JSE CLEAR MARGIN METHODOLOGY

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Table of Contents

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Version History

Version	Date	Summary of changes	Author
1.0	March 2016	Initial draft	JSE Clear Risk team
2.0	September 2017	Adjusted to reflect the change in methodology for the interest rate derivatives market, from JSPAN to Portfolio VaR	JSE Clear Risk team
3.0	February 2019	Reviewed; assumption included regarding 2-day liquidation period.	JSE Clear Risk team
4.0	November 2020	Reviewed • Stress period for interest rates changed from 2008 (GFC) to 2015-2016 (Nene-gate) • For commodities stress periods specified per product type • Added the new comprehensive approach for an improved calibration of CSMRs • Updated the frequency of calibration of certain IM parameters and included a summary of the various calibration frequencies As agreed at the Risk Committee meeting on 3 Nov 2020 • Mention of the value of the large exposure add-on threshold removed. This will ensure that any changes to this threshold value will not necessitate an update of the document (while still requiring formal Risk Committee approval)	JSE Clear Risk team
5.0	October 2021	Reviewed IRD hedge cost matrix update frequency, removed carry factor table from CSMR calibration section 2.1.1 and other minor updates	JSE Clear Risk team

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1. Introduction

Initial margin (IM) represents the primary prefunded line of defense for JSE Clear (JSEC) in managing the risks associated with clearing financial instruments. IM is called at an individual account level, and the IM posted against the exposures held in a particular account can only be used to satisfy the losses incurred in liquidating the positions held in the particular account, in the event of default. The aim of this document is to articulate the methodologies used by JSEC to calculate account-level IM requirements.

JSEC's underlying philosophy with regards to account level-IM requirements is to ensure that:

- IM requirements are reflective of a "defaulter pays" risk waterfall;
- As far as possible, IM requirements should avoid procyclicality by being stable during times of stress; and
- IM should mitigate the risk associated with large and concentrated positions.

To this end, account-level IM is made up of three distinct components:

1. A **base** IM requirement, calculated under the Portfolio VaR framework for interest rate derivatives, and the JSPAN framework for all other derivatives. The base IM requirement represents the account-level IM before taking large and concentrated positions into account. For a portfolio consisting of a single position in a single contract, the base IM requirement should be calculated as follows:

Methodology	Confidence Level	Liquidation Period	Look-Back Period
Historical Value-at-Risk	99.7%	At least 2-days	Rolling 750-days plus 250-days stressed

Table 1: JSEC VaR Methodology

- A **liquidation period** IM requirement which adds to the base requirement in order to mitigate the risks associated with positions that will take longer to liquidate than is assumed under the base requirement.

2. A **large exposure** IM requirement which adds to the base and liquidation period requirements in order to address the risk presented by portfolio exposures which are large enough to put the JSEC risk waterfall at risk under extreme but plausible market conditions.

The structure of this document is as follows:

- Sections 2 and 3 describe the methodologies underlying the base IM requirement;
- Section 4 describes the methodology underlying the liquidation period IM requirement; and finally
- Section 5 describes the methodology underlying the large exposure IM requirement.

2. JSPAN

Apart from interest rate derivatives futures, the JSPAN algorithm is used to determine account-level base IM requirements for all contracts cleared by JSEC. The formulaic breakdown of the JSPAN algorithm is described in [1]. This section provides a high-level description of the parameters that feed into the algorithm, and describes the calculation methodology for each parameter.

Each contract has four JSPAN parameters associated with it:

- The Initial Margin Requirement (**IMR**). This parameter represents the total IM payable on a portfolio involving a single position in the particular contract, and no other positions.
- Calendar Spread Margin Requirement (**CSMR**). Each futures contract can belong to one and only one Class Spread Group **(CSG)**; a group of futures contracts that share the same underlying instrument. JSPAN then recognizes the risk reducing impact associated with having long and short exposures in different contracts in the same CSG, by reducing the total amount of IM required against the net exposure. In particular, the total amount of IM on a calendar spread position involving two contracts (A and B) in the same CSG, is calculated as follows:

  $$IM = Pos_A \times CSMR_A + Pos_B \times CSMR_B + |Pos_A \times IMR_A - Pos_B \times IMR_B|,$$

  where IMR_A is the IM that would be called for an outright position in contract A, IMR_B is the IM that would be called for an outright position in contract B and Pos_A and Pos_B are the absolute values of the number of positions in contracts A and B respectively.
- Series Spread Margin Requirement (**SSMR**). Highly correlated CSGs can be grouped together in Series Spread Groups (**SSGS**); however, each CSG can belong to one and only one SSG. JSPAN then recognizes the risk reducing impact associated with having long and short exposures in different CSGs within the same SSG; by reducing the total amount of IM required against the net exposure. In particular, the total amount of IM on a series spread position involving two contracts (A and B) in the different CSGs within the same SSG, is calculated as follows:

  $$IM = Pos_A \times SSMR_A + Pos_B \times SSMR_B + |Pos_A \times IMR_A - Pos_B \times IMR_B|$$

- Volatility Scanning Range (**VSR**). This parameter is used to determine the extent to which At-the-Money volatilities should be shocked when calculating the risk arrays for options on the particular future. A risk array is an array of contract-level Profit and Losses (PnLs) under various futures price/volatility permutations. The smallest (most negative) element of a risk-array for a particular option represents the total IM payable on a portfolio involving a single position in the particular option contract, and no other positions.

2.1. IMR Methodology

The IMR for a particular future represents the total IM payable on a portfolio involving a single position in the particular contract, and no other positions. Contract-level IMRs are to be calculated as per Table 1 above. Currently, the stressed periods to be added into the look-back periods for the various asset classes are as follows:

Asset Class	Benchmark	Stressed Period
Equities	FTSE/JSE Top40 Index	1-Jun-2008 to 1-Jun-2009
Fixed Income	GOVI Index	4-Nov-2015 to 3-Nov-2016
Agriculture	White Maize	22-Oct-2013 to 22 – Oct-2014
	Yellow Maize	2-Nov-2016 to 2-Nov-2017
	Meal	3-April-2009 to 7-Apr2010
	Soya	10-Nov-2010 to 8-Nov-2011
	Other soft commodities	1-Jun-2008 to 1-Jun-2009
Metals	Gold (USD)	1-Jun-2008 to 1-Jun-2009
Energy	Brent	1-Jun-2008 to 1-Jun-2009
	Diesel	29-Oct-2015 to 29-Oct-2016
FX	USDZAR	1-Jun-2008 to 1-Jun-2009

Table 2: Asset class and product stressed periods.

The stressed periods applied to each asset class are determined by considering the period with the highest realised 90-day volatility for the benchmark instrument in the asset class, and in cases for specific products. Stressed periods are reviewed at least annually.

The assumptions underlying JSE Clear's current 2-day liquidation period are:

- The period that may elapse from the last collection of margins up to the declaration of a clearing member default is equal to 1-day; and
- The estimated period needed to design and execute a strategy for the close-out of the defaulted portfolio is no more than 1-day from the time the default is declared.

2.2. CSMR Methodology

2.2.1. Simplified Calibration Algorithm

There are three main factors that can affect the Mark-to-Market (MtM) value of a calendar spread position:

- The cost of carry associated with the long futures position;
- The cost of carry associated with the short futures position; and
- The value of the underlying instrument.

An algorithm for determining CSMR values should thus consider the extent to which changes in the above-mentioned factors can affect the MtM value of a spread position.

For agricultural derivatives, the set of factors that can affect the MtM value of spread positions are generally more intricate than described above. In particular, factors such as expected future weather patterns, and differences between new and old harvesting seasons can have a significant impact on the value of spread positions. Even though a conservative CSMR-value can be estimated without considering these factors, the algorithm which is described in the next section (2.2.2) will be used in most cases for all asset classes apart from agriculture derivatives. A specific methodology to be applied for agricultural derivatives is discussed alongside the calibration of series spread margin parameters.

The following algorithm provides a simplified way to calibrate the $CSMR$ parameters associated with a particular CSG. It can be used instead of doing a full analysis of the historical contract pricing data.

1. Determine the number of contracts in the CSG, n;
2. Determine the contract with the least amount of time to maturity, contract A;
3. Set $i = 1$;
4. Determine the i^{th} contract to expire after A, contract B;
5. Determine the current MtM value of a calendar spread position involving contracts A and B;

6. Calculate the absolute change in the abovementioned MtM under the scenarios below. The cost of carry (Λ) is defined by asset class (equity, commodities, fixed income, and FX) and tenor (≤ 2 years or > 2 years).

Scenario	Underlying	Cost of Carry A	Cost of Carry B
1	Up by $\max(IMR_A, IMR_B)$	Up by Λ_A	Up by Λ_B
2	Up by $\max(IMR_A, IMR_B)$	Up by Λ_A	Down by Λ_B
3	Up by $\max(IMR_A, IMR_B)$	Up by Λ_A	Unchanged
4	Up by $\max(IMR_A, IMR_B)$	Unchanged	Up by Λ_B
5	Up by $\max(IMR_A, IMR_B)$	Unchanged	Down by Λ_B
6	Up by $\max(IMR_A, IMR_B)$	Unchanged	Unchanged
7	Up by $\max(IMR_A, IMR_B)$	Down by Λ_A	Up by Λ_B
8	Up by $\max(IMR_A, IMR_B)$	Down by Λ_A	Down by Λ_B
9	Up by $\max(IMR_A, IMR_B)$	Down by Λ_A	Unchanged
10	Unchanged	Up by Λ_A	Up by Λ_B
11	Unchanged	Up by Λ_A	Down by Λ_B
12	Unchanged	Up by Λ_A	Unchanged
13	Unchanged	Unchanged	Up by Λ_B
14	Unchanged	Unchanged	Down by Λ_B
15	Unchanged	Unchanged	Unchanged
16	Unchanged	Down by Λ_A	Up by Λ_B
17	Unchanged	Down by Λ_A	Down by Λ_B
18	Unchanged	Down by Λ_A	Unchanged
19	Down by $\max(IMR_A, IMR_B)$	Up by Λ_A	Up by Λ_B
20	Down by $\max(IMR_A, IMR_B)$	Up by Λ_A	Down by Λ_B
21	Down by $\max(IMR_A, IMR_B)$	Up by Λ_A	Unchanged
22	Down by $\max(IMR_A, IMR_B)$	Unchanged	Up by Λ_B
23	Down by $\max(IMR_A, IMR_B)$	Unchanged	Down by Λ_B
24	Down by $\max(IMR_A, IMR_B)$	Unchanged	Unchanged
25	Down by $\max(IMR_A, IMR_B)$	Down by Λ_A	Up by Λ_B
26	Down by $\max(IMR_A, IMR_B)$	Down by Λ_A	Down by Λ_B
27	Down by $\max(IMR_A, IMR_B)$	Down by Λ_A	Unchanged

7. Calculate the maximum of the absolute changes calculated in step 6, and let ψ denote this quantity;
8. If $i = 1$, set the CSMR for both A and B to $\psi/2$, else set the CSMR for B equal to $\psi - CSMR_A$;
9. Repeat steps 3 to 8 for $i = 2,3,\ldots,n-1$.

The cost of carry factor for a particular asset class is determined by considering the performance of benchmark spread positions over a specific look-back period and are defined in terms of continuously compounded yields. In particular, the same look-back period used to quantify IMR values for the particular asset class are used to quantify cost of carry factors. Cost of carry factors are reviewed annually as part of the CSMR calibration process.

2.2.2. Comprehensive Calibration Algorithm

The CSMR definition laid out in this section can be used to imply the calibrated CSMR values in a more direct way using historical contract prices. The approach has certain similarities to the way in which the SSMR calibration is performed in that it is based on the change in a hypothetical portfolio value instead of individual contract prices. The generic application of the CSMR is expressed as follow:

$$IM = Pos_A \times CSMR_A + Pos_B \times CSMR_B + |Pos_A \times IMR_A - Pos_B \times IMR_B|$$

The CSMRs are intended to capture the discrepancy in price movements between different expiries on contracts with the same CSG when the IMR components of the contracts' margins are offset against each other. The definition implies that where there are two contracts in a CSG with the same IMR, the total CSMR between the two contracts must be enough to cover the difference in price movement between the two contracts from one day to the next when the IMR margins are being offset. For the purposes of a CSMR calibration, we therefore observe the change in the value of a portfolio that consists of a long position in the one expiry and a short position in the other different expiry. The CSMR will then be based on the change in the value of such a portfolio.

Based on this logic, the following generic algorithm is used to calibrate CSMR parameters:

1. Source the historical futures contract price data of all the CSGs for which CSMRs are required.
2. Determine the *near* contract expiry for each CSG for each historical date.
3. Determine the *next* contract expiry for each CSG for each historical date.
4. For each CSG for each historical day, create a portfolio that consists of a long position in the *near* contract, Pos_{near}, and a short position in the *next* expiry in the CSG, Pos_{next}, where
$$Pos_{next} = \frac{IMR_{near}}{IMR_{next}}$$
5. Determine the value of the portfolio for each historical date per CSG.
6. Determine the 2-day change in the portfolio value per day per CSG.
7. By considering all of the calculated portfolio value changes of a CSG, determine corresponding 99.7% change, $P\&L_{near;next}$.
8. The value from #7 represents the total margin amount that should be covered by the combined CSMR-values of the long and short contracts. As such, set the CSMR-values as follow per CSG:
$$CSMR_{near} = CSMR_{next} = \frac{P\&L_{near;next}}{2}$$
9. In order to determine the CSMR-values for the other contract expiries in the CSGs, repeat steps 3 to 7 with the following changes:
    a. Replace the *next* expiry for each CSG with each of the following contracts that expire after it, contract *next+i*.
    b. In step 7, since $CSMR_{near}$ is already known, the CSMR for the each of the following contracts that expire after it becomes:
$$CSMR_{next+i} = P\&L_{near;next+i} - CSMR_{near}$$

This algorithm represents the generic approach for calibration CSMRs. Certain simplifications might be applied to an actual calibration if they can be justified from a materiality point of view.

2.3. SSMR Methodology

Under JSPAN, the maximum offset for a particular series spread is obtained when:

$$Pos_B = Pos_{A,B}^{Optimal} = \frac{IMR_A}{IMR_B}.$$

An incremental increase in Pos_B beyond $Pos_{A,B}^{Optimal}$ is margined at an outright basis. When calculating SSMRs, careful consideration should be given to the maximum obtainable offset, in order to ensure that JSPAN never understates the risk associated with a particular series spread position.

The following algorithm is used to calibrate SSMR parameters:

1. For each SSG construct a matrix where element (i, j) represents the portfolio-level Value-at-Risk (calculated by extending the contract-level IMR framework to a portfolio-level framework) associated with a long position in contract i and $Pos_{i,j}^{Optimal}$ short positions in contract j, where $i, j = 1,2, \dots n$, and n is the number of CSGs in the SSG.
2. Guess a value for all SSMRs in the SSG (use 30% of the IMR as an initial guess).
3. Construct a matrix where element (i, j) represents the portfolio-level J-SPAN requirement associated with a long position in contract i, and $Pos_{i,j}^{Optimal}$ short positions in contracts j.
4. Determine the difference (matrix Δ) between the matrices calculated in steps (3) and (1).
5. Determine the smallest possible values for all applicable SSMRs, such that none of the elements of Δ are less than zero.

The same methodology as that described above is used to calibrate the CSMR parameters for the agricultural derivatives market. In particular, each CSG in this market is interpreted as an SSG (for the purpose of calibrating CSMRs only), comprised of the following:

- A generic spot month contract;
- A generic spot vs. near hedge month contract; and
- A generic near hedge vs. next hedge contract.

In general, a higher CSMR value will be attributed to the spot month contract to reflect the higher level of risk typically associated with spot vs. non-spot calendar spreads.

2.4. Calibration Frequency

It should be noted that IMR, CSMR, and SSMR values are loaded into the clearing system in the settlement currency of the particular futures contract, and not as a percentage of the notional value of the contract. In order to minimize the operational risk faced by JSEC when updating values while keeping portfolio-level IM requirements as stable and transparent as possible, the IM parameters are updated as follows:

- IMR : Recalibrated on a scheduled fortnightly basis (instead of daily)
- CSMR and SSMR : The calibration of these parameters is not dependent on the latest contract prices and therefore can be updated much less frequently. They are recalibrated on an annual basis.

JSEC can, however, perform ad-hoc JSPAN parameter recalculations should market circumstances warrant such a recalculation.

3. Portfolio VaR for Interest Rate Derivatives

The simplistic nature of the JSPAN framework often implies a lack of IM offset between highly correlated contracts. This is particularly problematic in the interest rate derivatives market, where portfolios often comprise of long and short exposures across the entire curve. To this end, the JSE makes use of an alternative framework for the purpose of calculating account-level base IM requirements for accounts in this market.

3.1. Calculation Overview

The formulaic breakdown of the VaR methodology is described in [2]. This section provides a high-level description of the calculation methodology. An overview of the account level calculation is as follows:

1. Calculate the Value-at-Risk (VaR) for a particular account using the following parameters:

VaR Methodology	Confidence Interval	Liquidation Period	Look-Back Period
Historical VaR	99.7%	2-days	Rolling 750-day plus stressed 250-day

2. Calculate the cost, as it relates to the number of basis points away from mid-market rates, that would be incurred when liquidating all positions within the particular account;
3. Calculate the profit and loss for the particular account under a series of what-if scenarios, designed to estimate the extent to which the account could incur losses if historically observed correlation patterns break down; and finally
4. The account level IM is estimated as the smallest (most negative) of the following:
    a. The sum of the VaR and liquidation cost calculated in steps 1 and 2 above; and
    b. The smallest (most negative) loss calculated under the set of what-if scenarios calculated in step 3.

3.2. Calibration Frequency

The contract level parameters (vectors) which are used to calibrate the VaR estimates, are only updated on a scheduled fortnightly basis instead of daily; in an effort the keep portfolio-level IM requirements as stable and transparent as possible. JSEC can, however, perform ad-hoc parameter recalculations should market circumstances warrant such a recalculation.

4. Liquidation Period Margin

A key component of an IM methodology is its ability to incorporate the costs associated with liquidating a defaulting portfolio. To this end, JSECs account-level IM methodology applies a more punitive IM requirement (in relative terms) for large positions than for small positions; in order to acknowledge the higher liquidation costs typically associated with large positions. This higher IM requirement is achieved by adding the so called liquidation period margin to the base account-level IM requirement. The calculation of liquidation period margin (LiPAO) for interest rate derivatives is different to the calculation for all other contracts.

4.1. General LiPAO Calculation Methodology

Assume that the IMR for a particular future is calculated using an $\alpha\%$ confidence level and an n-day liquidation period, and let $VaR_{\alpha;n}$ denote the effective VaR percentage associated with a particular IMR.

Let Γ denote the 90-day adjusted average daily value traded[1] in the underlying to the abovementioned futures contract. The maximum participation in the said underlying on any given day is M, where:

$$\mathrm{M} = \frac{\Gamma}{3},$$

Let Π denote the size (in terms of delta-adjusted net notional) of an arbitrary position in the abovementioned underlying. The position-level liquidation period represents the number of days it will take to liquidate the particular position. The liquidation period ν, is calculated as:

$$\nu = \min(x \in \mathbb{N}_{>0} : \Pi - xM \leq 0).$$

The liquidation period margin relating to Π is then calculated as follows:

$$IM_{Conc} = \begin{cases} M \times VaR_{\alpha;1}\left(\sqrt{2} + \sqrt{3} + \cdots + \sqrt{\nu}\right) + (\Pi - [\nu - 1]M)VaR_{\alpha;1} \times \sqrt{\nu + 1} - \Pi VaR_{\alpha;n}, & \nu > n - 1 \\ 0, & \nu \leq n - 1 \end{cases}$$

The total account-level liquidation period margin requirement is then derived by aggregating the position-level liquidation period margin across all underlying instruments.

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[1] Adjusted average daily value traded is the average of the last 90 days value traded excluding the 9 (10%) days with the largest value traded. This avoids the average value being skewed by infrequent large trades which cannot be depended upon when liquidating a position.

4.2. Interest Rate Derivatives LiPAO Calculation Methodology

The following algorithm is applied to each account containing interest rate derivatives futures:

- After completion of the portfolio VaR IM calculation, determine the change in the MtM value of each account associated with:
    - Changing the MtM value of the first input to the yield curve up by one basis point, and reconstructing the entire yield curve whilst leaving all other inputs unchanged.
    - Repeating the above for each input to the curve recursively.
- The above step creates a so-called PV01 ladder for each account. The i^{th} "step" of the PV01 ladder for a particular account represents the change in the MtM of the account associated with a one basis point change in the value of the i^{th} input to the curve.
- Each "step" of each PV01 ladder is then multiplied by the corresponding element in the so-called hedge cost matrix, in order to determine the liquidation period margin due to each input to the curve. Element (i,j) of the hedge cost matrix represents the anticipated basis point cost associated with executing a trade with a PV01 of j, in the i^{th} curve input. The elements of the hedge cost matrix are determined through market consultation, and updated annually, or more regularly if market conditions warrant so.
- Finally, the account-level liquidation period margin is determined by adding the account-level liquidation margin per curve input.

4.3. Calibration Frequency

In order to minimize the operational risk faced by JSEC, and in an effort the keep portfolio-level IM requirements as stable and transparent as possible, all liquidation period margin parameters are only updated on a scheduled monthly basis instead of daily. JSEC can, however, perform ad-hoc parameter recalculations should market circumstances warrant such a recalculation.

5. Large Exposure Margin

Under JSE Clear's stress testing framework, the stressed exposure at default (sEAD) for a particular client under a particular stress scenario is calculated by:

1. Calculating the Mark-to-Market (MtM) of each contract cleared by JSE Clear on day T+0;
2. Using the contract-level MtM values to calculate the MtM value of the particular client account on day T+0;
3. Calculating the stressed Mark-to-Market (sMtM) value of each contract under the particular scenario, for valuation date T+n, where n denotes the liquidation period specified in Table 1 (generic asset-class price changes are applied, and options are revalued under the stressed futures price and volatility scenario);
4. Using the sMtM values calculated in step 3 to calculate the associated stressed profit and loss (sPnL) for each contract under each scenario (associated with having a long position in each contract);
5. Using the above contract-level sPnL values to calculate the stressed variation margin (sVM) associated with the change in the MtM value of the client portfolio (from MtM T+0 to sMtM T+ n); and finally
6. Calculating the stressed exposure at default (sEAD) as the smaller of zero and difference between the total amount of IM held (base IM and liquidation period IM) against the exposure and sVM per account (client account or trading member's proprietary account).

The large exposure margin is then calculated as the greater of zero and the absolute value of the smallest (largest negative) sEAD across all of JSE Clear's historic stress testing scenarios for that account, less the predefined large exposure threshold. However, if the abovementioned sum is greater than zero, no large exposure margin will be applied.

5.1. Calibration Frequency

In order to minimize the operational risk faced by JSEC, and to in an effort the keep portfolio-level IM requirements as stable and transparent as possible, contract-level sPnL vectors are only updated on a scheduled fortnightly basis instead of daily. JSEC can, however, perform ad-hoc PnL vector recalculations should market circumstances warrant such a recalculation. The sPnL vectors for new contracts (loaded after the most recent recalibration) are set to zero until the next scheduled recalibration.

Summary of Calibration Frequencies

	Frequency of update/calibration		
Parameter	**EDM and FXM**	**CDM (Commodities)**	**IRD**
IMR	Fortnightly	Fortnightly	N/A
CSMR	Annual	Annual except WMAZ and YMAZ which is seasonal	N/A
SSMR	Annual	Annual	N/A
VSR	Annual	Annual	Annual (options only)
Liquidation Period Add On	Calculated Daily (Parameters updated Monthly i.e. ADVT and 1-Day VAR)	Monthly	N/A
Large Exposure Add-on	Daily	Fortnightly	Fortnightly
IRD Var PnL vectors	N/A	N/A	Fortnightly
Safety Net Scenarios	N/A	N/A	Annually
Hedge Cost Matrix	N/A	N/A	Annually (or ad hoc as required)

6. Policy Governance

This methodology is owned by the JSE Clear Chief Risk Officer and will be reviewed annually or when there are any material changes to the JSEC's risk profile, methodologies or processes.

The JSEC Risk Committee will recommend the initial approval of this policy by the JSEC Board or when there are material changes. The regular annual review of this policy will be approved by the JSE Clear Risk Committee.

7. References

[1] JSE Derivatives Market Margining: Technical Specification, JSE, March 2012.

[2] Portfolio VaR Methodology, JSE, April 2017.