RisCura R&D

# JSE MARGINS CALCULATION PROCESS

Straight advice from an independent perspective.

# 1 INTRODUCTION

RisCura calculates margin amount parameters on a daily basis used for JSE failed trade margining process during the clearing and settlements. This documents details the calculation methodology used to determine these parameters. A high level overview of the margin process and methodology can be found the JSE document titled "Margining Methodology for Trades in STRATE Approved Securities".

## 1.1 JSE SETTLEMENT PROCESS

The process of "fails management" and the required margin duration is highlighted in Figure 1 below, more detail of which can be found in the annexure.

As the JSE guarantees trades subject to price discovery, transparency and challenge of the Central Order Book, all uncovered or uncommitted trades at the end of day on T+3 introduce settlement risk. In order to mitigate this risk margining is utilised. These uncovered or uncommitted trades are marked to market (MtM) at close of business on T+3, and this MtM trade value is then applied to a margin calculator that takes into account the specific risk of the position, including the price volatility, liquidity and specific size or nominal amount of securities involved.

The margin amount calculated must cover the settlement risk to which the JSE is exposed from end of day on T+3 to final settlement, including any losses or part thereof that may be incurred by the JSE in settling or closing the transactions on behalf of the member. It is therefore crucial that the margin be of sufficient quantum to compensate for extremely price volatile, illiquid or large positions.

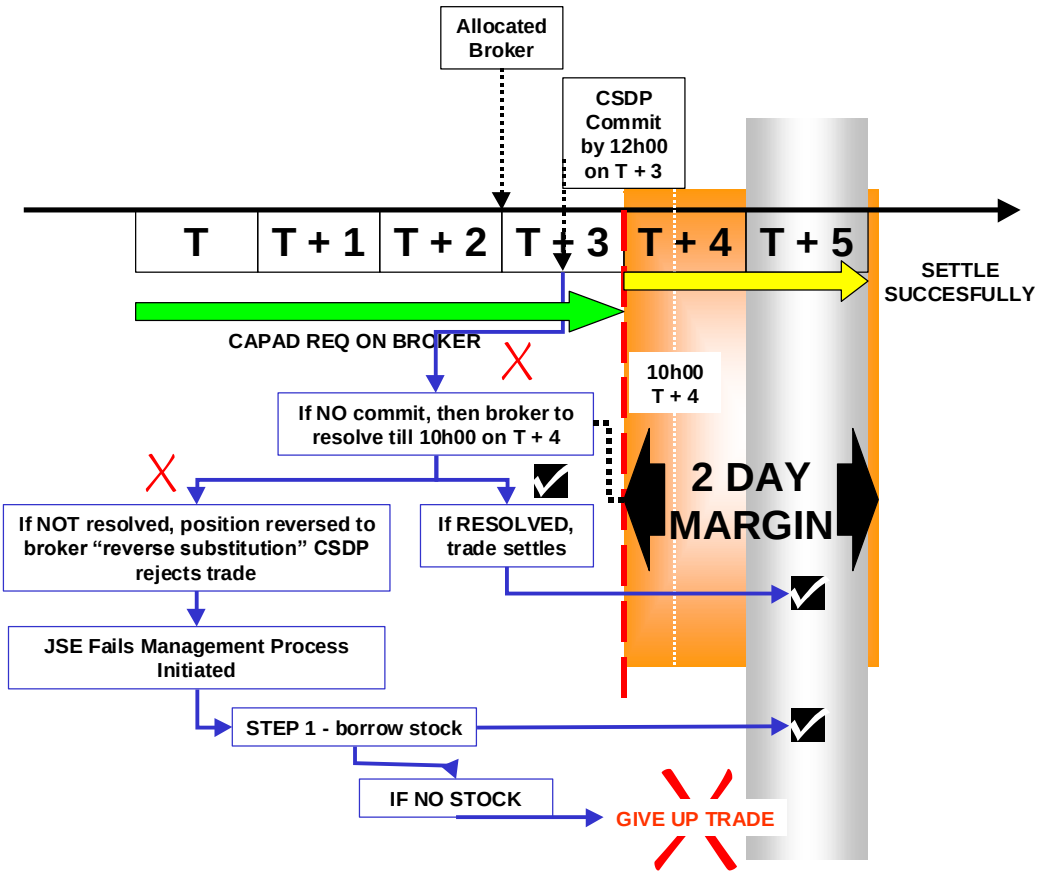


Figure 1 JSE Settlement process

## 1.2 RISK FACTORS

The following risk factors need to be catered for in the margining calculation:

- Price Volatility Risk
- Spread Risk
- Liquidity Risk
- Impact Cost Risk

### 1.2.1 PRICE VOLATILITY RISK

The more volatile a security price, the greater the chance of an insufficient margin to offset the losses incurred. RisCura utilises a parametric Value at Risk (VaR) approach in order to quantify the risk of the "failed" trade over the 2-day margin period, using a 99.95% confidence interval. This VaR measure, however does not measure liquidity and spread risk.

### 1.2.2 LIQUIDITY RISK

Liquidity risk is defined as the inability to liquidate or purchase large positions in the market due to a lack of willing buyers or sellers. For margining purposes, a 2-day margin may be insufficient to compensate the exchange for losses if the trade takes more than 2 days to liquidate. Even if the trade is "given up" the buyer still needs to be compensated for this risk at market re-entry.

Each trade therefore has a "trade-out" period that needs to be considered for risk purposes. A 2 day VaR risk figure is meaningless unless this can be adjusted for the trade-out period, where this is longer than 2 days.

### 1.2.3 SPREAD RISK

Generally speaking, the more liquid a security, the smaller the spread, and the lower the potential spread risk or cost is when dealing in that security. This means that the costs of "crossing" the bid offer spread are higher for less liquid shares. This is particularly problematic where less liquid shares are margined.

Should the non-defaulting party to a transaction be forced to re-enter the market and purchase the securities in the market, the spread may have widened. Moreover, given a large transaction, the spread may widen as the party attempts to transact in the market. Clearly, this risk and cost needs to be taken into account given the failed trade.

### 1.2.4 IMPACT COST

Where positions or trades are large, the risk of impact costs is raised. A buyer of securities incurs impact costs where the volume purchased is high relative to the total volume traded on the day. The required margin clearly needs to take into account the potential impact costs of any position and adjust the margin accordingly with the potential costs.

# 2 MARGIN CALCULATION FORMULA

## 2.1 MARGIN AMOUNT

The margin methodology includes the following steps:

- Calculate a 2-day VaR margin for the position.
- Adjust the VaR margin to accommodate liquidity risk.
- Adjust the Liquidity VaR margin for spread costs if applicable.

### 2.1.1 2-DAY VAR MARGIN

The 2-day VaR margin amount is calculated using a parametric Value as Risk method. If we assume that a trade in a security of quantity $N$ is unconfirmed or uncommitted at the end of day on T+3 with a close price, $P$, then the value at risk is given by:

$$VaR = Value * \sqrt{2}\,\sigma Z_\alpha$$

Where

- The trade value is given by $Value = N * P$
- The estimate of the one day volatility is given by $\sigma$
- The z-score $Z_\alpha$ is determined by the confidence interval chosen for the value at risk calculation. In the JSE margining process, a confidence interval of 99.95% has been selected so the z-score is 3.29.

### 2.1.2 ADJUSTMENT FOR LIQUIDITY RISK

If the time taken to trade the quantity of shares is greater than 2 days, then we need to adjust the 2-day VaR in order to accommodate for the liquidity risk. If we assume that the trade out period is given by $D$ and that the trade is spread equally over the trade out period, then $N/D$ shares are traded each day.

In order to determine the risk involved in this trade, we can consider the trade to be separate tranches whose value at risk can be determined for each tranche, and then sum across the tranches for those days greater than 2 days, so that the the adjustment for the liquidity risk is given by

$$LVaR = \sum_{i=3}^{D} \frac{N * P}{D} * \sqrt{i}\sigma Z_\alpha \ , \qquad D > 2$$

We can approximate this sum by an integral so that

$$LVaR \cong \int_2^D \frac{N * P}{D} * \sqrt{i}\sigma Z_\alpha = \sigma Z_\alpha * \frac{N * P}{D} * \frac{2}{3}\left(D\sqrt{D} - 2\sqrt{2}\right)$$

$$= Value * \sigma Z_\alpha * \frac{2}{3}\left(\sqrt{D} - \frac{2\sqrt{2}}{D}\right)$$

### 2.1.3 SPREAD

The adjustment for the spread is given by

$$Spread\ Adjustment = \frac{1}{2} * Average\ Spread * Value$$

### 2.1.4 MARGIN AMOUNT

The margin amount is thus determined by combining the above components:

$$Margin = Spread\ Adjustment + VaR + LVaR$$

$$= \begin{cases} \frac{1}{2} * Average\ Spread * Value + Value * \sigma Z_\alpha * \sqrt{2} & D \le 2 \\ \frac{1}{2} * Average\ Spread * Value + Value * \sigma Z_\alpha * \left[\sqrt{2} + \frac{2}{3}\left(\sqrt{D} - \frac{2\sqrt{2}}{D}\right)\right] & D > 2 \end{cases}$$

## 2.2 RISK MATRIX

In order to ensure that the margin amount is scaled to take into account the impact cost for larger trades, RisCura calculates the margin amounts for various potential trade quantities in a security. These quantities form the basis of the risk matrix and increase in a stepped interval. As the size of the trade becomes larger the interval is increased. The table below specifies how the intervals are bucketed to determine the output.

| Range | Interval |
|---|---|
| 1 – 1 000 | 100 |
| 1 000 – 100 000 | 1 000 |
| 100 000 – 200 000 | 10 000 |
| 200 00 – 1 000 000 | 100 000 |
| 1 000 00 – 5 000 000 | 1 000 000 |

Thus for each security, 131 margin amounts are calculated using the quantities from the above buckets.

# 3 DATA REQUIRED PER ASSET

As can be seen from the margin amount formula above, the following input data is required for each asset

1. The 1 day volatility estimate
2. The average trade out period for each trade quantity in the risk matrix
3. The average spread
4. The close price

## 3.1 VOLATILITY

The estimate of the daily volatility is calculated using the log returns of the price movements,

$$R_t = \ln \frac{P_t}{P_{t-1}}$$

In order to obtain a good estimate, 60 price points are used, and the daily volatility is given by

$$\sigma = StdDev(R_t)$$

If there are less than 60 price points available, then an exponentially weighted moving average is used to calculate the volatility. The daily volatility is then given by

$$\sigma = \frac{\sum_i {R_{t-i}}^2 * DF^i}{\sum_i DF^i}$$

where $i = 1$ to number of data points and $DF = 0.94$ .

## 3.2 AVERAGE TRADE OUT PERIOD

To determine the average number of days that it would take to trade a quantity $N$ for the security, we first need to determine the current average daily volume that is traded, where the average is taken over the last 30 days.

In order to minimise the market impact risk, we assume that when the determining the trade period that only 30% of the average daily volume is traded each day so that the trade out period is then given by:

$$D = N/(0.3 * Average\ trade\ volume)$$

where $N$ is the quantity of shares that the margin amount is calculated for in the risk matrix.

## 3.3 AVERAGE SPREAD

The average spread is determined by averaging the daily spread over the last 30 days. The daily spread is determined frim the close bids and offers and is given by

$$Spread = (Offer - Bid)/Close\ Price$$