The analysis of trend is at the core of technical analysis, and moving averages are one technique that directly addresses the issue of how to define trend in an objective manner. In the financial markets, a moving average is an average of price that changes as price action develops over time. Moving averages are easy to understand, simple to use and are an extremely consistent and reliable means of defining trend.

**A Weighty Matter**

There are many different types of average that a technician can choose. The deciding factor will be the weight they wish to attach to the data: should the most recent price action carry more weight in an average or should all prices be regarded as the same? The three most commonly used types of average are simple, weighted and exponential averages. The simple moving average attaches equal importance to all prices in the average, whereas weighted and exponential averages give more weight to most recent prices (Figures 1 and 2).

The simple or arithmetic average is constructed by summing regular price readings over a given time period (n) and then dividing the answer by n. For example, to construct a ten-day average, take the last ten days’ closing prices, add them up and divide by ten; the answer gives your average for today. Tomorrow you would recalculate the average leaving out the price eleven days ago. All prices are treated equally, so a large change in price can have a disproportionate effect on the average not only on the day it occurs, but also on the day it drops out of the average.

A weighted average is calculated by allocating different weights to the prices averaged. The vast majority, though not all, of weighted averages are front-loaded, i.e., the most recent price is given the greatest weight. In a linearly weighted average, each price will be multiplied by regularly decreasing amounts going back in time; once multiplied by its weight, the adjusted prices are summed and then divided by the sum of the multipliers. For example, for a ten-day weighted average, multiply today’s price by ten, yesterday’s by nine…and the price ten days ago by one. The ten readings are then added together and divided by 55 (the sum of ten plus nine plus eight…plus one), to get the average for today. As time passes, prices drop out of the average to be replaced by new readings. One of the perceived advantages of a weighted average is that it reacts more quickly than a simple average to price moves.

An exponentially smoothed moving average is a little more complicated. It is based not a sequential average of individual time periods but on the price today and the average yesterday adjusted by a smoothing coefficient. The formula for the smoothing coefficient X is 

\[ X = \frac{1}{n/2} - 1 \]

where n is the number of days to be averaged.
The formula for calculating the new average is 
\[(1-X)*\text{old average} + [X*\text{new price value}]\]

For example, to calculate a ten-day exponential average for copper, the smoothing coefficient is 0.25. If the average yesterday was $1,990 and the price today is $2,010, then the ten-day exponential average for today would be $1,995. The average accounts for all prices, but the most importance is attached to the most recent price: it is a front-loaded average.

**Characteristics of Moving Averages**

Averages can be based on any price throughout a time period, or even an average of prices, but the most widely used price is that at the end of a period – the close. To determine the trend of a market, the most recent price is compared to the average: if the price is above the average, then the market is trending higher; if the price is below the average, the market is trending lower. No matter which type of average is used, the characteristics of these trend-following tools are broadly the same.

Moving averages are lagging indicators: when a market trends they will follow the trend at a distance, when a market is directionless all averages will eventually move into the middle of the range. Shorter-term averages lag the price most closely: fewer data points or higher smoothing coefficients mean that they are more responsive to price changes, and vice versa (Figure 3).

**Avoiding the Small Losses**

A 3:1 ratio of losing to profitable trades is not an attractive proposition for many investors and therefore techniques have been developed to reduce this ratio. But increased comfort comes at a price, and even though the number of losses can be reduced, the flipside will be that the signal to enter and exit a trend will come much later – and therefore the profitability of the trending phase will also be reduced.

**Patterns Recognition** – Relating the slope of a moving average to price, or another moving average, when a signal is generated can also determine which trading response to adopt. For example, when a short-term average rallies above a flat or slightly rising longer-term average after a prolonged decline, this is known as a Golden Cross and is regarded as a strong buy signal, as opposed to a short-term average rallying above a falling longer-term average, which would be regarded as a sell signal under Joe Granville’s eight rules for Moving Averages.
How Good Are Moving Averages?

Even at their most complex, moving averages are a very simple forecasting tool relative to many other statistical techniques – but they do have a strong pedigree. Academic research by Armstrong in 1984 and Makridakis in 1995 has shown that moving averages outperform other, more complex forecasting techniques, such as multiple regressions. Financial markets studies, notably Hochheimer in 1978, have discovered that simple moving averages generally outperform weighted or exponential averages.

Most charting packages nowadays offer the opportunity to back test combinations of averages with trading rules and can produce a track record for a given combination of factors. Although these tools are useful, I would strongly caution against constantly optimising moving averages to obtain the perfect fit. Curve fitting is little more than trading with the benefit of hindsight and is rarely profitable in the long run. Instead choose averages that best explain the world as you see it and then stick with those through thick and thin.

Moving averages are a simple effective tool for objectively defining trend and as such they are invaluable to a technician. In trending markets they will perform well but in ranging markets they can disappoint. Nevertheless, although they lack the complexity of other forecasting techniques they have a good academic pedigree. At the heart of many trend following systems and models you will find a moving average.

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