWAP/TWAP accumulation, dark pool, or block trades)**
  - **Traders are introduced to marketable limit orders to control price impact and liquidity risk management strategies**
- **Case brief, teaching notes, discussion questions, and solution hints:**
- **Reports:**

# Sample Risk Management Case: Price & Production Risks

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## RIT2 Crop Hedging (AH1) Case:

- **Students may have already practiced how futures contracts are valued and traded using the F1 and F2 cases**
- **The AH1 case introduces the problem of hedging price risk for wheat when there is also production risk which will influence the optimal number of futures contracts**
- **Case brief:**
  
- **Case solution:**

# Sample Commodities Case: NG Futures

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## RIT2 COM2 – NG Futs Case

- **Analyze news affecting supply & demand for natural gas and transact NG futures contracts for alternative delivery months**
- **Case brief:**
- **Case tutorial:**
- **Excel support: see next slide**

# Example Excel Support for the Commodities 2 Case

**Rotman INTERACTIVE TRADER** Excel Support Sheet Template for Commodities 2 Case (NG Futures) RIT 2.0

	POSITION	LAST	BID SIZE	BID	ASK	ASK SIZE	VOLUME
NG1JUL	0	5.76	3	5.76	5.79	1	855
NG2AUG	0	5.56	2	5.56	5.58	5	791
NG3SEP	0	5.66	9	5.66	5.67	2	817

User Name	Eric Kang
Current P&L	0

Month	July
Time Remaining	444

Recent #	PERIOD	HEADLINE	BODY
1st	1	** Severe Weather Forecast for Aug/Sept **	Weather forecasters suggested that there was a slightly lower chance of severe tr
2nd	1	WK #1 July - Storage Estimate (Historic Base Case) : 60 BCF.	
3rd	1	WK #1 July - Department of Energy Weekly Storage Data : 78 BCF.	
4th	1	WK #1 July - Department of Energy Weekly Usage Data : 437 BCF.	

	Expected BCF (Do Not Touch)			Input Area (Input Forecasted & Actual)			Calculation Area (Do Not Touch)			Forecasted prices			
	July	NG Supply	NG Usage	NG Storage	NG Supply	NG Usage	NG Storage	NG Supply	NG Usage	NG Storage			
July	Week 1	500	440	60				500	440	60	July Variance Factor	90	
	Week 2	500	440	60				500	440	60	July Forecast Shortfall	0	BID 5.76
	Week 3	500	440	60				500	440	60	Expected Historic Price	\$6.00	ASK 5.79
	Week 4	500	440	60				500	440	60	Forecasted July Price	\$6.00	Signal BUY
	<b>Total</b>	<b>2000</b>	<b>1760</b>	<b>240</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2000</b>	<b>1760</b>	<b>240</b>			
August	Week 1	495	405	90				495	405	90	Aug Variance Factor	70	
	Week 2	495	405	90				495	405	90	Aug Forecast Shortfall	0	BID 5.56
	Week 3	495	405	90				495	405	90	Expected Historic Price	\$5.80	ASK 5.58
	Week 4	495	405	90				495	405	90	Forecasted Aug Price	\$5.80	Signal BUY
	<b>Total</b>	<b>1980</b>	<b>1620</b>	<b>360</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1980</b>	<b>1620</b>	<b>360</b>			



# Sample Commodities Case: Commodities Capstone

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## RIT2 Commodities Capstone Case:

- **Buy and sell crude oil and related products**
  - **In response to their analysis of various news releases affecting the price of oil**
  - **Introduces asset technologies: storage, ships, pipelines, refineries, etc.**
  - **Identify and exploit arbitrage opportunities occurring in the spot and futures markets as well as across different location and crude oil products**
  
- **Case brief and solution discussion**
  
- **Example Excel support: see next slide**

# Example Excel Support for Commodities 5 Case

RIT2 - Trader Support - COM5 - Commodities Capstone.xlsx - Microsoft Excel

File Home Insert Page Layout Formulas Data Review View Developer Add-Ins Acrobat

Arial 10 Bold Italic Underline Merge & Center General \$ % .00 .00 Conditional Formatting as Table Normal Bad Good Neutral Calculation Check Cell Insert Delete Format Cells


H19 fx

**Rotman** **Excel Support Sheet Template for Commodities 5 Case (Commodities Capstone)**  
 INTERACTIVE TRADER Support Sheet v1.0

Current Market Monitor								Trader Status Monitor		Case Data	
	POSITION	LAST	BID SIZE	BID	ASK	ASK SIZE	VOLUME	Trader ID	Eric	Month	1
CL	0	99.62	3,000	99.61	99.63	3,000	0	Name	Eric Kang	Time Remaining	526
CL-1F	0	100.62	3,000	100.61	100.63	3,000	0	P&L	0	Commission per Contract	\$1.00
CL-2F	0	101.60	3,000	101.59	101.61	3,000	0				

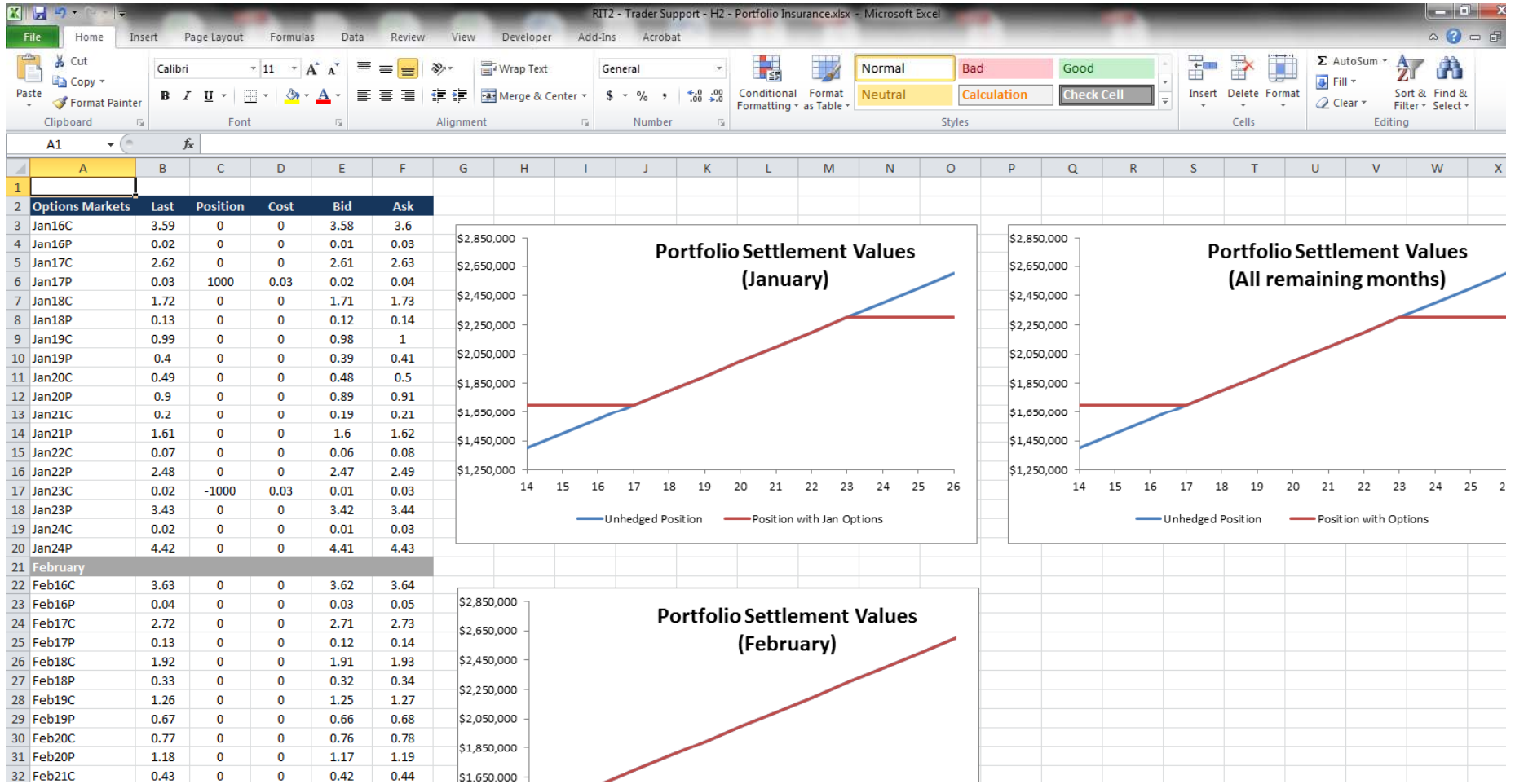
**News Monitor (Displays the Most Recent 4 News Items)**

Recent #	MONTH	News
1st	1	Welcome to the Commodities Trading 5 Case,
2nd	1	
3rd	1	
4th	1	



Crude Oil (CL) Fundamental Model					Forecasted Price				
<b>EIA Statistics Month 1</b>					<b>News Report Effects</b>			<b>Starting Price</b>	
	Actual	Expected	Differential	Net Effect	News Item	Month 1	Month 2		\$100.00
Week 1	7	8	1	0.1	1	\$0.20		Month 1 EIA Report Effect	(\$0.10)
Week 2	6	6	0	0	2	\$0.24		Month 2 EIA Report Effect	\$0.00
Week 3	4	2	-2	-0.2	3	\$1.00		<b>Total Effects from EIA Reports</b>	<b>(\$0.10)</b>
Week 4			0	0	4	\$0.75		Month 1 News Report Effect	\$1.86
<b>Total</b>	<b>17</b>	<b>16</b>	<b>-1</b>	<b>-\$0.10</b>	5	-\$0.23		Month 2 News Report Effect	\$0.00
					6	-\$0.10		<b>Total Effects from News Reports</b>	<b>\$1.86</b>
<b>EIA Statistics Month 2</b>								Commission	
	Actual	Expected	Differential	Net Effect					\$1.00
Week 5			0	0				<b>Forecasted Price</b>	<b>\$101.76</b>
Week 6			0	0					<b>BUY</b>
Week 7			0	0					
Week 8			0	0					
<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>Total</b>	<b>\$1.86</b>	<b>\$0.00</b>		

# Example Excel Support for Portfolio Insurance (H2) Case



# Sample Options Case: Trading Volatility

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## RIT2 OP2 Compound Options Case

- **Having practiced how options are priced (OP1) and used for portfolio insurance (H2), this case allows participants to practice building compound option positions (such as, straddles, strangles, butterflies, condors), in order to speculate on volatility**
- **Case brief**

# Evaluation of RIT Case Performance

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- **Due to stochastic outcomes, have to be careful to not base marks on outcomes from a small number of replications**
- **Average of rank across replications is often better than average profits/losses across replications**
- **Some cases have a reliable mapping between rank and ability for two or three replications -- other cases require more replications due to a greater impact of stochastic realizations**
- **In all cases, thinking about the learning objective, one can come up with a reward scheme that reflects and reinforces the learning objectives**

# Evaluation of RIT Case Performance, continued

- **Evaluating performance based on profits is not appropriate in all cases**
  - **Example: H2 Case – hedging effectiveness is the objective**
  
- **Case reports summarizing case objectives, appropriate strategies, and outcomes**

**For example:**

  - **Executive summary including an explicit summary of the strategy**
  - **A comprehensive but succinct summary of results in the context of the strategy**
  - **Tables and Figures supporting results integrated into the text of the report**
  - **Supporting Appendices: trading history (must be output from the RIT case) and**
  - **Excel support application used to apply finance theory for deriving the strategy**
  
- **Complementary RPM Case**
  - **Apply what you learned with the simulated RIT Case to real-time quotes for actual securities**

# What is RPM (Rotman Portfolio Manager)?

- **RPM platform: allows participants to construct, track and analyze a portfolio of stocks, bonds, options and futures in real time**
  - **Excel applications are linked to real-time quotes for actual securities**
  - **Designed to maximize educational value by providing simple, relevant and realistic portfolio management tools**
  - **Instructors have access to customizable monitoring and evaluation tools that generate meaningful data about student performance**
  
- **RPM cases can be designed to complement RIT cases**
  - **Reinforce the learning objectives of the RIT simulation cases by applying the strategies to real-time quotes for actual securities**
  - **Contributes to knowledge of institutional details**