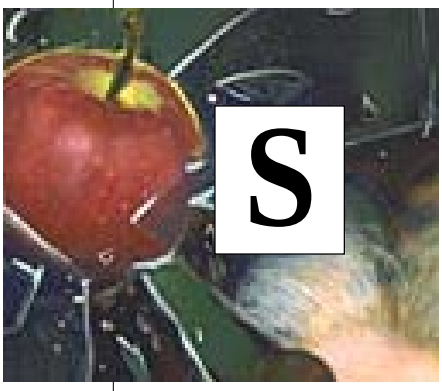
NEW TECHNIQUES

Automated Support And Resistance

Support and resistance analysis is a proven method for selecting key price levels for trading decisions; traders usually perform the analysis by hand. The automatic charting method and new oscillators presented here are easy to implement and give a precise comparison of price to these important levels.

by Mel Widner, Ph.D.



Sir Isaac Newton's first law of motion is one that is familiar to us all, stating that "Every body continues in its state of rest, or in uniform motion in a straight line, unless compelled to change that state by forces impressed upon it." It is relevant here, because the same can be said for price behavior. Like physical objects, prices have inertia and momentum. When at rest, prices often stay at rest, building congestion. When in motion, prices often stay in motion, along a trend. But like Newton's apple, price momentum changes when market forces are applied. The influencing event is sometimes known and sometimes not, but in any case cannot be hidden and can be seen in the price. Prices will often move in one direction for a period, only to stop and flatten or move in the other direction. This occurs because market forces have changed the momentum. The turning point has significance for future price behavior.

Consider an example. Suppose prices are moving higher, fed by steady cash flow and favorable expectations. Then, at some point, the advance begins to slow. Upward momentum is still dominant, but at that point it is diminishing and the rate of rise is decreasing, evidence of resistance. It is like throwing a ball into the air; the ball starts with initial momentum, then slows under the influence of gravity before eventually falling.

Prices behave in a similar manner. After opposing resistance forces are applied for a time, prices slow, finally stop, and reverse direction. The turning point is a resistance level and is the highest high price for that particular period. The converse is true for declining prices. A slowing decline results from support forces and a support level is established at the point where prices turn upward.

Simply, forces cause acceleration. Market forces do not directly produce momentum, but rather momentum *changes*. These momentum changes in turn are integrated or accumulated to establish momentum. The presence of market forces is evident when the slope of prices, or momentum, changes over time. The effect is most dramatic when forces also change, triggered by price moves or changes in expectations, and abrupt reversals occur. Examination of price histories can confirm the presence of these features.

SOME ORDER AMID CHAOS

The premise of technical analysis is that the past influences the future and that insight for trading and investment decisions can be gained by analysis of past data. Support for this premise is particularly evident here. Look at just about any price chart. Note the peaks, the highest highs for a period, and troughs, the lowest lows for a period. Over and over, peak values coincide or very nearly coincide with one another, and the same is true for troughs. If prices reverse once at a particular level, they may reverse again at that same level. Another feature is that a support level often becomes a future resistance level and vice versa and can be seen when peak values nearly coincide with trough values.

Are these coincidences? Is this a totally random process? Probably not, since it recurs frequently. Support and resistance seem to be features with some degree of repetition in a process dominated by randomness and volatility.

What precisely *are* peaks and troughs? The question *sounds* simple. Identification even *looks* simple when examining a chart, but in fact, there are many possible choices. Here are just a few.

Defining a peak or trough requires three steps: First, specifying a period; second, finding the maximum high or minimum low value within that period; and third, determining whether the maximum or minimum values are turning points. Applying *stochastics†* takes care of the first two, but the maximum or minimum values for the period may or may not be turning points. When combined with a trading method that triggers on a pullback, stochastics implicitly captures market turns as well.

A second approach (as detailed in a 1997 STOCKS & COMMODITIES article by Alex Saitta) captures turning points as *reactionary highs and lows*. In Saitta's approach, the highest high preceding a crossing of a moving average of lows — when the market is above that average — is considered a reactionary high. A reactionary low is the lowest low preceding a crossing of a moving average of highs, when the market is below the average. Here, the period can vary.

A third approach is to consider *isolated highs and lows*, as discussed in a recent article by S&C Editor Thom Hartle. An isolated high is one that is greater than the preceding high and following high, and an isolated low is one that is less than the preceding low and following low. All of these accomplish the objective and could, in fact, be adapted to the method that follows.

The method used here builds on these approaches and is designed to directly identify the turning points, and to be

BRAD WALKER

simple, flexible and manageable. It extends the isolated high and low and considers longer lookback periods. If the central high of a period is the maximum high value for the period, then the central high is considered to be a resistance level. If the central low of a period is the minimum low for the period, then the central low is considered a support level. By waiting several bars after the occurrence of the central high or low, the value is confirmed as a turning point.

To have a value at the center of the period, the period must be an odd number of bars; for example, a lookback period of three bars has a central value one bar back from the current value. A period of five bars has a central value two bars back from the current value, and so on. In general, for a lookback period of N bars (N is an odd number that is equal to or greater than 3), then the central value precedes the current value by $M = (N\text{-}1)/2$ bars. A new support level is established if the following condition is met:

If Low(M) = Lowest low in lookback period, ***then*** new support level
= Low(M)

If the condition is not met, then the most recent support level is the previously established level. The process for establishing a new resistance level is similar:

If High(M) = Highest high in lookback period, ***then*** new resistance level
= High(M)

The lookback period N should be chosen long enough that the peak or trough is significant and not just a minor blip. Short periods can also lead to a large number of levels that are difficult to manage. On the other hand, the period should not be so long that important levels are missed. Since the level is not identified until after it occurs, a delay of $M = (N\text{-}1)/2$ bars is also introduced. If the pe-

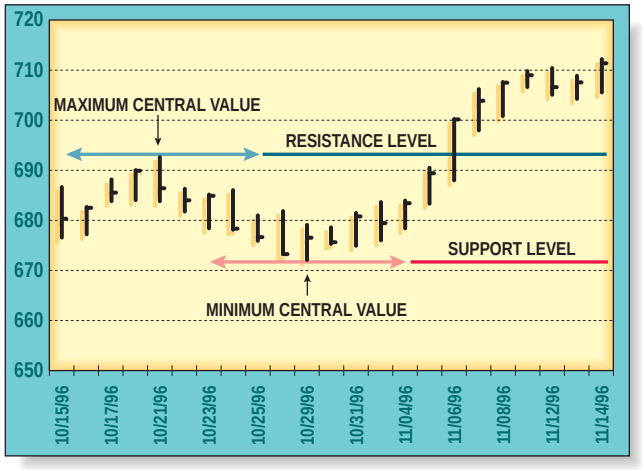


FIGURE 1: OEX CHART PATTERN. OEX chart pattern illustrating support and resistance levels is defined here using an isolated high and low method with a lookback period of N = nine bars.

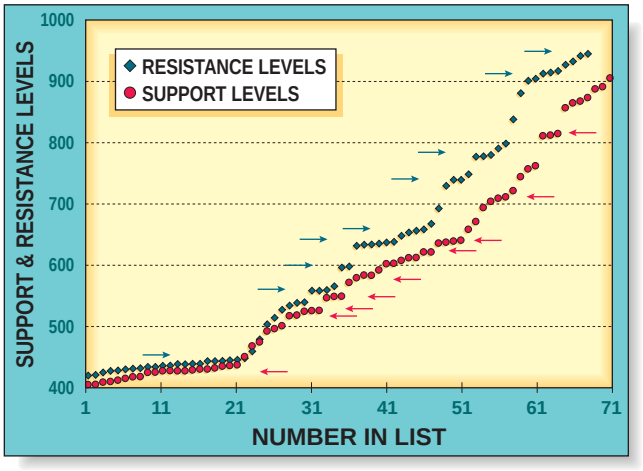


FIGURE 2: SUPPORT AND RESISTANCE TURNING POINTS FOR PRIOR FIVE-YEAR PERIOD FOR THE OEX. Values were rearranged in order by magnitude to show clusters of values that are nearly the same value. Once established, these values are frequently revisited and repeated.

riod becomes too long, then signals can come too late. Some balance is needed, depending upon the time horizon and style of the trader. The choice of $N = 9$ is a good compromise.

Figure 1 shows an example of support and resistance levels as determined by this method. Support and resistance values are not established until four bars after the peak or trough value. Each level is then projected forward for future reference. Successive support values must be separated by at least five bars. Successive resistance values must also be separated by at least five bars. Resistance and support levels can be closer and theoretically could occur on the same bar, although this does not occur frequently. The values are often close; however, the periods can overlap, as was the case for the example in Figure 1. An interesting observation is that penetration of resistance on November 6, 1996, was accompanied by a move that was larger than normal. This is seen frequently. Usually, prices either reverse or break through a level and do not spend much time there (essentially, the opposite of congestion).

If you're skeptical about technical analysis, consider the data shown in Figure 2. The OEX was analyzed for about the past five years, and peaks and trough values were determined using the nine-day period as described above. Support levels and resistance levels were separated into their two respective groups. Since price values bounce around, it is sometimes difficult to determine if prices return to previous levels, since there may be many intermediate peaks and troughs.

For a clearer comparison, simply take the sequential list of turning points and rearrange them in order of increasing price. If a price returns to a previous level, then it will be adjacent to that level in the rearranged list. Results were plotted in Figure 2. Turning point values are clustered for the most part and not uniformly distributed. This is not always the case, as there are exceptions during long steady trends and breakouts, but it does happen frequently.

The clusters occur in differing numbers from groups of two or more. There are several examples of very large clusters. There are also examples where support values coincide with resistance values (support becomes resistance and vice versa); once established, a level is frequently revisited. If the market were totally random and independent of the past, this would not be the case.

CHARTING AND OSCILLATORS

Standard analysis methods display support and resistance levels as chart patterns with horizontal lines drawn at critical price levels. Future price movements are gauged relative to these levels. The levels are tested and trading action is taken depending upon whether prices bounce off or penetrate these levels. The analysis process consists of several steps:

1. Identify support and resistance levels.
2. Project these levels forward in time for future references.
3. Determine the current price relationship to previously established levels.

To automate the process, start by identifying levels using methods previously discussed in Figure 1. Keep the levels for future reference for some period. Form a queue of several most recent support levels and a separate queue of several most recent resistance levels. To maintain manageability, limit the number of levels kept in each queue. As a new level is established, add it to the queue in sequential order and remove the oldest value from the queue at the same time. Enough levels are needed to be meaningful, but not so many that there is excessive clutter and redundancy when plotted. I would recommend six levels in each queue. Another feature of queuing is that it takes some time to start up. A long dataset, preceding the period of interest, is needed to fully populate the queues. There is no absolute rule to follow here, and results should be inspected to be certain all levels are populated before continuing with the analysis.

Several definitions are helpful. Support levels are: S1 = most recent support level; S2 = second most recent support level; S3 = third most recent support level, and so on, with S6 being the oldest support level kept. The queue of support levels is S1 through S6, in reverse order of occurrence. These are determined by moving sequentially through a data series and examining the central value of the lookback period at each bar, and updating the queues. A new support level *SL* is identified as

If Low (four days back) = MIN (lows of previous nine days), ***then***
SL = Low(four days back)

If there is a new support level *SL* for the current bar, then shift and overwrite the values in the following order as S6 = S5, S5 = S4, S4 = S3, S3 = S2, S2 = S1, and S1 = *SL*. If there is no new support level for the current bar, then the current values are the same as the values for the previous bar and S1 through S6 remain unchanged.

Definitions are similar for resistance levels. Resistance levels are: R1 = most recent resistance level; R2 = second most recent resistance level; R3 = third most recent resistance level, and so on, with R6 being the oldest resistance level kept. The queue of resistance levels is R1 through R6, in reverse order of occurrence. A new resistance level *RL* is identified as:

If high(four days back) = MAX (highs of previous nine days), ***then***
RL = High(four days back)

If there is a new resistance level *RL* for the current bar, then shift and overwrite the values in the following order as R6 = R5, R5 = R4, R4 = R3, R3 = R2, R2 = R1, and R1 = *RL*. If there is no new resistance level for the current bar, then the current values are the same as the values for the previous bar, and levels R1 through R6 remain unchanged.

These are the first two steps in the process. The levels are identified and will persist for some time until new levels are established and replace the old ones.

Next, a measure is needed of the current price compared with support and resistance levels. There are several questions. Is the current price above or below most of the recent support and resistance levels? Is the amount of support or resistance building or diminishing with time? These questions can be answered by constructing oscillators that gauge the price with the support levels and separately with the resistance levels.

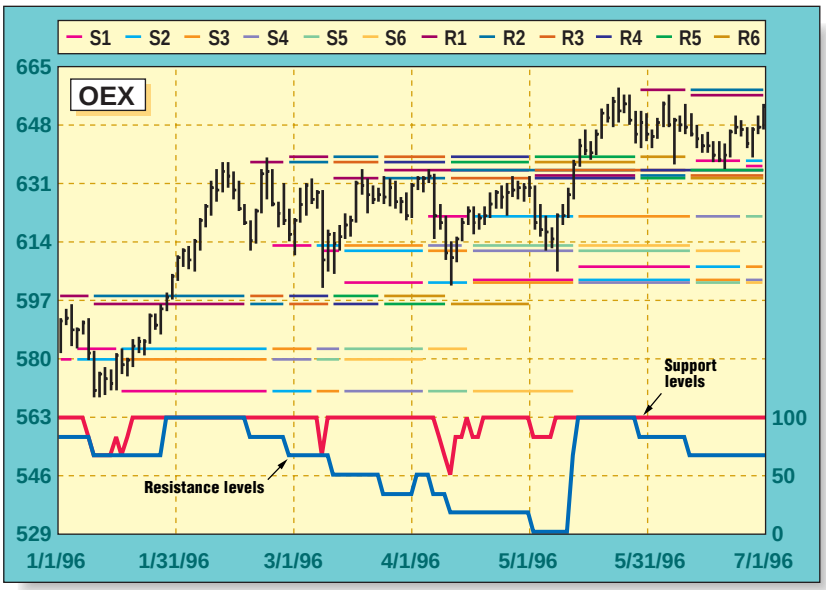


FIGURE 3: RECENT OEX PRICE HISTORY ILLUSTRATING THE PLOTTING METHOD AND WSO AND WRO OSCILLATORS. The method is automatic. Once established, support and resistance levels persist until they are replaced and flushed from the queue.

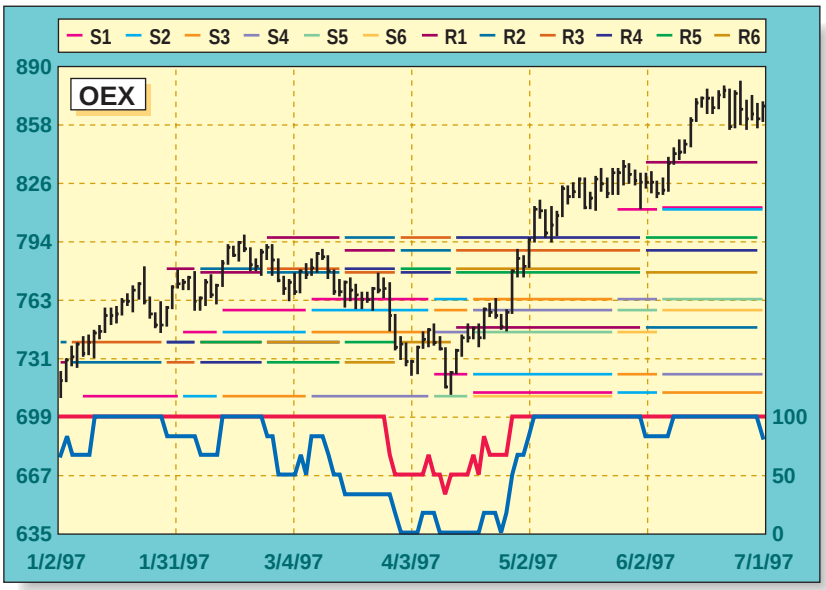


FIGURE 4: MARKET CORRECTION. Here's OEX chart behavior showing a moderate correction in a rising market.

Two oscillators are defined: the WSO (Widner support oscillator) and the WRO (Widner resistance oscillator). The WSO compares the current close with the most recent six support levels. Values range from zero to 100. WSO = zero means that the close is below all of the six support levels, and WSO = 100 means that the current close is above all of the six support levels. Changes in WSO indicate changes in support, either breaking of an old level or establishing a new one. The WSO is defined as:

WSO = 100(1 – (INT(S1/C) + INT(S2/C) + INT(S3/C) + INT(S4/C) + INT(S5/C) + INT(S6/C)) / 6)

CALCULATION AND PLOTTING METHOD

The following uses Excel spreadsheets and plots. Initial values for support levels in cells E9:J9 and resistance levels in cells K9:P9 are entered as constants. These were determined here using prior data not shown. Normally, these are initially set to zero and a long series of data is needed to populate the support and resistance columns. Next, enter the following formulas:

{Cell E10} = IF(C6=MIN(C2:C10), C6, E9)

{Cell F10} = IF($E10=$E9, F9, E9)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	OEX	High	Low	Close	S1	S2	S3	S4	S5	S6	R1	R2	R3	R4	R5	R6	WSO	WRO
2	02/22/94	439.13	435.22	438.94	434	435	428	427	424	423	447	441	435	429	431	430	100	67
3	02/23/94	440.14	437.32	438.34	434	435	428	427	424	423	447	441	435	429	431	430	100	67
4	02/24/94	438.24	432.34	432.34	434	435	428	427	424	423	442	447	441	435	429	431	67	33
5	02/25/94	434.15	432.07	433.32	434	435	428	427	424	423	442	447	441	435	429	431	67	33
6	02/28/94	436.15	433.32	433.76	434	435	428	427	424	423	442	447	441	435	429	431	83	33
7	03/01/94	434.18	429.45	431.71	434	435	428	427	424	423	442	447	441	435	429	431	67	33
8	03/02/94	432.19	425.27	432.17	434	435	428	427	424	423	442	447	441	435	429	431	67	33
9	03/03/94	432.45	429.85	430.18	434	435	428	427	424	423	442	447	441	435	429	431	67	17
10	03/04/94	433.07	429.25	431.68	434	435	428	427	424	423	442	447	441	435	429	431	67	33
11	03/07/94	434.36	431.68	432.92	434	435	428	427	424	423	442	447	441	435	429	431	67	33
12	03/08/94	433.98	431.05	431.82	425	434	435	428	427	424	442	447	441	435	429	431	67	33
13	03/09/94	434.06	430.00	433.63	425	434	435	428	427	424	442	447	441	435	429	431	67	33
14	03/10/94	433.94	429.63	430.82	425	434	435	428	427	424	442	447	441	435	429	431	67	33
15	03/11/94	433.00	429.32	432.74	425	434	435	428	427	424	434	442	447	441	435	429	67	17
16	03/14/94	433.64	432.07	433.27	425	434	435	428	427	424	434	442	447	441	435	429	67	17
17	03/15/94	434.68	431.68	432.78	425	434	435	428	427	424	434	442	447	441	435	429	67	17
18	03/16/94	435.73	431.09	435.18	425	434	435	428	427	424	434	442	447	441	435	429	83	50

SIDEBAR FIGURE 1: EXCEL SPREADSHEET. Here's how to calculate the methods shown in Widner's article.

Select cell F10 and fill right through cell J10.

{Cell K10} = IF(B6=MAX(B2:B10), B6, K9)

{Cell L10} = IF($K10=$K9, L9, K9)

Select cell L10 and fill right through cell P10.

{Cell Q10} = 100 * (1 - (INT($E10/$D10) + INT($F10/$D10) + INT($G10/$D10) + INT($H10/$D10) + INT($I10/$D10) + INT($J10/$D10)) / 6)

{Cell R10} = 100 * (1 - (INT($K10/$D10) + INT($L10/$D10) + INT($M10/$D10) + INT($N10/$D10) + INT($O10/$D10) + INT($P10/$D10)) / 6)

Select cells E10:R10 and fill down.

On March 8, 1994, a new support level was established. All the previous support levels were shifted one column to the right, dropping the old S6 value. Similarly, on March 11, 1994, a new resistance level was established, and all the previous resistance levels were shifted one column to the right, dropping the old R6 level. The values in columns E to R were formatted to save space. They are not rounded off as integers in calculations.

Finally, plot columns B through P on the primary *y*-axis and column A on the *x*-axis. The levels in columns E through P should be plotted as points with no line. Columns Q and R are plotted on the secondary *y*-axis.

—M.W.

where all values are for the current time and C = the current close. The formula uses integer arithmetic to determine if close is above or below a certain level. For those not familiar with the integer function INT(), when applied to a fixed number, it returns the next lowest integer value. Several examples are:

INT(532.85) = 532, INT(0.99) = 0, INT(1.01) = 1

For example, INT(S1/C) = 1 if S1 is greater than C and is zero if S1 is less than C. This assumes that S1 is not more than double C; otherwise, it would return an integer greater than 1. This is essentially not possible for most cases of interest and would require a halving or greater reduction in price in, say, 100 bars or so. The formula could be corrected for this possibility by substituting Min(1, INT(S/C)) for each of the terms in the expression for WSO, but that was not done here. Integer arithmetic has the desirable property of identifying breaks or changes as a stepwise change in the indicator.

Like physical objects, prices have inertia and momentum. When at rest, prices often stay at rest, building congestion. When in motion, prices often stay in motion, along a trend.

A similar discussion applies to the WRO. The WRO compares the current close with the most recent six resistance levels. Values range from zero to 100. WRO = zero means that the close is below all of the six resistance levels, and WRO = 100 means that the current close is above all of the six resistance levels. Changes in WRO indicate changes in resistance, either breaking an old level or establishing a new one. The WRO is defined as follows:

WRO = 100(1 – (INT(R1/C) + INT(R2/C) + INT(R3/C) + INT(R4/C) + INT(R5/C) + INT(R6/C)) / 6)

Usually, WSO is greater than WRO, and the occurrence of support and resistance levels alternate. There are exceptions, however, where there is not a one-to-one pairing of support and resistance levels. Consequently, WSO and WRO can cross, but this is very uncommon.

Plotting the levels can be tricky. Plot S1 through S6 and R1

through R6 along with the price history. If plotted as solid lines, the graph is very cluttered, with all of the vertical connections between levels being juggled as each new value appears and values are shifted in the queue. To avoid this problem, simply plot as points with no line. As new levels appear, each of the old levels remains intact and appears as continuous, dotted, horizontal lines. These dotted lines persist for the period that the level remains in the queue.

Figure 3 is a good example of the plotting method. Support levels extend to the right until that value drops out of the queue. Resistance levels are labeled. Each line begins four bars following the peak or trough that produced that level. The length of each line is not fixed and depends upon the frequency that new levels are produced. These levels are plotted as points to give the appearance of a dotted line.

Some of the layers from the period just before the plot that extend into the plotting period have been removed if they fall outside the price range. The WSO and WRO oscillators (lower traces) reflect the price behavior. A rising WSO indicates building support and WSO = 100 (maximum value) indicates strong support. A rising WRO confirms the building support and WRO = 100 (maximum value) an upward breakout and *very* strong support. A declining WRO indicates building resistance and WRO = zero (minimum value) indicates strong resistance. Further, a declining WSO confirms building resistance and WSO = zero indicates *very* strong resistance.

Prices are advancing strongly in Figure 3, beginning in mid-January, with a breakout (WSO = 100 and WRO =100) in late January. A top is formed in mid-February that is retested several times up to about the first of May. Prices remain contained between support at about 600 and resistance at about 635. WSO and WRO are expanding apart during this period consistent with price containment between newly developing support and resistance levels. There is an additional price rise in mid-May through resistance and a pullback to support in mid-June. This is a great example of resistance becoming support.

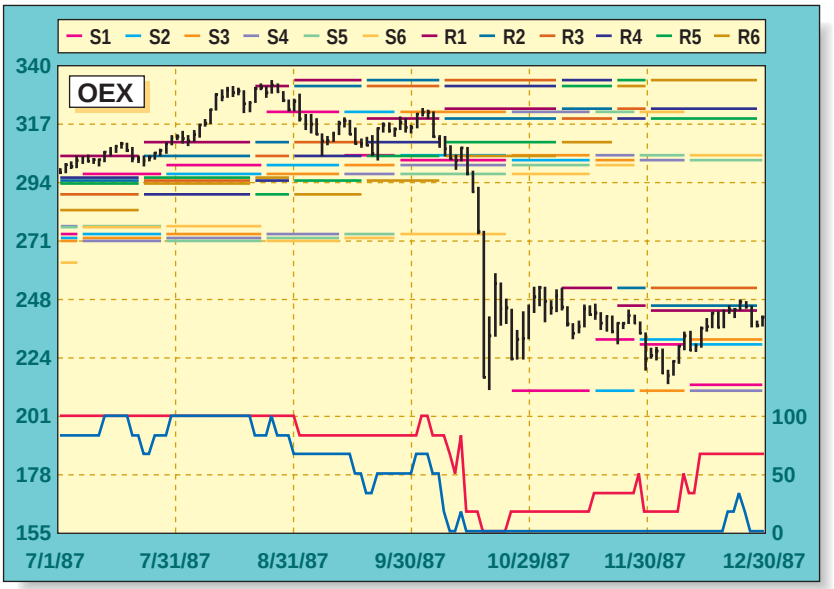


FIGURE 5: MARKET COLLAPSE, 1987 CRASH. Indicators identify breaking of critical support levels two days prior to the dramatic drop.

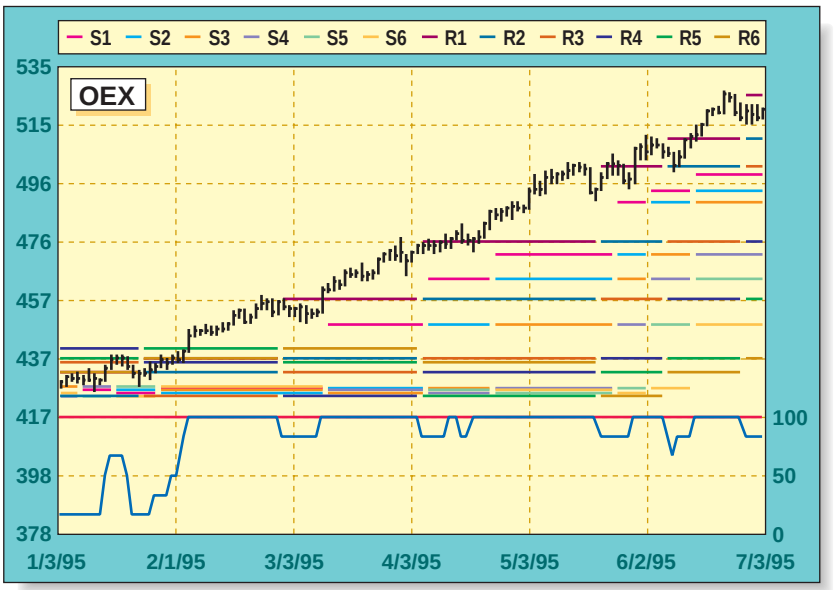


FIGURE 6: A STEADY UPWARD TREND IN 1995. The support indicator WSO is at its maximum value and the WRO is very high throughout the period, confirming very strong support.

MORE EXAMPLES

A similar example with a larger pullback is shown in Figure 4. In this case, the market is moving strongly higher in January, peaks in mid-February and declines in March to mid-April. As the decline begins, the WRO declines first, since resistance levels are above support levels. Prices turn down and support levels are broken in late March, as seen in the WSO. This is relatively short-lived, and the market resumes its upward rise in mid-April. When the market is rising strongly, WSO is at 100 and WRO is near 100. When both are at 100, the market is freely ascending.

A collapsing market can be seen in Figure 5 showing the 1987 crash. In this case, beginning in early September, both support and resistance levels are broken as the decline begins. Both the WSO and the WRO collapse prior to the abrupt

climax. Setting stops below the support region near 300 would have been wise in hindsight. Following the crash, the market recovers, building support with the WSO, rising while the WRO remains low. During this period, prices are contained between support and resistance levels as the oscillators separate from one another.

A steady trend is shown in Figure 6. Following the initial start in January, there would appear to be very little reason, based upon the oscillators, to do anything but hold a long position. There are several minor steps in the price rise that are reflected in minor dips in the WRO. Meanwhile, the WSO has remained at 100 for the entire period, indicating strong support.

The method was also adapted to MetaStock; an example can be seen in Figure 7. In this case, Compaq is charted for a short period in 1996. Following an abrupt drop about March 1, support builds with the WSO rising first, followed by a rise in WRO for the next five months. Finally, prices break through resistance in late July and begin a sustained rise.

Another example can be seen in Figure 8. Here, Pepsi peaks in late June, declines for two months and forms a bottom. The decline is strong and both support and resistance levels are broken, with accompanying drops in the WRO followed by drops in the WSO. Finally, a bottom is formed in early September that is tested several times in late September and early October. Prices rise from the bottom and again the WSO rises, first followed by the confirming rise in the WRO.

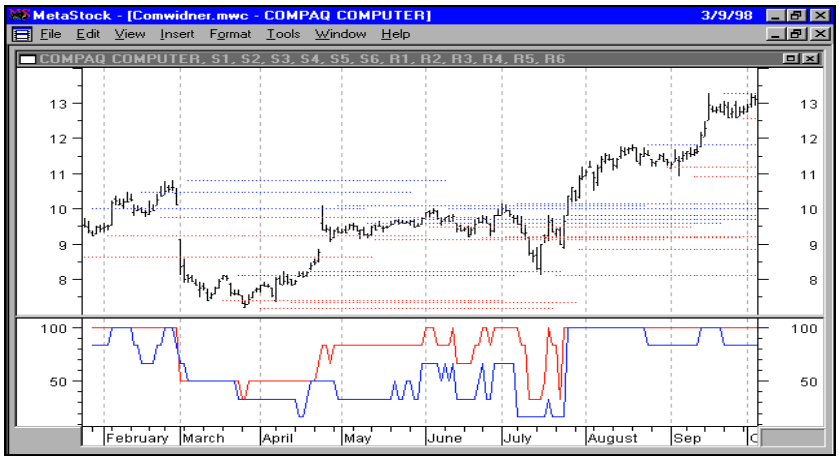


FIGURE 7: PLOTTING AND OSCILLATOR, COMPAQ. The plotting and oscillator method is easily adaptable. Here, a recent history of Compaq is shown for 1996.

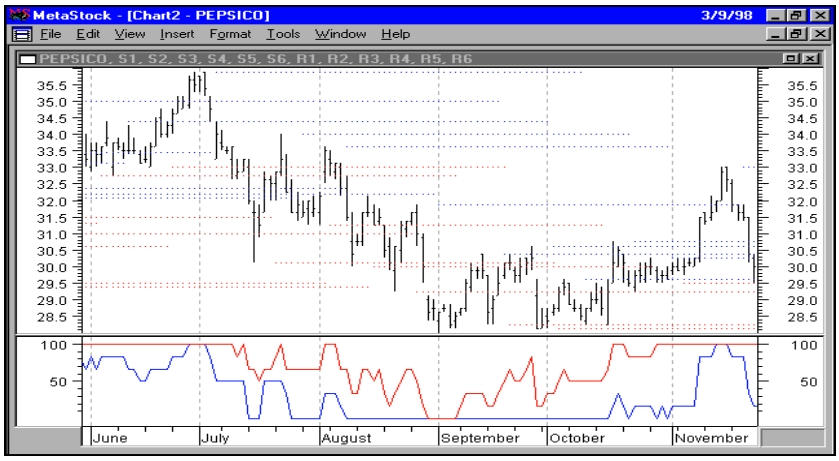


FIGURE 8: PEPSI. Here's an application of the method to a recent price history of PepsiCo in 1996.

TRADING STRATEGIES

Many trading strategies are possible using support and resistance analysis. One strategy is to simply observe the plotted price levels and either enter stops or initiate transactions depending upon price behavior relative to the levels. If prices are moving toward a level, they will frequently continue on to test the level. When this occurs, positions can be opened or closed, depending upon the outcome of the test. When holding a long position and prices are rising toward resistance, close if the price bounces from resistance and hold or add to the position if resistance is broken. Another approach would be to consider support and resistance levels as retracement levels and initiate positions in the direction of the prevailing trend when the outcome of the test is known and favorable.

Another approach is to develop a trading system based upon the WRO and WSO oscillators. Entering long positions when support is strong and resistance is weak is one possibility. Another would be entry when support is building. Such a method was developed and tested against the OEX for a long period —about 14 years — with favorable results. The system considered long positions only with entry when support was building or if support was very strong. (See "Traders' Tips" for detailed MetaStock formulas.)

Open long position

Enter long if WSO > simple moving average of WSO for the previous four bars

Or

Enter long if simple moving average of WRO for previous 30 days > 95

Close long position

Close positions using stops, primarily trailing stops, with added breakeven and maximum-loss stops.

Results summarized in Figure 9 show a return greater than buy-and-hold for the period. The returns are consistently favorable over subsets of the selected history and not too

sensitive to precise choices of parameters. When applying this type of trading system to other issues, it is important to select system parameters appropriate for the particular cyclic behavior and volatility of the particular issue.

SUMMARY

A new technique can be applied to an old, proven method. Support and resistance levels are reference points for price behavior. As prices move to these reference points, the values are tested. There is a good chance the price will reverse at or near that level, as opposed to some other value. If it breaks through the level, there is a good chance it will continue on. This information can be the basis for trading strategies and decisions.

Falling back to the mechanics analogy, prices testing support and resistance can be likened to a rubber ball hitting a pane of glass. Sometimes it bounces off and sometimes it breaks through. The outcome depends upon the strength of the glass (support or resistance level) and the momentum of the ball (prices). Newton would have had fun with the stock market!

SUMMARY OF RESULTS

Total net profit	8,169.69	Open position value	265.07
Percent gain/loss	816.97	Annual percent gain/loss	57.42
Initial investment	1,000.00	Interest eamed	796.43
Current position	Long	Date position entered	9/12/97
Buy/hold profit	4,613.91	Days in test	5,193
Buy/hold pct gain/loss	461.39	Annual B/H pct. gain/loss	32.43
Total closed trades	110	Commissions paid	0.00
Avg. profit per trade	71.86	Ave. win/Ave. loss ratio	2.95
Total long trades	110	Total short trades	0
Winning long trades	70	Winning short trades	0
Total winning trades	70	Total losing trades	40
Amt. of winning trades	8,816.50	Amount of losing trades	-1,708.30
Average win	125.95	Average loss	-42.71
Largest win	1,518.80	Largest loss	-222.13
Average length of win	27.09	Average length of loss	14.10
Longest winning trade	90	Longest losing trade	33
Most consecutive wins	10	Most consecutive losses	4
Total bars out	1,344	Average length out	12.11
Longest out period	97		
System close drawdown	0.00	Profit/loss index	82.71
System open drawdown	-3.83	Reward/risk index	99.95
Max open trade drawdown	-315.19	Buy/hold index	82.81

FIGURE 9: Here's a summary of results from a trading system based upon WRO and WSO oscillators. Consistent, above-average performance is possible here following straightforward trading rules. System parameters were optimized.

Mel Widner holds a doctorate in engineering and is the developer of several new analytical methods, including projection bands, mobility oscillators, and rainbow charts.

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†See Traders' Glossary for definition

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