Initial Margin
Historical Simulation Approach

Alex Eydeland

Financial Risk Mitigation Senior Task Force

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Purpose

- Present a general overview of the progress in the development of a new Initial Margin Methodology: Initial Margin Method based on Historical Simulations (IM-H)

- Contents:
  - Summary of the method and its main characteristics
  - Review of the past key implementation results
  - Current developments
  - Future steps

Previous presentations on IM-H

- Original report: Results of Risk Model Quantitative Analysis: Initial Margin, Part 1. Historical Simulation Approach

  https://www.pjm.com/-/media/committees-groups/task-forces/frmstf/20190925/20190925-item-07-results-of-risk-model-quantitative-analysis-presentation.ashx

- The full paper is available here: https://www.pjm.com/-/media/committees-groups/task-forces/frmstf/20190925/20190925-item-07-results-of-risk-model-quantitative-analysis.ashx

Review: Variation Margin and Initial Margin

- Margin is the amount of **financial** collateral deposited by a market participant with the Central Counter-Party (CCP) to collateralize trade exposures introduced by the participant. There are two principal forms of margin: **Variation Margin (VM)** and **Initial Margin (IM)**.
- **Variation Margin (VM)** has been described in the Variation Margin and Post-Auction Settlement Discussion Paper. VM value is determined by the change in Mark-to-Auction value of a market participant's portfolio over a period of time between two auctions.

Review: Initial Margin

- **Initial Margin (IM)** provides further protection in case the market participant is not able to post Variation Margin, hence triggering default.
- **IM** is a good-faith deposit, posted by a trading participant as collateral to protect against the financial consequences of default. It reflects potential losses that would be incurred by the PJM members in case of default, calculated to a high degree of statistical likelihood, across the participant's entire portfolio.
- **IM** must cover the period between the time when the position was incurred or variation margin (VM) last levied, and the time when the position could be liquidated or taken to final settlement (whichever is sooner) in the event of default. This time period is called the **liquidation period.**
- **IM** is computed at the time of every auction and, if necessary, more frequently.

Review: IM-H Methodology

- Proposed methodology follows standard practices employed elsewhere: e.g., see Standard Initial Margin Model for Non-Cleared Derivatives, ISDA, December 2013

https://www.isda.org/a/cgDDE/simm-for-non-cleared-20131210.pdf

- In the current proposal
  - IM is determined on a portfolio level
  - Provides protection with high degree of confidence of the portfolio exposure over the liquidation period

Review: IM-H Methodology

- For a given portfolio, a procedure for computing IM involves the following steps:
  - Historical price data is used to generate *N* scenarios for FTR prices for all paths in the portfolio; these price scenarios should simulate price movements over the liquidation period
  - For each price scenario a new portfolio value is computed, and consequently, the corresponding change of the portfolio value as compared to the current base case
  - After computing portfolio value changes for all scenarios, and creating the distribution of these values, the quantity is found such that all portfolio value changes are above this quantity with high degree of confidence (typical confidence levels are 95% or 99%).

Review: IM-H Methodology

- For all price scenarios compute

$$\Delta\Pi^{scen} = \Pi(scenario\_prices) - \Pi(current\_prices)$$

where $\Pi(prices)$ is the value of the portfolio for a given set of path prices

scenario_prices are computed using historical price movements over the liquidation period; historical prices are *only* used to determine the movements of today's prices, i.e. the volatility of today's prices.

- Find δ such that

$$\Pr\{\Delta\Pi^{scen} < \delta\} = 1\% \ (5\%)$$

Review: IM-H Methodology

- **Initial Margin.** Once the portfolio exposure is calculated with high degree of confidence, this exposure value is used to compute IM:

$$IM = Const \cdot |\delta|$$

where *Const* is a pre-fixed scaling factor greater than or equal to 1.

In other words, 99% of the times *IM* should protect against the portfolio losses over the liquidation period based on scenarios generated using historical data.

Review: IM-H Methodology

- What are the choices for the length of the liquidation period?
  - 1 or 2 auction periods; or “to settlement”.
- *Monthly Contracts:*
  - 1 or 2 months to unwind a defaulted portfolio
  - “to settlement” – wait till every contract in the portfolio is settled in DA market
- *Annual Contract:* Every month the balance of the annual contract is split into monthly contracts and its IM is determined the same way as for the monthly contracts.
- *Long Term Contract:*
  - *Liquidation period* – 3-6 (2-4) months; or “to settlement”

What has been done at the POC stage

- Basic analysis of FTR price dynamics for zonal paths
- Back testing of the methodology for zonal paths
- Analysis of a few real-life portfolios including GH.

Back-Testing

- Back-testing is a standard method for validating a particular trading or risk management methodology. The back-testing procedure works as follows:
  - Fix a particular time *t* in the past and calculate IM using historical data for times preceding *t*.
  - Assume that a default happens at time *t* and it takes a time period equal to the liquidation period to unwind the position.
  - Compare the loss during the liquidation period with the computed IM.
  - Repeat this test for a number of times *t* and compute a percentage of times IM was less than actual loss.
  - Check if this frequency is consistent with target risk percentile fixed in IM calculation methodology.

Back-Testing

- Back-testing results for zonal path prices. Liquidation Period of 2; 99% confidence

PATH	# TESTS	# FAILS
AECO-AEP	62	0
AECO-APS	62	0
AECO-BGE	62	0
AECO-COMED	62	0
AECO-DAY	62	0
AECO-DOM	62	1
AECO-DPL	62	2

- **Total Number of Tests = 10724**
- **Total Number of Fails = 139**
- **Fails/Total = .013**

- ***Const*** = 125%; *inPromptNum* measures how far the contract month is from the auction month

Liquidation Period	inPromptNum	numFails/numScenarios
2	2	0.0092
2	3	0.0053
2	4	0.0043
2	5	0.0034
2	6	0.0029
2	7	0.0026
3	3	0.0041
3	4	0.0042
3	5	0.0038
3	6	0.0035
3	7	0.0032

Back-Testing

- ***Const*** = 100%

Liquidation Period	inPromptNum	numFails/numScenarios
2	2	0.0226
2	3	0.0130
2	4	0.0106
2	5	0.0085
2	6	0.0073
2	7	0.0065
3	3	0.0106
3	4	0.0113
3	5	0.0103
3	6	0.0096
3	7	0.0090

Discussion

- The concepts underlying the approach are common and preferred by regulators and market governing bodies. See, for example, Standard Initial Margin Model for Non-cleared Derivatives, ISDA, 2013
- Although called Historical Simulations, the method uses historical data only to determine the distribution around the forward prices and *not* the forward prices themselves. The forward prices, which at any auction reflect participants' expectations of future settled FTR prices, are determined at the auction time and, ideally, incorporate all information participants have about the future, including topology changes, outages, fuel prices, etc.
- Changes in participants' expectations result in changes in auction prices, changes in Mark-to-Auction portfolio values, and, finally, changes in VM which is levied to protect CCP against adverse movements of portfolio values.
- Initial Margin provides an additional protection against participant's default.

Discussion

- IM is computed after we construct distributions of potential movements of all forward contract prices over relatively short period of time, the liquidation period. These distributions are constructed using historical price movements.
- **Summary.** VM is needed to neutralize portfolio losses due to changes in forward expectations, while IM is needed to protect (with a high degree of confidence) against losses during the period of liquidation caused by default. Calculation of IM never requires predicting of forward prices.
- Key benefit of HS approach – it produces a joint distribution of price movements without requiring correlation or covariance inputs.

Next Steps

- Begin Parallel Testing and Backtesting
  - Identify impacts to members
  - Ensure methodology performs as expected
- Discuss comprehensive FTR Credit Requirement package
- Discuss liquidation options