it’s about time

**Kx for Surveillance Alerts**

Product Overview
Kx for Surveillance Alerts: Cross Market Capabilities

Contents

1 Energy and Commodities

1.1 Action Tracker ................................................................. 4
1.2 Market Replay .................................................................. 5
1.3 Trade Out of Bounds ...................................................... 6
1.4 Wash Trades ...................................................................... 7
1.5 Spoofing ........................................................................... 8
1.6 Layering .......................................................................... 10
1.7 Stuffing ............................................................................ 11
1.8 Large Volumes - Real Time Alert ..................................... 12
1.9 Insider Trading ............................................................... 15
1.10 Price Sensitive Periods ................................................... 17
1.11 Collusion .......................................................................... 18
1.12 Alert Summary ............................................................... 19
1.13 Company Analysis Screen ............................................. 20

2 Fixed Income

2.1 Price Interday ................................................................. 21
2.2 Price Intraday ................................................................. 22
2.3 Pre-arranged Trades ....................................................... 23
2.4 Wash Trades ..................................................................... 24
2.5 Marking the Close .......................................................... 25
2.6 Insider Trading ............................................................... 26

3 Equities

3.1 Unusual Price Movement Trade to Trade ......................... 27
3.2 Price Movement Alert - Intra/Interday ............................. 28
3.3 Extreme Trade Range ...................................................... 29
3.4 Broker & Security Market Capitalization ......................... 30
3.5 High Order Rate ............................................................ 31
3.6 Crossing to the Exclusion ............................................... 32
3.7 Pre Arranged Trade ........................................................ 33
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.8</td>
<td>Intent to Trade</td>
<td>34</td>
</tr>
<tr>
<td>3.9</td>
<td>Withdrawing Orders</td>
<td>35</td>
</tr>
<tr>
<td>3.10</td>
<td>Price Support / Marking the Close</td>
<td>36</td>
</tr>
<tr>
<td>3.11</td>
<td>Volume Alert</td>
<td>37</td>
</tr>
<tr>
<td>3.12</td>
<td>Large Orders</td>
<td>38</td>
</tr>
<tr>
<td>3.13</td>
<td>Bait and Switch</td>
<td>39</td>
</tr>
<tr>
<td>4</td>
<td>Foreign Exchange</td>
<td>40</td>
</tr>
<tr>
<td>4.1</td>
<td>WMReuters Benchmark Fixing</td>
<td>40</td>
</tr>
<tr>
<td>4.2</td>
<td>Front Running</td>
<td>41</td>
</tr>
<tr>
<td>4.3</td>
<td>Best Execution</td>
<td>42</td>
</tr>
<tr>
<td>5</td>
<td>Kx for + Surveillance Alerts Engine</td>
<td>43</td>
</tr>
</tbody>
</table>
1 Energy and Commodities

1.1 Action Tracker

- A dashboard is supplied to display all alerts which have occurred in real time, or been generated by an analyst within the commodity trade surveillance system.
- The alerts can be filtered by alert type, by particular ‘security’ or by assignee.
- This screen can be used as a case management system over the lifecycle of each alert item.
- Each alert enters initially in an ‘Open’ status and from here it can be progressed to a variety of different queues for example ‘Investigating’ or ‘Escalated’.
- All action items can be edited to include comments or documents/emails attached on the workflow.
- Finally the alert item can be reassigned to a better suited user if necessary.
- Each alert item when selected includes a button linking to the relevant investigation dashboard and to launch the Order Book replay.
- The bottom application shows the Twitter data (linking of transactional and unstructured data worlds). This has been mapped on a per product basis to associated Users and hashtags (see later section on Twitter mapping section 9.2). Twitter data can be searched based on this criteria or by user defined selected though the input boxes. Also includes an option to ignore Re-tweets.
- Double clicking on any of the tweet row items will bring the user to the Insider trading screen (see section 9) to analyze the market on the day the tweet occurred.
1.2 Market Replay

- The market replay module enables users to identify previously unknown misdemeanors or simply review the conditions surrounding an alert (The ability to replay market conditions can offer invaluable insight).
- In the screenshot above the graph in the centre presents bids prices on the left and offers on the right.
- The leftmost panel presents all incoming trade events in the market (bids, asks, trade, amend, cancels etc.) along with time stamped data from unstructured sources like email and tweets.
- Finally on the top a price/volume chart for the security in question is illustrated.
1.3 Trade Out of Bounds

- This dashboard screen can be populated by passing alert details from the Action Screen or by directly inputting parameters.
- The screen allows a user to visualize the trades/orders present in the market around the time that a 'Trade Out of Bound' alert fired.
- An 'app' is populated for each of market trades and orders and these include conditional formatting to show the exact trade/orders that were identified in the alert.
- Finally, the information is displayed visually in the bottom 'app':
  - Blue line – ask price (orders)
  - Green line – bid price (orders)
  - Yellow plot – Trade prices
  - Red plot – Alerted trade price
1.4 Wash Trades

- The wash trades investigation dashboard is displayed in a report style.
- It contains three containers:
  - General container (Outright Wash Trade/One to Many/Many to Many)
  - Geographical Spread Manipulation Container
  - Time Spread Manipulation Container
- Each of these containers follows a similar style:
  - The user can firstly change configuration parameters pertaining to items such as time or notional thresholds.
  - Following this the 'report' can be run over a user defined date range and the results are displayed.
  - From here, interlinked 'apps' allow the user to investigate the group of trades involved in one wash trade alert.
  - All details of the grouped trades are displayed as rows.
  - And also the notional amounts of the trades are displayed graphically in a line/column chart.
1.5 Spoofing

- The spoofing dashboard allows the user to enter a number of parameters:
  - Date range
  - Company
  - Configurable Interval (at Top) - A spoof is defined any update/removal after interval seconds of entering (This should approx. 3 seconds for ‘real’ alerts)
  - Configurable Time Frame (at Top) – The alert takes the sum of the ‘spoofs’ in this time frame
  - Threshold (num Adjustments at Top) – An alert is fired if the sum in a given time frame is greater than this figure
  - Unique identifier combination (of Code1, Reltag1, Code2, Reltag2 - trayport)
- The top application allows the user to define the thresholds used for the graph creation – Interval, Timeframe and a threshold number of adjustments.
- The middle graph shows the all spoofing incidences for the selected identifier combination bubbled on total volume.
- The bottom app is linked to the bubble graph above and double clicking on a particular bubble allows the user to view the adjusted orders of interest in greater detail in tabular form.
• The spoofing report view allows the user to enter a number of parameters:
  o Date range
  o Interval - A spoof is defined any update/removal after interval seconds of entering (This should approx. 3 seconds for ‘real’ alerts)
  o Time Frame – The alert takes the sum of the ‘spoofs’ in this time frame
  o Threshold – An alert is fired if the sum in a given time frame is greater than this figure
• The top application shows a summarized result set for all unique identifier combinations.
• The bottom two apps are interlinked to this and allow the user to view the orders of interest in greater detail.
1.6 Layering

- In the top graph:
  - The bid and ask order volume placed in the market by the company being surveyed is displayed as blue and red area charts respectively.
  - This is overlaid with trade information with a yellow column indicating the magnitude/side of a given trade (above the axis shows a buy while below the axis shows a sell).
  - A layering alert is declared when a company cancels or removes order quantities over a configurable threshold amount within a given timeframe of transacting on the other side of the market.
  - For example a company has a very large ‘ask’ volume of 500 but then they execute a trade on the buy side and simultaneously reduce their ‘ask’ volume to 100.
- The bottom graph displays the Intra-Day Profit and Loss with PnL shown in blue and trades in yellow.
1.7 Stuffing

- Stuffing is defined as when a market participant intends to overload the quotation system and includes activities like submitting or cancelling bids/offers, or submitting non-actionable messages like RFQ etc.
- The alert looks for orders where the order ACTION is either ‘Remove’ or ‘Update’.
- The interval to survey over as well as the alert threshold can be user defined.
- The top application allows the user to edit the configurable parameters such as the Time Interval to examine, and the number of occurrences in that interval over which the incident will qualify as a stuffing event.
- The tree-map at the top of the ‘Stuffing Analysis’ dashboard displays the result set with the number of occurrences dictating both the size and color of each square.
- The app below this shows the result set in tabular form.
- Finally the bottom app shows all individual orders (occurrence) involved.
1.8 Large Volumes – Real-time Alert

- This alert surveys for instances when a particular company or the market in general acts unusually compared to its typical behavior.
- The Large Volumes Dashboard allows the user to enter a number of parameters:
  - Date range/Time range
  - Company/Trader of Interest (Trader vs. Whole Market view)
  - Unique identifier combination of CODE1/INDEX1, RELTAG1, CODE2/INDEX2 & RELTAG2
  - Table selection (orders or trades)
- The top application shows a timeline of the data with any trader associated orders/trades highlighted in red for a buy or blue for a sell.
- The middle graph is a plot of the orders/trades selection with the 7 day prior benchmark volume thresholds highlighted by the colored lines (see details on benchmarking in next section); red lines correspond to market level thresholds, orange are trader specific. The trader associated orders/trades are the green columns while the rest of market is shown in yellow. This too includes an option to filter by trader only (as is selected above) and other input is filtered down by selection in the top application.
- The bottom app is a bubble chart of execution/order price (depending on table selection) with the Volume the basis for the bubble size. Buy orders/trades are again in red and the converse in blue.
Benchmarking is used for the four Large Volume alerts – this is used to generate a typical behavior for the market and in this instance is run over the last 7 days of trading.

Benchmarking is handled by the Report Run Management inbuilt system. This is a framework for running reports periodically allowing for reports to be run automatically e.g. hourly, daily, weekly etc or manually run ad hoc.

The Report Generator will cause the benchmarks to be calculated nightly at 3:00am based on the last seven days of data and populated to the relevant processes for use within the alerting framework. This also has the option to email to users the reports once generated, and shows the status of scheduled reports.

There are four different benchmark reports required for the different Large Volume alerts, typical Market Order Volumes, typical Trader Order Volumes, typical Market Trade Volumes and typical Trader Trade Volumes.
The Large Volume alert has four different subsections
  - Large Trader Volume
  - Large Market Volume
  - Large Trader Order
  - Large Market Order

The Large Volume alert is a real-time alert which runs automatically when a new Order or Trade message is received from the data feed (Trayport).

The alert is calculated based on the previous 30 minutes average volume (per unique identifier) and the benchmark thresholds using the following devised metric.

\[
PC \text{ Move: } 100 \times \left( \frac{\text{abs} \left( V_{\text{Last 30 Mins}} - V_{\text{Benchmark}} \right)}{\left( V_{\text{Last 30 Mins}} + V_{\text{Benchmark}} \right)} \right) \%
\]

This Percentage Move is compared with user defined threshold which are configured in the Alert Configuration screen above on a unique identifier basis.

Messages which breach any thresholds are automatically entered as alert items into the Action Tracker.

Any amendment to the alert configuration is implemented in real time.
1.9 Insider Trading

- The Insider Trading Dashboard allows the user to enter a number of parameters:
  - Date
  - Announcement Time
  - Time Window
  - Unique identifier combination of CODE1/INDEX1, RELTAG1, CODE2/INDEX2 & RELTAG2
  - Company of Interest
  - Trader of Interest
  - Option to include results only for the trader specified or for the whole market
  - Twitter ID (this is the unique identified for the database of twitter messages)

- The top graph is a Price bubble chart with the size of the bubble determined by the Volume. All Orders and trades are show on this – Trades in green, buy Orders in blue and sell Orders in red. The yellow bar indicates the tweet. This graph includes an option to filter the bubbles displayed either showing all, Trades only or Orders only.

- The middle application shows a timeline of all Orders and Trades, combined with the selected tweet. If a trader is selected his buy Orders and Trades are highlighted in red, Sell in blue. Tweet messages are identified by the yellow coloring.

- The lowest graph is a plot of the specified Trader intraday profit. This allows options to modify the buckets chosen or the viewable window. The green columns are the traded amount, the yellow is the tweet and the brown shading is the Traders Profit.
Twitter items are associated with the structured data though the configurable items shown above.

The top application maps the CODE1/INDEX1 symbol to the relevant PRODUCT grouping.

For each PRODUCT grouping there is an associated Twitter User and Hashtag mapping.

These mappings are used to search though the twitter data on the action tracker screen, allowing the user to search for items in the following combinations:

- User AND Hashtags (returns only items from the associated User list which were Hashtagged with an item from the Hashtag list)
- User OR Hashtag
- Users Only
- Hashtag Only
- ALL Tweets
1.10 Price Sensitive Periods

- The Price Sensitive Periods Dashboard allows the user to enter a number of parameters:
  - Date range
  - Time range
  - Company of Interest
  - Unique identifier combination of CODE1/INDEX1, RELTAG1, CODE2/INDEX2 & RELTAG2
  - Option to include inactive days.

- The top application functions as a summary, showing a breakdown by trader of their trading behavior over the selected time period. This is benchmarked over the selected period and variances form the average Trade Volumes or Frequency are highlighted by a color ladder. Double clicking on any one row propagates the row values for unique identifier and Trader to the lower applications.

- The first graph plots the volume for each day of the period, bucketed by a selectable amount, and super imposes a “profile” line indicating the Traders typical behavior.

- The Heatmap is labelled with times, with the size of the boxes indicating the Trading frequency within the time bucket, and the Color indicating the overall Volume traded.

- The chart to the right of this plots the buy (red) and sell (blue) volumes (also bucketed) over the period, with a green step function indicating trade frequency within the bucket.

- The bottom application displays the trades as per the table, with the Traders Trades highlighted in red for a buy and blue for a sell.
1.11 Collusion

The Collusion dashboard requires the user to enter the following parameters:

- A date
- Period - the period (in days) to look back on preceding this date
- Threshold - the percentage that the agreed price of any trade can fall outside the current order book level 1 price

The report displays the sum of the quantity traded together with the number of occurrences for each distinct suspect trader/counter trader combination.

Any particular suspect trader can be investigated further through the use of the visual tree-map app (shows number of occurrences with each of the counterparties).

Finally all the details for each occurrence can be viewed individually in tabular form in the lowermost application.
1.12 Alert Summary

- The Alert Summary screen allows the user to conduct a historical analysis of the data collected within the trade surveillance system.
- Data mining tools (OLAP) are shown on the top of this dashboard in both tabular and graphically form.
- A column chart container displays the total amount of alerts items and is aggregated in three methods:
  - By Sym (unique INDEX1,RELTAG1,INDEX2,RELTAG2 & PROFILE combination)
  - By Assignee
  - By Alert Type
- Finally the above information is also shown in pie chart form in the bottom app.
1.13 Company Analysis Screen

- The ‘Company Analysis’ dashboard is made up of three apps:
  - Intraday PnL – This displays the magnitude/direction of trades means of a column chart which is overlaid by an area chart showing profit.
  - Market Depth - This shows the user the price of the chosen ‘security’ in yellow, and also the market percentage that the surveyed company is bid/offerred (blue/red area chart).
  - The third app shows the actual bid/ask depth throughout the day (comparison of surveyed company vs. the entire market once again).
2 Fixed Income

2.1 Price Interday

- Price Movement Inter-day – an alert which identifies an abnormal price movement between days where the price change exceeds Parameter thresholds or Benchmarks. Significant price movements may not necessarily lead to, but often initiates, investigations into potential prohibited trading activities in the market.
- Traded prices in a security are compared to the previous day’s closing price.
- A price alert is triggered when the absolute price movements of a security exceeds a set of pre-defined and pre-calculated benchmark thresholds i.e. the price movement alerts are agnostic to the direction of the price movement.
- To minimize alerts and false positives an alert is only reissued when the price movement in the security continues to increase beyond an expanded Threshold.
- Benchmarks for normal trading ranges are calculated daily and are based on traded prices and quotes over a day.
- In the above example an Inter-day Price alert is triggered in a 3 Year swap. The price of the trade is 2.3250 compared to yesterdays price of 2.3825, being a price change of -0.0575 and exceeding the calculated threshold of 0.0491.
2.2 Price Intraday

- Price Movement Intra-day Trade-To-Trade – an alert which identifies an abnormal price movement in a trading day where the price change from one trade to the next exceeds Parameter thresholds or Benchmarks. Significant price movements may not necessarily lead to, but often initiates, investigations into potential prohibited trading activities in the market.
- Traded prices in a security are compared to the previous traded price.
- A price alert is triggered when the absolute price movements of a security exceeds a set of pre-defined and pre-calculated benchmark thresholds i.e. the price movement alerts are agnostic to the direction of the price movement.
- To minimize alerts and false positives an alert is only reissued when the price movement in the security from trade to trade continues to increase beyond an expanded Threshold.
- Benchmarks for normal trading ranges are calculated daily and are based on traded prices and quotes over n day.
- In the above example an Inter-day Price alert is triggered in a 10 Year swap. The price of the trade is 30.1500 compared to previous traded price of 50.3550, being a price change of -20.2050 and exceeding the calculated threshold.
2.3 Pre-arranged Trades

- Pre-arranged trading is the buying and selling of shares between market participants at an agreed upon price. This practice is illegal under the Commodity Exchange Act and Commodity Futures Trading Commission (CFTC) because it can create an unfair market for other participants.
- Improper pre-arranged trading occurs when a dealer trades with a counterparty who is not the first one responding to the RFQ with the best quote or who is not offering the best price. In effect, this constitutes an attempt to defeat normal market price and time priority rules.
- Each RFQ and subsequent quotes in response are examined to check for pre-arranged trading. It applies to quotes in leg securities and also to strategies such as spreads and fly.
- When a quote is Hit or Lifted other competing quotes are checked to see if better prices were available.
- Alerts may often be explained by insufficient size or credit between the counterparties.
- In the above example the Taker Hit a quote with Price = 3.325, when a better Price is available at 3.345. Note that here price types are based on yield.
### 2.4 Wash Trades

- Wash trading comprises transactions to give the appearance that purchases and sales have been made, without incurring market risk or changing the trader's market position. For example, a dealer sells to and later buys back from another dealer the same amount of contracts. An appearance of an active market can be created if wash trading is repeated regularly.

- The wash trading alert requires the following data input as minimum for implementation:
  - Contract
  - Date/time of trades
  - Price maker, Price taker and dealer for trades
  - Trade price
  - Trade volume

- The Alert is configurable to execute at one or more for the following Entity levels:
  - Firm
  - Firm + Trader
  - Trader

- The alert groups Trades in a security at the Entity level that have the same buyer and seller and if there is equal volume on each side an alert is generated.

- In the example above, two traders traded against each other without a change in net position in an IRS instrument. The settlement date was the only difference between the trades.
2.5 Marking the Close

- Orderly trading during the closing period is breached when any activities occurring within the closing period demonstrate an intentional or disregard of the fair prices in the market at the time.
- Marking the close is a form of market manipulation that refers to trading aggressively at or near the market close to fix or influence the closing price such that the closing price does not reflect the normal forces of supply and demand. This typically occurs the final 15 minutes prior to market close for liquid stocks and longer periods for illiquid securities. The artificially inflated/deflated price would normally be expected to reverse in the next trading period (Reversing the Close).
- In the Inter-dealer broker context, this alert identifies participants which initiate trades or quotes that change the price significantly either upwards or downwards, during a period prior to the close.
- Benchmarks of Trades and Quotes that occur during the closing period are calculated over the last X days. This determines Thresholds of normal trading ranges expected during the close period. If price movements during the close period exceed the threshold then an alert is generated.
- In the example above, 3 brokers have been identified as potential culprits of Marking the Close, by calculating a score from various contributing factors, over a period of 25 days.
2.6  Insider Trading

- Insider trading refers to a situation where price sensitive information ends up in the hands of a privileged few dealers/traders rather than the market as a whole. Such a situation might occur for example, when the price of a swap contract fluctuates abnormally before the issue of announcements on market information such as the Reserve Bank on interest rates, or Bureau of Statistics on CPI figures, Unemployment figures.
- In the Australian context such information is released at known days/times.
- Benchmarks are generated to determine normal trading ranges.
- The alert is scheduled to run daily immediately after benchmarks have been calculated.
- The alert ranks traders who have the most impact on prices over a period prior to the announcement. Only traders within top X percentile are considered by the alert.
- If the price movement of a security immediately after an announcement compared to price movements from N days prior to the announcement exceeds the benchmark threshold, then generate an alert for each trade in the period for the trader which is the aggressor.
- From the screenshot example above, these are the parameters associated with the Insider Trading Alert Instance for RBA (Reserve Bank of Australia) Announcement:

<table>
<thead>
<tr>
<th>Sym</th>
<th>AUDIRS7Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>transactTime</td>
<td>2014-06-12D16:13:27.260</td>
</tr>
<tr>
<td>alertClass</td>
<td>InsiderTrading</td>
</tr>
<tr>
<td>alertInstance</td>
<td>RBAAnnouncement</td>
</tr>
</tbody>
</table>

The announcement time occurred on 2014.06.13 at 14:30:00.

The suspect trader was in the top 0.05 percentile in terms of trading turnover over the 15 days prior to announcement.
Kx for Surveillance Alerts: Equities

3 Equities

3.1 Unusual Price Movement Trade to Trade

- This alert identifies participants which execute trades that cause price movements from the previous trade that exceed a price threshold. Such price anomalies can be used as leads for investigations into suspicious market behavior, which may uncover trading activities that violate market integrity rules.

- Thresholds can either be:
  - Static - set to pre-determined values, or
  - Dynamic - calculated by benchmarking sample observations from a set of historical data.

- For a price movement alert, various thresholds may be applied, for example, a dynamic price movement threshold and a static price percentage threshold.

- To minimize false positives, a price movement alert is only reissued if the magnitude of a subsequent price movement increases significantly.

- Benchmarks are calculated on a daily basis over a configurable date range.

- Alert parameters can be modified in real time, and can be set to take immediate effect.

In the above example, an Unusual Price Movement Trade to Trade alert was triggered in a stock. The trade that triggered the alert was priced at $0.110, compared to previous traded price of $0.095, which was a change of $0.015 (15.789%), exceeding the thresholds of $0.007 (15.000%).
3.2 Price Movement Alert - Intra/Interday

- The price movement alert identifies price change anomalies by comparing the current traded price to a configurable and dynamic reference price.
- The reference price can be defined as:
  - The price X seconds/minutes prior (Intraday).
  - The closing price X days prior (Interday).
- The screen shot above shows the Price Movement Report that calculates and aggregates the total number, size and direction of Price Movements for each Broker+Account combination. The total price movement is tallied per combination to easily identify those participants that have heavily impacted the price during the trading day and at market close.
The Extreme Trade Range alert identifies price movements that are outside a configurable threshold.

The thresholds are defined per trading price range of a security. This ensures significant price fluctuations will be detected.

A transaction will trigger this alert if the price move is greater than an absolute value or percentage from the reference price for the product.

The example above shows a trade on one market (CXAC) for $0.01 and a following trade on a different market (ASXT) for $0.16. The total price movement cross markets is $0.15 which is above the threshold for the original price.

The thresholds are set for price bands and are expressed as absolute price movements or percentage moves. An example of the Price Range and Threshold Movement is tabulated below:

<table>
<thead>
<tr>
<th>Price Range</th>
<th>Threshold Price Movement</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.1 cents</td>
<td>3 cents</td>
</tr>
<tr>
<td>0.1-9.9 cents</td>
<td>10 cents</td>
</tr>
<tr>
<td>10-99.5 cents</td>
<td>30 cents</td>
</tr>
<tr>
<td>100-199.5 cents</td>
<td>50 cents</td>
</tr>
<tr>
<td>200-499 cents</td>
<td>50%</td>
</tr>
<tr>
<td>500-699 cents</td>
<td>40%</td>
</tr>
<tr>
<td>700-999 cents</td>
<td>35%</td>
</tr>
<tr>
<td>1000-1999 cents</td>
<td>30%</td>
</tr>
<tr>
<td>2000-4999 cents</td>
<td>25%</td>
</tr>
<tr>
<td>&gt;=5000 cents</td>
<td>20%</td>
</tr>
</tbody>
</table>
3.4 Broker & Security Market Capitalization

- This alert is triggered when a broker’s daily turnover in a security exceeds a configured percentage of the security’s market capitalization.
- Market capitalization is calculated from the last known number of shares on issue multiplied by the previous close price.
- From the screenshot example above, the Parties pane identifies the broker which exceeded the threshold. The Alert Data pane displays trading volume and percentages for high turnover brokers, sorted and displayed in descending order.
3.5 High Order Rate

- The High Order Rate Alert triggers if a broker submits a large number of orders for a single security over a brief time frame. The purpose is to identify potential instances of "quote stuffing" or "fishing" that can bait participants and their algorithms to trade.
- This alert can also detect whether a particular algorithm is defective and consequently placing an abnormal number of orders into the market.
- This alert looks at all order book changes (#orders = #new + #amends + #cancels) within a timeframe threshold received by a single broker in a security and generates an alert if the number of orders pass the order number threshold.
- The Alert is configured by setting a time frame and a number of orders that if reached within the timespan will trigger the alert against the offending participant.
- The screen shot above visualizes the High Order Rate Alert through the market replay screen. The highlighted (tagged) orders in the left panel and central panel indicate the offending participant. The alert fired after 304 orders (threshold of 300) were placed within a 1 second window.
3.6 Crossing to the Exclusion

- This seeks to capture instances whereby market participants are attempting to trade to the exclusion of other market participants.
- This report captures all instances whereby the broker is the same on both of the transaction, the trade quantity breaches the quantity threshold, and the underlying orders are placed within a defined time frame.
3.7 Pre-Arranged Trade

- The report seeks to capture instances whereby two different participants are attempting to trade to the exclusion of other market participants and have potentially pre-arranged the execution of an order.
- This is similar to Crossing to the Exclusion, where the participants are different and time and volume constraints apply.
- This report aggregates possible instances of trades being pre-arranged between participants. Pre-arrangement actions can be indicated by a trade where both the buy and sell orders were placed at similar times and had matching order details.
- The report shows any trades between different participants where the bid and offer orders are placed within a nominated timeframe and meet the quantity threshold.
The report is designed to identify instances whereby the participant does not have a genuine intent to trade.

The report has a particular focus on those orders that are continually modified.

If an order is entered and modified a certain number of times before trading or cancellation, the details of the order should be included within the report.

Parameters will be set differently for the pre-open period and after hours trading compared to normal session trading hours.
3.9 Withdrawing Orders

- This report is designed to capture instances whereby a participant has withdrawn an order to facilitate a cross trade.
- The report captures scenarios where a participant enters an order, cancels the order then enters a new order within a defined order timeframe and that order is executed against an opposing order from the same participant within an execution timeframe.
- The opposing order does not have to be the same volume as the withdrawn order.
3.10 Price Support / Marking the Close

- The Price Support Alert identifies a specific pattern of trading synonymous with market the close.
- The Alert compares the closing price to the high and low prices for a range of trading days. The range of days creates a cumulative a score related to how close the closing price is to the high. If there is a statistically significant positive skew for a period of days the alert will fire. Additionally, any participant that has a significant impact on the skewed score will be identified.
- The Market Replay screenshot above illustrates an instance of the Price Support/Marking the Close Alert. In this case there have been three days in succession where the score of each day exceeded the threshold. The high closing price can be seen at the top of the screenshot by the rapid increase in price (yellow line in top chart) at the end of each trading day.
3.11 Volume Alert

- The Volume Alert will trigger for unusual volumes traded in an instrument relative to the Benchmarked Volume and Configurable Traded Value figures.
- The Volume Benchmarks are calculated each night using the previous 20 trading days to determine the average figures for each equity across three distinct periods during the trading day. These periods are configurable:
  - 09:59 - 10:30: Pre-open auction period
  - 10:30 - 15:30: Open trading period
  - 15:30 - 16:15: Pre-close auction period
- If the accumulated Volume and Traded Value for a period both exceed the threshold values the alert will fire.
- The above example shows the Volume Alert firing after:
  - 2,661,936 shares were traded – exceeding the Market Cap Benchmarked Volume threshold of 2,637,018.
  - $1,291,087 value was traded – exceeding the value threshold of $1,000,000.
3.12 Large Orders

- The Large Order Alert monitors the Volume and Value of each order relative to benchmarked values.
- The Order Volume and Value benchmarks are calculated each night using the previous X trading days to determine the average figures for each security.
- If the Order Volume and Order Value for a period both exceed the benchmarked values the alert will fire.
- The above example shows the Large Order Alert firing after:
  - An order with quantity 8,975,000 was placed – exceeding the Order Quantity Benchmark of 450,271.14.
  - The value of the order was $4,352,875 – exceeding the value threshold of $172,993.98.
3.13 Bait and Switch

Bait and Switch is a form of market manipulation, and consists of these steps:

- A culprit market participant “baits” other participants by entering layering orders at various price steps, which gives an impression of intent to trade.
- Taking the bait, other participants enter orders at better prices.
- The culprit enters orders on the other side which match against the other participants’ orders.
- The culprit cancels some or all of its layering orders that were used as bait.
- The example above highlights a participant’s orders (in blue and purple) in the order book. The participant’s resting orders are layered on both the bid and ask side. The offending account trades on the bid side and proceeds to cancel off the ask orders within an hour of the trade time.
4 Foreign Exchange

4.1 WMReuters Benchmark Fixing

This dashboard enables investigation of traders’ trading activity pre, post and during a WMReuters Benchmark Fixing event.

The WMReuters benchmark rates for trade currencies are determined over a one-minute fix period, from 30 seconds before and after the fixing time. Fixes occur at hourly intervals from Monday 06:00 Hong Kong/Singapore time to Friday 22:00 UK time, with the most important being the 4 p.m. UK Closing Spot Rate fix. During this window, bid/offer rates and executed trades are captured from the matching system. Since trades occur in milliseconds, only a sample is captured. The median bid/offer is calculated using valid rates over the fix period, and the mid-rate is then calculated from them.

The following screenshot shows the WMReuters Benchmark Fixing Dashboard:

- The top left pane displays information on trade activity before and after fixing and associated P&L profiles by trader by region. Clicking on a row loads trader-specific statistics in the top right pane and bottom graph.
- The top right pane displays statistics for each of the trader’s house trades. Trades are highlighted purple, green or blue, depending on whether they happened before, during or after the fix, respectively.
- The bottom graph is a visualization of the data in the top right pane:
  - Trade bubble sizes indicate traded volumes

Kx for Surveillance Alerts: FX

Kx for Surveillance Alerts: Cross Market Capabilities
Kx for Surveillance Alerts: FX

4.2 Front Running

This dashboard enables monitoring of traders’ house and client trading activity for possible instances of front running.

Front running is the illegal practice of a stockbroker executing orders on a security for its own account while taking advantage of advance knowledge of pending orders from its customers. The front running broker either buys for its own account before filling customer buy orders that drive up the price, or sells for its own account before filling customer sell orders that drive down the price.

The following screenshot shows the Front Running Dashboard:

- The top left pane displays aggregated house and client trade statistics executed by each trader, which include house and client trade quantities and the overall fill percentage of client orders. Clicking on a row loads trader-specific statistics in the top right pane and bottom graph.
- The top right pane displays statistics for each of the trader’s house trades. For each house trade, client trades that were executed afterwards within a configurable time window are aggregated. From this, the House-Client price difference and House trade profit are calculated. To reduce investigative workload, house trades that did not make a profit are filtered out.
- The bottom graph is a visualization of the data in the top right pane:
  - The vertical green bars represent the House-Client price difference.
  - The dark blue bubbles represent the House trade price and profit.
4.3 Best Execution

This dashboard enables monitoring of trades against best execution policies, which is regulatory requirement in most jurisdictions. Best execution refers to the duty of an investment services firm executing orders on behalf of customers to ensure the best execution possible for their customers’ orders.

The following screenshot shows the Best Execution Dashboard:

- The top left pane displays all of a trader’s trades, and calculates the number of price levels that the trade was executed from the best prevailing price in the market. Clicking on a row loads trade-specific statistics in the top right pane and bottom graph.
- The top right pane is a visualization of market conditions at the time of a trade. The green/red bars represent the best 5 bid and ask quote sizes in the market, at the time of trade execution. All quotes are sequenced according to price/time priority. The executed quote is represented by the dark blue highlight.
- The bottom graph is a visualization of the data in the top right pane:
  - The green/red lines represent the prevailing best bid/ask price in the market.
  - The yellow bubble represents the executed trade.

Kx for Surveillance Alerts: FX

Kx for Surveillance Alerts: Cross Market Capabilities
Kx for Surveillance Alerts: Alerts Engine

5 Kx for Surveillance Alerts Engine

The alerts engine within the Surveillance architecture enables alerts to be grouped and triggered by common “events” (e.g. one alert engine might subscribe to trade changes, one to order changes, and yet another to news feed changes). There can be several instances of each type of alert engine, so there could be multiple trade alert engines (each subscribing to trades) allowing hundreds or thousands of different alerts to run in parallel in engines so the system may scale. The design and technology that enable this is based on Kx for Surveillance’s origin in the Algo trading world. Each alert engine can receive any required subset of market data and has access to any available static or configuration data. Given that the basis of the design comes from the algorithmic trading world, the alerts that are possible can be simple or arbitrarily complex. Below is a sample of the range of alerts that can be configured.

<table>
<thead>
<tr>
<th>Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price Movement Alert</td>
<td>Identifies price movement anomalies inter-day, trade to trade and intraday which exceed threshold values or benchmarks for price impact trades. Thresholds are determined using parameters such as price level, market capitalization and can vary throughout the day depending on trading activity.</td>
</tr>
<tr>
<td>Volume</td>
<td>Identifies where there is an unusual volume traded in an instrument in a trading day, based on comparison to threshold values or benchmarks for all trades excluding information only trades.</td>
</tr>
<tr>
<td>Broker and Security Market Cap</td>
<td>Compares the running total accumulated trade volume for the day in an instrument against a real-time dynamic market capitalization threshold taking into account previous alerts and the instrument’s free float shares on issue.</td>
</tr>
<tr>
<td>Extreme Trade Range</td>
<td>Identifies trading (price impact trades only) at unexpected and extreme price levels, ie: price moves greater than an absolute value or percentage away from the reference price at which the regulator considers a transaction is likely to impact market integrity.</td>
</tr>
<tr>
<td>Large Order</td>
<td>Identifies unusual large orders where both quantity and value for new orders exceed dynamic benchmarks (calculated daily from historical data) or pre-defined default thresholds.</td>
</tr>
<tr>
<td>High Order Rate</td>
<td>Alerts if a broker is submitting a large number of orders for a single security into an order book in a short time period. Identifies any potential &quot;quote stuffing&quot; and can also detect defective algorithms which place abnormal numbers of orders into the market.</td>
</tr>
<tr>
<td>Price Support / Marking the Close</td>
<td>Alerts when the price of an instrument is moved more than necessary around market close over a sustained period – a trading pattern synonymous with price support/marking the close.</td>
</tr>
<tr>
<td>Layering</td>
<td>Identifies when a participant enters orders to buy or sell which give a misleading impression of intent with a switch to the other side of the book.</td>
</tr>
<tr>
<td>Order to Trade Ratio</td>
<td>Alerts for new, replaced or cancelled (excluding restated) orders when orders for a single instrument by participant exceeds thresholds for order / trade ratio, order count and trade count.</td>
</tr>
<tr>
<td>Collusion</td>
<td>Alerts on instances of possible market collusion. The alert is subject to various configured parameters which lower and upper bounds on individual and collective traded volumes and trade counts.</td>
</tr>
<tr>
<td>Spoofing</td>
<td>Detects manipulation of the price of one Instrument by using another Instrument before the opening auction period.</td>
</tr>
<tr>
<td>Black Listed Trader</td>
<td>Surveys trades and orders for black listed participants at any of broker / account / secondary account levels.</td>
</tr>
<tr>
<td>Movement From Underlying</td>
<td>Identifies movements between futures and/or derivatives contract prices and their underlying asset / index prices which exceed threshold parameters.</td>
</tr>
</tbody>
</table>
Kx for Surveillance Alerts: Alerts Engine

All alerts are published and stored in the database along with the market data. Once alerts are published, they can be picked up by auxiliary processes and acted on. A usual approach is to display the alert in a dashboard, or generate an email notification.

With email notification there is an option to add associated text to provide further context and insight.
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