PORTFOLIO MANAGEMENT FOR COMPETITIVE TRADING

FINAL EXERCISE

FALL 2016

I. Overview:

Managerial factor is just as important as entrepreneurial factor in trading. A good idea needs to be accompanied by a powerful risk management system to thrive and bring the most profit (Gehm, 1995). However, the case is different for trading competitions, where the uniform currency is virtual and less sentiment is involved. A wide-known, time-tested strategy for general stock picking competition is to select two highly risky stocks and hold them. Even though this method does not guarantee any significant chance of success, it might give you the highest chance to win (John Huang, 2015).

CME Group Trading Challenge, nevertheless, leverages the difficulty even more significantly by restricting the forms of contracts, available commodities, number of trades per day and trading platform. Thus, this paper would aim at analyzing how risk factors are managed and capital is allocated in unconventional, semi-realistic situations with CME Group Trading Challenge the foremost subject. This paper would also differ from other approaches by including emotions and utilities in portfolio management guidelines for competitive trading[1][2].

II. Definitions:

- CME Trading Challenge: is an annual trading challenge in which participants are confined to specific commodities. The contracts for 2017

[1] #audience: The paper is tailored for academic readers, hence the formal and technical writing. This does not only make it easier for the audience to read, but also adds a sense of credibility to the paper.

[2] #presentation: The paper follows APA guidelines, thus presents itself effectively and professionally.

include Agriculture, Energy, Metals, Equity Index, Interest Rates, and Currency Futures. It is required that each team trade at least 10 contracts per day[3].

- Trading strategies: While they are as important as the managerial aspect, in the scope of this paper, I assume that trading strategies are basic moving average, momentum, and long-short hedging that could be simply implemented on a semi-automated robo adviser. The challenge includes 2 rounds: a 10-day Preliminary round and a 14-day Final Round. Trades on a margin is available (CME Website, 2016)
- Platform: The official platform is CQG Integrated Client Platform. However, for sake of familiarity and simplicity, mock strategies are created and back-tested on Quantiacs and MetaTrader 4. Simple simulation of chances is created on Python.

III. Method:

To win the CME Group Trading Challenges, participants are required to finish in the top 10% in the Preliminary Round and the Top 5 in the Final Round (CME Group Website, 2016). This requires aggressive trading techniques. Per the data available on the official website, profits of 34% in 10 days and 75% in 15 days respectively are required for one team to win. This means a gross profit of 3% per day to win the Preliminary Round and a profit of 4.1% a day (not

[3] #selflearning: Teach myself about Futures market, CME Trading Challenge, and back testing. Three techniques that I find most effective for this purpose is Self-explanation (explain how futures market works then cross check on the internet), Elaborative Interrogation (constantly questions about competition regulations), re-reading, and Imagery for text. Two principles, namely deep processing, and desirable difficulty, are also used to enhance learning experience.

trading on margin) to win the Final Round, which is much higher than the usual daily profit of an average day trader (0.6% per day) (Mitchell, 2016). Thus, extensive risk exposure is a staple part in this competition. The above daily profit requirement, together with the drawdown limit (accounts would be prevented from further trading if a daily loss of 20% is realized), would be the main constraint for risk management. Other constraints include varied trading hours for specific commodities, ban of algorithmic trading, and the number of minimum daily contracts required (10). [4, 5]

Regarding the nature of the competition, I seek to establish a framework for utility and risk management so they could be systematically categorized and managed. This will minimize the unnecessary losses, prevent negative feelings (regret) and optimize trading strategies so they could obtain optimal results.

To estimate risk and how it relates to profit, probability risk assessment is considered. Per Fred Gehm in *Quantitative Trading & Money Management: Revised Edition,* it involves six steps. Nevertheless, as the scenario to analyze is a competition, not only the effectiveness of the strategies but also the probability of the goal of getting to top 5 is stressed. Thus, I reverse the problem heuristics of Fred Gehm's method from a bottom up to a top down approach. We would start by estimating the probability of winning the competition, then

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[4] #constraints: Constraints, which place boundaries for a solution, are identified. This sets up a framework on how to reach the goal of winning the CME Trading Challenge. Later, these constraints would be considered and embraced in problem solving process (devising and back testing trading strategies).

[5] #support: Evidences are effectively structured to support the argument that aggressive trading techniques are necessary to win CME Trading Challenge. Evidences involve numbers from reliable, primary sources (CME Website) and justify the argument, showing its consistency.

set up mini-goals and analyze what hazard might prevent us from reaching those goals. The heuristics would, hence, be presented in the following order:

- Figure out potential hazards. By the author's description, a hazard should be "clear, intractable, and serious", which means that it is big enough that everyone would realize after its occurrence. In this case, the two biggest problems would be the logics of the strategies and their implementations. Ideally, strategies should consider the fore mentioned constraints to spot rapid, possibly intraday, trading opportunities. Strategy implementation requires, at the same time, a firm grasp of the strategy and rational decisions.[6]
- Figure out what causes the hazard. This step is subject to biases as emotions prevent the traders from realizing their mistakes and encourage them to condemn the general market or its various agents.
- Organize and categorize the causes of failure. For this purpose, a more formal variation of the fishbone diagram called the fault tree is made use of.
- Calculate the total system risk by adding up the probabilities of failures. A simple simulation of the interaction of trading strategies would be implemented for this purpose. Due to its nature as a complex system, emergent properties caused by irrational behaviors (i.e. inexperienced traders make risky decisions or a crisis happens in real life causing extreme drawdowns for strategies) may happen. Such events could only be

[6] #rightproblem: The two principle problems are identified and targeted during risk management. Goal states are defined, obstacles, constraints and possible consequences are then further discussed in the following paragraphs as we move on to other steps in probability risk assessment.

generalized as extreme situations; it is impossible to correctly estimate their probabilities. However, participants should always take note and anticipate them as our guideline's purpose is to limit negative emergent properties as much as possible[7].

- Estimate the probability of each failure or sub-failure. Human-rooted risks aside, there are two ways to measure a strategy's risk (Narang, 2009): the direct approach measures volatility, which is the standard deviation of the returns of instruments over time, the indirect approach measures cross-sectional association of involved instruments (the less correlative they are, the more diversified the trading strategy hence less risk the trader is exposed to). Depending on the portfolio construction model, trading ideas might be position-weighted (every idea receives equal proportion), risk-weighted (every idea is weighted based on its inherent risk), or alpha-driven weighted (the "alpha" model or the core strategy model of the algorithm determines which idea should be prioritized) (Rishi Narang, 2009). To reduce complication and prevent unnecessary risk exposure for inexperienced traders (namely undergrad participants of the competition), I include only two former weighting methods in the process of probability risk assessment.
- Figure out the solutions for each specific risk. This step would be supplemented and complimented by simulations of the trading strategy, a

[7] #emergentproperties: Possible random effects formulated as a result of complex interactions among agents are identified. This identification is integrated to make more realistic comment about the approach

Minimax Regret equation and an analysis of previous data and a simulation of the winning chance. The goal is to test the combination of trading strategies (or trading system) on three levels of analysis (of the system itself, of the system in relevance to those of other participants, and of the system's emotional impact on team members).

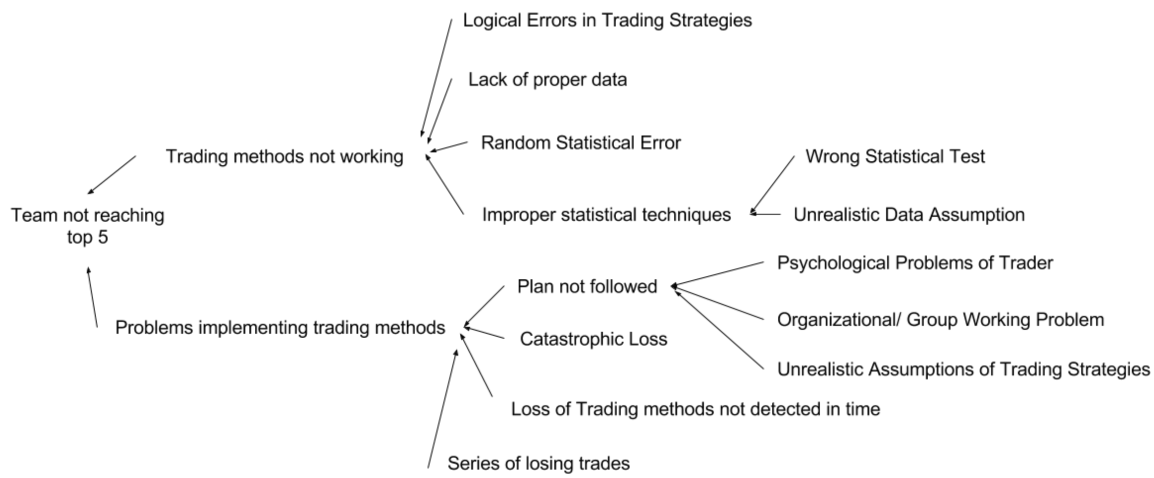

Fig 1. Fault Tree for CME Group Trading Challenge.

For the purpose of this paper, which is portfolio management, I focus on hazards which require simulation and modeling while leaving others for further professional approaches.

IV. Case study – CME Group Trading Challenge:

Following the method above, portfolio management aims at minimizing technical errors. These errors, however, root in the irrational minds of traders and possible illogical decision in trading strategies.

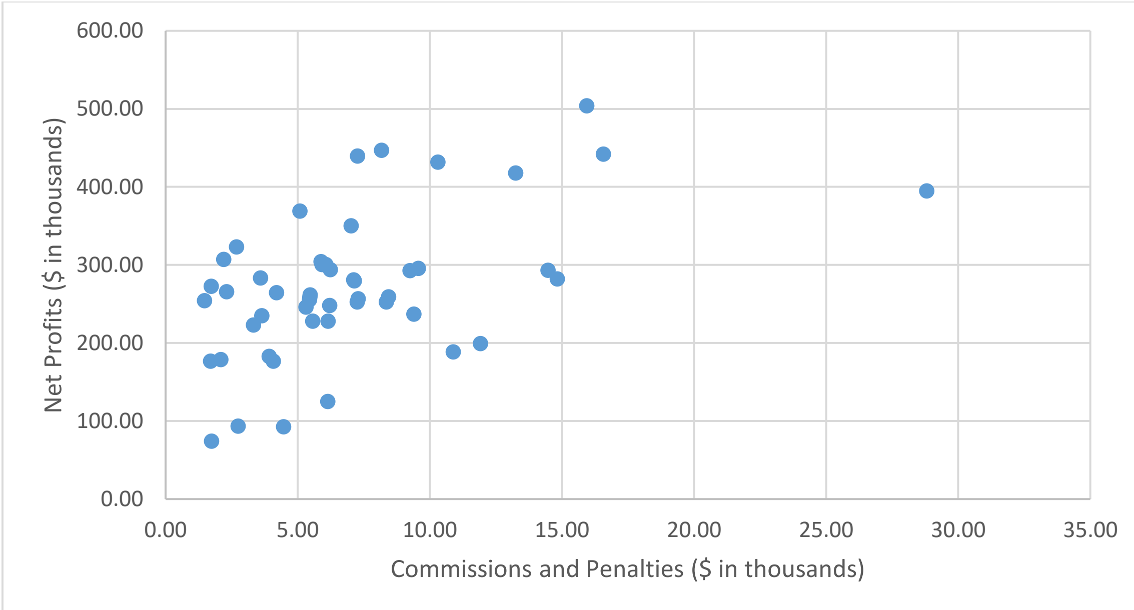

Fig 2. Scatterplot of Commissions and Penalties versus Profits among CME participants in 2016 (data retrieved from CME Group Official Website[8])

As a trading competition without the involvement of real money, it is expected that participants would be extra aggressive. This is indeed visible through the above scatterplot, where there is a positive correlation between commissions and penalties and net profits. While it may seem a hasty generalization to group penalties (for the lack of trading activities) and commissions (which increase proportionally to the number of trades), they could both be regarded as calculated risks (One group of participants could choose to hold their assets as they believe those assets return much more than the $1,000 penalty). In fact,

[8] #dataviz: Interpret, analyze, and create data visualization. The correlation between commissions and penalties and net profits (or on a more abstract level, the correlation between calculated risk and gain) is displayed in the above scatterplot. Scatterplot proves to be optimal to display data in this scenario as viewers could mentally and visually realize the trend line, which indicates correlation between these two variables.

the 1st prize winners are one of the most aggressive group, which ranks third in terms of commissions and penalties.[9]

The level of activeness required by CME enforces participants to day trade instead of trading inter-daily as asset held overnight carries the risk of loss and penalties. The more trades there are, the more likely loss may happen. At this point, the profitability relies on the logic of the trading system.

Even when the trading system tries to play with chances (John Huang's favorable cases), the buy-and-holder could not take all the first five leading positions in one competition (as the chance is 22%^5 = 0.05%, which is extremely slim). To attempt to recreate a close resemblance of the competition, where the teams coming to final round have skill and choose to expose to more risks, I modify John Huang's code so that alpha (or stock selection skill) and beta (or volatility in relation to a hypothetical low risk benchmark) is included[10].

```
import numpy as np
num_sims = 1000 #total number of test cases. 1000 would be large enough to return objective result
num_participants = 500 #total number of groups participating in the competition. 500 is the norm in CME.
i_won = [] #create a blank array which stores binary result of each test case.
personal_alpha = float(raw_input("Insert alpha: ")) #insert alpha
personal_beta = float(raw_input("Insert beta: ")) #insert beta
for sim in range (0, num_sims): #create loops equal to total number of test cases
```

[9] #correlation: Correlation is realized through the scatterplot displayed above. However, no causation is assumed. I approach the correlation merely as a constraint to a goal (each team is required to make 10 trades a day) than a goal itself. This is the foundation for further thoughts regarding risk management.

[10] #optimization: Evaluate and apply optimization techniques. The shortfall of the original cost is realized (it does not satisfy the intended situation where most teams take risky decisions). This code, however, could be further optimized by adding the number of trades. This approach, nevertheless, might not be necessary due to teams' dynamic nature (we cannot estimate how many trades they make). The consequence of this is further discussed when the final probability is considered.

```
    returns = np.random.uniform(0,2, num_participants) #fill blank array with random beta of each group
    benchmark = np.random.uniform(-0.5,0.5) #generate a random benchmark
    returns = [x*benchmark for x in returns] #include benchmark in the return of each group (benchmark*beta)
    returns = [x + np.random.uniform(-0.1, 0.1) for x in returns] #include alpha in the return of each group. (benchmark*beta+alpha)
    my_ret = personal_beta*benchmark + personal_alpha #compare max value to individual return
    returns = sorted(returns) #sort returns array in increasing order
    i_won.append(1 if my_ret > returns[-5] else 0) #add binary value of result into i_won array
win_prop = np.array(i_won).mean() #calculate the probability that my team is included in prize winners list
std_err = 1.96*np.sqrt (win_prop * (1 - win_prop) / num_sims) #calculate standard error

print "Win probability (Upper)", win_prop + std_err
print "Win probablity (Lower)", win_prop - std_err
```
[11]

Per the result, even when a group adopt the buy-and-hold strategy, they could still only have a slightly higher than average chance to win (3.5% compared to the default 2% chance), daily penalties not to mention.

The competition, as it turns out, is no longer a game of randomness, but calculated risk. A good system (which is accompanied by a higher than average alpha) has a clear edge. A beta of 1.5 and an alpha of .15 result into over 22% of winning. If the same edge is maintained throughout the competition, the team would, then, stand high chance of winning.

The risk of one strategy, then, requires back testing. The following back-test of a sample Moving Average conducted via Metatrader 4 gives valuable information about the trading strategy, which the guideline provided by Justin Kuepper (Investopedia) explicitly presents. For the purpose of portfolio management, due attention is paid towards net profits and drawdown. Net

[11] #modeltypes: a mathematical model of how participants' strategies affect each other in the competition is included. One shortfall of the mathematical model in this case is that the relationships are defined numerically and one trading instance (one trading idea) is considered. More nuances of it is discussed later in the paper.

profit should reveal the alpha (commodity' beta could be calculated by comparing its price with the proper index as benchmark); and max drawdown should not exceed the permitted daily drawdown to prevent unnecessary emergent properties in the trading process.

Initial deposit	10000.00			Spread	Current (13)
Total net profit	238.40	Gross profit	607.40	Gross loss	-369.00
Profit factor	1.65	Expected payoff	1.40		
Absolute drawdown	18.60	Maximal drawdown	350.40 (3.39%)	Relative drawdown	3.39% (350.40)
Total trades	170	Short positions (won %)	81 (97.53%)	Long positions (won %)	89 (97.75%)
		Profit trades (% of total)	166 (97.65%)	Loss trades (% of total)	4 (2.35%)

Fig 3. Backtest result of Moving Average Strategy on EUR/USD 2005-2016

(self-conducted via MetaTrader 4)

In a complex trading system involving various trading ideas, however, strategies involving the same or fundamentally correlated commodities present inherent risks. All strategies would be severely affected should an event occurs to the commodities in general. In this case, the Minimax Regret Formula proves to be quite useful by comparing strategies' returns in distinct scenarios so that minimum regret would be suffered should a loss occurs. Contrary to the popular beliefs, I am convinced that emotions play a significant role even in a market simulation game. While the experience of loss may not incur any significant emotions, the margin between expected and experienced utilities may lead to series of faulty decisions after a loss, especially in a manual trading competition such as CME[12]. Comparing and selecting a solid, emotion-

[12] #emotionaliq: In this case, I do not assume how participants feel in a market simulation games, but rather go against the popular belief in support of their nuanced sentiments in competitions. I go further to justify this variety of emotions by the concept of #utility and use it to improve my guidelines.

detached system at the beginning would minimize erroneous decisions in the future.

	State A	State B	State C	State D
Investment A	50.00	**60.00**	140.00	2,200.00
Investment B	**200.00**	0.00	**170.00**	**2,210.00**
Investment A	**150.00**	0.00	**30.00**	**10.00**
Investment B	0.00	**60.00**	0.00	0.00

Fig 4. The Minimax Regret Rule encourages decisions that incur smallest maximum regret (with regret defined as the hypothetical loss of profit choosing among investment ideas), in this case investment B.

V. Conclusion:

CME Group Trading Challenge proves to be a Goldilocks condition to learn about portfolio management. It cuts out much of the noises (market movements due to trading volume and human factors such as bubbles and social pressures) while retain pretty much the essence of the market (varied commodities, time constraints and competitive factors). By going through the steps of simulating the competition on three levels, namely inter-group (strategy selection in relevance to others'), intra-group (Fault Tree) and individual (Minimax Regret Rule), I hope to set up a guideline for portfolio management that could be used in competitive trading and later expanded to wider, more complicated environments such as the financial market or any social scenarios that require collectively rational and critical thinking.

VI. References:

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