Johannesburg Stock Exchange

Trading and Information Solution
Equity Market

JSE Guidance Note
Statistical Market Data

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1 DOCUMENT CONTROL

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1.2   Revision History

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27 January 2012	1.00	Initial Draft
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1.3   References

Volume 00 – Trading and Information Overview
Volume 05 - Market Data Feed (MITCH - UDP)
Volume 06 - Market Data Feed (FAST_UDP)

1.4   Contact Details

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2   INTRODUCTION

This document details the statistical market data that will be computed and published by the new Equity Trading and Information solution.

3 MARKET DATA STATISTICS

3.1 General Requirements

3.1.1 The System will publish the instrument statistics outlined in this section for the current trading day only. The statistics for the JSE will be independent of those of the NSX.

3.1.2 All On Book trade types, excluding CrossTrades will update all On Book market data statistics. i.e. AT and UT trades will be included and XT trades will be excluded.

3.1.3 Statistics calculated will be rounded down to three decimal places.

3.1.4 The ShortCode field in the 'TradeTypeEntries' CSV file will indicate whether a trade type (Off Book) is included in the cumulative statistics. Please refer to Volume 1200 – Trading and Information Overview V1.00, Appendix A for a detailed list of trade types and their respective statistics eligibility.

3.1.5 Off Book trades with the ShortCode set to "no" will not be considered for updating statistics.

3.1.6 Off Book trades with the ShortCode set to "yes" will update the following statistics:

- (a) Turnover (Off Book)
- (b) VWAP (All Trades i.e. On Book and Off Book)
- (c) Volume (Off Book)
- (d) Number of Trades (Off Book)

3.1.7 For High Price only On Book Trades should be used for calculating statistics (Off Book trades should not be included).

3.1.8 For Low Price only On Book Trades should be used for calculating statistics (Off Book trades should not be included).

3.1.9 Cross Trades (XT) and Volume auction trades (VT) will not update the statistics sent out by the trading engine but can be used to determine Closing Prices

Following are the various statistics published real time in the system.

3.2 Opening Price

3.2.1 The opening price of an instrument will be determined as per the OpeningPriceConvention field.

3.2.2 If the parameter is "Opening Auction" the opening price will be the trade price of the opening auction (uncrossing trade).

3.2.3 If no opening auction uncrossing takes place, no opening price will be published for that instrument by the System, i.e.no message will be published.

3.2.4 If the parameter is "First Trade" the opening price will be the opening auction uncrossing trade price. However if no opening auction uncrossing takes place, the first automatic trade price will update the opening price.

3.2.5 If the parameter is "Mid-Point", the midpoint just after the opening auction will be the opening price for that instrument.

3.2.6 The "Mid-Point" will be determined using the Visible Order book.

3.2.7   If no trading happens for an instrument there will be no opening price published for that day i.e. no message will be published.

3.2.8   However, if the parameter is "Mid-Point", opening price will be published by the first ever visible midpoint the moment it gets updated.

3.2.9   The OpeningPriceConvention will be published together with the opening price for an instrument.

3.2.10   If the parameter is "First Trade" the indicator published with the opening price would be either UT or AT as per the indicator which was used ultimately.

3.2.11   If the parameter is "None", the opening price will not be published for an instrument i.e. no message will be published.

3.3   Closing Price

3.3.1   The closing price of an instrument will be determined as per the PrimaryClosingPriceConvention and SecondaryClosingPriceConvention fields.

3.3.2   PrimaryClosingPriceConvention - A mandatory field which defines the preferred method of determining the closing price for an instrument. The following values are supported:
1. Closing Auction
2. VWAP (Fixed Window)
3. VWAP (Variable Window)
4. VWAP (Mid Point)
5. Last Trade
6. Mid-Point
7. None

3.3.3   SecondaryClosingPriceConvention – An optional field which defines the method of determining the closing price for an instrument if the PrimaryClosingPriceConvention is "Closing Auction" and if a closing auction is not available in the system. Possible values are as follows:
1. VWAP (Fixed Window)
2. VWAP (Variable Window)
3. VWAP (Mid Point)
4. Last Trade
5. Mid-Point
6. None

3.3.4   ClosingPriceDuration – An optional parameter which determines the duration in minutes of trades considered when the closing price is computed as a VWAP. This parameter should only apply if the PrimaryClosingPriceConvention or SecondaryClosingPriceConvention field is set as 'VWAP (Fixed Window)', 'VWAP (Variable Window)', or 'VWAP (Mid Point)'. Zero (0) can be used to represent null as it is not a valid value for this parameter.

3.3.5   The closing price for an instrument should be published if its PrimaryClosingPriceConvention is not "None".

3.3.6   The closing price should be computed and published at one of the following events:

        End of Closing Auction Call session

        Start of the Post Close session

        Start of the Halt and Close session

        When an instrument is suspended (either directly or if its market, segment or underlying is suspended)

3.3.7   The description of the parameters that can be defined under the PrimaryClosingPriceConvention and SecondaryClosingPriceConvention fields is given below from section 3.4 onwards.

3.3.8   Closing Price will be rounded to the nearest real number, and is applicable across all closing price conventions. E.g.:

- 1550.00 -> Rounded Value = 1550.00
- 1551.49 -> Rounded Value = 1551.00
- 1551.50 -> Rounded Value = 1552.00

1551.90 -> Rounded Value = 1552.00

3.4   VWAP (Fixed Window)

3.4.1   An instrument's closing price should be the VWAP of On-Book trades (Automated and Uncrossing trades) calculated within the last 'n' number of minutes of trading prior to the point of the closing price calculation.

3.4.2   The configurable last 'n' number of minutes is defined in the ClosingPriceDuration field. If a duration is not specified, the closing price should be the VWAP for the entire day's On-Book trades (Automated and Uncrossing trades).

3.4.3   If there were no trades during the Closing Price Duration, the closing price should be the price of the most recent last On-Book trade (Automated or Uncrossing trade).

3.4.4   If there were no trades for the entire day, the closing price should be the previous day's closing price.

3.4.5   If an instrument has never traded, the closing price should be zero.

3.5   VWAP (Variable Window)

3.5.1   An instrument's closing price should be the VWAP of On-Book trades (Automated and Uncrossing trades) calculated within the last 'n' (configurable) number of minutes of trading prior to the last On-Book trade (VWAP should include the last On-Book trade).

E.g. If an instrument's last On-Book trade was at 1:25pm, VWAP for the closing price should be calculated using On-Book trades that were executed 'n' minutes prior to 1.25pm.

3.5.2   The configurable last 'n' number of minutes is defined in the ClosingPriceDuration field. If a duration is not specified, the closing price should be the VWAP for the entire day's On-Book trades (Automated and Uncrossing trades).

3.5.3   If there were no On-Book trades for the entire day, the closing price should be the previous day's closing price.

3.5.4   If an instrument has never traded, the closing price should be zero.

3.6 VWAP (Mid Point)

3.6.1 An instrument's closing price should be the VWAP of On-Book trades (Automated and Uncrossing trades) calculated within the last 'n' number of minutes of trading prior to the point of the closing price calculation.

3.6.2 The configurable last 'n' number of minutes is defined in the ClosingPriceDuration field. If duration is not specified, the closing price should be the VWAP for the entire day's On-Book trades (Automated and Uncrossing trades).

3.6.3 If there were no On-Book trades during the Closing Price Duration, the closing price should be the mid-point of the best bid and offer prices at the time the closing price is computed.

Mid Point = [Best Bid Price + Best Offer Price] / 2

3.6.4 The calculated mid-point should always be the last mid-point of the Visible BBO during continuous trading.

E.g. If the closing price calculation event is the Post Close session, closing price should be the mid-point of the Visible BBO just before the closing auction call.

If the instrument was suspended the closing price should be the mid-point immediately prior to the suspension (i.e. not after as all orders are cancelled on a suspension).

If the instrument was Suspended (or Halted and Closed) during any auction call session, the closing price should be calculated using the Visible BBO just before the initiation of Auction Call session.

3.6.5 If there is no best bid or offer price, the closing price should be the last On-Book traded price for the day (Automated trade or Uncrossing trade).

3.6.6 If there were no On-Book trades for the entire day, the closing price should be the best bid price or the best offer price (whichever is available).

3.6.7 If both the best bid and offer prices are unavailable the closing price should be zero.

3.7 Last Trade

3.7.1 An instrument's closing price should be the last On-Book traded price for the day.

3.7.2 The price of the last trade will be considered irrespective of the method (Automated trade or Uncrossing trade) under which it was executed. However, Off Book trades will be excluded from the closing price computation.

3.7.3 If there were no On-Book trades for the entire day, the closing price should be the previous day's closing price.

3.7.4 If an instrument has never traded, the closing price should be zero.

3.8 Mid Point

3.8.1 An instrument's closing price should be the mid-point of the best bid and offer prices at the time the closing price is computed.

Mid Point = [Best Bid Price + Best Offer Price] / 2

3.8.2 The calculated mid-point should always be the last mid-point of the Visible BBO during continuous trading.

E.g. If the closing price calculation event is the Post Close session, closing price should be the mid-point of the Visible BBO just before the closing auction call.

If the instrument was suspended the closing price should be the mid-point immediately prior to the suspension (i.e. not after as all orders are cancelled on a suspension).

If the instrument was Suspended (or Halted and Closed) during any auction call session, the closing price should be calculated using the Visible BBO just before the initiation of Auction Call session.

3.8.3 If there is no best bid or offer price, the closing price should be the last On-Book traded price for the day (Automated trade or Uncrossing trade).

3.8.4 If there were no trades for the entire day, the closing price should be the best bid price or the best offer price (whichever is available).

3.8.5 If both the best bid and offer prices are unavailable the closing price should be zero.

3.8.6 A mid-point will be computed even if the best bid and offer prices lock or cross.

3.9 None

3.9.1 An instrument's closing price should not be calculated or published. These will be the instruments which will be traded off the exchange.

3.9.2 Closing prices for these instruments may be received from their primary markets which could be uploaded to the system (market operations user may update the closing prices via a file upload or individual statistic update)

However, closing prices should not be disseminated for these instruments.

3.9.3 If the closing price was updated manually, previous close prices should be disseminated on the following day for reference data related calculations.

3.10 Closing Auction

3.10.1 An instrument's closing price should be the price of the closing auction.

3.10.2 If an uncrossing did not take place in the closing auction, the closing price should be calculated as per the methodology defined in the SecondaryClosingPriceConvention field.

3.10.3 Depending on the SecondaryClosingPriceConvention field, closing price should be calculated as follows:

3.10.4 Last Trade – Last On-Book trade (Automated or Uncrossing trade)

3.10.5 Mid-Point - mid-point of the best bid and offer prices at the time the closing price is computed. If the order book was moved to the closing auction call session early due to a circuit breaker, the mid-point of the Visible BBO just before the Visible BBO is locked/crossed by the remainder of the incoming order, should be used.

3.10.6 VWAP (Fixed Window) – VWAP calculated within the last 'n' number of minutes of trading prior to the point of the closing price calculation.

Exception: If the event which triggered the calculation of the closing price is the start of Post Close session, the VWAP should be within the last 'n' number of minutes of trading prior to the start of Closing Auction Call session.

3.10.7 VWAP (Variable Window) – VWAP calculated within the last 'n' number of minutes of trading prior to the last trade.

3.10.8 None – The instrument's closing price should not be calculated or published if a closing auction did not take place.

3.10.9 There will be four methodologies maintained in the System:

    1) Methodology 1
    2) Methodology 2
    3) Methodology 3
    4) Methodology 4

3.11 Methodology 1

3.11.1 The closing price of an instrument will be determined as follows:

3.11.2 The price of the uncrossing trades at the end of the closing auction;

3.11.3 If there are no uncrossing trades at the end of the closing auction then the closing price should be the VWAP calculation (determined during the number of minutes specified in the ClosingPriceDuration field prior to the start of the closing auction);

3.11.4 If there is no VWAP calculation then the closing price will be the price of the last Automated Trade (which could be either an Automated Trade (i.e. last AT) or an Uncrossing Trade (i.e. last UT)) for the current day;

3.11.5 If there has been no Automated Trades or Uncrossing Trades (UTs & ATs) in the System for the day, the closing price will then be the previous closing price (previous close).

3.11.6 For a new listing, if there are no trades for the day, the closing price will be zero.

3.11.7 VWAP will be calculated as follows:

VWAP = $\sum$ (Trade Price$_i$ * Trade Volume$_i$) / $\sum$ Trade Volume

Where;

Trade Price$_i$ – Price of the ith eligible trade (Only ATs and UTs are eligible trades)

Trade Volume$_i$ – Volume of the ith eligible trade (Only ATs and UTs are eligible trades)

3.11.8 To achieve the methodology mentioned above, the configuration details should be as follows:

PrimaryClosingPriceConvention – CLOSING AUCTION

SecondaryClosingPriceConvention – VWAP (FIXED WINDOW)

3.12 Methodology 2

3.12.1 The closing price of an instrument will be determined as follows:

3.12.2 Based on the Mid Point of the last BBO during continuous trading (at the start of the Post Close Session);

3.12.3 If only one side of the book contains orders at the end of the continuous trading session,

the closing price will be the last Automated Trade or Uncrossing Trade (ATs and UTs) for the day;

3.12.4 If there have been no trades for the day and only one side of the book contains orders, the closing price will be the price of the best order of the particular side;

3.12.5 If the book is empty then the closing price will be zero.

3.12.6 To achieve the methodology mentioned above, the configuration details should be as follows:

PrimaryClosingPriceConvention – MID POINT

SecondaryClosingPriceConvention – NONE

3.12.7 The above mentioned closing price priority is applicable only for those Trading Cycles as indicated in BFS Volume 3 - Trading Sessions for more details.
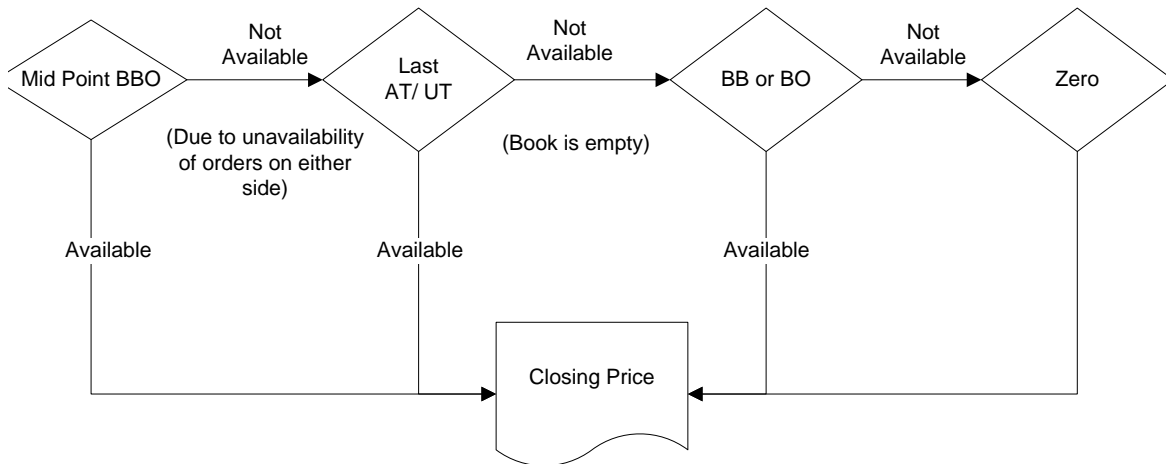
3.13   Methodology 3

3.13.1 The closing price of an instrument will be determined as follows:

3.13.2 The price of the uncrossing trades at the end of the closing auction;

3.13.3 If no trades occurred in the closing auction then it is based on the Mid Point of the last BBO during continuous trading;

3.13.4 In the event where there are insufficient orders to calculate the Mid Point of Visible BBO, the closing price will be as follows:

3.13.5 If only one side of the book contains orders at the end of the continuous trading session,

the closing price will be the last Automated Trade or Uncrossing Trade (ATs and UTs) for the day;

3.13.6 If there have been no trades for the day and only one side of the book contains orders, the closing price will be the price of the best order of the particular side;

3.13.7 If the book is empty then the closing price will be zero.

**3.13.8** To achieve the methodology mentioned above, the configuration details should be as follows:

PrimaryClosingPriceConvention – CLOSING AUCTION

SecondaryClosingPriceConvention – MID POINT
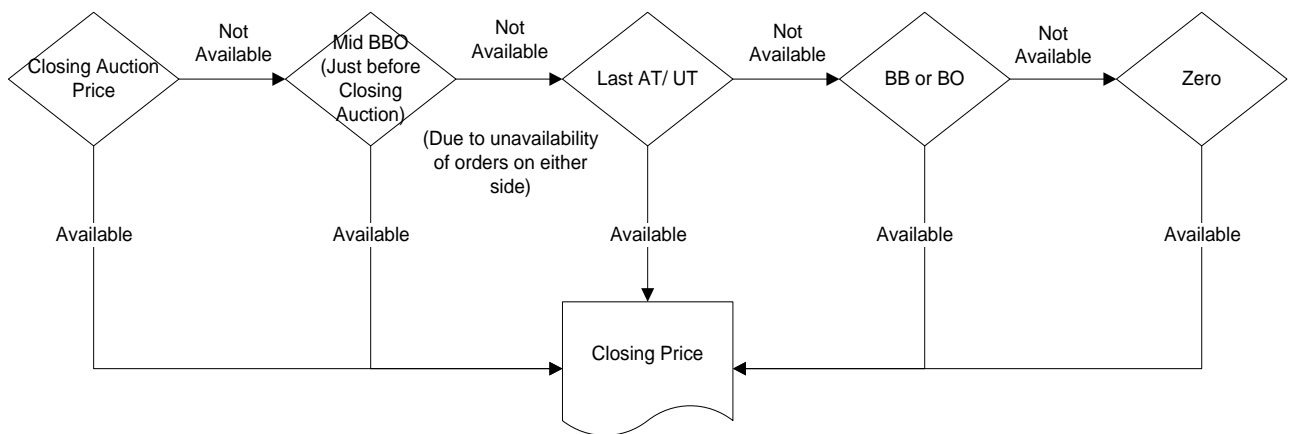
3.14 Methodology 4

3.14.1 The closing price of an instrument will be determined as follows:

3.14.2 The price of the Uncrossing trades at the end of the closing auction;

3.14.3 If there are no uncrossing trades at the end of the closing auction then the closing price should be the VWAP calculation (determined during the number of minutes specified in the ClosingPriceDuration field prior to the start of the closing auction);

3.14.4 If there is no VWAP calculation, then the closing price will be the Midpoint of the last BBO during continuous trading;

3.14.5 In the event where there are insufficient orders to calculate the Mid Point of BBO (i.e only one side of the book contains orders), then the closing price will be Last Automated Trade or Uncrossing Trade for the day (AT or UT);

3.14.6 If there have been no Automated Trades or Uncrossing Trades (ATs and UTs) for the day then the closing price will be the price of the best order of the particular side. (i.e BB or BO)

3.14.7 If there are no orders in the order book, then the closing price will be zero.

3.14.8 To achieve the methodology mentioned above, the configuration details should be as follows:

PrimaryClosingPriceConvention – CLOSING AUCTION

SecondaryClosingPriceConvention – VWAP (MID POINT)
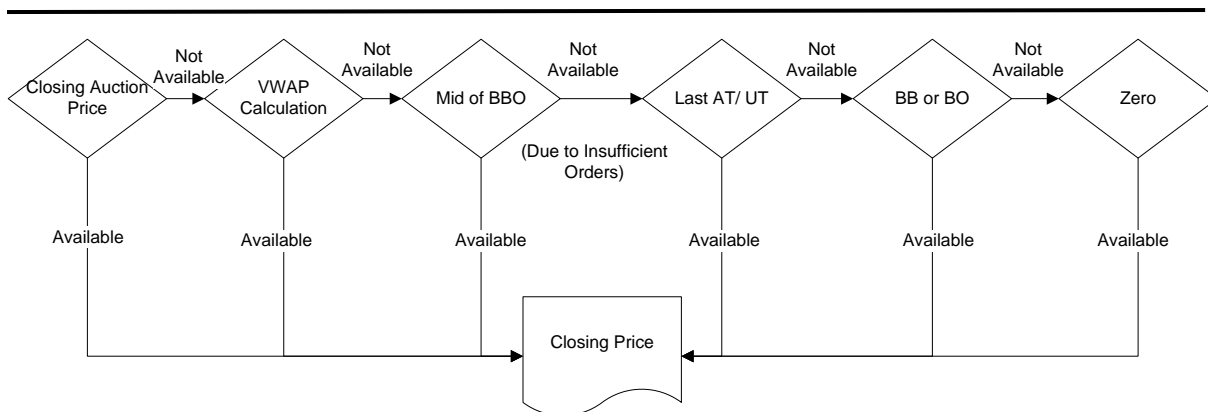
3.15   General closing price functionality

3.15.1   The closing price of an instrument will be calculated and published real-time to the market data gateways (FAST and MITCH), the Service Desk front end and the Surveillance system through the Downstream Gateway.

3.15.2   The method of determining the closing price will be published together with the closing price for an instrument i.e. for methodology 1 and 2: any of the four different levels of reasons and for methodology 3: any of the five different levels of reasons.

3.15.3   In the case where an instrument gets suspended during the trading day (anytime between the Market Start and the Market End) the closing price will automatically be published upon the suspension action. If a closing price has already been published another one will not be published.

3.15.4   Similarly, if the market operations performs the halt and close action for an instrument, then the closing price will automatically be published upon that action.

3.15.5   The method of determining the closing price for such suspended or halted and closed instruments will be as defined for the segment that the instrument belongs to.

3.15.6   In the event where it is an instrument's first trading day and no trades occur for the entire day, the closing price will be published as zero

3.15.7   When an Instrument is suspended the Closing Price will be published, at the suspension. On the day(s) following suspension, if the Instrument remains suspended, a Closing Price will not be published at the end of the day. However the Closing Price at the time of suspension will be carried forward as the Previous Close of the Instrument. The Previous Close of the instrument will be carried forward across trading days and will be published via the Market Data Gateways in case the instrument suspension is carried forward to subsequent trading days.

4 STATISTICS

4.1 Previous Close

4.1.1 Closing price published on the previous day. On the first trading day, the instruments Previous Closing Price field will not display a value i.e. it will be blank. The Previous Close is disseminated via the Market Data Gateways at the start of day. Please refer to Volume 06 - Market Data Feed (FAST - UDP) and Volume 05 - Market Data Feed (MITCH - UDP) for further details.

4.2 Closing Bid Price

4.2.1 The best bid price just before moving to the closing auction call. This will be disseminated by the System only if the way of determining the closing price is "mid of BBO" just before moving to the closing auction call.

4.2.2 In this scenario, the Closing Bid Price will be disseminated via the FAST Market Data Gateway in the same message as the Closing Price.

4.3 Closing Offer Price

4.3.1 The best offer price just before moving to the closing auction call. This will be disseminated by the System only if the way of determining the closing price is "mid of BBO" just before moving to the closing auction call.

4.3.2 In this scenario, the Closing Offer Price will be disseminated via the FAST Market Data Gateway in the same message as the Closing Price. Please refer to Volume 06 - Market Data Feed (FAST - UDP) for further details.

4.4 High Price

4.4.1 Highest On Book trade price of the day will be published real time by the System.

4.4.2 Where no high price is published for an instrument, the first On Book trade to execute in the System will publish its first high price of the day.

4.4.3 High price is one of the market data statistics that can be updated manually by Market Operations and the updated value is published to the market via the market data gateways.

4.5 Low Price

4.5.1 Lowest On Book trade price of the day will be published real time by the System.

4.5.2 Where no low price is published for an instrument, the first On Book trade to execute in the System will publish its first low price of the day.

4.5.3 Low Price is one of the market data statistics that can be updated manually by Market Operations and the updated value is published to the market via the market data gateways.

4.6 VWAP (On Book)

4.6.1 The System will publish the Volume Weighted Average Price for On Book trades during the current day.

4.6.2 VWAP will be calculated as follows;
VWAP = $\sum$ (Trade Price$_i$ * Trade Volume$_i$) / $\sum$ Trade Volume
Where;
Trade Price$_i$ – Price of the ith On-Book trade

Trade Volume$_i$ – Volume of the ith On Book trade

4.7 VWAP (All Trades i.e. On Book and Off Book)

4.7.1 The System will publish the Volume Weighted Average Price for all published trades (On Book and Off Book) during the current day.

4.7.2 VWAP will be calculated as follows;
VWAP = $\sum$ (Trade Price$_i$ * Trade Volume$_i$) / $\sum$ Trade Volume
Where;
Trade Price$_i$ – Price of the ith eligible trade

Trade Volume$_i$ – Volume of the ith eligible trade

4.8 Turnover (On Book)

4.8.1 The System also will publish the turnover for all the On Book trades published during the current day.

4.8.2 Turnover will be calculated as follows:
Turnover = $\sum$ (Trade Price$_i$ * Trade Volume$_i$)
Where;
Trade Price$_i$ – Price of the ith On Book trade
Trade Volume$_i$ – Volume of the ith On Book trade

4.9 Turnover (Off Book)

4.9.1 The turnover of all the eligible Off Book trades published during the current day too will be calculated by the System.

4.9.2 Turnover will be calculated as follows:
Turnover = $\sum$ (Trade Price$_i$ * Trade Volume$_i$)
Where;
Trade Price$_i$ – Price of the ith eligible Off Book trade
Trade Volume$_i$ – Volume of the ith eligible Off Book trade

4.10 Volume of Trades (On Book)

4.10.1 The total quantity of all the On-Book trades published during the current day will be determined.

4.11 Volume of Trades (Off Book)

4.11.1 The total quantity of all the eligible Off Book trades published during the current day will be determined.

4.12 Number of Trades (On Book)

4.12.1 The total number of On Book trades published during the current day will be determined.

4.12.2 If the trades executed at an auction are published as a bunched trade the number of trades executed at the auction will be considered as one (1).

4.13 Number of Trades (Off Book)

4.13.1 The total number of Off Book trades included in the cumulative statistics for the current trading day will be determined.

4.14 Statistics Calculated Automatically upon Trade Cancellations and Corrections

4.14.1 The following statistics will be updated automatically upon trade cancellations and corrections which take place on trades executed on the current trading day.

- (a) VWAP (All trades i.e. On Book and Off Book)
- (b) VWAP (On Book)
- (c) Turnover (On Book)
- (d) Turnover (Off Book)
- (e) Volume of Trades (On Book)
- (f) Volume of Trades (Off Book)
- (g) Number of Trades (On Book)
- (h) Number of Trades (Off Book)

4.14.2 The remaining statistics may, if required be manually updated by Market Operations.

4.15 Statistics Published for Suspended Instruments

4.15.1 Off Book trades can be reported for suspended instruments. Hence, Off Book statistics will be published for such suspended instruments even after publishing its closing price upon suspension.

4.16 Extended Stats Message

4.16.1 A new application message called "Extended Stats message" will provide clients with detailed statistics previously not available on the MITCH gateway (Refer to *Volume 05 - Market Data Feed (MITCH - UDP)*). This message will disseminate the High Price, Low Price, VWAP, Volume, Turnover and Number of Trades.

5   APPENDIX A

5.1   Primary Closing Price and Secondary Closing Price Methodology per Segment

Segment	Primary Closing Price	Secondary Closing Price	Methodology
ZA01	Closing Auction	VWAP	Methodology 1
ZA02	Closing Auction	VWAP	Methodology 1
ZA03	Closing Auction	VWAP	Methodology 1
ZA04	Mid-point	None	Methodology 2
ZA06	Closing Auction	Mid-point	Methodology 3
ZA11	Closing Auction	VWAP	Methodology 1
ZA12	Closing Auction	VWAP	Methodology 1