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Chart School

Moving Averages - Part 1

Introduction

Moving averages are one of the most popular and easy to use tools available to the technical analyst. By using an average of prices, moving averages smooth a data series and make it easier to spot trends. This can be especially helpful in volatile markets.

In the first part of this series on moving averages, we will examine the differences between the two most popular moving averages: the simple moving average and the exponential moving average. In part two, we will look at how moving averages can be used as tools of technical analysis.

Simple Moving Average (SMA)

(Click here to see a live example of a Simple Moving Average)

A simple moving average is formed by finding the average price of a security over a set number of periods. Most often, the closing price is used to compute the moving average. For example: a 5-day moving average would be calculated by adding the closing prices for the last 5 days and dividing the total by 5.

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

$$60 \div 5 = 12$$

A moving average *moves* because as the newest period is added, the oldest period is dropped. 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 moving average would be calculated as follows:

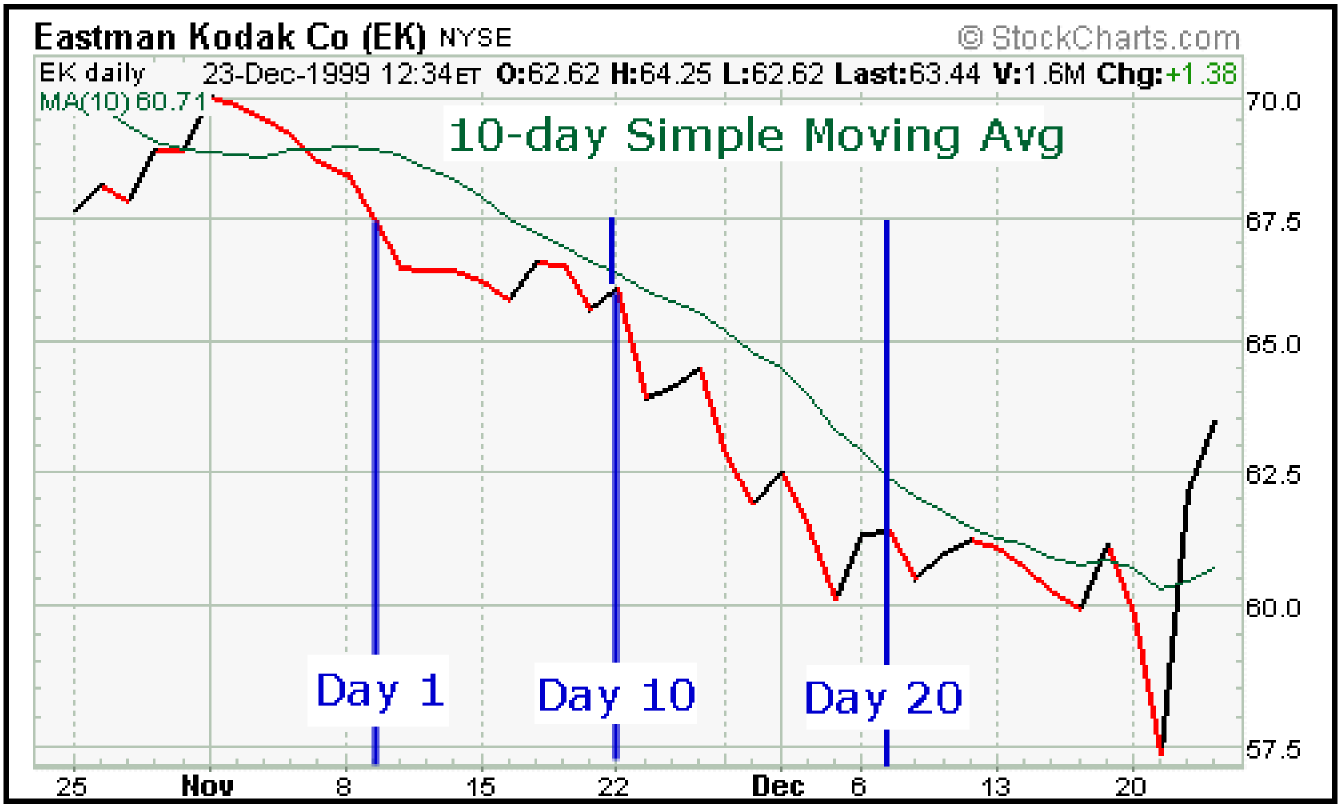
$$11 + 12 + 13 + 14 + 15 = 65$$

$$65 \div 5 = 13$$

Over the last 2 days, the moving average 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

In the example above, using closing prices from Eastman Kodak (EK), day 10 is the first day possible to calculate a 10-day moving average. As the calculation continues, the newest day is added and the oldest day is subtracted. The 10-day moving average for day 11 is calculated by adding the prices of day 2 through day 11 and dividing by 10. The averaging process then moves on to the next day where the 10-day moving average for day 12 is calculated by adding the prices of day 3 through day 12 and dividing by 10.



The chart above is a plot that contains the data sequence in the table. The moving average begins on day 10 and continues.

This simple illustration highlights the fact that moving averages are lagging indicators and will always be behind the price. The price of EK is trending down, but the moving average, which is based on the previous 10 days of data, remains above the price. If the price were rising, the moving average most likely be below. Because moving averages are lagging indicators, they fit in the category of trend following. When prices are trending, moving averages work well. However, when prices are not trending, moving averages do not work.

Exponential Moving Average (EMA)

(Click here to see a live example of an Exponential Moving Average)

In order to reduce the lag in simple moving averages, technicians sometimes use exponential moving averages, or exponentially weighted moving averages. Exponential moving averages 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 length of the moving average. The shorter the exponential moving average is, 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% and a 20-period exponential moving average weighs the most recent price 9.52%. The method for calculating the exponential moving average is fairly complicated. 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. For those who wish to see an example formula for an exponential moving average, one is provided below. Others may prefer to skip this section and move on the comparison of the moving averages.

Exponential Moving Average Calculation

The formula for an exponential moving average is:

$$X = (K \times (C - P)) + P$$

X = Current EMA
C = Current Price
P = Previous period's EMA*
K = Smoothing constant
(*A SMA is used for first period's calculation)

The smoothing constant applies the appropriate weighting to the most recent price relative to the previous exponential moving average. The formula for the smoothing constant is:

K = 2/(1+N)
N = Number of periods for EMA

For a 10-period EMA, the smoothing constant would be .1818.

$$\frac{2}{\text{(Time periods + 1)}} = \frac{2}{(10 + 1)} = .1818 \quad (18.18\%)$$

The EMA formula works by weighting the difference between the current period's price and the previous period's EMA and adding the result to the previous period's EMA. There are two possible outcomes: the weighted difference is either positive or negative.

1. If the current price (C) is higher than the previous period's EMA (P), the difference will be positive (C - P). The positive difference is weighted by multiplying it by the constant ((C - P) x K) and the answer is added to the previous period's EMA, resulting in a new EMA that is higher ((C - P) x K) + P.

2. If the current price is lower than the previous period's EMA, the difference will be negative (C - P). The negative difference is weighted by multiplying it by the constant ((C - P) x K) and the final result is added to the previous period's EMA, resulting in a new EMA that is lower ((C - P) x K) + P.

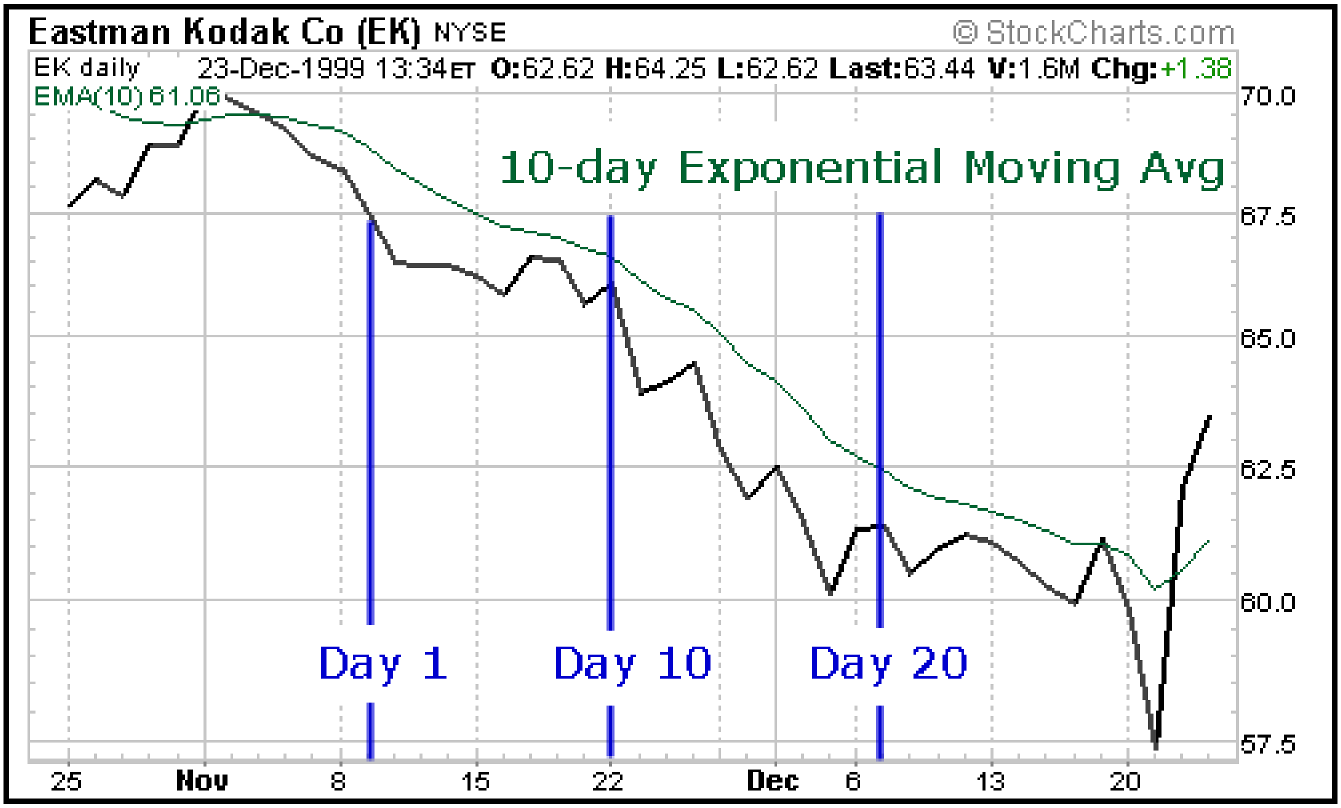
Below is a table with the results of an exponential moving average calculation for Eastman Kodak. For the first period's exponential moving average, the simple moving average was used as the previous period's exponential moving average (yellow highlight for the 10th period). From period 11 onwards, the previous period's EMA was used. The calculation in period 11 breaks down as follows:

1. (C - P)= (73.81 - 74.28) = -.47
2. (C - P) x K= -.47 x .1818 = -.08
3. ((C - P) x K) + P= -.08 + 74.28 = 74.20

The current price was 71.81, which was lower than the previous period's EMA. In order to pull it closer to the EMA, .08 of a point was shaved off of the previous period's EMA and the new EMA was 74.20.

Period	Current Price (C)	Previous Period's EMA* (P)	10-day EMA (X)	EMA Periods (N)	Smoothing constant (K)
1	76.69				
2	76.13				
3	75.50				
4	74.94				
5	74.81				
6	75.19				
7	73.81				
8	73.38				
9	73.06				
10	72.75	74.63*	74.28	10	0.18182
11	73.81	74.28	74.20	10	0.18182
12	75.63	74.20	74.46	10	0.18182
13	75.25	74.46	74.60	10	0.18182
14	76.94	74.60	75.03	10	0.18182
15	76.38	75.03	75.27	10	0.18182
16	76.31	75.27	75.46	10	0.18182
17	75.44	75.46	75.46	10	0.18182
18	74.75	75.46	75.33	10	0.18182
19	74.69	75.33	75.21	10	0.18182
20	72.44	75.21	74.71	10	0.18182

*The 10-period simple moving average is used for the first calculation only. After that the previous period's EMA is used.



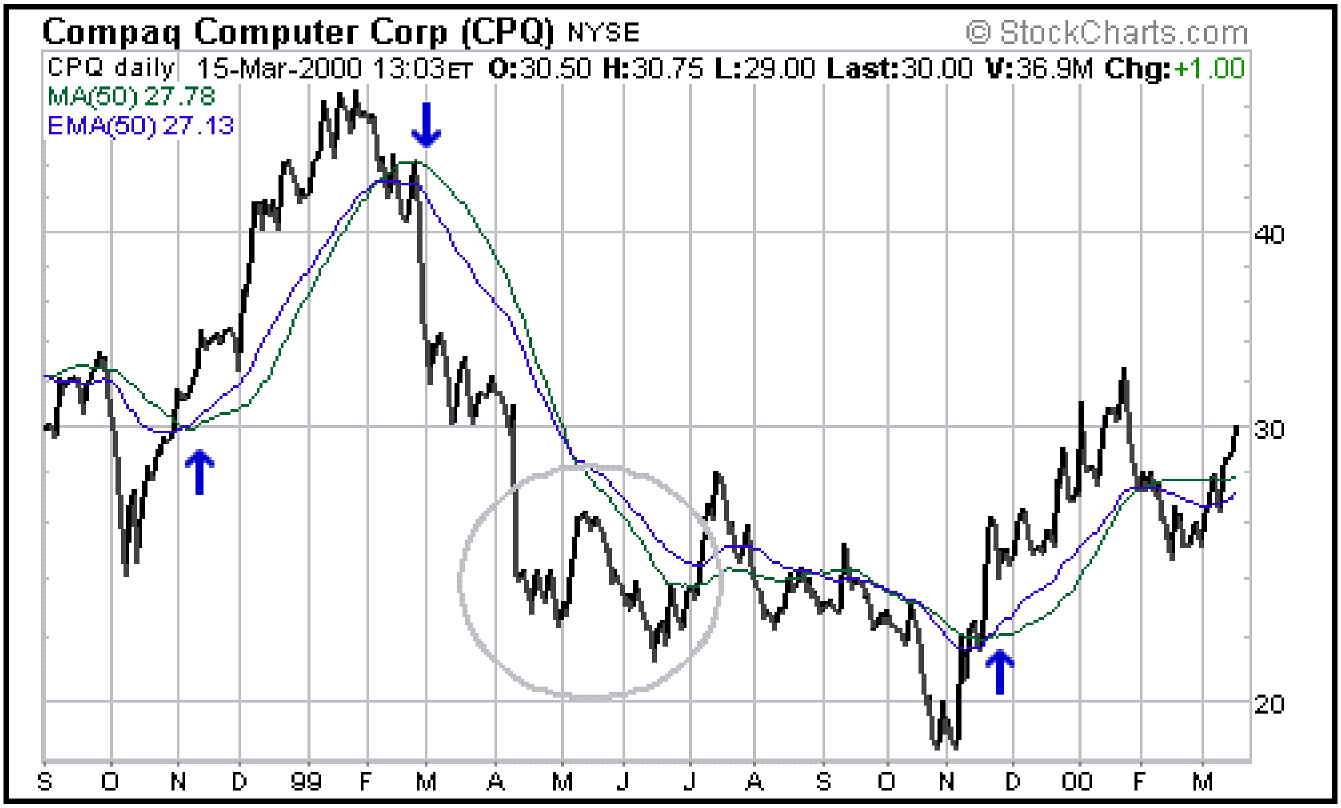
Simple Versus Exponential

From afar, it would appear that the difference between an exponential moving average and a simple moving average is minimal. For this example, which uses only 20 trading days, the difference is minimal, but a difference nonetheless. The exponential moving average is consistently closer to the actual price. On average, the EMA is 3/8 of a point closer to the actual price than the SMA.

Period	EMA Absolute Difference	SMA Absolute Difference
10	1.53	1.88
11	0.39	0.53
12	1.17	1.34
13	0.65	0.99
14	1.91	2.47
15	1.10	1.76
16	0.85	1.58
17	0.02	0.54
18	0.58	0.28
19	0.52	0.51
20	2.27	2.72
Average Difference	1.00	1.33

From day 10 to day 20, the EMA was closer to the price than the SMA 9 out of 10 times. The only time the SMA was closer was in period number 18 (yellow highlight), and this did not last long. The average absolute difference between the exponential moving average and the current price was 1 and the simple moving average had an average absolute difference of 1.33. This means that on average, the exponential moving average was 1 point above or below the current price and the simple moving average was 1.33 points above or below the current price.

When EK stopped falling and started to trade flat, the SMA kept on declining. During this period, the SMA was closer to the actual price than the EMA. The EMA began to level out with the actual price and remain further away. This was because the actual price started to level out. Because of its lag, the SMA continued to decline and even touched the actual price on 13-Dec.



A comparison of a 50-day EMA and a 50-day SMA for Compaq also shows that the EMA picks up on the trend quicker than the SMA. The blue arrows mark points when the stock started a strong trend. By giving more weight to recent prices, the EMA reacted quicker than the SMA and remained closer to the actual price. The gray circle shows when the trend began to slow and a trading range developed. When the change from trend to trading began, the SMA was closer to the price. As the trading range continued into the latter part of 1999, both moving averages converged. In later 1999, CPQ started to trend up and the EMA was quicker to pick up on the recent price change and remain closer to the price.

Which is better?

Which moving average you use will depend on your trading and investing style and preferences. The simple moving average obviously has a lag, but the exponential moving average may be prone to quicker breaks. Some traders prefer to use exponential moving averages for shorter time periods to capture changes quicker. Some investors prefer simple moving averages over long time periods to identify long-term trend changes. In addition, much will depend on the individual security in question. A 50-day SMA might work great for identifying support levels in the Nasdaq, but a 100-day EMA may work better for the Dow Transports. Moving average type and length of time will depend greatly on the individual security and how it has reacted in the past.

The initial thought for some is that greater sensitivity and quicker signals are bound to be beneficial. This is not always true and brings up a great dilemma for the technical analyst: the trade off between sensitivity and reliability. The more sensitive an indicator is, the more signals that will be given. These signals may prove timely, but with increased sensitivity comes an increase in false signals. The less sensitive an indicator is, the fewer signals that will be given. However, less sensitivity leads to fewer and more reliable signals. Sometimes these signals can be late as well.

For moving averages, the same dilemma applies. Shorter moving averages will be more sensitive and generate more signals. The EMA, which is generally more sensitive than the SMA, will also be likely to generate more signals. However, there will also be an increase in the number of false signals and whipsaws. Longer moving averages will move slower and generate fewer signals. These signals will likely prove more reliable, but they also may come late. Each investor or trader should experiment with different moving average lengths and types to examine the trade-off between sensitivity and signal reliability.

In Part 2, we examine how to use moving averages to identify support and resistance levels, recognize trends and develop a trading system.

Written by Arthur Hill

Part 1 | Part 2

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