Algorithm for Computing Initial Margin: Historical Simulations

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Long Term Contracts: Data Structure

- **Market Participant's Portfolio** – no changes
- **Historical Data Structure**

YEAR	MONTH	Sourcepnode	Sinkpnode	Classtype	YR1	YR2	YR3	YR0	Yrset
2016	6	02CLINTN138 KV TR72	02CLINTN 138 KV TR71	OnPeak	-6.1	-23.4	-25.3	29.1	20.1

1. YEAR, MONTH – year and month of a past auction
2. Source, Sink – pnode names
3. Classtype – OnPeak, OffPeak, 24H
4. YR1, YR2, YR3 – planning years of LT contract cleared during this auction

   For the June 2016 auction (YEAR = 2016, MONTH = 6)
   - YR1 = planning year 2017/2018 (June 2017 – May 2018)
   - YR2 = planning year 2018/2009 (June 2018 – May 2019)
   - YR3 = planning year 2019/2020 (June 2019 – May 2020)

5. YR0 – price of the annual contract cleared in April (we take the average of 4 rounds in April) of the YEAR.

   YR0 = planning year 2016/2017 (June 2016 – May 2017)

6. YRset – settled price of the annual contract for the planning year **that contains the auction** dated (YEAR, MONTH)

Long Term Contracts: Unwinding Schedule

- **Table 1.** Unwind schedule for fixed **MPOR = 1**.
- Each auction is represented by three rows – each row corresponds to an auction round. Each unit of six columns is the unwind schedule: the columns 1,2, 4,5 of the sextuplet is year/month of the in-auction (auction when we enter the LT contract) and year/month of the out-auction (auction when we exit the LT contract); the column 3 contains the label of the year in the long-term contract cleared in the in-auction: 1 corresponds to YR1 of LT contract, 2 = YR2, 3 = YR3, 0 = annual contract; column 6 of the sextuplet corresponds to the label of the same YR in the out-auction.

In year	In mo	In YR	Out year	Out mo	Out YR	In year	In mo	In YR	Out year	Out mo	Out YR	In year	In mo	In YR	Out year	Out mo	Out YR
2008	6	1	2008	9	1	2008	6	2	2008	9	2	2008	6	3	2008	9	3
2008	9	1	2008	12	1	2008	9	2	2008	12	2	2008	9	3	2008	9	3
2008	12	1	2009	4	0	2008	12	2	2009	6	1	2008	12	3	2009	6	2

Long Term Contracts: Unwinding Schedule

- **Table 2.** Unwind schedule for fixed **MPOR = “to settlement”**.
- The structure is the same as in Table 1 with one addition: we have introduced a label “-1” to identify the settlement year YRset. The difference between YR0 and YRset is that the price of YR0 is determined in April auction before the start of the year, while the price of YRset is determined after its end (it is the sum of settled prices during the year).

In year	In mo	In YR	Out year	Out mo	Out YR	In year	In mo	In YR	Out year	Out mo	Out YR	In year	In mo	In YR	Out year	Out mo	Out YR
2008	6	1	2009	6	-1	2008	6	2	2010	6	-1	2008	6	3	2011	6	-1
2008	9	1	2009	6	-1	2008	9	2	2010	6	-1	2008	9	3	2011	6	-1
2008	12	1	2009	6	-1	2008	12	2	2010	6	-1	2008	12	3	2011	6	-1

Long Term Contracts: Algorithm for Computing Initial Margin

- **Objective:** To generate scenarios of prices for each LT year and for each path using historical data.
- Each auction in history will generate **one** scenario for **all** paths. Scenarios are generated as follows:
  - Choose an auction in the past, e.g., June 2008. Fix a path *p*. For every component year, YR1, YR2, YR3, compute the price move between in-auction (June 2008) and out-auction, specified in the unwind schedule structure. This price move is denoted

$$D^{p}_{Scenario=\ June2008}$$

  - Vary past auctions and determine as many scenarios as possible. Each scenario is a vector of price moves for all paths.
  - For each scenario compute the given market participant's portfolio value change. It is done by taking participant's position for each path and applying the corresponding price move while taking into account the position amount and Buy/Sell flag. Namely, for a given scenario of price moves (e.g., the scenario that was generated by data for June2008 auction) compute

$$\Delta\Pi_{Scenario=June2008} = \sum_{p} \left\{ \pm 1 \cdot Amount^{p} \cdot D^{p}_{Scenario=\ June2008} \right\}$$

The multiplier is +1 if "Buy" and -1 if "Sell".

Long Term Contracts: Algorithm for Computing Initial Margin

- After we computed portfolio value changes for all scenarios, compute the standard deviation of these changes, std$(\Delta\Pi)$. Then

$$IM = factor \cdot std(\Delta\Pi)$$

The multiplier *factor* depends on the total number of scenarios and the confidence level. The table for this multiplier as a function of number of scenarios will be provided.

Monthly Contracts: Algorithm to Compute IM

Objective: To compute IM using historical prices movement scenarios for each monthly contract.

Notation:

- As the contract months in the planning year can have either ACTUAL numbering (June = 6, July = 7, …) or PLANNING_YEAR numbering (June = 1, July = 2, …).
- Fix the following indexing convention:
  - Indexes *M, m,* μ are used for ACTUAL indexing convention within the planning year;
    - their range: 6, 7, 8, 9, 10, 11, 12, 1, 2, 3, 4, 5 (May of the next year)
  - Indexes *N, n,* ν are used for PLANNING_YEAR indexing convention within the planning year;
    - their range: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 (May of the next year = the last month of the planning year)
- Specify the mapping: $N = act2plan(M)$, and its inverse connect both indexes.

- Given an auction: (M_0, $YEAR_0$)
  - For this auction, we loop over all (old and new) position records in the participant's position file.

Monthly Contracts: Algorithm to Compute IM

1. Given an auction: (M_0, $YEAR_0$)
2. For this auction, we loop over all (old and new) position records in the participant's position file.
3. Each position record is as follows:

   SOURCEPNODENAME SINKPNODENAME CLASSTYPE PERIODTYPE HEDGETYPE TRADETYPE CLEAREPRICE CLEAREDMW

   More specifically:
   - *path* = {srce, sink}
   - *classType* = {OnPeak, OffPeak, 24H}
   - *periodType* = {'JUN', 'JUL', 'AUG', 'SEP', 'OCT', 'NOV', 'DEC', 'JAN', 'FEB', 'MAR', 'APR', 'MAY'}
   - *hedgeType:* always 'Obligation'
   - *tradeType* = {'Buy', 'Sell', 'SelfScheduled'}
   - *clearedPrice* = auction cleared price for the *path*
   - *clearedMW* = the cleared amount of MW for the *path*

   We now represent a *periodType* contract month by the corresponding ACTUAL and PLANNING_YEAR indexes, *M* and *N.* Thus, if in the given position record the auction contract month *periodType* = 'SEP', it means that *M* = 9, and *N* = 4.

4. For a given contract month *M* (and correspondingly, *N*) we define a vector of contract proxies with the help of the pre-defined mapping

$$PROXYSET = \{\mu_1, \dots, \mu_K\} = \varphi(M)$$

- (Using the above mapping *act2plan(μ)* we can find the corresponding vector $\{\nu_1, \dots, \nu_K\}$ if necessary.)
- The proxies are necessary to increase the sample size in our IM calculations.

5. Algorithm Structure:

Outer Loop LEVEL$_0$: over position records (we specify *path,* index *M* of the contract month, …)

Loop LEVEL$_1$: over historical planning years (*HistPlanYear)*

Loop LEVEL$_2$: over *Contract_Months*, **PROXIES**, within the historical year

Loop LEVEL$_3$: over *inAuctionMonths* (months we entered the contract)

(the *inAuctionMonth* cannot be past *Contact_Month – MPOR,*

if ExitAtSettle, *inAuctionMonth* cannot be past *Contact_Month-1*)

Calculate *outAuctionMonths* (months we exited the contract)

(in case EXITatSETTLE, *outAuctionMonths* = *Contract_Month*;

in all other cases, *outAuctionMonths* = *inAuctionMonths* + *MPOR*)

Define the scenario index (sextuple):

$$scen = (HistPlanYear, Contract\_Month, inAuctionYear, inAuctionMonth, outAuctionYear, outAuctionMonth)$$

6. Within each scenario:

For a given scenario

$$scen = (HistPlanYear, Contract\_Month, inAuctionYear, inAuctionMonth, outAuctionYear, outAuctionMonth)$$

search price history files and find prices

$$p_{in}^{scen} \text{ and } p_{out}^{scen}$$

corresponding, respectively, to

$(inAuctionYear, inAuctionMonth)$ and $(outAuctionYear, outAuctionMonth)$

as well as to the required *path* and *classType.*

Once these prices are determined, we can compute the price change corresponding to this scenario:

$$d^{scen}(path, classType) = p_{in}^{scen}(path, classType) - p_{out}^{scen}(path, classType)$$

This, in turn, allows us to compute the change of the component of the participant's portfolio corresponding to this *path* and *classType* :

$$d\Pi^{scen}(path, classType) = tradeType \cdot clearedMW \cdot d^{scen}(path, classType)$$

Monthly Contracts: Algorithm to Compute IM

7. Recall that that particular scenario was generated for a specific contract *M* in the current participant's portfolio (or, *N* if we use the PLANNING_YEAR convention). Our goal is to create a distribution of portfolios for each contract *M* (*N*). There are maximum 12 distributions corresponding to participant's portfolios (combination of paths) at any given month *M.* At the end of our algorithm we should generate 12 arrays of portfolio scenarios. Each array has the format:

$$\left\{scen, \sum_{paths} \sum_{classTypes} d\Pi^{scen}(path, classType)\right\}$$

where *paths* and *classTypes* correspond to the same *scen* sextuplet. All scenarios, *paths* and *classTypes* in the sum correspond to proxies associated with the given contract *M*.

At the end we create distributions of portfolio values for each *M*

$$\Delta\Pi_M^{scen}, \qquad scen = 1, \dots, NumberScenarios_M, \qquad M = 5, \dots, 4 \quad (or, N = 1, \dots, 12)$$

8. We compute the initial margin as follows:

$$IM(N) = fac \cdot std(\Delta\Pi_N^{scen}), \qquad N = 1, \dots, 12$$

Constant *fac* is determined as in the case of the Long Term contracts.

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Algorithm for Computing Initial Margin: Historical Simulations

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