Standardized Initial Margin Model
Initial Margin

Margin Introduction

- Initial Margin is the amount of collateral required to open a position.
- Maintenance Margin is the minimum amount of collateral required to keep the position open after inception.
- Margin Balance = Asset value − Borrowed fund
- Margin Call: the broker issues a margin call that requires the investor to bring the margin balance back to initial margin if margin balance is below maintenance margin.
Initial Margin

Initial Margin Scope

- Initial margin calculation is counterparty-portfolio-based.
- Initial margin calculation in a bank contains non-cleared OTC derivatives only as cleared products are already covered by Exchanges.
- Derivative trades belonging to a counterparty will be divided into a cleared portfolio and a non-cleared portfolio. The initial margin is computed for the non-cleared portfolio.
Initial Margin Calculation hierarchy

- Calculation is conducted from the lowest level to the highest one:
  - risk factor → risk bucket → risk measure → risk class → product class → final initial margin

- Define 4 product classes
  - Interest Rates and Foreign Exchange Product (RatesFX)
  - Credit Product
  - Equity Product
  - Commodity Product
Define 6 risk classes

- Interest Rate
- Credit (Qualifying): non-securitization and simple securitization
- Credit (Non-Qualifying): complex securitization
- Equity
- Commodity
- FX

Define 3 risk measures

- Delta
- Vega
- Curvature
Initial Margin Calculation hierarchy (Cont’d)

◆ Define risk buckets
  ◆ Interest rate bucket: based on currency (USD, EUR, CAD, …)
  ◆ Credit bucket: based on credit quality (sovereign, financial, technology, …)
  ◆ Equity bucket: based on sector (financial, industrial, …)
  ◆ Commodity bucket: based on commodity type (crude, gas, …)
  ◆ FX: each FX rate is a bucket

◆ Define risk factors
  ◆ Interest rate curve: 12 yields per curve
  ◆ Credit curve: 5 spreads per credit curve
  ◆ Equity: spot price
  ◆ Commodity: spot price
  ◆ FX: spot exchange rate
Sensitivity Calculation

- **Delta calculation**
  - Interest rate (PV01): \[ s(i, r_t) = V_i(r_t + 1bp, cs_i) - V_i(r_t, cs_t) \]
  where \( r_t \) - interest rate; \( cs_t \) - credit spread; 1bp - 1 basis point; \( V_i \) - market value
  - Credit (CS01): \[ s(i, cs_t) = V_i(r_t, cs_i + 1bp) - V_i(r_t, cs_t) \]
  - Equity: \[ s_{ik} = V_i(EQ_k + 1\%EQ_k) - V_i(EQ_k) \]
    where \( EQ_k \) - spot price of equity k.
  - Commodity: \[ s_{ik} = V_i(CTY_k + 1\%CTY_k) - V_i(CTY_k) \]
    where \( CTY_k \) - spot price of commodity k.
  - FX: \[ s_{ik} = V_i(FX_k + 1\%FX_k) - V_i(FX_k) \]
    where \( FX_k \) - spot exchange rate of base currency k.
Sensitivity Calculation (Cont’d)

- **Vega calculation**
  \[
  VR_{ik} = \sum_j \sigma_{kj} \frac{dV_i}{d\sigma}, \quad \text{where } \sigma_{ik} \text{ – implied volatility}
  \]

- **Curvature calculation**
  \[
  CVR_{ik} = \sum_j SF(t_{ik})\sigma_{kj} \frac{dV_i}{d\sigma}
  \]
  where \( SF(t) = 0.5\min(1, \frac{14d}{t}) \) is a scaling factor and \( t_{kj} \) is the expiry date.
Initial Margin

Initial Margin Calculation

◆ A risk weight is defined for each risk factor.
◆ A correlation is specified for each risk factor pair.
◆ Within a product class, calculate initial margin for each risk class
  ◆ Net all sensitivities for each risk factor $k \rightarrow s_k$
  ◆ Compute risk weighted sensitivity $WS_k = RW_k s_k CR_k$
    where $WS_k$ – risk weight and $CR_k$ – concentration risk factor
  ◆ Aggregate weighted sensitivities within each bucket

$$K = \sqrt{\sum_k WS_k^2 + \sum_k \sum_i \rho_{ki} f_{ki} WS_k WS_i}$$

where $\rho_{ki}$ – correlation and $f_{ki}$ – correlation adjustment
Aggregates buckets to obtain a sensitivity initial margin

\[ \text{DeltaMargin} = \sqrt{\sum_b K_b^2 + \sum_b \sum_{b \neq c} \gamma_{bc} S_b S_c + K_{\text{residual}}} \]

\[ \text{VegaMargin} = \sqrt{\sum_b K_b^2 + \sum_b \sum_{b \neq c} \gamma_{bc} \delta_{bc} S_b S_c + K_{\text{residual}}} \]

\[ \text{CurvatureMargin} = \max \left( \sum_{b,k} CVR_{b,k} + \lambda \sqrt{\sum_b K_b^2 + \sum_b \sum_{b \neq c} \gamma_{bc}^2 S_b S_c} \right) + \theta_{\text{residual}} \]

Initial margin for a risk class

\[ IM_x = \text{DeltaMargin}_x + \text{VegaMargin}_x + \text{CurvatureMargin}_x \]
Initial Margin Calculation (Cont’d)

- Initial margin for the product class
  \[ IM_p = \sqrt{\sum_r IM_r^2} + \sum_r \sum_{s \neq r} \Psi_{rs} IM_r IM_s \]

- Final initial margin
  \[ IM = IM_{RateFX} + IM_{Credit} + IM_{Equity} + IM_{Commodity} \]
Reference:
https://finpricing.com/lib/EqVariance.html