JSE CASH EQUITY MARGIN METHODOLOGY

May 2022

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Version History

Version	Date	Summary of changes	Author
1.0	May 2022	Initial version	JSE Clear Risk team

1. Introduction

This document details the margin methodology used to calculate the margin rate (%) in the JSE cash equities market.

Margins are calculated at EOD on T+1 for all trades that are uncovered (shown to lack the required securities or funds for settlement) or where the participant's Central Securities Depository Participant (CSDP) has not committed to the trade. The margin is paid to the JSE and either repaid if settlement is successful or utilised to compensate the affected counterparties in the event of a default. The total margin on T+1 is the combination of the following components:

- The profit-and-loss component on a trade between T to T+1 due to realised price movements
- Potential future exposure (PFE) component to cover market risk exposure based on future price movements that may occur before the trade is settled and affected counterparties suitably compensated.

Margin on the market risk component aims to cover the market risk that the JSE is exposed to when it intervenes in trade settlement, and considers price volatility and liquidity using a parametric VaR model with an adjustment for spread risk.

A high-level overview of the JSE settlement and margin process can be found in Appendix A.

2. Margin risk factors

The JSE margin methodology models the potential future exposure component of the total margin requirement by considering adverse potential price movements and the impact of the liquidity of the securities.

The JSE margin methodology caters for the following risk factors:

- Price volatility risk
- Liquidity risk
- Spread risk

2.1 Price volatility risk

The more volatile a security's price, the greater the chance of an insufficient margin to offset the losses incurred. JSE utilises a parametric Value at Risk (VaR) approach to quantify the risk of the "failed" trade over the 2-day margin period, using a **99.95%** confidence interval.

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 JSE 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. Where the trade-out period is longer than 2 days the VaR calculation is extended to consider the liquidation period risk beyond 2 days (referred to as Liquidity-VaR or LVAR).

2.3 Spread risk

Generally, 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.

2.4 Impact cost and Risk matrix

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 consider the potential impact costs of any position and adjust the margin accordingly with the potential costs.

To ensure that the margin amount is scaled to consider the impact cost for larger trades, JSE 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 bucket size is increased. The table below specifies how the buckets size varies by quantity range to determine the margin rate.

Quantity range (number of shares)	Bucket size per quantity range
1 – 1,000	100
1,001 – 100,000	1,000
100,001 – 200,000	10,000
200,001 – 1,000,000	100,000
1,000,001 – 5,000,000	1,000,000

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

3. Margin calculation

The margin methodology includes the following steps:

- Mark-to-Market uncovered or uncommitted trades at EOD on T+1
- Calculate a 2-day VaR margin for the position
- Adjust the 2-day VaR margin to capture the additional liquidity risk for positions that take longer than 2 days to liquidate
- Adjust the margin for spread costs
- Generate a daily risk matrix for each individual share on the JSE, dependent on the size or the nominal of the trade
- Apply the day's margin rate, depending on size and volatility, to the uncovered or uncommitted trades

The following input data is required for each asset:

- Daily Closing prices (125-day history) to calculate 1 day volatility estimate
- Daily Trade volumes (30-day history) used in calculation of LVaR days to trade out (D)
- Daily Bid prices (30-day history) used in calculation of spread risk adjustment
- Daily Offer prices (30-day history) used in calculation of spread risk adjustment

3.1 2-day VaR margin

The 2-day VaR margin is calculated using a parametric Value at Risk method, with the confidence interval set to **99.95%** and the volatility parameter based on an Exponentially Weighted Moving Average (EWMA) using **125 days** of historical price movements. The use of the parametric VaR model assumes that the returns are normally distributed.

Assuming a trade in a security of quantity N is eligible for margining on T+1 with a closing price of P, then the VaR is given as:

$$VaR = value \cdot \sigma Z_{\alpha}\sqrt{2}$$

Where

Value	=	N × P
σ	=	the estimate of 1-day volatility of log returns (of daily prices)
Z_{α}	=	The z-score (on a standard normal distribution) 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**.

In general, the EWMA volatility method places more emphasis on recent returns as higher weights are assigned through the formula to more recent data. The λ value determines the weight of the data in the formula. The smaller the value of λ, the quicker the weights decay. An industry-standard value of 0.94[1] is used. This lends more weight to the most recent returns. The equation used to calculate the variance using EWMA is:

$$\sigma^2 = \sum_{t=1}^{125} (1-\lambda) \cdot \lambda^{t-1} \cdot R_t^2$$

Where

λ	=	Lambda (0.94) i.e., parameter determining the weight of each return
Rt	=	*Log returns of the daily stock price at time t (Pt) in 125-day lookback period*
σ	=	*1-day v*olatility

$$R_t = ln\left(\frac{P_t}{P_{t-1}}\right)$$

- The Exponentially Weighted Moving Average (EWMA) methodology places more emphasis on recent data
- The λ determines the weight of the data, the smaller the value the quicker the weight decays
- λ of 0.94 is used; this lends weight to the most recent returns

3.2 Adjustment for liquidity risk

If the time taken to trade the quantity of shares is greater than 2 days, the 2-day VaR is adjusted to compensate for this additional liquidity risk during the longer trade out period. To determine the average number of days (D) that it would take to trade out a position in 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**.

To minimise potential adverse market price impact, we assume that when 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:

$$D = \frac{N}{(30\% * average\ trade\ volume)}$$

Where

N	=	quantity of shares that the margin is calculated for
market participation	=	30%

[1] Source: Master Class: Calculating Value at Risk (VaR) by Jawwad

Where D is small, the trade involves a small quantity of shares and/or it involves highly liquid shares. Where D is large, it implies that it may take several days to replicate the original trade. This will hold for trades that either involve a large number of shares, relative to the volume traded, or involve illiquid shares that are not readily available for trading on a daily basis.

It is assumed that the trade will be equally spread over the trade out period, and N/D shares are traded per day in each "daily tranche". The VaR is calculated for each day in the trade out period and summed across those days of D over 2 days.

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

This is then approximated by the following integral, which implicitly assumes that the trade is executed continuously from EOD T+3 to T+3+D.

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

Hence,

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

3.3 Adjustment for spread risk

To adjust for the cost of "crossing" the bid-offer spread, the following adjustment is added to the margin calculation, using the average spread over the last 30 days.

$$Spread\ adjustment = \frac{1}{2} * average\ spread * value$$

$$Spread = \frac{Offer - Bid}{Close\ Price}$$

3.4 Final margin amount

The total final margin amount is a combination of the components described in sections **Error! Reference source not found.**, 3.3 and 3.3.

$$Final\ margin = 2\ day\ VaR + LVaR + Spread\ adjustment$$

$$= \begin{cases} \frac{1}{2} * average\ spread * value + value * \sigma Z_\alpha * \sqrt{2} & D \leq 2 \\ \frac{1}{2} * average\ spread * value + value * \sigma Z_\alpha * \left(\sqrt{2} + \frac{2}{3}(\sqrt{D} - \frac{2\sqrt{2}}{D}\right) & D > 2 \end{cases}$$

The VaR is calculated using the volatility of the log-returns of price movements but is applied to the MtM price as a straight percentage.

The VaR calculates the estimated price movement within a certain confidence interval. However, as this is calculated using log returns it in fact calculates the estimated log of the price movement. Hence, to correctly calculate the margin requirement, the VaR should be converted back into actual price movements. This correction is negligible for smaller margin percentages, but for anything over 7% it will noticeably increase the margin that is calculated. A large proportion of trades are margined at levels similar to this, and so the correction would have a noticeable effect on the calculation.

The following adjustment would need to be made:

$$Final\ margin\ with\ adjustment\ for\ VaR\ using\ log\ returns =$$

$$\begin{cases} \frac{1}{2} * average\ spread * value + value * \left(exp\left[\sigma Z_\alpha \sqrt{2}\right] - 1\right) & D \leq 2 \\ \frac{1}{2} * average\ spread * value + value * \left(exp\left\{\sigma Z_\alpha * \left[\sqrt{2} + \frac{2}{3}\left(\sqrt{D} - \frac{2\sqrt{2}}{D}\right)\right]\right\} - 1\right) & D > 2 \end{cases}$$

4. Appendix A: JSE settlement and margin process

RisCura calculates margin amount parameters on a daily basis used for JSE failed trade margining process during the clearing and settlements.

The JSE has a 3-day settlement cycle on the Cash Equities Market and guarantees trades executed on the Central Order Book. This guarantee exposes the JSE to certain market/settlement risk factors if one of the counterparties on a trade default. In such an event, the JSE will resort to using a number of actions to ensure the trade is settled or compensation is paid to the non-defaulting counterparty if it incurs an adverse mark-to-market loss as a result.

From T to T+1, this exposure is mitigated by a capital adequacy requirement placed on each broker to the trade. The JSE may then require counterparties to post margin at EOD T+1, depending on the risk characteristics of the trades.

- Propriety and controlled clients: The Broker-Dealer Accountancy (BDA) system allows the JSE a strong degree of visibility into propriety and controlled clients' accounts. For available securities, the JSE is able to look at clients BDA accounts, and for cash, the JSE is able to see cash available in the clients JSE trustees' account. As such, the JSE can deduce whether each of the counterparties will have sufficient securities and/or cash in their account by T+3 to cover the transaction. This determines whether a trade is covered or uncovered. Trades that are uncovered at EOD T+1 will be margined.
- Non-Controlled clients: Securities of non-controlled clients are held in 3rd party Central Securities Depositories (CSDPs), and the JSE and the broker-dealers have no view on non-controlled client underlying account holdings. If the JSE has not received a commitment to trade from the clients CSDP at EOD T+1 the associated transaction will be margined.

Margin on the trades is then called at the end of T+1 and is returned to once settlement has occurred or used as compensation to the non-defaulting party if the trade has been failed.

If the CSDP does not commit to a trade for a non-controlled client, the trade goes into "reverse substitution" on T+2 at 14h00. In this case the position reverts back to the broker's account. If the broker is unable to resolve a trade by 16h00 on T+2 of any propriety or client account type, it then falls upon the JSE Settlement Authority to manage the trade, which could involve Securities Lending & Borrowing or Give-up, otherwise known as Fails Management.