

Time-Weighted Average Price (TWAP): A New Approach

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Summary

The Time-Weighted Average Price (TWAP) is defined as the average price of a security over the course of a specified period of time. The TWAP is traditionally calculated by first averaging the open, high, low, and close prices for each bar and then calculating the average of those averages as time progresses. The problem is that there is often a difference between the open, high, low, and close prices and where a security actually spends the most time in any given bar. Therefore, the traditional TWAP may at times be incorrect, especially in the short run. For instance, how accurate would the TWAP calculation be if the trading range for a given bar is wide, but the security spent most of the time in the upper portion of the bar? In that case, the traditional TWAP value would be lower than it should be. The technical indicator introduced in this paper reveals a new approach to the TWAP calculation intended to improve its accuracy.

Figure 1 - TWAP Indicator



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Background

In addition to measuring trade execution against a TWAP benchmark, the TWAP is often associated with the first generation of execution algorithms. A large order might be broken up into smaller orders and spread out evenly over a specified time period in order to lessen its market impact – that is, to avoid an adverse effect on the price of the security. The goal would be to keep market perceptions undisturbed. A TWAP trade-execution algorithm may also replace a Volume Weighted Average Price (VWAP) algorithm when the security is illiquid and where volume analysis is of little use. Both the TWAP and VWAP execution algorithms are considered passive execution, versus aggressive algorithms that are common today.

Calculations and Displays

The custom indicator presented in this paper captures the security's price every second to create a custom data series. An average price using this data series is then computed every other second for a better representation of the market price up until that point. At the end of a bar, the last computed average price is displayed on the chart and is used in the TWAP calculation.

The displayed TWAP is the average of the averages of those prices, just like the traditional TWAP calculation. However, the resolution is much finer due to the process of sampling prices every second versus using only four prices per bar (open/high/low/close). (Note that it initially takes two bars of data to see the TWAP in the chart.)

TWAP bands, based on a number of standard deviations away from the TWAP, may be added to the display of the TWAP. The standard-deviation calculation takes place every other second, just like the average calculation mentioned above.

In summary, there are three different sets of plots in the chart:

1. the average of the security's price per bar calculated every other second
2. the TWAP, which is the cumulative average of the first plot
3. the TWAP bands, which are the different standard deviations around the TWAP.

Inputs

The inputs for the TWAP indicator are listed in Table 1 below.

Table 1 – TWAP Indicator Inputs

Input Name:	Default Value:	Description:
TimeReset1_or_RollingBars2	1	Switch (1 or 2) to either turn on the reset functionality for the TWAP indicator based on a specific time, or to turn on the rolling functionality based on a specified number of bars.
TimeResetInterval	60	Time interval in minutes for the TimeReset functionality (e.g., 60 = the TWAP resets every 60 minutes). This is effective only when TimeReset1_or_RollingBars2 is set to 1.
RollingTWAPBars	5	Number of bars used as the length for the RollingBars functionality. This is effective only when TimeReset1_or_RollingBars2 is set to 2.
NewSessionReset	True	Switch (True/False) to reset indicator at the start of a new session.
BandsDisplay	True	Switch (True/False) to display the TWAP bands.
TWAPColor	DarkRed	Color used for the TWAP.
BandsColor	DarkBlue	Color used for the TWAP bands.

Indicator Format

When the indicator is using a reset based on time (TimeReset1_or_RollingBars2 input set to 1), the TWAP value in the chart will be reset once the amount of time specified in the second input field (TimeResetInterval) has elapsed. On the other hand, when the indicator is using a rolling approach (TimeReset1_or_RollingBars2 input set to 2), data for the TWAP calculations will continually move forward. The oldest price for the TWAP calculation will be dropped when a new price becomes available. This approach is very similar to the approach used with a simple moving average. The selection is discretionary, but the most common approach is a reset based on time at the beginning of a new session. The two approaches are depicted in Figure 2 below, in which the TWAP with RollingBars is using the previous five bars to calculate the TWAP, whereas the TWAP with TimeReset is reset every 60 minutes (notice the red arrows in the chart).

Figure 2 – TWAP Indicator with TimeReset Versus TWAP Indicator with RollingBars



By default, the NewSessionReset is set to True, which means that no matter whether the indicator is using the TimeReset or the RollingBars, the indicator will be reset at the start of a new session. Notice that if you are using a custom session with pre-market data, the TWAP indicator will reset at the beginning of the pre-market session, not at the beginning of the regular session (see Figure 3 below). In this particular example, the chart is using pre- and post-market data and the reset takes place on the first bar of the pre-market session.

Figure 3 – TWAP on Microsoft (MSFT) Using a Custom Session (U.S. Stock with Pre- and Post-Market)



If the time interval in the chart is not an intraday time interval, or if the intraday time interval exceeds 60 minutes, the TradeStation Events Log will open with a runtime error. Another runtime error will be generated if the TimeReset1_or_RollingBars2 indicator input is not set to 1 or 2, prompting the user to change the indicator input value.

The intraday bar interval is discretionary. The number of prices used by the indicator is linearly proportional to the time interval. For example, if the intraday time interval is increased from 2 minutes to 10 minutes (five times the original setting), the number of prices will be increased at the same rate, from 120 prices to 600 prices (five times the original setting). This is to say that after 10 minutes from a reset, the TWAP value will be the same whether you are using a 2- or 10-minute bar interval. The only difference in this case is that the progression of the TWAP for those 10 minutes will remain visible with the 2-minute bar interval. Therefore, no particular bar interval is inherently better with the TWAP indicator discussed in this paper.

It is important to note that the TWAP indicator is a real-time indicator only; it cannot run on historical data. The indicator will only start plotting values from the time it is inserted into a TradeStation chart. Also, if the chart is refreshed, the indicator values displayed in the chart will be erased and the indicator will restart plotting values from the time the chart is refreshed.

The MaxBarsBack field in the Format Indicator dialog window has been set to 4,000 in order to ensure that the indicator can run properly. This setting should not be changed. It is also worth noting that enough historical data has to be loaded into the chart in order to meet the MaxBarsBack criteria.

Analysis

1) New TWAP Versus Traditional TWAP

The new TWAP can deviate from the traditional TWAP, as shown in Figure 4 below. The traditional TWAP indicator in the chart below is the common approach to the TWAP indicator, using only the open, high, low and close prices for each bar. The degree of variance between the TWAP presented in this paper and the traditional TWAP will vary and depend on different factors, such as the security's volatility. The largest difference between the two TWAPs is usually seen in the first few bars after a reset (notice the difference at the start of the new session in Figure 4 below). The variance usually gets diluted as the trading day progresses, as long as there is no reset. The finer resolution of the new TWAP, utilizing tick data on an intraday time interval, is what makes the indicator more precise versus the traditional TWAP.

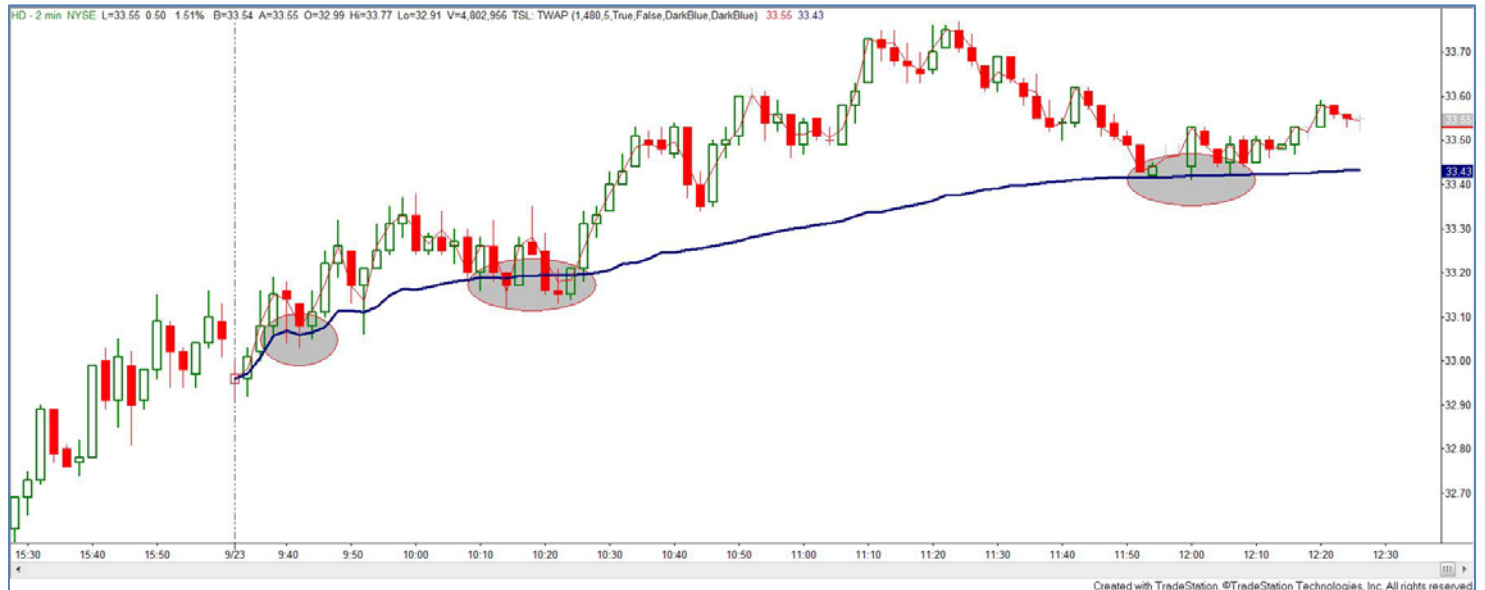
Figure 4 - Traditional Versus New TWAP Indicator



2) TWAP for Intraday Support/Resistance

Intraday support and resistance levels may be identified by the TWAP indicator, as shown in Figure 5 below. The significance of support or resistance does not seem to be tied to any particular bar interval when utilizing the new TWAP indicator. However, it appears that a longer time or greater number of bars between resets for the TWAP increases its reliability for support and resistance levels. For instance, a TWAP calculated from the beginning of the day may be more reliable for support and resistance than a TWAP computed by a limited number of bars.

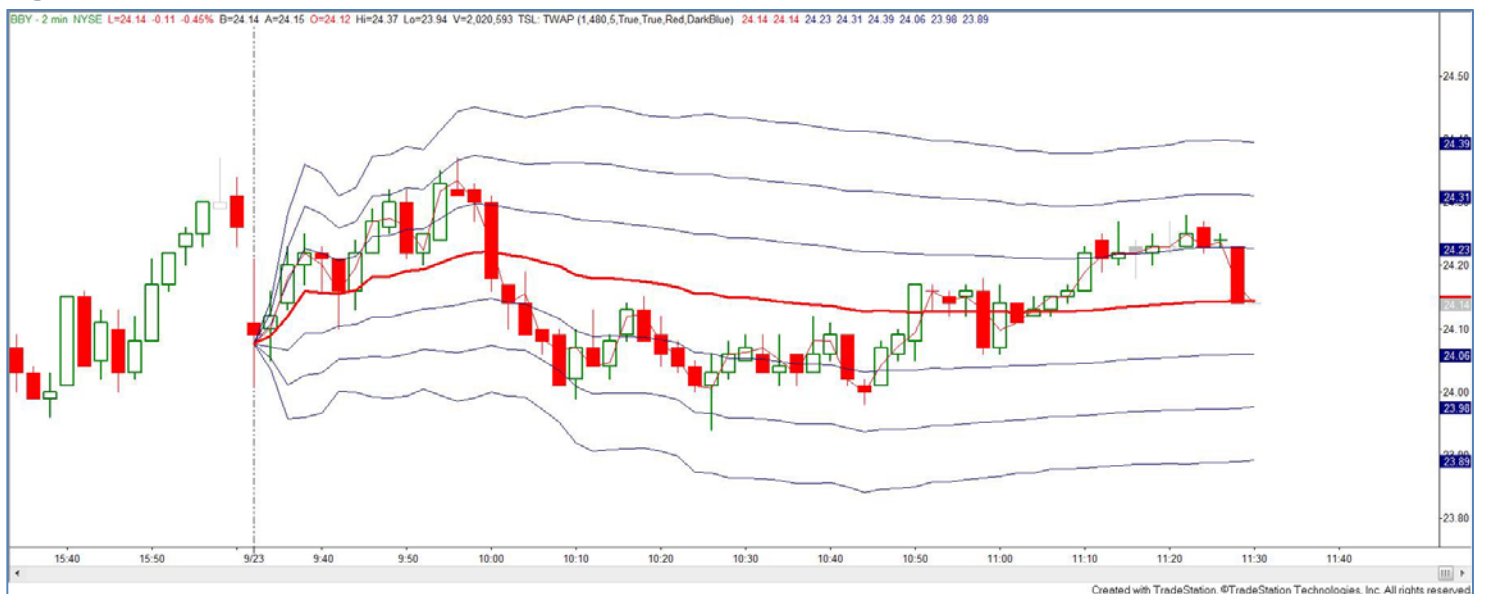
Figure 5 - TWAP Intraday Support and Resistance Levels



3) TWAP Bands

Bands around the TWAP can prove useful to determine potential price ranges or price targets for a short-term trading strategy (see Figure 6 below). The bands themselves might be used in conjunction with other technical indicators to provide valuable information. For instance, the TWAP bands can be compared to Bollinger Bands or to VWAP bands in order to derive trading signals. The TWAP bands are generated by plotting 1, 2 and 3 standard deviations below and above the TWAP. As a reminder, the bands may be turned off by specifying "False" for the BandsDisplay input on the Inputs tab of the Format Indicator dialog.

Figure 6 - TWAP Bands



4) TWAP Versus VWAP

During a slow trading day, the TWAP may be very similar to the VWAP, even to the penny at times. However, in a volatile session, or when volume is higher than usual, the two indicators may start to diverge (see Figure 7 below). Both indicators provide valuable information to traders; neither is more important than the other. An interesting idea could be to examine those times when the indicators cross.

Figure 7 – TWAP Versus VWAP Example



Conclusion

The TWAP indicator presented in this paper offers a noticeable improvement over the traditional TWAP. Recently introduced TradeStation technology now permits the TWAP to be much more accurate. The applications of the TWAP are broad, ranging from aiding in identifying intraday support and resistance levels to trading systems. The upcoming “Analysis Concepts – Meet the Author” event will expand on the subject. Feedback is always welcome at TSLabs@tradestation.com.

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