Daiwa Securities CM
Algorithm Trading System

Required Definition of Creating Historical Volume Curve

Confidential

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<History>

Version	Chapter	Detail	Update date	Writer
1.00D01	－	Create new draft. Sample is not yet translated.	2010/2/8	Iwasaki
1.00D02	3.3	Fixed the wrong value.	2010/2/8	Iwasaki
	3.6	New description added.	2010/2/8	Iwasaki
1.00D03	2	Modified the description of function to remove outlier since volatility to determine whether historical data is outlier or not is not +-3σ fixed.	2010/2/9	Iwasaki
	3.2	Correct the typo.	2010/2/9	Iwasaki
	3.3	Add the description which the variables used to determine whether the historical data is outlier or not are configurable.	2010/2/9	Iwasaki
	3.7	Modified the percentage of opening auction.	2010/2/9	Iwasaki
1.00D04	4	Chapter of Example .is translated.	2010/2/9	Iwasaki
1.01	3.2	Modified summary. Add the description about volume curve bin.	2011/4/25	Kakinaka
1.02	－	Update with result of review.	2011/4/26	Kakinaka

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1. About This Document

This document explains how to create historical volume curve.

2. Summary

The historical volume curve is created by taking following steps.

1. Calculate the average volume curve per minute from the historical data of past 20 days
2. Calculate average of above volume curve per bin
3. Detection and removing outliers.
4. Create volume curve.

3. Details

3.1 Calculation Logic of Weighted Average Volume Curve

Calculate the average volume curve per minute from the historical data of past 20 days.
Calculation logic will not simply average the historical data of 20 days but instead add more weight to data of newer historical days.
Data of major or minor SQ day will be skipped to calculate the volume curve.
Add the 50% weight to data before corporate action day.

Non-SQ day

Date Before	Weight
-1	100%
-2	95%
-3	90%
-4	85%
-5	80%
-6	75%
-7	70%
-8	65%
-9	60%
-10	55%
-11	50%
-12	
-13	
-14	
-15	
-16	
-17	
-18	
-19	
-20	

Including SQ day

Date Before	Weight
-1	100%
-2	95%
-3	90%
-4(SQ day)	—
-5	85%
-6	80%
-7	75%
-8	70%
-9	65%
-10	60%
-11	55%
-12	50%
-13	
-14	
-15	
-16	
-17	
-18	
-19	
-20	
-21	

Including Corporate Action date

Date Before	Weight
-1	100%
-2	95%
-3	90%
-4	85%
-5 (Corporate Action Day)	80%
-6	50%
-7	
-8	
-9	
-10	
-11	
-12	
-13	
-14	
-15	
-16	
-17	
-18	
-19	
-20	

Date Before	Weight
Corporate Action	—
-1	50%
-2	50%
~	~
-20	50%

* Calculate the volume curve using all historical data if there are historical data for less than 20 days historical data. Use the fixed volume curve if the historical data only exist less than 3 days.

3.1.1 Calculation Logic of Weighted Average Volume Curve for Minor SQ

Calculate the average volume curve per minutes by using the historical data of minor SQ for 3 days.
Calculation logic will not simply average the historical data of 20 days but instead add more weight to data of newer historical minor SQ days.

Minor SQ Date	Weight
Last	100%
2nd to Last	90%
3rd to Last	80%

Corporate action occurred during calculation period

Minor SQ Date	Weight
Last	100%
Corporate Action Day	—
2nd to Last	50%
3rd to Last	50%

Minor SQ Date	Weight
Last (Corporate Action Day)	100%
2nd to Last	50%
3rd to Last	50%

** SQ days before the Corporate Action day will not calculate the weight.

* Calculate the minor SQ volume curve using all historical data if there are historical data for less than 3 days.
Use the weighted average volume curve of non-SQ day if the historical data only have 1 or less data

3.1.2 Calculation Logic of Weighted Average Volume Curve for Major SQ

Calculate the average volume curve per minutes by using the historical data of major SQ for 3 days.
Calculation logic will not simply average the historical data of 20 days but instead add more weight to data of newer historical majar SQ days.

Major SQ Date	Weight
Last	100%
2nd to Last	90%
3rd to Last	80%

Corporate action occurred during calculation period

Major SQ Date	Weight
Last	100%
Corporate Action Day	—
2nd to Last	50%
3rd to Last	50%

Major SQ Date	Weight
Last (Corporate Action Day)	100%
2nd to Last	50%
3rd to Last	50%

** SQ days before the Corporate Action day will not calculate the weight.

* Calculate the major SQ volume curve using all historical data if there are historical data for less than 3 days.
Use the weighted average volume curve of minor SQ day if the historical data only have 1 or less data.
Use the weighted average volume curve of non-SQ day if there is no weighted average volume curve of minor SQ day.

3.2 Calculate average of volume curve per bin

The bin is the unit time to calculate the volume, ratio and amount. Each exchange can specify bin times by configuration file.
The volume curve per bin is created by taking following steps.

Bin settings

Bin no	Bin start time	Bin end time
1	9:00	9:10
2	9:10	11:00

1. Sum up the volume, ratio, and so on per bin

Time	volume	ratio
9:00*	1000	5%
9:01	700	3.5%
9:02	500	2.5%
～		
9:08	0	0%
9:09	500	2.5%
9:10	300	1.5%
9:11	0	0%
～		
10:58	300	1.5%
10:59	400	2%

Bin no	volume	ratio
1	3000	15%
2	5000	25%

* Exclude auction.

2. Allocate the volume, ratio, and so on per minutes

Bin no	volume	ratio
1	3000	15%
2	5000	25%

Time	volume	ratio
9:00	300	1.5%
9:01	300	1.5%
9:02	300	1.5%
～		
9:08	300	1.5%
9:09	300	1.5%
9:10	45	0.2%
9:11	45	0.2%
～		
10:58	45	0.2%
10:59	45	0.2%

3.3 Removing Outliers

Calculate S.D. of the same time volume ratio (*1) and remove the data of volume with volatility for more than +- 3σ (*1). It only works if there are historical data for more than 5 days (*1).
* Outlier values of SQ-days will not be removed.

Ex. 20 Days Historical Data of Volume Ratio of 10:00 to 10:01

Date	Weight	Volume	Volume Ratio	Gap	Is Outlier	Adjusted Volume Ratio
Current date – 1	100%	2,900	0.0290%	**-0.29σ**	**F**	**0.0290%**
Current date – 2	95%	3,500	0.0350%	**-0.27σ**	**F**	**0.0333%**
Current date – 3	90%	114,500	1.1610%	**+4.28σ**	**T**	**—**
Current date – 4	85% (*2)	5,200	0.0530%	**-0.20σ**	**F**	**0.0450%**
…						
Current date – 20	50%	3,800	0.0390%	**-0.26σ**	**F**	**0.0195%**

(Average Value μ = 0.10%, Standard Deviation σ = 0.24%)
*1 Time period to calculate S.D. (which is 5 days default) and the benchmark of volatility σ to determine that historical data is outlier or not (which is 3σ default (subject to change) can be modified by changing the value of configuration file.
*2 Value of weight will not change after removing outliers.

3.3.1 Calculation Logic after Removing Outliers

Weighted average volume after removed outliers is calculated by following equation.

Weighted average volume ratio = Weighted average volume ratio before adjusted * Adjust rate of volume ratio

Weighted average volume ratio before adjusted = Σ (volume ratio of day * Weight of day) / Σ (Weight of day)
Adjust rate of volume ratio = 1 / Σ (Weighted average volume ratio before adjusted of minute)

<Example with using the parameter example of 3.3>
Weighted average volume ratio before adjusted = (0.0290%×100% + 0.0350% * 95% + 0.0530 * 85% + … +0.0390% * 50%) / (100% + 95% + 85% + … + 50%)

* Record of Current date – 3 is removed since its outlier.
* Adjusted volume ratio of day is rounded to four decimal places.

3.4 Creating Volume Curve

Calculating logic of % of filled volume per time period from the 20 days historical tick data is as follows.

1. Get the filled volume data from the tick of every stock.

Time	AM Open	9:00	9:00	9:01	9:02	9:02	9:03	9:04	9:04	9:05	9:06	9:06	9:07	9:07	9:08	9:09	9:09
Volume	621	8	13	56	31	12	35	18	10	49	22	10	19	17	15	9	11

2. Sum up the volume of same time period.

Time	AM Open	9:00	9:00	9:01	9:02	9:02	9:03	9:04	9:04	9:05	9:06	9:06	9:07	9:07	9:08	9:09	9:09
Volume	621		21	56		43	35		28	49		32		36	15		20

3. Make the data table of 2. for 20 days.
   * Exclude the data of SQ-day.

Current Date - 1 (100%)	Time	AM Open	9:00	9:01	9:02	...	11:00	PM Open	12:30	...	15:00
	Volume	621	21	56	43	...	30	354	23	...	53
Current Date - 2 (95%)	Time	AM Open	9:00	9:01	9:02	...	11:00	PM Open	12:30	...	15:00
	Volume	1339	0	0	172	...	12	632	109	...	35
...	...	...	...	...	...	...	...	...	...	...	...
Current Date - 20 (50%)	Time	AM Open	9:00	9:01	9:02	...	11:00	PM Open	12:30	...	15:00
	Volume	687	29	77	5	...	5	341	56	...	7

4. Calculate the volume ratio of every time period from the summed volume for 20 days.

Current Date - 1 (100%)	Time	AM Open	9:00	9:01	9:02	...	11:00	PM Open	12:30	...	15:00
	Volume	621	21	56	43	...	30	354	23	...	53
	Volume Ratio	6.2100%	0.2100%	0.5600%	0.4300%	...	0.3000%	3.5400%	0.2300%	...	0.5300%
Current Date - 2 (95%)	Time	AM Open	9:00	9:01	9:02	...	11:00	PM Open	12:30	...	15:00
	Volume	1339	0	0	172	...	12	632	109	...	35
	Volume Ratio	8.9321%	0%	0%	1.1502%	...	0.0810%	4.2125%	0.7311%	...	0.2323%
...	...	...	...	...	...	...	...	...	...	...	...
Current Date - 20 (50%)	Time	AM Open	9:00	9:01	9:02	...	11:00	PM Open	12:30	...	15:00
	Volume	687	29	77	5	...	5	341	56	...	7
	Volume Ratio	7.6325%	0.3233%	0.8510%	0.0621%	...	0.0621%	3.7941%	0.625%	...	0.0810%

5. Calculate the average volume ratio and S.D. (σ) from the Volume Ratio for 20 days.
   Calculate in unit of AM open, PM open and every minute.

20 Days Statistics	Time	AM Open	9:00	9:01	9:02	...	11:00	PM Open	12:30	...	15:00
	Average Volume Ratio	6.8513%	0.2011%	0.4522%	0.5001%	...	0.2521%	3.0004%	0.2526%	...	0.0852%
	SD σ	0.012	0.001	0.005	0.006	...	0.002	0.010	0.005	...	0.005

6. Calculate the volatility of the volume ratio of every day which calculated in 4. from the average volume ratio.
Define as outlier for the volatility with over 3σ.

Current Date - 1 (100%)	Time	AM Open	9:00	9:01	9:02	...	11:00	PM Open	12:30	...	15:00
	Volume Ratio	6.2100%	0.2100%	0.5600%	0.4300%	...	0.3000%	3.5400%	0.2300%	...	0.5300%
	Volatility	-0.8σ	+0.8σ	+0.4σ	-0.4σ	...	+1.4σ	-0.7σ	-1.1σ	...	+1.1σ
Current Date - 2 (95%)	Time	AM Open	9:00	9:01	9:02	...	11:00	PM Open	12:30	...	15:00
	Volume Ratio	8.9321%	0%	0%	1.1502%	...	0.0810%	4.2125%	0.7311%	...	0.2323%
	Volatility	+1.4σ	-3.2σ	-1.4σ	+1.4σ	...	-0.3σ	+1.4σ	+1.3σ	...	+0.2σ
...	...	...	...	...	...	...	...	...	...	...	...
Current Date - 20 (50%)	Time	AM Open	9:00	9:01	9:02	...	11:00	PM Open	12:30	...	15:00
	Volume Ratio	7.6325%	0.3233%	0.8510%	0.0621%	...	0.0621%	3.7941%	0.625%	...	0.0810%
	Volatility	-0.6σ	+2.4σ	+1.0σ	-1.0σ	...	-1.0σ	-0.8σ	-0.2σ	...	-1.3σ

7. Calculate the Weighted Average Volume Ratio (before Adjusted) from Volume Ratio of result of table 6.
Calculate the Volume Limit Weight Adjust Rate to the Weighted Average Volume Ratio and calculate the Weighted Average Volume Ratio which become 100% when sum up all the time period of the ratio.

20 Days Statistics	Time	AM Open	9:00	9:01	9:02	...	11:00	PM Open	12:30	...	15:00
	Weighted Average Volume Ratio(before Adjusted)	44.6115%	1.2785%	1.9546%	4.2584%	...	0.9430%	22.4694%	3.154%	...	1.8156%
	Weighted Average Volume Ratio	44.8325%	1.3064%	2.0142%	4.4564%	...	1.0012%	23.5652%	3.3015%	...	1.9202%

3.5 Volume curve table

Table: VolumeCurve

No	Column Name	Detail
1	volume_curve_date	Date of volume curve (format: YYYYMMDD)
2	volume_curve_time	Time of volume curve (format: HHMM). AM Open:”9901”, PM Open:”9902”
3	symbol_code	Symbol code used in Daiwa CM.
4	exchange	Exchange code. TSE:”T”, OSE: ”OS”, Hercules: ”OJ”, NSE: ”NG”, JASDAQ: ”Q”
5	open_close_type	Code which shows the status of session. During session: "0"Open: ”1” Close: ”2”
6	sq_day_type	Code to show the type of SQ day. non-SQ day: "0" minor-SQ day:"1" major-SQ day:"2"
7	today_volume	Volume of the day
8	today_volume_ratio	Volume ratio of the “minute volume / day volume”
9	today_amount	Amount of the day
10	today_amount_ratio	Amount ratio of the “minute amount / day amount”
11	average_volume	20 days average volume of the day
12	average_volume_ratio	20 days average volume ratio of the day
13	average_amount	20 days average amount of the day
14	average_amount_ratio	20 days average amount ratio of the day
15	average_volume_ratio_std_dev	SD of 20 days average amount ratio of the minute. Use 3 days average for major or minor SQ day. Calculate major and minor SQ as different day type.
16	weighted_average_volume	20 days weighted average volume of the day. Outliers are removed.
17	weighted_average_volume_ratio	20 days weighted average volume ratio of the day. Outliers are removed.
18	weighted_average_amount	20 days weighted average amount of the day.
19	weighted_average_amount_ratio	20 days weighted average amount ratio of the day.
20	weighted_average_volume_ratio_std_dev (outliers are removed)	SD of 20 days weighted average amount ratio of the day. Outliers are removed. Use 3 days average for major or minor SQ day. Calculate major and minor SQ as different day type.

* Column no. 16 to 20 is the columns which are added new in this enhancement.
* Colored columns are the part which changed in this enhancement.

3.6 Notes

Fixed volume curve will be applied to stocks meeting the following conditions.

1. Stock which have no more than 2 non-SQ days’ historical data.
2. Stock which has count of more than specified %(*) of minute data of volume weighted volume curve which has Volume Ratio as 0 out of During Session Period in Minutes.
   * Set the initial value to 100% when go live (use fixed volume curve if all the values are 0.)

3.7 Fixed Volume Curve

Fixed volume curve is calculated by the logic of following.

Time	Ratio
AM Open	5.0000% fixed.
PM Open	2.0000% fixed.
PM Close	0.5000% fixed. * Do the calculation of formula below at last and add the remainder of the result to make the sum of volume percentage to 100%. 100.0000% - {AM Open % + PM Open % + PM Close % + ∑(During Session)}
Others (During Session)	{100.0000% - (AM Open % + PM Open % + PM Close %)} / During Session Period in Minutes * During Session Period in Minutes: TSE = 271, OSE or JASDAQ = 281 * Calculate to the four places of decimals.

The list below is the calculated result of fixed volume curve of the exchange.

TSE

Time	AM Open	9:00	9:01	9:02	~	・・・	~	11:00	PM Open	12:30	~	・・・	~	15:00
Fixed Volume Curve	5.0000%	0. 3413%	0. 3413%	0. 3413%	~	・・・	~	0. 3413%	2.0000%	0. 3413%	~	・・・	~	0. 5077%

During Session = 0.3413%
{100.000% - (5.000% + 2.000% + 0.500%)} / 271 = 0.341328… %

PM Close = 0. 5077%
100.000% - {5.000% + 2.000% + 0.500% +(0.3413 * 271)} + 0.5000%

OSE or JASDAQ

Time	AM Open	9:00	9:01	9:02	~	・・・	~	11:00	PM Open	12:30	~	・・・	~	15:10
Fixed Volume Curve	5.0000%	0. 3291%	0. 3291%	0. 3291%	~	・・・	~	0. 3291%	2.0000%	0. 3291%	~	・・・	~	0. 5229%

During Session = 0.3291%
{100.0000% － (5.000% ＋ 2.000% ＋ 0.500%)} / 281 = 0.329181…%

PM Close = 0.5229%
100.0000% - {5.000% + 2.000% + 0.5000% + (0. 3291* 281)} + 0.5000%

4. Example

This chapter uses the example to show the difference between creating the volume curve with using the outliers and not using the outliers. Logic of [3.3] Removing Outliers are used to avoid using outliers.

1. Get the volume and volume rate (rate of volume of minute in the day) from the volume curve data of the target days.

	10:00		10:01		10:02		10:03		10:04	
	Volume	Rate	Volume	Rate	Volume	Rate	Volume	Rate	Volume	Rate
Current Date – 1	2,500	16.8919%	2,500	16.8919%	2,400	16.2162%	4,800	32.4324%	2,600	17.5676%
Current Date – 2	3,000	2.0436%	136,300	92.8474%	2,700	1.8392%	3,300	2.2480%	1,500	1.0218%
Current Date – 3	100	0.7463%	1,000	7.4627%	5,000	37.3134%	4,000	29.8507%	3,300	24.6269%
Current Date – 4	2,000	12.9032%	2,300	14.8387%	4,000	25.8065%	5,200	33.5484%	2,000	12.9032%
…										
Current Date – 20	3,800	21.1111%	2,800	15.5556%	3,800	21.1111%	3,800	21.1111%	3,800	21.1111%

2. Remove the volume rate which the volatility is over 3σ. In this case, volume rate of 10:01 of Current Date -2 is determined as outliner since the volatility is μ＋4.35σ.

	10:00		10:01		10:02		10:03		10:04	
	Volume	Rate	Volume	Rate	Volume	Rate	Volume	Rate	Volume	Rate
Current Date – 1	2,500	16.8919%	2,500	16.8919%	2,400	16.2162%	4,800	32.4324%	2,600	17.5676%
Current Date – 2	3,000	2.0436%	136,300	92.8474%	2,700	1.8392%	3,300	2.2480%	1,500	1.0218%
Current Date – 3	100	0.7463%	1,000	7.4627%	5,000	37.3134%	4,000	29.8507%	3,300	24.6269%
Current Date – 4	2,000	12.9032%	2,300	14.8387%	4,000	25.8065%	5,200	33.5484%	2,000	12.9032%
…										
Current Date – 20	3,800	21.1111%	2,800	15.5556%	3,800	21.1111%	3,800	21.1111%	3,800	21.1111%

3. This is the result of calculating the weighted average volume rate per minute.

	10:00	10:01	10:02	10:03	10:04
Weighted Average Volume Rate (Outliers are removed)	11.6709%	14.4138%	24.2303%	28.1816%	16.7214%
Weighted Average Volume Rate（Outliers are not removed）	11.6709%	20.2579%	24.2303%	28.1816%	16.7214%

4. Calculate the volume curve.
   Here is the chart which shows the volume rate of every day (black thin line), 20 days weighted average volume rate with outlier included (red bold line) and 20 days weighted average volume rate with outlier excluded (blue bold line).
   Overall trend of the volume of 10:01 is low, but the 20 days weighted average volume rate with outlier result in high rate to the 10:01. 20 days weighted average volume rate with outlier excluded result in low rate to the 10:01 which describes the trend more accurate.