Margin requirement calculations for complex options portfolio
The need for a consistent regulatory framework
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1. Introduction

Equity option margin requirements in the U.S. markets are usually determined by either a Regulation T rule for regular customer accounts, covering most retail customers, or by Customer Portfolio Margin covering more sophisticated option portfolios.

Regulation T, commonly referred to as "Reg-T", is a collection of provisions established by the Federal Reserve Board that govern the amount of credit that brokerage firms and dealers may extend to customers for the purchase of securities, i.e. set of rules for the calculation of margin requirements for investors[1].
Reg-T is quite simple in that it is mostly based on percentage of the notional amount. Even for short options positions it is a percentage of the notional adjusted for the out of the money amount. However, when a portfolio consists of multiple options and equity positions, some which offset the risk of others – Reg-T calculations actually become quite complex and in some cases do not yield a unique result.

Depending on the calculation logic, very different Reg-T requirements are possible, even if they all follow the same rule set. This has been a major issue for clearing firms when dealing with complex option portfolios. This paper discusses the implementation of Reg-T for complex options portfolios along with suggestions and recommendations.

Customer Portfolio Margin ("CPM") on the other hand is based on the Option Clearing Corporation's TIMS methodology[2], which uses theoretical value calculations based on defined stress tests to determine the margin requirement for an options portfolio. However, CPM has it's own set of deficiencies that are also discussed in this paper.

The result is a fragmented, inconsistent options margining framework in the U.S. that needs an overhaul, recommendations for which are provided at the end.

2. Option portfolios and Reg-T

While the margin required for a single option under Reg-T is trivial, the regulators did recognize the need to offer relief for risk reducing positions as opposed to a punitive method of simply adding requirements of individual positions. This was originally done by explicitly defining various hedging strategies and the associated Reg-T margin calculation. The strategies include structures such as long option spreads, butterfly and condor strategies etc. The onus of calculating the correct Reg-T margin lies with the clearing firm, and even with calculations for each individual option strategy, while Reg-T may seem rather simple on first glance, it actually can be quite challenging for a complex options portfolio.

The question does arise as to why a complex options portfolio would be margined using Reg-T and not using a more sophisticated Customer Portfolio Margin based on the OCC TIMS methodology[3].

While it is true that most complex option portfolios will typically choose to be margined using Portfolio Margin, some sophisticated options traders prefer to use Reg-T margin primarily when the portfolio has

many options spreads. This is due to the fact that CPM imposes a short options minimum for all short options, with no such requirement in Reg-T and thus in such portfolios Reg-T can result in a lower margin requirement than CPM. In addition there are other issues with CPM calculations for deep out of the money options, discussed in section 6, which have resulted in some traders preferring Reg-T. Such an arbitrage condition between two regulatory calculations on the same portfolio should not exist and by definition RegT should produce a more conservative requirement than CPM.

3. Original Reg-T

The original Reg-T calculations for options[4], which is still used by many industry participants, required the explicit identification of various option spread strategies, and for each strategy provided the requirement calculation. This included Butterflies, long and short call or put spreads, condors etc.

The issue with this method was that a given portfolio could potentially be decomposed into different spread strategies, each with a different Reg-T requirement – thus the Reg-T requirement for a given portfolio was not necessarily unique. This is demonstrated in the example below:

Example #1:

100	Call	100
105	Call	-100
115	Call	-100
130	Call	100
140	Call	-100

Portfolio. Assume stock price of $100

Scenario 1: Portfolio was identified as having the following spreads and remaining short option

Long Call Spread	100 / 105	100 lots
Short Call Spread	115 / 130	100 lots
Short Call	140	100 lots

Total Reg-T requirement*:

$15*100*100 + Min[20%*100 – (140-100),10%*100] *100*100 = $250,000

Scenario 2: Portfolio was identified as having the following spreads and remaining short option

Long Call Spread	100 / 105	100 lots
Long Call Spread	130 / 140	100 lots
Short Call	115	100 lots

Total Reg-T requirement*:

$0*100*100 + Min[20%*100 – (115-100),10%*100] *100*100 = $100,000

Thus it is obvious that simply using a different logic to construct the spreads changes the Reg-T requirement significantly. In fact there could be several other spread scenarios for the same portfolio resulting in different requirements.

The above example is for a very simple portfolio. Larger, more complex portfolios can be extremely complicated to determine the correct Reg-T requirement

Another significant issue with the original Reg-T methodology was that the spreads had to be exactly as defined in the guidance, otherwise they would not be eligible for spread relief treatment. E.g.

Example #2

100	Call	100
110	Call	-100
120	Call	-100
130	Call	100

Portfolio. Assume stock price of $100

This meets the definition of a standard long condor and thus has no Reg-T margin requirement as it is fully hedged and riskless.

However, if the portfolio was:

100	Call	100
110	Call	-100
120	Call	-200
125	Call	200

The portfolio is also hedged and has no risk. However this does not meet the definition of a condor and will have a margin requirement of about $100,000 depending on how the spread pairings are created.

The calculation of Reg-T for a portfolio with many options spreads largely depends on the logic path taken by the calculation program. Depending on which type of spread is paired off first can result in very different requirements. Since there is no accepted or published logic recommendation, each software system has its own logic and thus a different Reg-T requirement.

4. Universal Spread treatment

In 2013 the CBOE proposed a universal spread margin rule[5] to solve the above deficiencies in Reg-T calculations, which was subsequently approved by the regulators[6].

The universal spread rule recognized that all strategies are essentially comprised of combinations of two-legged spreads. Thus a portfolio can be decomposed into a series of two-legged spreads and then the worst case loss can be calculated assuming intrinsic value of all spreads. This would result in a margin requirement with greater accuracy. While this is true, the universal spread treatment application has the following issues:

- The clearing firm will still need to identify the correct spreads. The identification of spreads may not unique and different or inefficient logic can result in non-optimal results
- After identifying the spreads, the profit/loss for each spread will have to all be calculated at various underlying price levels (no model based theoretical calculation, just intrinsic value calculations). This does add a layer of complexity to the methodology

Given these issues, the adoption of the universal spread rule has not been industry wide till date.

Let's return to our example #2

The traditional Reg-T did not recognize the spreads as they did not meet the standard definition of a condor. Using the universal spread rule however, it is paired off as:

Long Call spread 100/110 calls in 100 lots

Short call spread 120/125 calls in 200 lots

The methodology will calculate the intrinsic value at 100, 110, 120 and 125. In no case will there be a loss and thus the margin requirement will be 0

Saying this however, even the universal spread rule does not guarantee a unique result of spread pairings – for a complex portfolio there could exist multiple ways to pair off the spreads.

Let's take another example

Example #3

100	Call	-20
102	Call	-20
104	Call	-20
106	Call	-20
108	Call	-20
110	Call	100
115	Call	-50
120	Call	-50

If we create the following spreads:

Short Call Spread 100/110 20 lots
Short Call Spread 102/110 20 lots
Short Call Spread 104/110 20 lots
Short Call Spread 106/110 20 lots
Short Call Spread 108/110 20 lots
Remaining Short calls 115 Call -50 lots and 120 Call -50 lots

The Reg-T requirement based on the maximum loss at an underlying price of 110 will be $50,000 for the spreads + margin on the short options

However the same portfolio can be constructed as :
Long Call Spread 110/115 50 lots
Long Call Spread 110/120 50 lots
Remaining Short calls total of 100 lots from 100 to 108
The Reg-T requirement at an underlying price of 110 will be $0 for the spreads + margin on the short options

This clearly demonstrates that even the universal spread logic can result in different Reg-T margin requirements for exactly the same portfolio simply depending on the spread pairing logic deployed.

The universal spread methodology is a significant improvement from the original Reg-T however its details were limited at best. It did not address several related issues like the treatment of options covered with stock, leaving it to market participants to guess on the correct overall methodology.

5. Optimal logic for spread identification

From a logic perspective, the identification of options strategies or the spread pairs has too many degrees of freedom and thus for a complex portfolio with many positions of different strikes there could be many different results and thus differing Reg-T margin. A naïve algorithm will simply match off what is obvious and consider the rest as naked option positions.

However there actually does exist an optimal path for the calculation logic which will result in the lowest Reg-T requirement, i.e. finding the best offsetting option pairings that mitigate the risk of the portfolio. For the original Reg-T, this optimal path logic is a complex iterative process that first tries to create options spreads that have no margin requirements, such as butterfly positions and long spreads, and then proceed to try to pair off other types of structures. This process can be time consuming and quite involved for a very complex portfolio.

As an example, consider the following portfolio. On first glance, it is difficult to figure out the spread pairings as it looks like some combination of debit (long) and credit (short) calls spreads. But by running it through an iterative optimal path logic, we find that is perfectly pairs off into three long butterfly and spread positions with no net margin requirements. However most naïve pairing logic implementations are not able to determine this.

Example #3

100	Call	75
102	Call	-150
104	Call	150
107	Call	-150
110	Call	-35
115	Call	-80
120	Call	40

Even using the universal spread methodology, for any complex options portfolio, there are several possible outcomes of decomposing into two legged spreads. However here also there exists an optimal path possible in which the spreads created will result in the correct pairing off to yield the lowest Reg-T margin. The optimal path approach is superior than using a brute force approach which could result in a very large number of possible combinations such that the process becomes non-practical.

Take for example the following portfolio (real sub portfolio of a client account)

Example 5

410	P	52
410	P	58
420	P	55
430	P	-110
430	P	-52
430	P	-58
430	P	-220
440	P	55
440	P	1
440	P	26
440	P	1
440	P	220
450	P	-1
460	P	358
470	P	-1

470	P	-716
470	P	-52
470	P	-1
480	P	1
480	P	358
480	P	26
490	P	-52
490	P	-3
500	P	26
500	P	26
500	P	3

On the surface this portfolio looks complex and will confuse many systems in terms of decomposing it into a set of optimal spreads.
Our optimal path logic resulted in the following:

Strike1	Strike2	Qty1	Qty2
430	440	-55	55
430	440	-1	1
430	440	-26	26
430	440	-1	1
430	440	-27	27
430	440	-52	52
430	440	-58	58
430	440	-83	83
430	460	-137	137
450	460	-1	1
470	480	-1	1
470	480	-358	358
470	480	-26	26
470	500	-26	26
470	500	-26	26
470	500	-3	3
410	470	52	-52
410	470	58	-58
420	470	55	-55
460	470	112	-112
460	470	52	-52
460	470	1	-1
460	490	52	-52
460	490	3	-3

The entire portfolio can be decomposed into perfectly matched off 2 legged spreads, with 0 net Reg-T margin requirement. A compromised, non-optimal algorithm may not be able to identify all the spreads and would result in an unnecessary Reg-T margin call.

6. Portfolio Margin

The OCC's CPM is a totally different framework for calculating margin requirements for an options portfolio. It relies on calculating the theoretical values for all options in an options portfolio under various stress or price shock scenarios and calculating the potential portfolio loss. While this makes sense as it captures the offsets of various options and stock position and attempts to evaluate the true risk of the portfolio, it suffers from some significant deficiencies[7], some of which are mentioned below:

- CPM imposes a short option minimum margin of $0.375. This in our opinion is totally random and has no theoretical or practical basis. The short option minimum is a fixed value regardless of the underlying price of the stock, so it is the same for AMZN which trades near $1200 as well as for FORD which trades near $12. Thus this is punitive for any short options on lower priced stock, irrespective of the risk or volatility of such a stock.

- CPM uses the same shock value for all individual stocks (+/- 15%) regardless of the risk or volatility of the stock. Thus a stock like IBM with historical volatility of around 12% will be shocked the same as a stock like NFLX which has a historical volatility of 38%

- The theoretical value calculations use the current implied volatility for each strike. Thus many very deep out of the money options, which have a very small premium, will show an implied volatility that is very high resulting in a huge theoretical risk in a shocked scenario. This can result in several undesirable impacts on the actual risk calculation. Note that this is not an issue with the logic of the CPM methodology, but rather a deficiency in the OCC implementation of the methodology.

Recognizing some of these deficiencies, many large options traders have realized that the margin requirement in Reg-T could be lower than in CPM. This should never be the case. By definition Reg-T should be more conservative and in the boundary cases, the two methodologies should converge. However, given that they were developed and enhanced totally independently without any regulatory body reconciling the two, they do not converge nor are consistent in their approach in any way.

7. <u>Conclusion and recommendations</u>

Given the size, complexity and inherent systematic risk in the options markets in the U.S. it is inexcusable for the non-existence of a consistent, transparent and defendable margin calculation framework that is not "gameable" by sophisticated market participants.
The regulators should form a task force to develop such a framework that addresses the issues in both Reg-T and CPM.
As mentioned above, the Reg-T universal spread methodology does a fairly good job calculating the risk of a complex options portfolio based on intrinsic values and we would recommend the wider adoption

of it using an optimal path algorithm similar to the one we developed. However, the regulators should provide greater detail on the use of the logic for additional portfolio constructs. This could set the baseline for the retail and less sophisticated clients.
CPM should be revised such that it is consistent with Reg-T and such that the latter always produces a more conservative requirement. This can be achieved by a theoretically sound short options minimum applied in both Reg-T and CPM; a risk based shock determination in CPM and improvement of the implementation by the OCC.

Endnotes

1 FINRA Rule 4210 – (Margin Requirements) Interpretations
https://www.finra.org/sites/default/files/Industry/p122203.pdf

2 Customer Portfolio Margin - The Options Clearing Corporation
https://www.theocc.com/risk-management/cpm/

3 Portfolio Margin FAQ | FINRA.org
www.finra.org/industry/portfolio-margin-faq

4 Margin Manual - Cboe
https://www.cboe.com/learncenter/pdf/margin2-00.pdf

5 Assistant Secretary 05/29/2012 Date Associate General ... - CBOE
www.cboe.com/publish/RuleFilingsSEC/SR-CBOE-2012-043.pdf

6 Regulatory Notice 12-44 | FINRA.org
www.finra.org/industry/notices/12-44

7 Volatility surfaces for risk and OCC portfolio margin
http://raviunbound.com/wp-content/uploads/2015/12/Volatility-surfaces-for-Risk-and-OCC-margin.pdf