**Artificial Intelligence (AI) for Investments**
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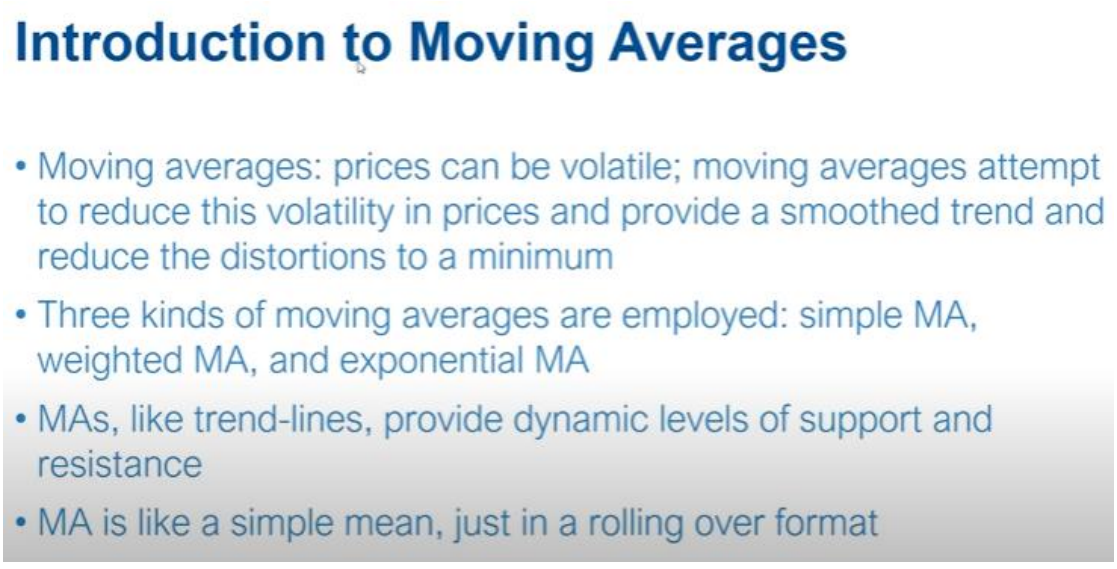
**Lecture- 39**

Let us introduce moving averages. Prices can be volatile. Moving averages attempt to reduce this volatility in prices and provide a smooth trend and reduce the distortions to a minimum. In this lesson, we will examine three kinds of moving averages that is simple moving average, weighted moving average and exponential moving average. We will start the discussion with computation of simple moving average, its properties and visual examination. We will highlight some of the key properties of moving averages and various moving average technical indicators in determining technical trend and its violation.

We will understand how to generate timely buy and sell signals with moving average chart. However, there is a trade-off in timely signal generation and the accuracy of the signal which we will understand through the discussions in this lesson. We will also understand the application of system of moving averages, for example, dual moving average or MA system such as short term and long term. In identifying trend and trend reversals, we will also draw parallels between moving averages and price patterns such as formation of trend lines, trading in ranges, classic patterns among others.

In this video, we will introduce the concept of moving averages. Moving averages are employed because prices can be volatile and moving averages attempt to reduce this volatility in prices and provide a smooth trend and reduce the distortions to a minimum. Three kinds of moving averages are often employed. These include simple moving averages, simple MA, weighted moving averages, WMA and exponential moving averages, EMA. Moving averages like trend lines provide dynamic levels of support and resistance.



Moving average is like a simple mean just in a rolling over format. For example, consider the table shown here which indicates the movement of an index over weekly interval. So, these are the weekly intervals 8, 15 and so on and this is the movement of prices over weekly period. Now, this is a 10 week simple moving average SMA. So, 1, 2 and 3, 4, 5, 6, 7, 8, 9, 10.

So, if this is my first observation, this would be my 10th observation. The simple average of all these 10 observations is 966 and average of this is 96.6. So, this is the summation, this is the average of 10 observations. So, divide by 10, we will get this figure.

## Computation of Simple MA

| Simple SMA | | | | |
|---|---|---|---|---|
| Date | | Index | 10-Week Total | MA |
| Jan. | 8 | 101 | | |
| | 15 | 100 | | |
| | 22 | 103 | | |
| | 29 | 99 | | |
| Feb. | 5 | 96 | | |
| | 12 | 99 | | |
| | 19 | 95 | | |
| | 26 | 91 | | |
| Mar. | 5 | 93 | | |
| | 12 | 89 | 966 | 96.6 |
| | 19 | 90 | 955 | 95.5 |
| | 26 | 95 | 950 | 95 |
| Apr. | 2 | 103 | 950 | |

As we move 1 week ahead, so we move here. So, now 10 observations are in rolling over format starting from 90 to 100 and their summation is 955 and average is 95.5 and so on. We keep on rolling on this window and compute the averages. So, these are like simple moving average which are rolling over.

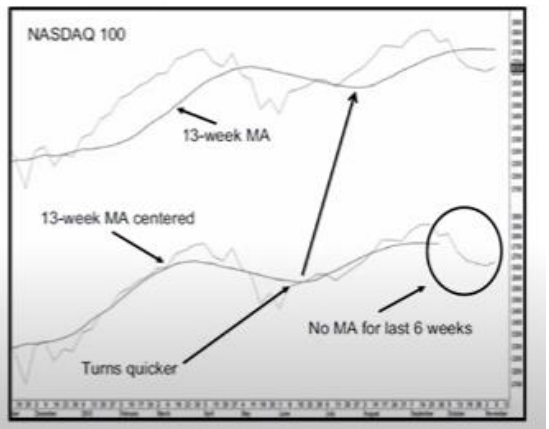
Now, please notice while the index value may be fluctuating, its moving average is not as fluctuating and probably may result in a smooth, I would help us in identifying a smooth trend. Notice here, as the window rolls over, new week is added and old week is subtracted. Thus, the average moves and therefore the term moving average. Changes in the price trends are identified by the price crossing and moving. For example, if this is my moving average which is rather smooth, fluctuating price can cross it from above or also from below.


Change from a rising to declining market is signaled when the price moves below its MA like this. A bullish signal is triggered when the price rallies above the average like this, this kind of crossover. Since the use of MAS gives a clear cut buy and sell signals, it helps to eliminate some of the subjectivity associated with the construction and interpretation of trend lines because these are like dynamic support and resistance levels or you can say dynamic trend lines. So, an MA is a smooth version of a trend and the average itself is an area of dynamic support and resistance because it is like rolling over format. So, the more times an MA has been touched, that is it acts as a support and resistance area, the greater the significance when it is violated.

To summarize this discussion, an MA is a smooth version of a trend. For example, this is a more smooth version as compared to the actual fluctuating prices. MA is more smooth and the average itself is an area of dynamic support and resistance. In a rising market, price reactions are often reversed as they find support in the area of MA. If the rest of the evidence agrees, it is not a bad idea to wait for the price to reach its MA prior to making a purchase.

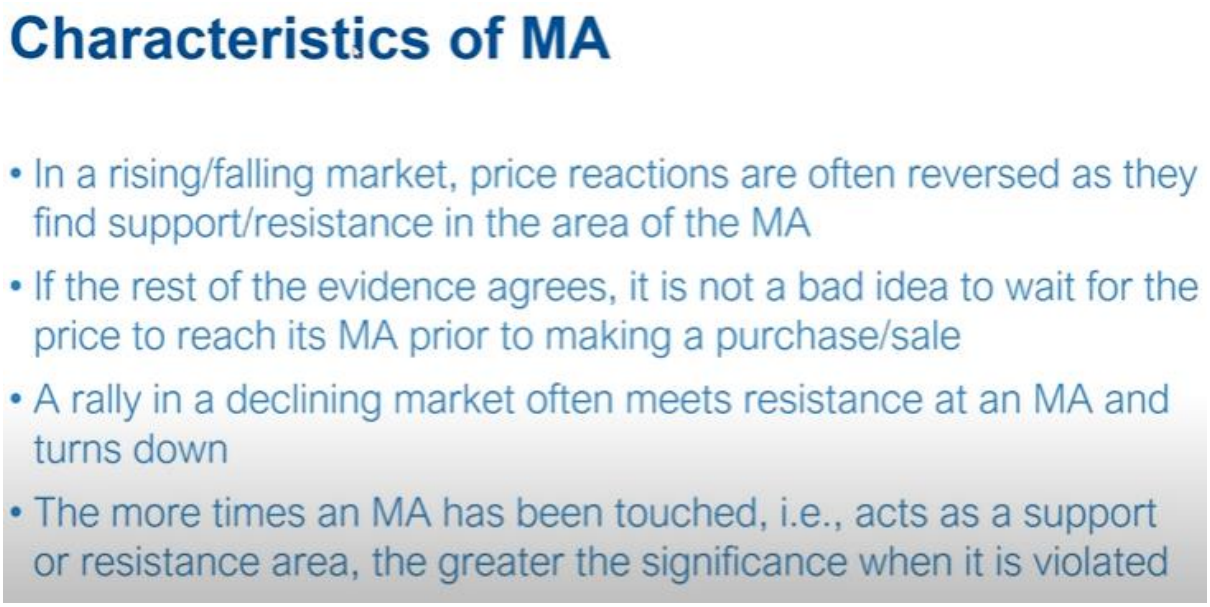
# Introduction to Moving Averages

- An MA is a smoothed version of a trend, and the average itself is an area of dynamic support and resistance
- The more times an MA has been touched, i.e., acts as a support or resistance area, the greater the significance when it is violated

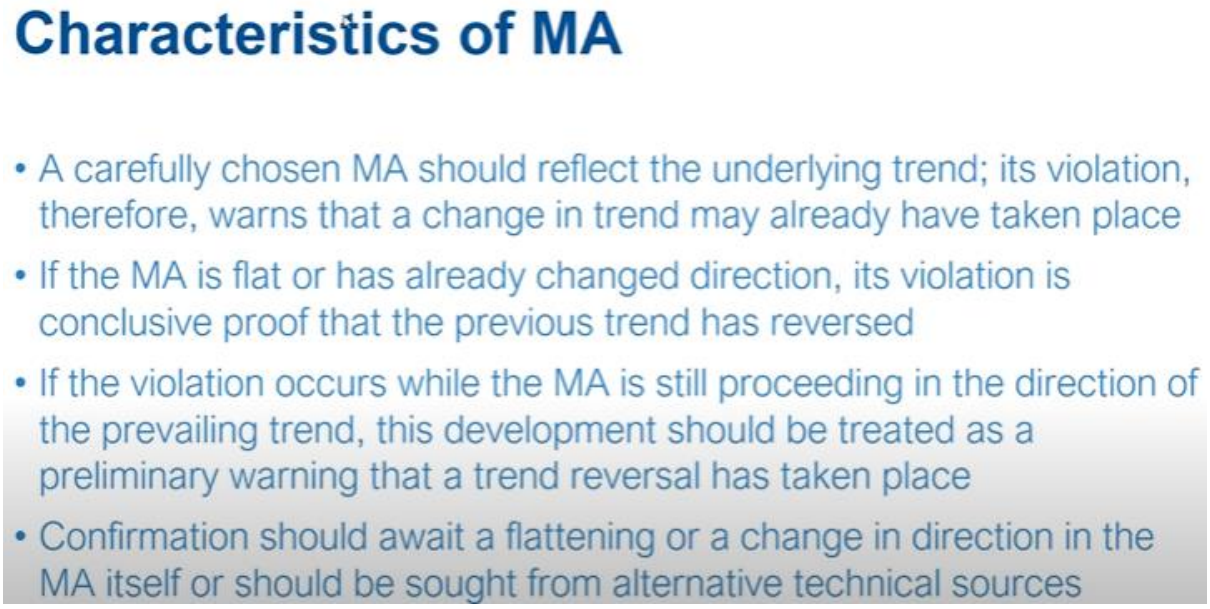



Similarly, a rally in a declining market often meets resistance at a moving average and turns down. The more times an MA has been touched, that is it acts as a support or resistance area, the greater the significance when it is violated. A carefully chosen moving average MA should reflect the underlying trend. Its violation therefore warns that a change in trend may have already taken place. A carefully chosen MA should reflect the underlying trend and its violation therefore warns that a change in trend may have already taken place.

If the MA is flat or has already changed direction, its violation is fairly conclusive proof that the previous trend has reversed. If the violation occurs while the MA is still proceeding in the direction of prevailing trend, this development should be treated as a preliminary warning that a trend reversal has taken place. Convenience should await a flattening or change in the direction of MA itself or should be sought from the alternative technical sources like price formation or price patterns. Generally speaking, the longer the time span covered by the MA, the greater is the significance of a crossover signal. For instance, the violation of a 15 or 18-month MA is substantially more important than a crossover of 1-month 30-day MA.




Reversals in the direction of an MA are usually more reliable than a crossover. In instances in which a change in direction occurs close to the market turning point, a very powerful and reliable signal is given. However, in most instances, an average reverses well after a new trend has begun and so it is only useful as a confirmation. Characteristics of Moving Average In this video, we will discuss some basic characteristics of moving average plot. An MA or moving average is a smooth version of a trend and the average itself is an area of dynamic support and resistance.

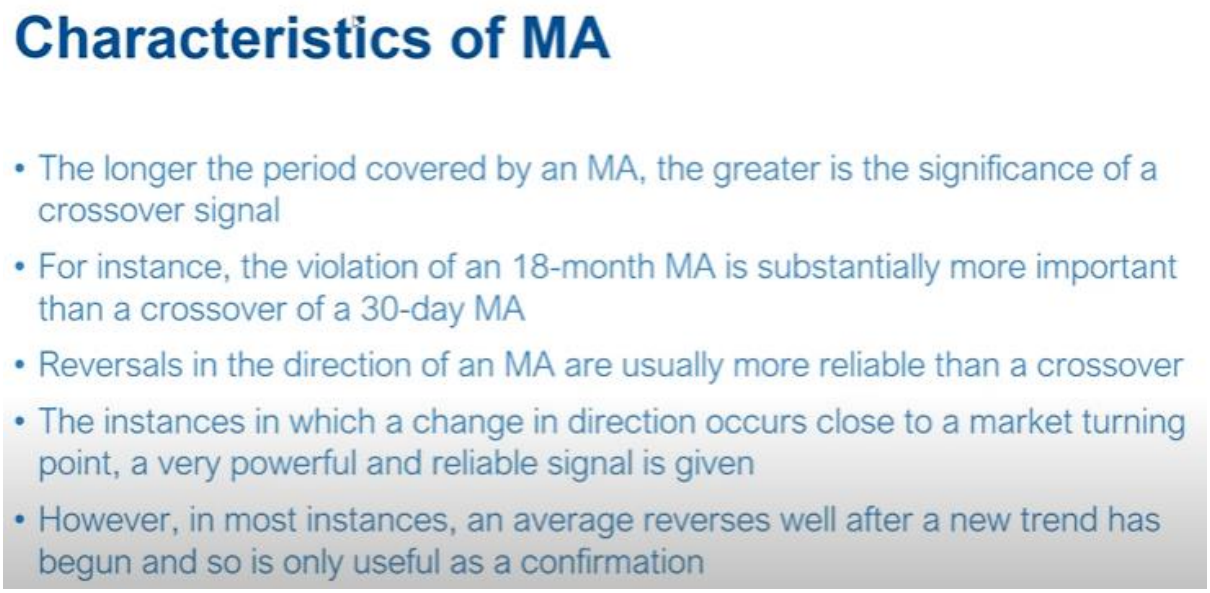



In a rising market, price reductions are often reversed as they find support in the area of MA. If the rest of the evidence agrees, it is not a bad idea to wait for the price to reach its MA

prior to making a purchase. After all, if the MA represents support, you can place a stop below support i.e. the MA. Similarly, a rally in a declining market often meets resistance at an MA and turns down. The more times an MA has been touched i.e. it acted as a support or resistance area, the greater the significance when it is violated. A carefully chosen MA should reflect the underlying trend.

Its violation therefore warns that a change in trend may already have taken place. If the MA is flat or has already changed direction, its violation is fairly conclusive proof that the previous trend has reversed. If the violation occurs while the MA is still proceeding in the direction of the prevailing trend, this development should be treated as a preliminary evolving that a trend reversal has taken place. Confirmation should await a flattening or change in direction of moving average itself or should be sought from alternate technical sources such as price formation or price patterns. Generally speaking, the longer the time span covered by an MA, the greater its significance of a crossover signal.

For instance, the violation of an 18-month MA moving average is substantially more important than a crossover of 13-day MA. Stages available in the direction of an MA are usually more reliable than crossover. In instances in which a change in direction occurs close to a market turning point, a very powerful and reliable signal is given. However, in most instances, an average reverses well after a new trend has begun and is only useful as a confirmation. A crossover is any penetration of an MA.



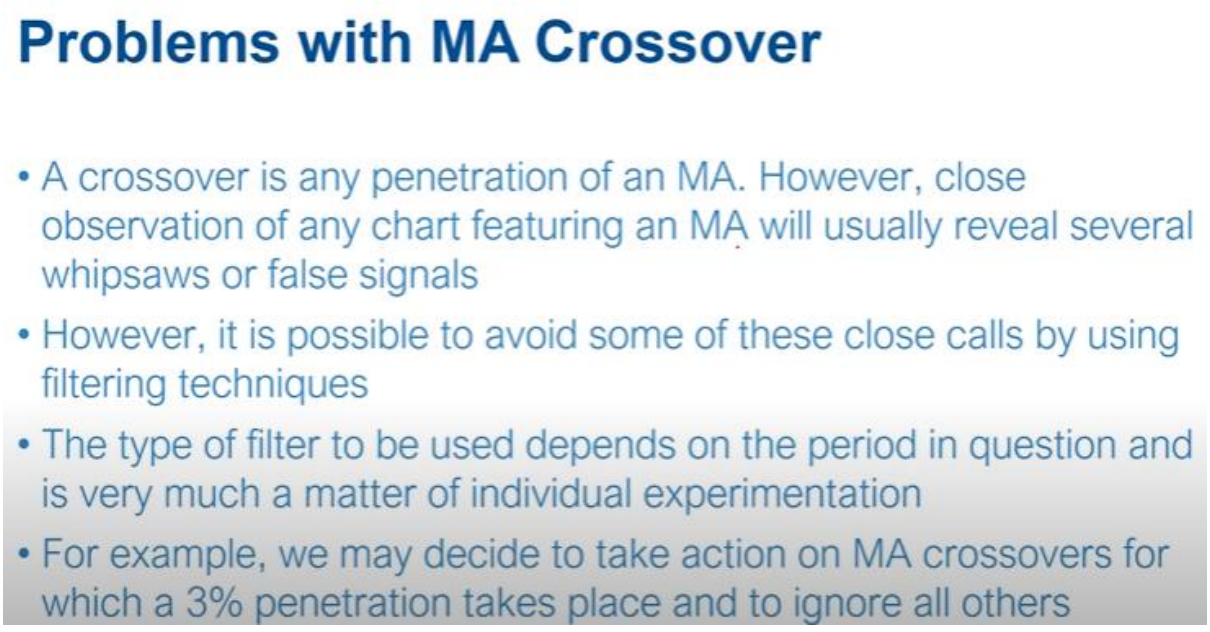

However, close observation of any chart featuring MA will usually reveal a number of whipsaws or false signals. However, it is possible to avoid some of these close calls by using filter techniques. The type of filter to be used depends on the time span in question and is very much a matter of individual experimentation. For example, we may decide to take an action on MA crossover for which 3% penetration takes place and to ignore all others. What

do we mean here is that, let us say, there is some kind of whipsaw price move which confuses us.

So, to avoid these kind of whipsaws, you only consider them when there is a substantial magnitude. For example, look at this moving average. So, now there is substantial sudden whipsaw signal, false whipsaw and then price again comes back. So, this indicates that there is about to be some kind of price reversal, but it is a false signal. So, how do we avoid that? We put a cut-off band, we put a band.

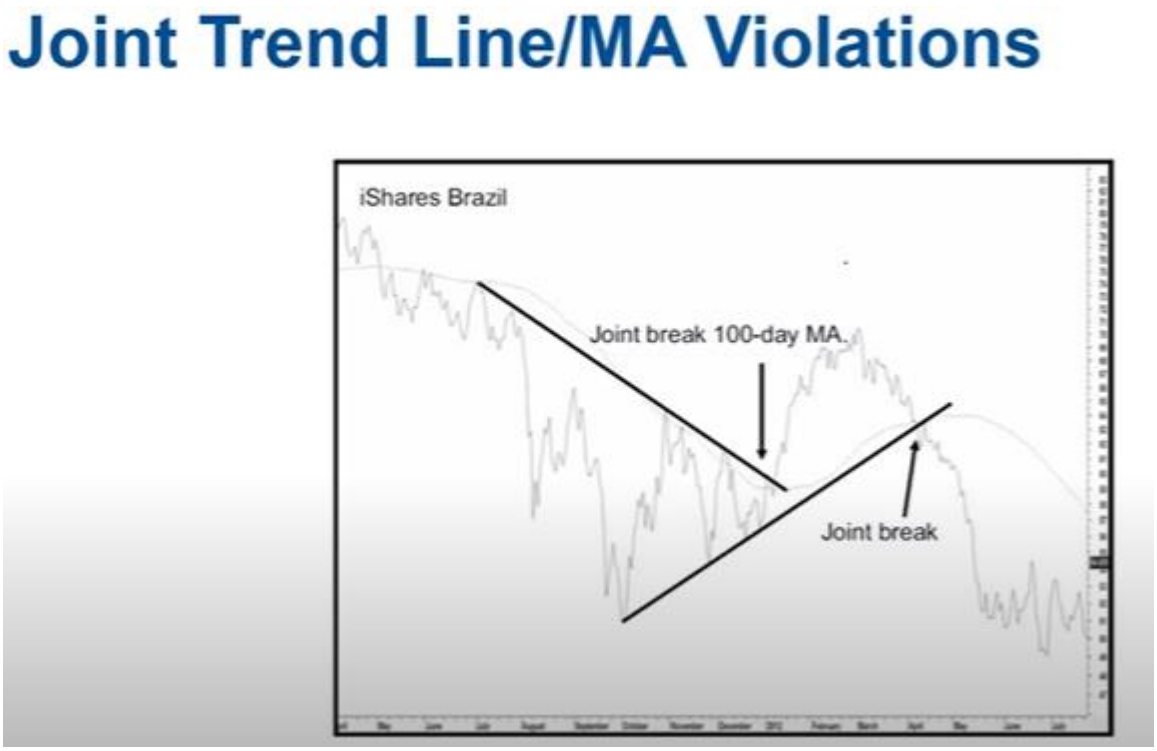
So, this is our moving average line, this is the upper level, this is the lower level. Now, this filter of 3% or maybe 5%, some kind of filter or band, which can cut out all the whipsaw signals and only those signals that are substantially large are considered useful. And therefore, violations of a 40 week MA might result in an average price move of 15 to 20%. In this sense, a 3% penetration would be a reasonable filter. On the other hand, since 3% would probably encompass the whole moving signal by a 10 RMA crossover, this kind of filter would be of no use whatsoever.

So, we need to use cautious judgment while selecting these filters. A useful tip is to wait for an MA crossover to take place at the same time a trend line violation also occurs or a price pattern, price formation completed. These signals strongly reinforce the trend line or price pattern signals and therefore need less in the form of filter requirement. For example, if an MA crossover has taken place at the same time a trend line is violated or a price pattern is completed, these signals strongly reinforce each other and therefore need less in the form of a filter requirement. Sometimes it is possible to see an MA crossover accompanied with exceptionally heavy volume.



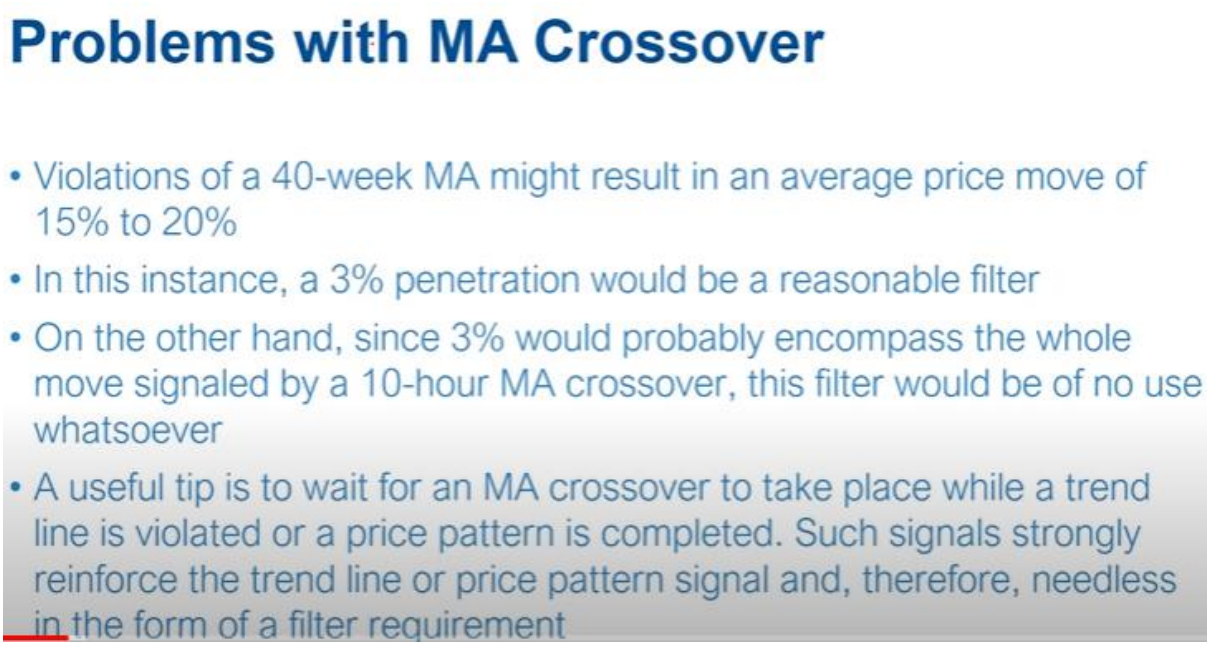

Just look at this diagram here. So here, this moving average violation, this moving average

violation or crossover occurs at the same time where the trend line violation also occurs. So trend line is also crossed and moving average is also crossed. Same here, the trend line is also crossover and moving average is also crossover and the signal is much more strong here. So the reversal signal is much more strong. Sometimes this information can also be gauged from the heavy volume.

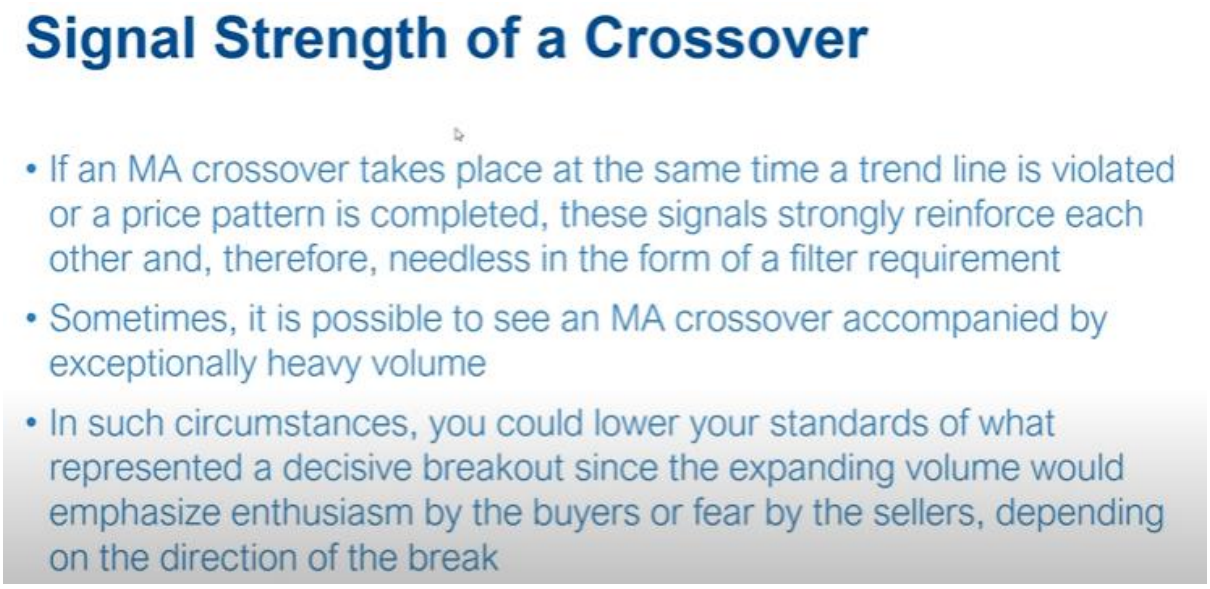



In similar circumstances, you could lower your standards of what represented a decisive breakout since the expanding volume would emphasize enthusiasm by the buyers or fear of sellers depending upon the direction of the break. To summarize this video, an MA is a smooth version of trend. We discussed some of the basic properties of MA. MA, the average itself is area of dynamic support and resistance. The more times an MA has been touched, the better it is to act as a support and resistance area and greater its significance when it is violated.

A carefully chosen MA would reflect the underlying trend and therefore its violation would be important. Longer the time span covered by MA, the greater its significance when there is a crossover. The problem with crossovers is that oftentimes there is a whipsaw or fall signals that can confuse us and therefore it is a good approach to have some kind of filter which filters out insignificant or small moves. Many times if we have some kind of corroborative evidence, for example, trend line violation happening same time with MA crossover or evidence from volume which corroborates the evidence from MA, then such kind of filtration may not be required.




A more solid signal is generated. Signal generation with moving averages. In this video, we will examine the application of moving averages in identifying price trend reversals and signal generation. If a MA crossover takes place at the same time a trend line is violated or a price pattern is completed, then these signals strongly reinforce each other and therefore need less in the form of a filter requirement. Sometimes it is possible to see a MA crossover accompanied with exceptionally heavy volume. And in such circumstances, you could lower your standards of what represented at the decisive breakout since the expanding volume would emphasize enthusiasm by the buyers or fear by the sellers depending on the direction of the break.

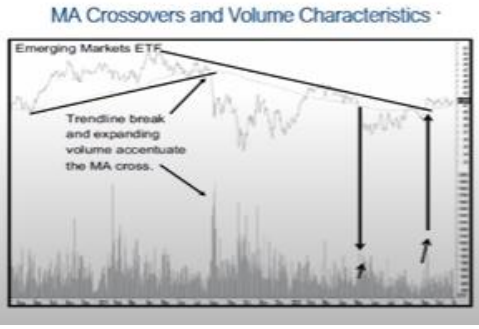



Notice the figure here. The cross, this cross was accompanied by expanding volume, expanding volume activity and also a trend line break which indicates a very strong signal. In addition, there are two other breaks with expanding activity as we can see volume has

expanded. In fact, for this particular break, the trend line is also violated and was upside violation. The trend line is also violated.

## Signal Strength of a Crossover

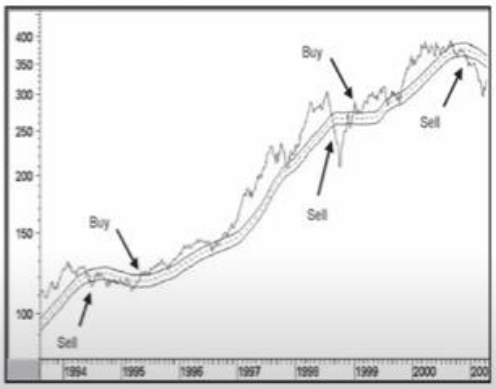
- The cross was accompanied by expanding volume and a trend line break
- Two other breaks also developed on expanding activity, one of which was an upside violation, which was also associated with a trend line break




So, the signal is particularly strong. The figure here features Eurotip index with 40 week MA and two bands that have been plotted at 3% above and below. So, the two bands are there below and above the average itself. Buy signals are generated when the price crosses above this line and sell signals are generated when it crosses below. Now given the length of this band or amplitude of this band, many of the Wipso signals are eliminated, not very significant moves are eliminated because of this band itself. Only those moves where the band itself is violated for sell signal, the lower side of the band and for the buy signal, the upper side of the band is violated, only those signals are considered useful.

## Problems with MA Crossover

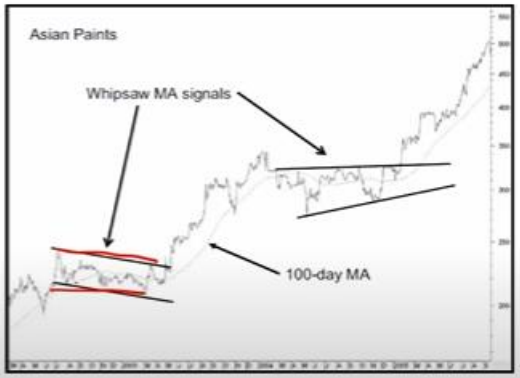
- The figure features the Eurotop Index together with a 40-week MA and two bands that have been plotted 3% above and below the average itself
- Buy signals are generated when the price crosses above the upper line and sell signals when it crosses below the lower one
- This has the effect of filtering out some of the whipsaws



This has a very important effect of filtering out some of the Wipso signals or fall signals. Also, during a trading range, MA crossovers have a strong tendency to be counterproductive. In these situations, it is usually best to use the outer ends of trading range for signal generation rather than MA itself. Obviously, no one rings a bell to say that the price has entered a trading range, but after a couple of Wipso signals, it becomes apparent and that is the time when a well-constructed trend line for the trading range should be substituted for MA crossover.

## Problems with Crossovers

- During a trading range, MA crossovers have a strong tendency to be counterproductive
- In these situations, it is usually best to use the outer ends of the trading range for the signal rather than the MA
- That is the time when a well-constructed trend line should be substituted for an MA crossover

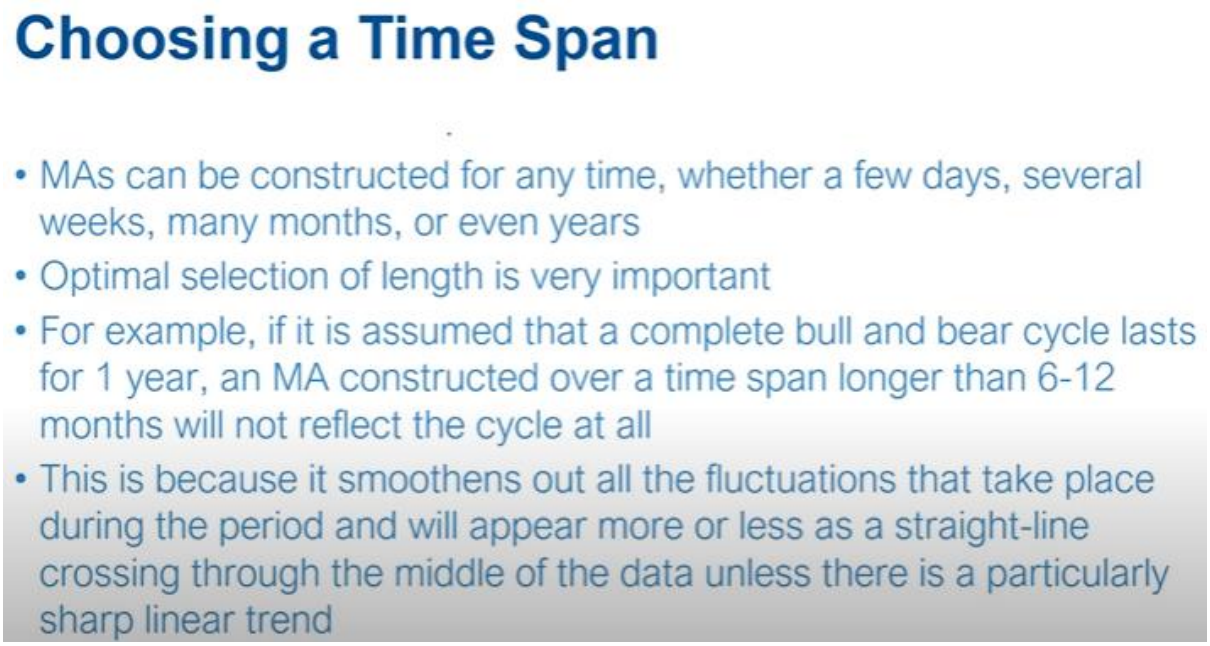



As we can see here, these are the trading ranges. Within these trading ranges, there are number of Wipso signals and therefore, such trading ranges offer useful trend lines. Only when these trend lines or trading ranges are crossed, then the signal becomes important or the signal generation is useful. Within this band, if we look at MA, there are number of times false Wipso signals that may create a false impression of breakout. Such false signals can be eliminated by constructing these trend lines where trading in ranges is identified and those signals which are signal generated within these trend lines can be not considered or filtered out. Please note that MA's can be constructed for any time period, whether a few days, several weeks, many months or even years.'

Optimal selection of length is very important. For example, if it is assumed that a complete bull or bear cycle has 4 years, MA constructed over a time period more than 48 months will not reflect the cycle at all and it may give this kind of expression. For example, if your bull run is like this over a 4 year period and you construct a moving average for this complete 4 year, you use let us say 48 months or 4 years itself, you get a straight line. So, the moving average is not useful at all. This is because it smoothes out all such fluctuations. All such fluctuations are smoothed out that takes place during the period and it will become more or less like a straight line if my average is for complete 4 year.

And therefore, the straight line crossing through the middle of the data, almost middle of the

data it will cross through. Unless and until there is a very sharp, some kind of sharp linear trend, it will broadly represent a straight line. So, for example, over the period if this kind of move for period it will represent a straight line. So, no signal generation would be possible. On the other hand, a 5 day moving average will catch every minor move in the stock cycle and will be useless for the purpose of identifying the actual top and bottom of the overall cycle.




Even if the 48 month or 4 year average were shortened to 24 months using the crossover signals would still cause the 24 month average to give a agonizingly slow confirmation of a change in trend. So, it will be very slow. The 4 week average would be so sensitive that it would continuously give misleading or whipsaw signals. Only an MA that can catch the movement of the actual cycle will provide the optimum tradeoff between lateness and oversensitivity.

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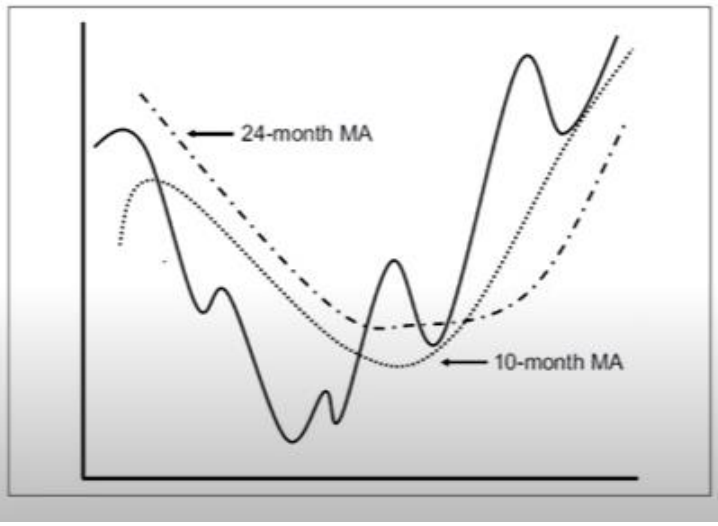
## Choosing a Time Span

- On the other hand, a 5-day MA will catch every minor move in the stock cycle and will be useless for identifying the actual top and bottom of the overall cycle
- Even if the 48-month average were shortened to 24 months, using the crossover signals would still cause the 24-month average to give an agonizingly slow confirmation of a change in trend
- The 4-week average would be so sensitive that it would continually give misleading or whipsaw signals
- Only an MA that can catch the movement of the actual cycle will provide the optimum trade-off between lateness and oversensitivity

For example, 10 month MA. So for a fluctuating price like this, a very short period MA would also behave like this. So it may not be so useful, a very short period MA and a very long period MA will be so slow that will fail to catch any trend. So it will be very slow. So a compromise between a very large period and a very small period is desirable. To summarize, in this video we discussed the signal generation process with moving averages.

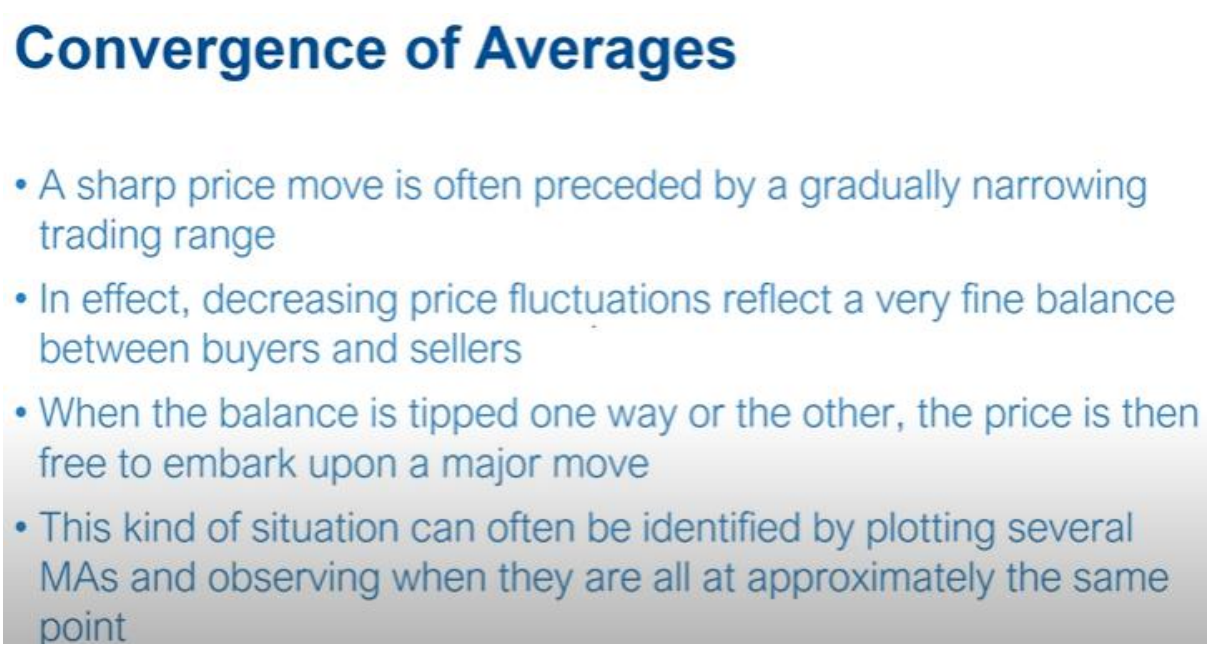
## A Short-Term Versus a Long-Term MA




We noted that if a moving average crossover is taking place at the same time a trend line is violated or a price pattern is forming, such signals reinforce each other and are very useful in

signal generation. For example, some kind of expanding volume activity. Another useful feature is to use some kind of bands above and below the moving average to filter out whipsaw signals. We also noted that constructing MA or selection of a period is a reasonable compromise between the lateness and sensitivity. MA constructed over a very short period will be very fluctuating and would generate lot of whipsaw and fall signals and an MA constructed over a very long period may miss out many useful signals.

In this video, we will examine the application of multiple simple moving averages in signal generation and trend determination. Notice the price movement in this figure here and also 10 month moving average and 24 month moving averages are plotted together. The signal generation by 24 month moving average is amazingly slow while 10 month moving average is reasonably fast as compared to 24 month MA. If you think that going smaller or lower in terms of duration, for example, 4 week MA would be a good strategy, think again it will be so fluctuating that you may not capture signal but mostly false moves or whipsaws and therefore a reasonable compromise would be somewhere between 10 month to 6 month moving average for signal generation. Here a good strategy is examining the convergence of averages, how two averages converging together.




Usually a sharp price move is often preceded by a gradually narrowing trading rate like this sharp price move and then trading rate. In effect, decreasing price fluctuations reflect a very fine balance between buyers and sellers, buyers who are putting the price down and buyers who are putting the price up. When the balance is tipped one way or the other, the price is free to embark upon a major move like this up or down depending upon which side wins buying or selling. This kind of situation can be often identified by plotting several ways, multiple MA's and observing when they are all approximately at the same point or converging with each other. Have a look at this diagram here, the figure shows the daily price for cash Euro MA.

Notice the 3 MA's, notice the 3 MA's 10 day MA, 25 day MA and 45 day MA, how these 3 MA's almost completely converge just before the price embarks on a sharp decline here. The convergence of averages, all the three averages are converging here, warns that a major move is likely. However the actual signal comes from the violation of trend line here after which after the violation a very solid signal of price decline is there and there is a very sharp decline so all the 3 MA's converge and then also a trend line violation towards the downside which indicates a down move. Many such techniques involve trend determination with more than one moving average. Signals are given by a shorter term MA crossing above or below a longer one.

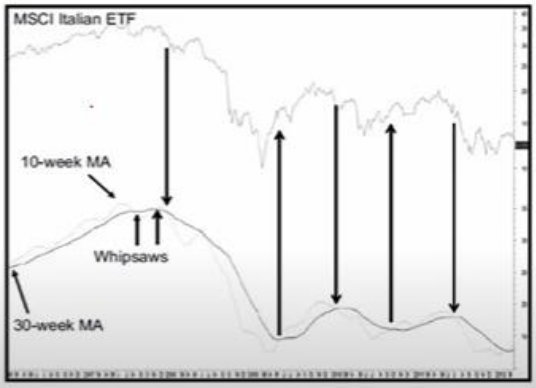
## Convergence of Averages

- The figure, for example, shows the daily price for cash Euroyen
- Note how the three MAs almost converge entirely just before the price embarks on a sharp decline
- The convergence of the averages warns that a major move is likely, but the actual signal comes from the violation of the trend line.


This procedure has the advantage of smoothing the data twice. For example longer 1 MA, let's say here as you can see 10 week MA, there is one 10 week MA and 30 week MA. This reduces the possibility of whipsaw and it warns of trend changes fairly quickly after they have taken place. For example, notice the shorter MA, 10 week MA is much more fluctuating, less fluctuating than price but is still fluctuating while 30 week MA is much more smoother and trend generation happens whenever this 10 week MA crosses over. There are some whipsaw signals, some whipsaw signals but a major signal here where actually the 30 week MA itself changes the direction. So when this short term MA crosses towards the downside, this is a signal generation but a more solid confirmation happens when this 30 week MA itself changes the direction.

## Application of Multiple Simple MAs

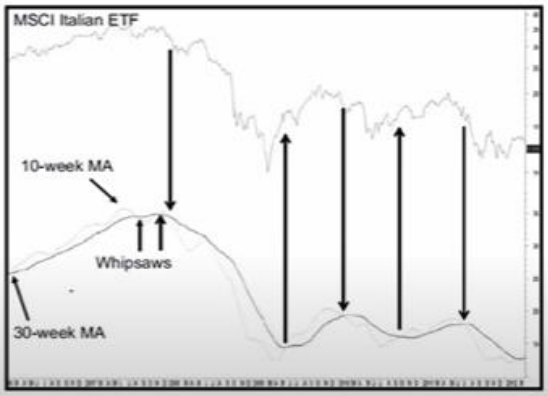
- Some techniques of trend determination involve more than one MA
- Signals are given by a short-term MA crossing above or below a longer one
- This procedure has the advantage of smoothing the data twice, which reduces the possibility of a whipsaw, yet it warns of trend changes fairly quickly after they have taken place



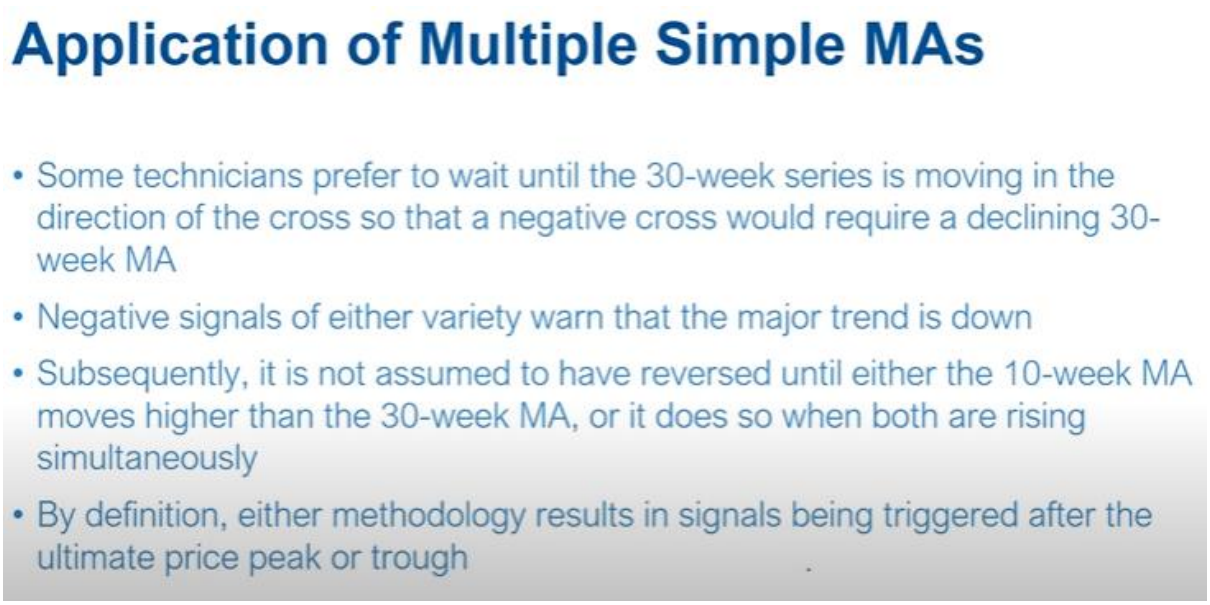

In the figure here, notice iShares MSCI ETF, the two averages of 10 week and 30 week are plotted. These have been identified or used to identify the primary trends. Signals are given when the dashed or 10 week, this is the 10 week MA, moves below the 30 week here average. In the previous diagram, some technicians may prefer to wait until 30 week series is moving in the direction of the cross, that is here, it is also turning, the 30 week MA is also turning.

## Application of Multiple Simple MAs

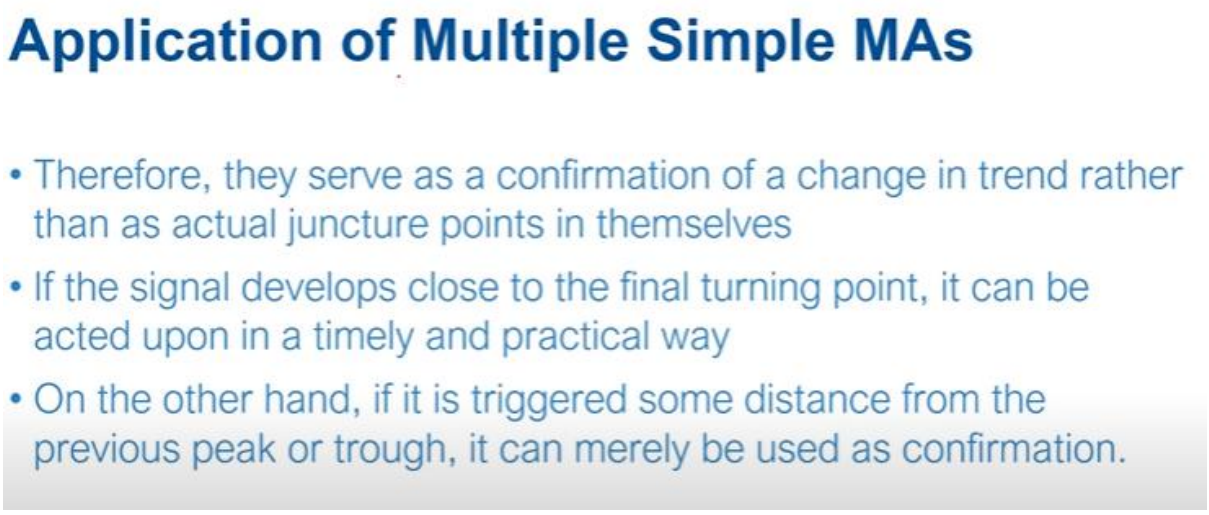
- In the figure here, for iShares MSCI Italian ETF, the two averages that have traditionally been used for identifying primary trend moves are the 10- and 30-week spans
- Signals are given when the (dashed) 10-week average moves below the 30-week average




So a negative cross would require declining 30 week MA. Negative signals of either variety warn that a major trend is downside. It is not assumed to have reversed until either the 10 week MA moves higher than the 30 week MA or it does so when both are rising simultaneously. By definition, either methodology results in signals being triggered after the ultimate price peak or trough. Therefore, they serve as a confirmation of a change in trend rather than the actual juncture points in themselves. If the signal develops close to the final turning point, then it can be acted upon in a timely and practical way.



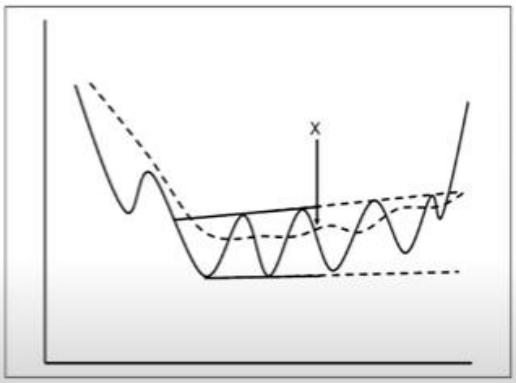

On the other hand, if it is triggered by some distance from the previous peak or trough, then it can be merely used as a confirmation. To summarize, in this video, we discussed application of multiple simple moving averages in signal generation and trend determination. We noted that a shorter duration MA is more fluctuating and it can be used along with a long term MA in generating signals. Crossing over a short term MA from up to down or down to up may indicate some kind of trend reversal. A very solid signal is generated when the long term MA also changes the direction or there is some kind of trend line violation or confirmation from volume.




MA is in trading range. In this video, we will discuss how to examine when moving averages are in a trading range. MA's moving averages should always be used in conjunction with other indicators. This is because prices occasionally fluctuate in broad sideways pattern for an extended period like this. Here you can see moving averages fluctuating in a sideways range pattern.

## MAs in Trading Range

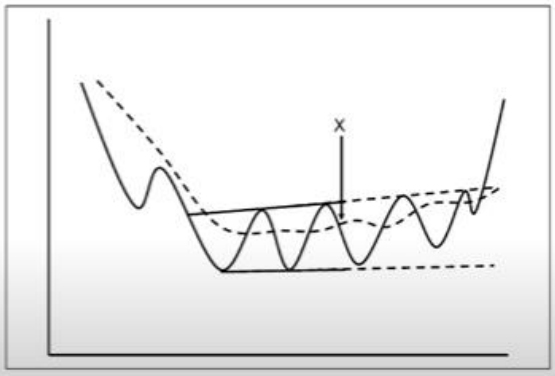
- MAs should always be used in conjunction with other indicators
- This is because prices occasionally fluctuate in a broad sideways pattern for an extended period, resulting in a series of misleading signals
- The good news is that such frustrating trading-range action is often followed by an extremely strong trend in which the losses incurred from the trendless period of whipsaw signals are more than made up for




This results in number of misleading signals like here. These are whipsaw signals, false signals. The good news is that such frustrating trading range action is often followed by a sharp strong trend in which the losses incurred from the trendless period of whipsaw signals are more than made up for like this or maybe in opposite direction also. Such sharp price action is expected because whipsaw signals indicate some confusion between buyers and sellers and this implies a big battle between them. When one or the other party wins out, the victorious side is able to push the prices in a much stronger way. The figure here shows an example of an MA or moving average offering numerous whipsaw signals as it moves through a trading range.

## MAs in Trading Range

- This is because the whipsaws indicate confusion between buyers and sellers, and this implies a big battle
- When one or the other wins out, the victorious side is then able to push prices in a much stronger way
- The figure shows an example of an MA offering numerous whipsaw signals as it moves through a trading range

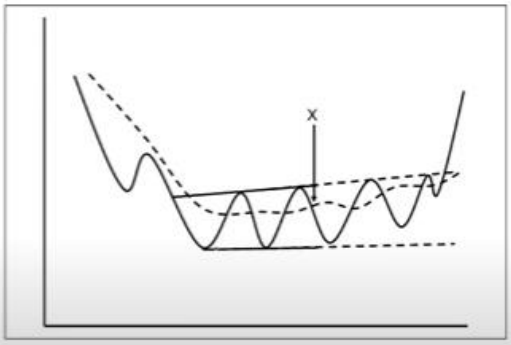



Notice this. In the beginning, it may not be very obvious that this is a trading range kind of sideways pattern. However, at point X, if one draws these trend lines within our rectangle pattern, at point X, when the price crosses below the MA again, it is possible to construct two trend lines that reflect this range action. At such a time, it makes it much better sense to

weight the verdict by acting on a trend line break rather than MA crossover. For example, at this stage, it would be better to wait for this kind of trend line break.

## MAs in Trading Range

- At first, it is not obvious that the price action is a trading range
- However, at point X, when the price crosses below the MA again, it is possible to construct two trend lines that reflect this ranging action
- At such a time, it makes much better sense to await the verdict by acting on a trend line break rather than an MA crossover since there is no reason to suspect that the next crossover after X will not turn out to be a whipsaw




Either on the upside or downside. This is so because there is no particular reason to believe that the next move like this crossing up would be a sharp move and it will not be a whipsaw as was the case earlier. So we do not have any reason to believe that next move is going to be different than these whipsaws. So we prepare these kind of trend lines and only when the price crosses these trend lines, then only we consider it as a solid signal. To summarize, in this video, we discussed that often trading in range action or sideways pattern can be confusing and therefore it is more advisable to set up trend lines in the sideways pattern like we can see here on the up and down. One can set the trend lines and only when the price crosses these trend lines on the upside or downside crossover, then that should only be considered as a solid signal.

In that case, MA crossing over the prices up and down may be a whipsaw and filtered out because of these trend lines. Weighted Moving Averages – WMAs In this video, we will examine the concept of WMAs and their computation through a simple example. A simple moving average SMA can only correctly represent a trend from a statistical point of view if it is centered. But centering an average lays the signal. Reason being, all the observations in SMA are given equal weightage and therefore older observations drag the MA and makes it less timely.

## Weighted Moving Averages (WMA)

- A simple moving average (SMA) can only correctly represent a trend from a statistical point of view if it is centered but centering an average delays the signal
- One technique that attempts to overcome this problem is to weigh the data in favor of the most recent observations. An MA constructed in this manner (WMA) can "turn" or reverse direction much more quickly than a simple MA

One technique that attempts to overcome this problem is to weight the data in favor of most recent observations so that recent observations or the MA, WMA can capture the more recent information. An MA constructed in this manner or WMA weighted moving average is able to turn or reverse direction with much more quickly than a simple MA. Let us understand the computation of this through a simple example. There are countless ways in which data can be weighted. But the most widely used method is a technique whereby the first period of data is multiplied by 1, second by 2, third by 3 and so on until the most recent one.

## Weighted Moving Averages: WMA

- There are countless ways in which data can be weighted, but the most widely used method is a technique whereby the first period of data is multiplied by 1, the second by 2, the third by 3, and so on until the most recent one. The calculations for each period are then totaled. The divisor for a simple MA is the number of periods, but for this form of weighted average, the divisor is the sum of the weights, i.e., 1 + 2 + 3 + 4 + 5 + 6 = 21
- For a 10-week weighted MA, the sum of the weights would be 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 = 55

Then the calculations for each period are then totaled. This is used as a divisor for simple MA is the number of periods. But for this form of weighted average, the divisor is sum of the weights. For let us take example, if you have 6 observations, the most recent observations will be multiplied by 6 because there are 6 periods or 6 observations, then previous observation by 5 and the last observation by 1. The total of all these is 21, so the divisor will be 21.

Similarly, for a 10 week WMA, you have sum of the weights from 1 to 10 is 55. The most recent observation will be multiplied by 10, the previous one with 9 and so on so forth until the last observation will be multiplied with or given a weight of 1. Let us do this an example. This table we have seen earlier, we have computed simple moving average for this table where weekly index price data is given like this, dates are provided and data shifts week by week. In the first set of observations, we compute weighted moving average by multiplying this 101 with 1, then 100 by 2 and so on so forth until 99 is multiplied with the 6 because 99 is the most recent observation and 101 is the oldest observation.

## Weighted Moving Averages: WMA

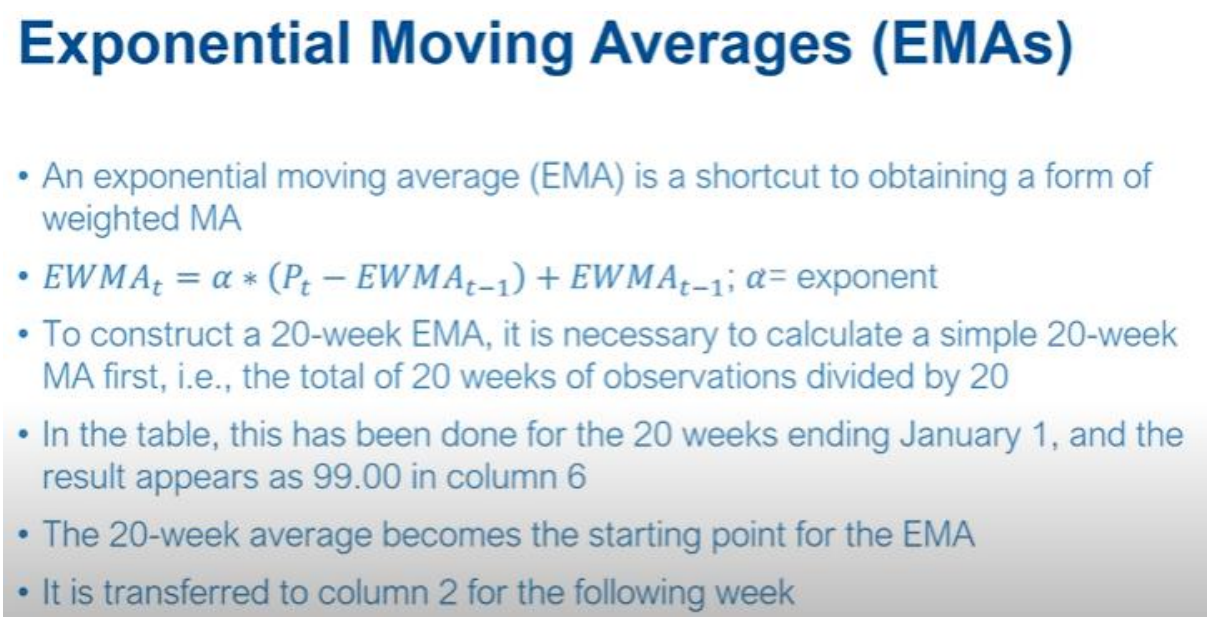
Weighted Moving Average Calculation

| | | | 6 x col. 1 | 5 × col. 1 | 4 × col. 1 | 3 × col. 1 | 2 × col. 1 | 1 × col. 1 | Total | Total /21 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Present | 1 week ago | 2 weeks ago | 3 weeks ago | 4 weeks ago | 5 weeks ago | | |
| Date | | Index | | | | | | | | |
| Jan. | 8 | 101 | | | | | | | | |
| | 15 | 100 | | | | | | | | |
| | 22 | 103 | | | | | | | | |
| | 29 | 99 | | | | | | | | |
| Feb. | 5 | 96 | | | | | | | | |
| | 12 | 99 | 594 | 480 | 396 | 309 | 200 | 101 | 2080 | 99.1 |
| | 19 | 95 | 570 | 495 | 384 | 297 | 206 | 100 | 2052 | 97.7 |
| | 26 | 91 | 546 | 475 | 396 | 288 | 198 | 103 | 2006 | 95.5 |
| Mar. | 5 | 93 | 558 | 455 | 380 | 297 | 192 | 99 | 1981 | 94.3 |
| | 12 | 89 | 534 | 465 | 364 | 285 | 198 | 96 | 1924 | 92.5 |

Summation of all these which is 1080 is divided by 21 which is the sum of 1 to 6. Now when we are computing or shifting by 1 period and then 95 is the most recent observation, then 95 is given a weight of 6 and 100 which is the 6th observation or the last observation is given a weight of 1. So, 100 into 1, then 103 into 2, 99 into 3 and so on up till 95 into 6. All these observations are summed up to 2052 and divided by 21 to get this observation. Notice that these observations, the WMAs that we are computing here give more weight to the recent observation therefore probably generate more timely signals as compared to SMAs which were slightly slow because they were giving equal weight to the most recent observation same as the older observations.

To summarize, in this video, we understand the computation of weighted moving averages. We noted that SMA suffers with a simple problem that they offer, SMAs offer equal weight to old and new information therefore generate a slightly delayed signal. To overcome this problem, WMAs weighted moving averages are employed where higher weight is given to the most recent observation and lower weights are given to older observations so that the signal generation is more timely. Exponential moving averages. In this video, we will try to understand the concept of EMAs or exponential moving averages with the help of simple

example.




$$EWMA_t = \alpha * (P_{t-} EWMA_{t-1}) + EWMA_{t-1};$$

An exponential moving average is a shortcut to obtaining a form of weighted MA itself. However, it offers an improvement by using this alpha or exponent. Notice the formula of EWMA. Here alpha is multiplied by the difference between the latest price and the previous period EWMA which is EWMA t-1 plus the value of EWMA for the previous period itself. Now please notice the choice of alpha is very important here. If alpha is let's say very small let's say close to zero then this term will be close to zero and the EWMA for the current period will be same as EWMA for the previous period that means we are ignoring the latest information and we are considering the previous EWMA itself.

So less weightage to the latest information. However, if alpha is very large let's say tending to one then this becomes EWMA t-1 is cancelled and it becomes PT itself. So this will be cancelled because alpha is one and EWMA becomes PT itself. So all the weight is given to the latest price. So this is a trade-off how much information or weight you want to offer to the previous observation vis-a-vis latest observation or latest information.

# Exponential Moving Averages (EMAs)

| Exponential Moving Average Calculation | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | EMA for previous week | Difference (1)-(2) | Exponent | (4)*(3) | (2)+(5) |
| | | (1) | (2) | (3) | (4) | (5) | (6) |
| Date | | Index | | | | | |
| Jan. | 1 | .... | .... | ... | ... | ... | 99.00 |
| | 8 | 100.00 | 99.00 | 1.00 | 0.10 | 0.10 | 99.10 |
| | 15 | 103.00 | 99.10 | 3.90 | 0.10 | 0.39 | 99.49 |
| | 22 | 102.00 | 99.49 | 2.51 | 0.10 | 0.25 | 99.74 |
| Mar. | 29 | 99.00 | 99.74 | -0.74 | 0.10 | -0.07 | 99.67 |

Let's try to understand this concept with the help of simple example now. Notice the table here we have already seen this table. Now we are doing the calculation for 20 week EMA as shown here. In order to construct a 20 week EMA first it is necessary to calculate or we need that EWMA t-1 but we do not have that so we will take simple EMA for previous 20 weeks that works out to 99. So this is done for 20 weeks ending January 1st.

The simple EMA is computed we will use that as a proxy for EWMA t-1 it appears at 99. Now it is put here as previous period EWMA t-1. The 20 week average becomes the starting point for the EMA it is transferred to column 2 for the first week. Next the entry for the 21st week January 8 in the example is compared with the EMA.

# Exponential Moving Averages (EMAs)

- Next, the entry for the 21st week (January 8 in the earlier example) is compared with the EMA, and the difference is added or subtracted and posted in column 3, i.e., 100 – 99 = 1.00
- This difference is then multiplied by the exponent, which for a 20-week EMA is 0.1
- This exponentially treated difference, 1.00 × 0.1, is then added to the previous week's EMA, and the calculation is repeated each succeeding week
- In the example, the exponentially treated difference for January 8 is 0.1, which is added to the previous week's average, 99.00, to obtain an EMA for January 8 of 99.10. This figure in column 6 is then plotted. The exponent used varies with the time span of the MA

The difference is taken. So this difference between (100 – 99) which is 1. Alpha here is the

exponent so this is this one is multiplied by 0.1 so we get the first term as 0.1 and this is added to the previous period EWMA t-1 which is 99 to get 99.1. Now this is our latest EWMA t-1 so we will transfer this to the next week and the price is 103 again the difference would be taken.

This 3.9 and multiplied with exponent 0.39 and it will be added to 99.1. In a similar manner we will compute the EWMA for all the weeks. Notice the choice of alpha or exponent determines how much weightage is given to the current or new information incorporated in this price. More the alpha greater weightage is given to the latest information less the alpha more weightage is given to the older information. Another very important aspect here is the choice of exponent.

The correct exponent for various time spans are shown here by using this formula 2 upon time span. On the left we have number of weeks 2 divided by time span will give us the exponent. Time periods have been chosen as weekly in effect however the exponent of 0.1 can be used for any measure of 20 days whether it is month week or anything so 2 upon 20 would give us 0.1.

$$\frac{2}{Time\ Span}$$

## Exponential Factors for Various Time Frames

| Number of Weeks | $\frac{2}{Time\ Span}$ | Exponent |
|---|---|---|
| 5 | | 0.4 |
| 10 | | 0.2 |
| 15 | | 0.13 |
| 20 | | 0.1 |
| 40 | | 0.05 |

Exponents for time periods other than those shown in the table can be easily calculated by dividing with 2. For example 5 week average will need to be twice as sensitive as compared to a 10 week average thus dividing 2 by 5 will give us 0.4. It gives an exponent of 0.

4. On the other hand a 20 week average should be half as sensitive for a 10 week period. So its exponent is 2 by 10 which sorry 2 by 20 which works out to 0.1 and so on. If an M-A proves to be too sensitive for the trend being monitored one solution is to extend its time period and therefore all forms of M-A's represent some form of compromise between timelines and sensitivity. To summarize in this video we discussed the concept of exponential moving averages EMAs. We saw the computation of EMAs with the help of simple example and we also saw how to determine the exponent employed in the concept of EMAs.

To summarize this lesson one of the basic assumptions of technical analysis is that stocks move in trends. Since major trends comprise many minor fluctuations in prices a moving average is constructed to help smooth out the data so that the underlying trend will be more clearly visible. Often M-A crossovers are employed to provide warnings of a reversal in trend and using weighted moving averages or exponential moving averages which are more sensitive to changes in the prevailing trend since they weigh data in favor of the most recent periods. There is no such thing as perfect average. The choice of time span always represents a tradeoff between timeliness that is catching the trend at an early stage and sensitivity that is catching the trend too early and causing an undue movement of whipsaws or false signals. In this lesson we computed three main types of moving averages including simple moving averages, weighted moving averages and exponential moving averages.

We discussed the advantages and disadvantages of these moving averages and their properties and applications. We also discussed the application of moving averages in identifying trend and trend reversals. We noted that moving average is smooth version of trend. The more time an M-A is touched the greater the significance attached to it. Its violation and its role as support or resistance.

Many times moving average crossovers generate false or whipsaw signals. These whipsaw signals can be filtered out by using upper and lower bands around the moving average line. Signal generation with moving average follows weight of evidence approach that is other Other evidences such as volume, trend line, price patterns etc. are also given due consideration. Selection of an M-A period is a compromise between lateness and sensitivity.

A small period M-A can be extremely fluctuating resulting in many false signals. A very large period M-A will be very slow but may not identify very useful signals. Then a system of short term and long term M-A can be employed in signal generation. Here short term M-A line is more fluctuating and its cross of long term M-A leads to signal generation. The signal generation strength is even more stronger if the long term M-A itself changes direction. Thank you.