

Some Techniques Used in Technical Analysis

Moving Averages

Simple Moving Averages (SMA)

A simple moving average is formed by computing the average (mean) price of a security over a specified number of periods. While it is possible to create moving averages from the Open, the High, and the Low data points, most moving averages are created using the closing price. For example: a 5-day simple moving average is calculated by adding the closing prices for the last 5 days and dividing the total by 5.

$$10 + 11 + 12 + 13 + 14 = 60$$

$$60 \div 5 = 12$$

The calculation is repeated for each price on the chart. The averages are then joined to form a smooth curving line - the *moving average line*. Continuing our example, if the next closing price in the average is 15, then this new period would be added and the oldest day, which is 10, would be dropped. The new 5-day simple moving average would be calculated as follows:

$$11 + 12 + 13 + 14 + 15 = 65$$

$$65 \div 5 = 13$$

Over the last 2 days, the SMA moved from 12 to 13. As new days are added, the old days will be subtracted and the moving average will continue to move over time.

Day	Daily Close	10-day SMA
1	67.50	
2	66.50	
3	66.44	
4	66.44	
5	66.25	
6	65.88	
7	66.63	
8	66.56	
9	65.63	
10	66.06	66.39
11	63.94	66.03
12	64.13	65.79
13	64.50	65.60
14	62.81	65.24
15	61.88	64.80
16	62.50	64.46
17	61.44	63.94
18	60.13	63.30
19	61.31	62.87
20	61.38	62.40

Note that **all moving averages are lagging indicators** and will always be "behind" the price. The price of EK is trending down, but the simple moving average, which is based on the previous 10 days of data, remains above the price. If the price were rising, the SMA would most likely be below. Because moving averages are lagging indicators, they fit in the category of trend following indicators. When prices are trending, moving averages work well. However, when prices are not trending, moving averages can give misleading signals.

Exponential Moving Averages (EMA)

In order to reduce the lag in simple moving averages, technicians often use exponential moving averages (also called exponentially weighted moving averages). EMAs reduce the lag by applying more weight to recent prices relative to older prices. The weighting applied to the most recent price depends on the specified period of the moving average. The shorter the EMA's period, the more weight that will be applied to the most recent price. For example: a 10-period exponential moving average weighs the most recent price 18.18% while a 20-period EMA weighs the most recent price 9.52%. As we'll see, the calculating and EMA is much harder than calculating an SMA. The important thing to remember is that the exponential moving average puts more weight on recent prices. As

such, it will react quicker to recent price changes than a simple moving average. Here's the calculation formula.

Exponential Moving Average Calculation

Exponential Moving Averages can be specified in two ways - as a percent-based EMA or as a period-based EMA. A percent-based EMA has a percentage as its single parameter while a period-based EMA has a parameter that represents the duration of the EMA. The formula for an exponential moving average is:

$$\text{EMA}(\text{current}) = ((\text{Price}(\text{current}) - \text{EMA}(\text{prev})) \times \text{Multiplier}) + \text{EMA}(\text{prev})$$

For a percentage-based EMA, "Multiplier" is equal to the EMA's specified percentage.

For a period-based EMA, "Multiplier" is equal to $2 / (1 + N)$ where N is the specified number of periods.

For example, a 10-period EMA's Multiplier is calculated like this:

$$\frac{2}{(\text{Time periods} + 1)} = \frac{2}{(10 + 1)} = .1818$$

(18.18%)

This means that a 10-period EMA is equivalent to an 18.18% EMA.

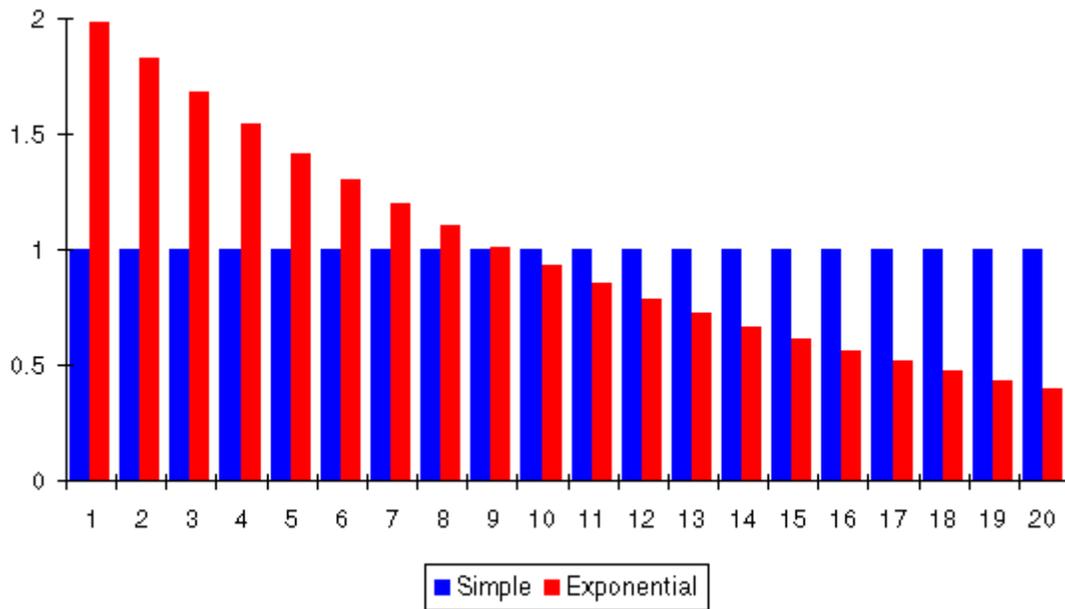
		EMA Period (N): 10		
		Smoothing Constant (K): 0.181818		
Period	Date	Close (C)	Previous Period's EMA (P)	10-Day EMA (X)
1	09-Nov-99	\$ 64.75		
2	10-Nov-99	\$ 63.79		
3	11-Nov-99	\$ 63.73		
4	12-Nov-99	\$ 63.73		
5	15-Nov-99	\$ 63.55		
6	16-Nov-99	\$ 63.19		
7	17-Nov-99	\$ 63.91		
8	18-Nov-99	\$ 63.85		
9	19-Nov-99	\$ 62.95		
10	22-Nov-99	\$ 63.37		\$ 63.682 - *
11	23-Nov-99	\$ 61.33	\$ 63.682	\$ 63.254
12	24-Nov-99	\$ 61.51	\$ 63.254	\$ 62.937
13	26-Nov-99	\$ 61.87	\$ 62.937	\$ 62.743
14	29-Nov-99	\$ 60.25	\$ 62.743	\$ 62.290
15	30-Nov-99	\$ 59.35	\$ 62.290	\$ 61.755
16	01-Dec-99	\$ 59.95	\$ 61.755	\$ 61.427
17	02-Dec-99	\$ 58.93	\$ 61.427	\$ 60.973
18	03-Dec-99	\$ 57.68	\$ 60.973	\$ 60.374
19	06-Dec-99	\$ 58.82	\$ 60.374	\$ 60.092
20	07-Dec-99	\$ 58.87	\$ 60.092	\$ 59.870

Weighted Moving Average (WMA)

The exponential moving average is just one of many forms of *weighted moving averages*. Instead of just adding up the measurements for a sequence of days and dividing by the number of days, in a weighted moving average each measurement is first multiplied by a *weight factor*, which differs from day to day. The final sum is divided, not by the number of days, but by the sum of all the weight factors. If larger weight factors are used for more recent days and smaller factors for measurements further back in time, the trend will be more responsive to recent changes without sacrificing the smoothing a moving average provides.

An unweighted moving average is simply a weighted moving average with all the weight factors equal to 1. You can use any weight factors you like, but a particular set with the jawbreaking monicker ``Exponentially Smoothed Moving Average" has proven useful in applications ranging from air defense radar to trading the Chicago pork belly market. Let's put it to work on our bellies as well.

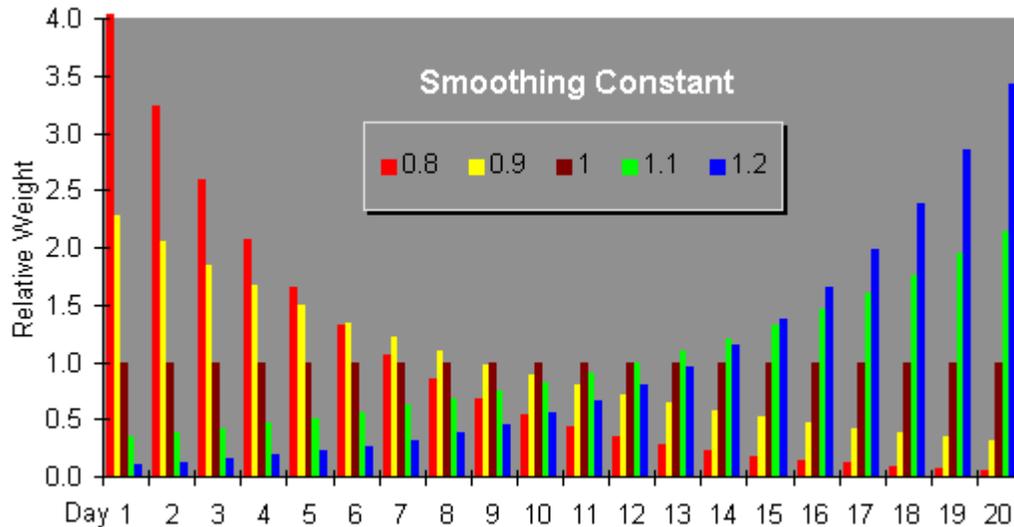
This graph compares the weight factors for an exponentially smoothed 20 day moving average with a simple moving average that weights every day equally.



Exponential smoothing gives today's measurement twice the significance the simple average would assign it, yesterday's measurement a little less than that, and each successive day less than its predecessor with day 20 contributing only 20% as much to the result as with a simple moving average.

The weight factors in an exponentially smoothed moving average are successive powers of a number called the *smoothing constant*. An exponentially smoothed moving average with a smoothing constant of 1 is identical to a simple moving average, since 1 to any power is 1. Smoothing constants less than 1 weigh recent data more heavily, with the bias toward the most recent measurements increasing as the smoothing constant decreases toward zero. If the smoothing constant exceeds 1, older data are weighted more heavily than recent measurements.

This plot shows the weight factors resulting from different values of the smoothing constant. Note how the weight factors are all 1 when the smoothing constant is 1.



When the smoothing constant is between 0.5 and 0.9, the weight given to old data drops off so rapidly compared to more recent measurements that there's no need to restrict the moving average to a specific number of days; we can average all the data we have, right back to the very start, and let the weight factors computed from the smoothing constant automatically discard the old data as it becomes irrelevant to the current trend.

Channels

Moving Average Envelopes

A moving average band, or envelope, forms a channel or zone of commitment around a moving average. A moving average is calculated first, and then a band above and below the average is calculated.

Formula:

Upper Band:

$$UB = MA_t + (U\% \times MA_t)$$

Where:

UB = upper band

MA_t = current moving average value

U% = upper percentage value

And:

Lower Band:

$$LB = MA_t + (L\% \times MA_t)$$

Where:

LB = lower band

MA_t = current moving average value

L% = lower percentage value

The moving average in a moving average envelope can be calculated using any of the moving averages.

Bollinger Bands

Bollinger Bands are a type of envelope that are plotted at standard deviation levels above and below a moving average. This produces an effect of having the bands widen during periods of higher volatility and contract during less volatile periods. Bollinger bands allow for an understanding of changes in supply and demand for the underlying security as a quick view. During periods of lower volatility, in sideways moving markets, the bands contract toward the moving average. When the market is in a period of indecision, between major news or prior to the maturing of market perception, volatility drops off. Often there is a build up of stop orders outside of the current trading range to protect against a breakout of the current trading range. If this period of lower volatility lasts for a long time, the resulting breakout can be fairly strong as resolution creates an imbalance in supply and demand as well as the build up of orders outside the previous trading range. This may lead to trading opportunity.

Price Channels

Price channels are a graphic representation of channel breakouts. Some fund managers work on rules in which they will buy and sell only when price has penetrated a channel. They wish to avoid all the noise of shorter term time frames and look for the bigger trending opportunities. The breakout points are commonly derived of a break of the highest high or the lowest low for a particular period. They will either use these signals on their own and will always carry a position as a new trade exits the previous trade. The alternative is to enter a trade and use a trailing stop to organize the exit, then only enter again when the opposite channel is broken.

Oscillating Indices

RSI Indicator (Relative Strength Index)

RSI is an oscillator (meaning the value "oscillates" between 0 and 100), that measures the strength of a stock or index by measuring changes in its closing prices, which is very important because traders pay more attention to closing prices than to any other prices. It is considered a "leading indicator", meaning it usually makes significant changes before price movements. Usually oversold and overbought reference lines are drawn in at 30 (oversold) and 70 (overbought), but these levels can and should be adjusted for bull or bear markets. I like to use an 8 period RSI, but one can use anywhere from a 6 to 14 period. Trading signals using shorter periods will become more visible.

$$RSI = 100 - (100 / (1 + RS))$$

$$RS = (UP / DOWN)$$

$$UP = (\text{Total 'Up Period' Points} / \text{Period Length})$$

$$DOWN = (\text{Total "down period" points} / \text{Period Length})$$

Example:

Chart Interval: 10 Minutes

Period Length: 10 (150 minutes)

Total "Up" Points: 7

Total "Down" Points: 11

$$UP = 7 / 10 = .7$$

$$DOWN = 11 / 10 = 1.1$$

$$RS = (.7 / 1.1) = .636$$

$$RSI = 100 - (100 / (1 + .636)) = 38.89$$

Fast/Slow Stochastic

Given a period length, X, the fast stochastic is given by:

$$\%k = (\text{Close} - \text{Low}(X)) / (\text{High}(X) - \text{Low}(X))$$

Where Low(X) and High(X) are the high and low piece over period X

Note that when $\%k = 1$, the price is at a recent high and when $\%k = 0$, the price is at a current low.

$\%d = y$ period moving average of $\%k$.

A slow stochastic is a z period moving average of $\%d$.

As with the RCI, 30% is considered “oversold” and 70% is “overbought”.

MACD (Moving Average Convergence/Divergence)

The MACD indicates the % difference between two (exponential) moving averages. A MACD indicates that “something is going on”. There are few ways of using MACD. A basic use is as follows: signals are generated when the line crosses zero. Crossing from negative into the positive is considered a buy signal, while crossing from the positive to negative is considered a sell signal. The MACD requires the MA lengths, and a signal length. The signal length is just a moving average of the indicator.