

# 02-06 Technical Analysis

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*Compiled by Shipra De, Fall 2016*

## Technical Versus Fundamental Analysis



- There are two broad categories of approaches to use for choosing stocks to buy or sell. They're based on Fundamental analysis and Technical analysis.
- Fundamental analysis involves looking at aspects of a company in order to estimate its value. Fundamental investors typically look for situations where the price of a company is below its value.
- Another camp is based on Technical analysis. Technicians don't care about the value of a company. Instead, they look for patterns or trends in a stock's price.
- This lesson will focus on technical analysis.

## Characteristics

### Characteristics of Technical Analysis

#### What it is

- historical price and volume only
- compute statistics called indicators
- indicators are heuristics

#### Why it might work

- there is information in price
- heuristics work

- Let's start by looking at a few characteristics of technical analysis. First, what is it? One of the most important things to remember about technical analysis is that it looks only at price and volume.
- That's as opposed to fundamental analysis that looks at fundamental factors, like earnings, dividends, cash flow, book value, and so on.
- Technical analysis is price and volume only. We look back at historical price and volume to compute statistics on this time series, and these statistics are called indicators.
- Indicators are heuristics that may hint at a buy or sell opportunity.
- Now there is significant criticism of the technical approach. Folks consider that it's not an appropriate method for investing, because it's not considering the value of the companies. Instead, maybe you could think about it as a trading approach as opposed to an investing approach.
- Still there are reasons to believe that technical analysis might have value and that it might work.
- First of all, there is indeed information in price and information in price change. It reflects sentiments of buyers and sellers, and especially if we see that the price for a particular stock is moving in a different direction than the overall market, that might be a hint that there's something going on.
- Additionally, we know that in other domains of artificial intelligence, heuristics can work, and they work frequently. So even though it's controversial, there are reasons to believe technical analysis can work.

## Potential Indicators

Q: Fundamental or Technical?

- moving average of price
- % change in volume
- Price/earnings ratio
- intrinsic value

☐  
☐  
☐  
☐

T or F?

- Okay, now that you know some differences between fundamental and technical factors, I want you to look at each one of these four factors and fill in the box, T for technical or F for fundamental. So, for each one decide whether its technical or fundamental and fill in the box.

Q: Fundamental or Technical?

- moving average of price
- % change in volume
- Price/earnings ratio
- intrinsic value

☒  
☒  
☒  
☒

T or F?

- Remember that technical factors use only price or volume, whereas fundamental factors use other components.
- So moving average of price is only using price, so that one's technical.
- Percent change in volume is only using volume and that's allowed for technical factors, so that one's technical.
- This one is using price, yes that's technical, but it's also using earnings which is a fundamental factor, so that makes this whole thing a fundamental factor.
- So over here intrinsic value is based on dividends, which is a fundamental, so this one is a fundamental indicator.

## When Is Technical Analysis Valuable?

### When is Technical Analysis Effective

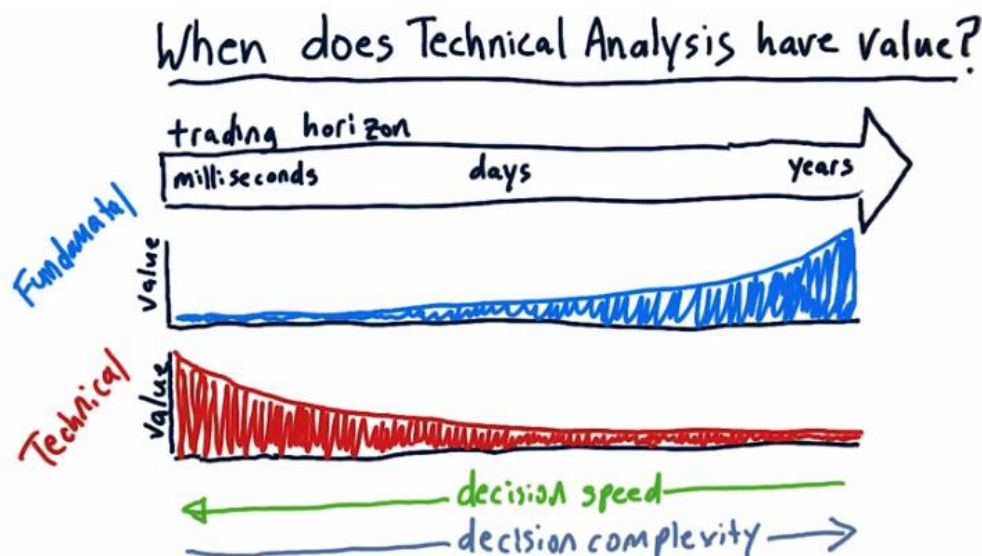
- Individual indicators weak
- Combinations stronger
- Look for contrasts (stock vs market)
- Shorter time periods

- So over the last few years I've been using technical analysis a lot. I've also been using fundamental analysis. And people often ask me well, you know, when is one valuable versus the other.
- Let's look first at technical analysis and where it's effective. Here's some rules of thumb that I've built for myself over the last few years.
- First is individual indicators, by themselves, are weakly predictive. Now back in the 80's and 90s when some of these were creative, I believe they had stronger value. But since that time, more and more people have been trading according to them, and essentially the more people who are following a particular approach, the less value is realized by any person by themselves. So individual indicators are weak.
- However, combining multiple indicators adds value. I see over and over again that combinations of three to five different indicators, in a machine learning context, provide a much stronger predictive system than just an individual indicator.
- Another useful approach is to look for contrasts. In other words, look for one stock that has a strongly different indicator than another stock, or a stock that is contrasting to the market. In other words, if all stocks are behaving in the same way as the market, there's no reason to pick any one stock over another, but if you see certain stocks are behaving differently than the market then they are worth a further look.
- Finally, technical analysis generally works better over shorter time periods than longer time periods.

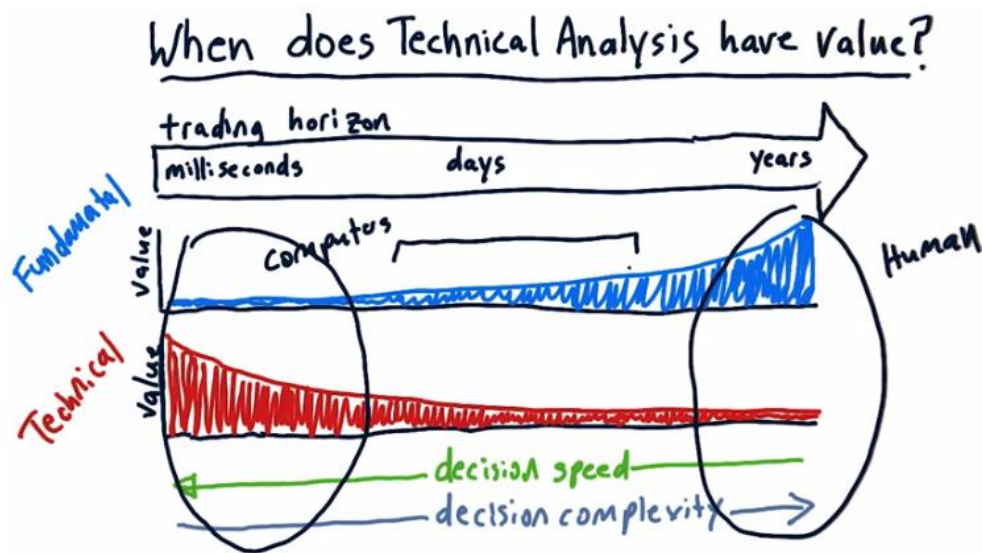
## When Is Technical Analysis Valuable? (Part 2)



- To understand the value of technical analysis versus fundamental, it's valuable to consider the trading horizon. In other words when you buy a stock and sell it, what's the time period between those two activities.
- So, it can be milliseconds, maybe even smaller time periods. It can be days or it can be years. So, for instance, Warren Buffett often buys and holds stocks for years, high frequency traders are trading on the order of milliseconds.
- So to illustrate what I mean, consider Fundamental factors. If we are trading over a time period of milliseconds how much do fundamental factors contribute to the change in price over those short periods of time? When we're trading machines on the stock exchange, what really matters is what's happening there on the stock exchange. For instance, the order book or momentum and so on. So at these short time periods, Fundamental factors really have low value.
- Now consider all the way out to years, we know from, for instance, Warren Buffet's success, that fundamental factors over long periods of time may have significant value.
- What about days? Well, maybe over a period of days Fundamental factors do have value.

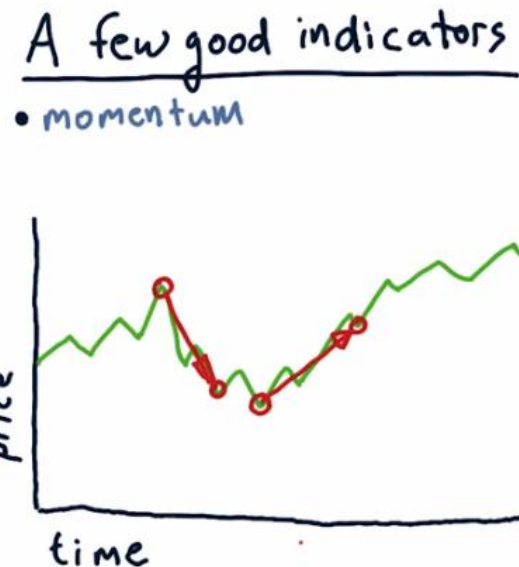


- So, imagine that we sort of chart it like this. Over long periods of time, fundamental factors provide a lot of value.
- Consider the same sort of chart now, but for technical factors. Let's start out over here, over many years. Think about if we make a technical analysis of a stock, what it's 20 day momentum is, which we'll talk about in a moment. How much is that really going to affect the price of a stock years later. Very little. So over long terms technical analysis is not so valuable.
- Think back now to very, very short periods of time. This is where technical analysis can shine, and it potentially has high value over very short periods of time.
- So we have a chart that looks a lot like the fundamental chart, but it's swapped.
- Let's consider a couple other factors. I won't draw the charts like these, but just think about these. So consider for instance, decision complexity. How complex is the decision to buy or sell a stock if you're going to hold it for years. Becomes more complex this way.
- How about decision speed? How fast do the decisions have to be made? Well, certainly, we have to be able to make the decisions really, really fast if we're trading at the millisecond level. And of course we can take a long time to make a decision if we're going to buy and hold for years.



- So as you look across this spectrum, consider where is the best region for humans to operate and where is the best region for computers to operate? Well, because at this very high frequency the complexity of decisions is simple. Computers can make this decisions very, very fast and that also happens to be where technical analysis has value which is the domain of the computer. So computers excel in this region of the chart.
- Over here where we can take a long time to make a decision and the decisions are complex. This is the best region for human investors.
- So, if you look at different types of hedge funds the high frequency trading computer driven hedge funds are operating over here. The insight driven, human based hedge funds are operating over here. And then there's this region in the middle where we often see humans and computers working together.

## A Few Indicators: Momentum

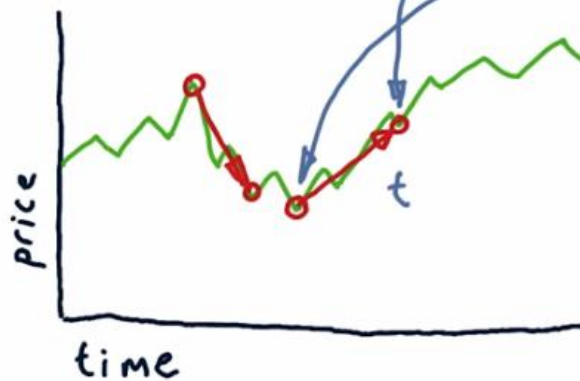


- There are hundreds of technical indicators out there. We're going to take a look at just three because, of course, our time is limited, but I will point you to resources online where you can learn about other indicators.
- These three are some of the most common and most popular that people use. The three we will look at are momentum, simple moving average, and Bollinger Bands.
- Let's take a look first at momentum. Momentum is really one of the simplest indicators, and it's just over some number of days how much has the price changed.
- So for instance, if we look at this point to this point, we've got positive momentum. Or if we were to look from here to here, we've got negative momentum.
- The steepness of that line is the strength of the momentum, either positive or negative.
- Now, in terms of using this in a trading strategy, there are many folks who look at the momentum for a stock, the recent momentum, and if it's positive they buy, because they anticipate that the momentum is going to continue.
- Now, I'm not necessarily recommending that to you. I'm just telling you how some people use it. Now I'm going to show you in a later slide, how we can use momentum as part of a combined strategy.



## A few good indicators

•  $\text{momentum}[t] = \frac{\text{price}[t]}{\text{price}[t-n]} - 1$   
 n-day 5,10



Visual  
quantitative

range  
-0.5 +0.5

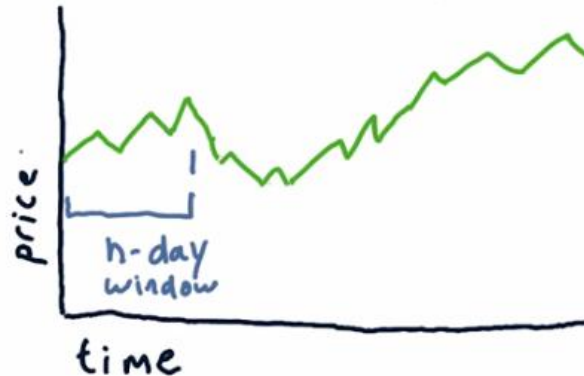
- Now, you can see here how we can look at momentum visually. But for machine learning, which of course we're going to get to in the next mini course, we actually need to convert these to numbers that we can use quantitatively. And, of course, this course is about quantitative analysis.
- So there's always, for technical analysis, a graphical or visual presentation, but we need to also consider the quantitative presentation.
- So, when we talk about momentum, we talk about how many days of momentum that is. So, that might be  $n$  days, where we use  $n$  right there. So,  $n$  might be a number like 5 or 10 and so on.
- Here's the pseudo code for how we compute momentum on a particular day. So let's suppose this is day  $t$  right here. We just take the price as of that day and we divide it by the price in days earlier and subtract 1. So this will give us a number, say 0.1, if the price has gone up 10% or -0.1, if it's gone down 10%.
- So we usually see numbers in the range of, say, about -0.5 for a big, significant, 50% drop, to about +0.5. So on any particular day, this is how we would calculate the value of this technical indicator momentum.



## A Few Indicators: Simple Moving Average

### A few good indicators

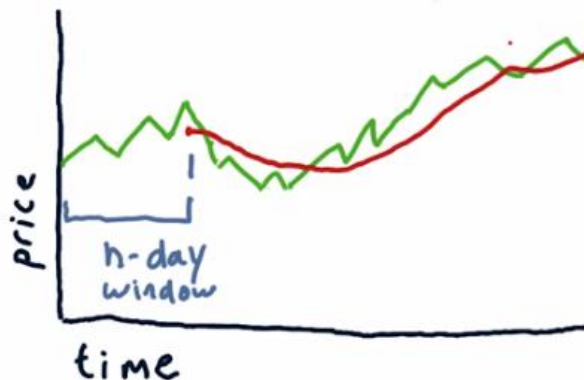
- Simple moving average SMA  
n-day



- Our next indicator is simple moving average or SMA. And again, it's indexed by  $n$ , which is how many days are we looking back. So if we want to calculate the value of the simple moving average for this day, we look back over  $n$  days, and this is called an  $n$ -day window.
- So the SMA for today is simply the average of the values over this look back period. So it would be a value about right there.

### A few good indicators

- Simple moving average SMA  
n-day



- And if we carry it forward, it'll look like this. So, the SMA looks essentially like a smoothed value of the price chart as it moves around. And an important thing to note is it sort of lags the

movement. So as we started down here, it slowly started coming down, and when we started up here, it lagged that movement upwards.

## A few good indicators

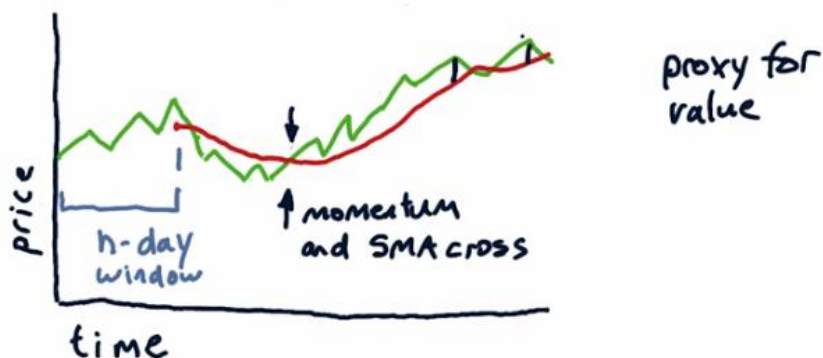
- Simple moving average SMA  
n-day



- There are at least two different ways that technicians use simple moving average as parts of trading strategies.
- The first is they look for places where the current price crosses through the simple moving average. Those tend to be important events, especially if the average is over many, many days.
- If you combine that with momentum, in other words, the price has strong momentum, and it's crossing through that simple moving average, that can be a signal.
- This particular crossing, where the price goes through the simple moving average, doesn't really illustrate strong momentum because it just started going up. However, when you do see strong momentum crossing those lines, then again, that can be a trading signal.

## A few good indicators

- Simple moving average SMA  
n-day



- Another way that technicians use simple moving average is as a proxy for underlying value. In other words, if you look back over a certain period of time and take that average price, that might represent the true value of the company.
- And if we see a large excursion from that price, we should, for instance, here and here, we should expect that the price is eventually going to come back down to that average. And so it's an arbitrage opportunity, sort of like we saw with fundamental analysis.

## A few good indicators

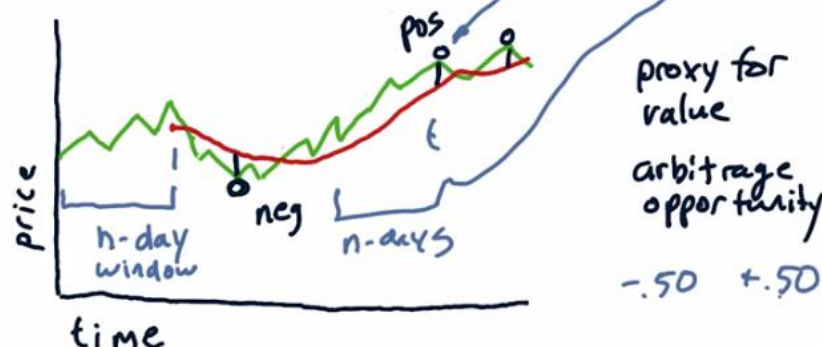
- Simple moving average SMA  
n-day



- And again, for example, there's a large excursion downward here, so this might represent a buy opportunity, and these two might represent sell opportunities. Because there was a strong diversion from that moving average.

## A few good indicators

- Simple moving average SMA[t] =  $\frac{\text{price}[t]}{\text{price}[t-n:t], \text{mean}()}$  -1

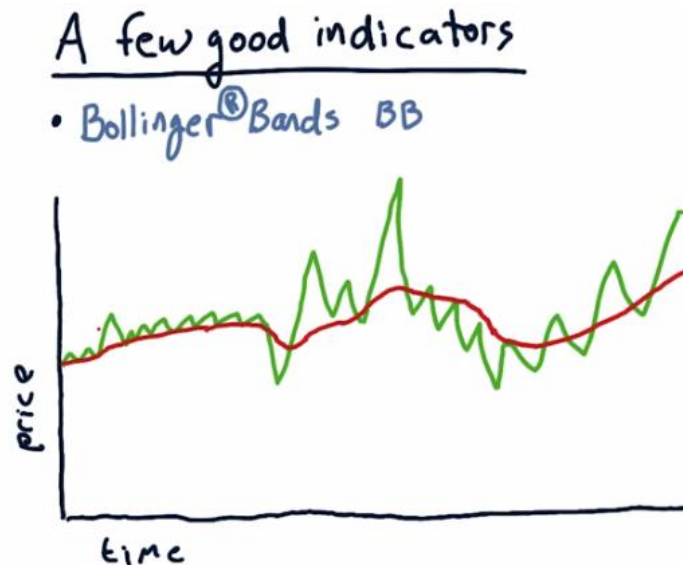


- Now we talked about earlier how every technical indicator has a visual presentation like I'm showing you here, but we also need a way to quantify it, to turn it into a number. The way we

do that is to compare the current price with the current simple moving average, and construct a ratio.

- So, in this case, we would look for a negative value. And in these cases, we'd want to see positive values. So, if we were to calculate, say, the value of the simple moving average on this day, we take the price for that day, and we compute the mean for the last n-days, which is here.
- And remember, this is over a look back window of n-days. Divide that into the price and subtract one. So, if, for instance, the price is 10% above the simple moving average, we'd end up getting a positive 0.1. If it were 10% below, we'd get a negative 0.1.
- So similar to the momentum, we typically see values here ranging from, at most, minus 50% to plus 50%.

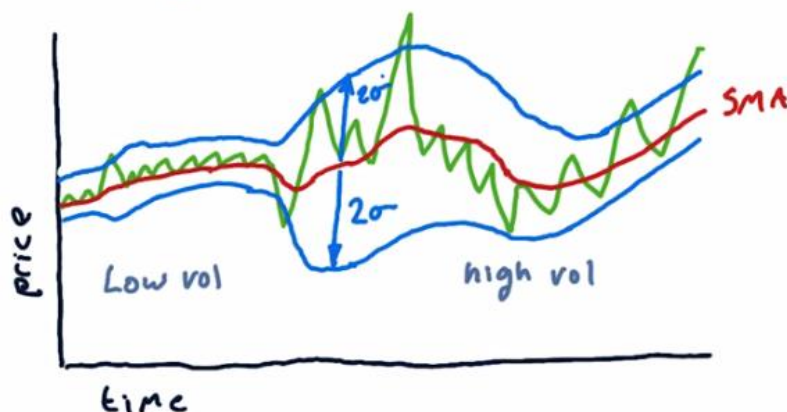
## A Few Indicators: Bollinger Bands



- Let's suppose you liked what I told you about simple moving average, and you're looking at the historical price of this stock. And you're trying to decide, okay, how much of an excursion from the simple moving average should I use as a signal for a buy or sell? So let's add our simple moving average line here.
- Now you might say, okay, I think I see an excursion of say 1% like this, that that's a meaningful excursion and I should trade based on that. So let's carry forward and now you're getting this huge excursions all the time and you'd be chasing it trying to trade all the time. So clearly a fixed number is probably not the best way to go.
- If you look at this chart, you'll see that we've got a region of low volatility over here. And high volatility over here. So John Bollinger observed that for low volatility stocks or stocks that are currently experiencing low volatility, you probably want to use a smaller number for that trigger. And when we see high volatility, you probably want to use a larger number. Well, how can we accomplish that, well, we can use the standard deviation.

## A few good indicators

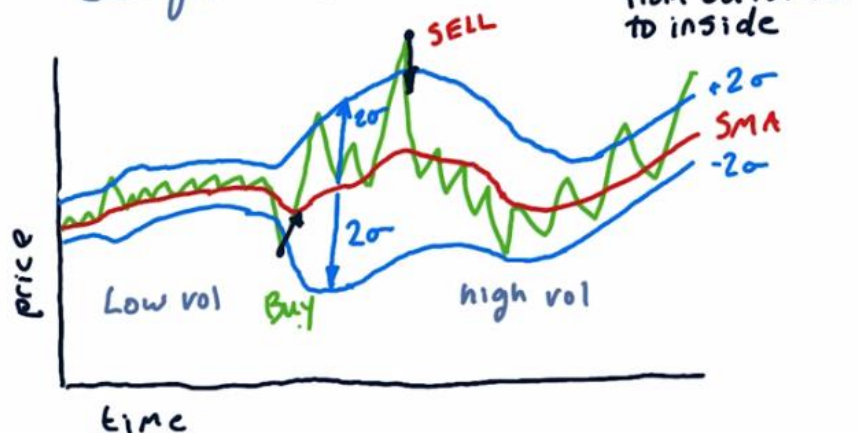
### • Bollinger® Bands BB



- So what Bollinger suggested was, okay, let's take this simple moving average, but let's add a band above and below two standard deviations. And that's our measure for how strong of a deviation we want to see before we respond to it.
- So for instance in this region, this smaller excursion goes outside that band, so we should take a look at it. But over here, it takes a much larger excursion to get our attention. How might we use Bollinger Bands now for trading signals?

## A few good indicators

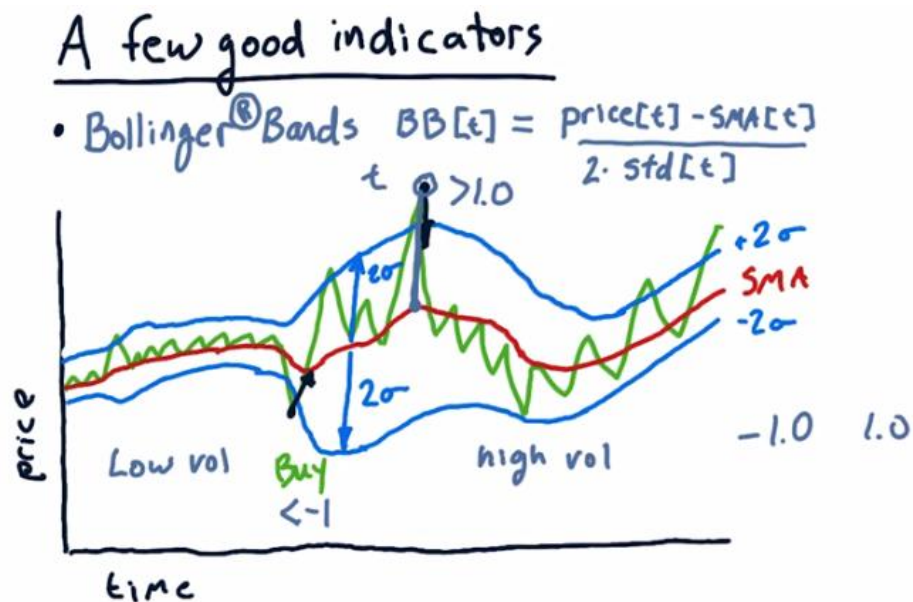
### • Bollinger® Bands BB



- Here's a method that I've seen that is effective. So here's a rule of thumb for using Bollinger Bands that might be effective.
- You look for times where the price's outside, one of these Bollinger Bands and when it crosses to the inside. So for instance, here, we're outside and we cross to the inside. So this would be a sell signal. We've got a large excursion from the simple moving average. And we're expecting

that it will retreat back to the average. And it's demonstrated that it's retreating because it's gone from outside the band back towards the moving average.

- Conversely, here we're moving from below the lower band. Back towards the simple moving average. And that would be a buy signal.
- So, recapping. The way that people use Bollinger Bands is they look for the price to go outside the bands. And then look for it to retreat back through the band. And that's verification that it is moving back toward the simple moving average.



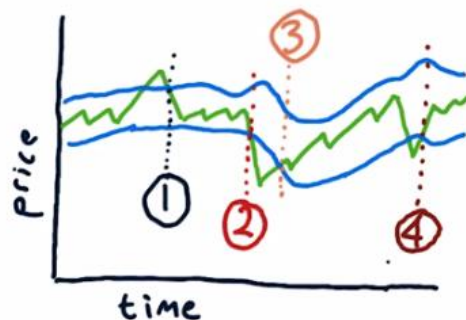
- Here's how to calculate the Bollinger Band on a particular day  $t$ . So here's the price on that particular day  $t$ , we subtract the value of the simple moving average, so we are comparing these two values, and then divide by 2 times the standard deviation.
- So the value up here is going to be something greater than 1.0 because if it's exactly at this band, it's exactly 2 standard deviations away, so it would be a value of 1 right at the band. It's greater than 1 here.
- Similarly, down here, we would have a value less than negative 1. Because the price excursion is more than 2 standard deviations below.
- So we typically expect to see values for this Bollinger Band calculation to be between negative 1, and 1. In other words, most of the time the stock is going to be between those bands. But occasionally, we'll see excursions above and below those values.



## Buy or Sell?

Q: Buy or Sell?

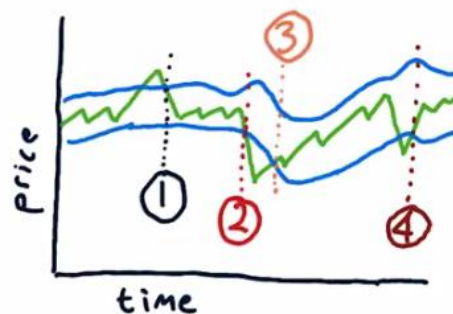
	Buy	Sell	nada
①	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
②	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
③	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
④	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



- All right suppose you like that whole idea that I told you about Bollinger bands. Let's see now how well you might use it. So I've identified four different times here where the actual price crosses and upper or lower Bollinger band.
- I want you to look at each one of those, and identify here whether it's a buy signal, a sell signal or no signal at all.

Q: Buy or Sell?

	Buy	Sell	nada
①	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
②	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
③	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
④	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



- Let's take a look at this first one. So we went from outside the upper band and crossed down inside it. That is a sell signal because we've gone very far from the moving average, and we've validated now that we're moving back towards the moving average so that's a sell.
- Here, we've gone from inside to outside, and that is never a signal. It does indicate, of course, a significant excursion from the moving average, but we're looking for the validation that it comes back inside, so this is not a signal at all.
- Here however we've come back through that bottom band, and that is a buy signal.
- Finally for this last one, number four, we've gone outside the lower band and we've transitioned up inside it, that is a buy signal. So that's Bollinger bands and how you might use them.

## Normalization

### Normalization

- SMA -0.5 to +0.5
- momentum -0.5 to +0.5
- BB -1.0 to +1.0
- PE ratio 1 to 300

normalization  
-1 +1

$$\text{normed} = \frac{\text{Values} - \text{mean}}{\text{Values.std()}}$$

- Before we leave technical analysis I want to bring up one more point called normalization. So, take a look at these different technical indicators we created here, simple moving average, momentum, and Bollinger bands.
- They have different ranges that they typically operate over, so, like I said we would expect to see values of -0.5 to +0.5 for simple moving average. For momentum, similar kind of range. Bollinger Band typically inhabits -1.0 to 1.0.
- If we were to plug these values into some sort of machine learner we would have a little bit of a problem. And what would happen, we'll have to go into the details later, but the Bollinger Band factor would tend to overwhelm these other factors and become the most important one. It might get even worse if we included fundamental factor like PE ratio that can range from 1 all the way up to 300.
- The solution is something called normalization. And what normalization does it takes each of these factors and essentially compresses them or stretches them so that they vary on average from -1 to +1.
- Normalization is simple, you take your original values for a particular factor subtract the mean from all of them, then divide by the standard deviation of all of them. This will give you a normed result that, on average, is going to vary between -1 and 1, and it'll have a mean of 0.
- So remember this trick for later when we get to machine learning, or if you're working with technical indicators yourself, you may want to apply this normalization approach to the numbers you're working with.

## Wrap Up

### T.A. wrap up

- heuristics
- Tucker's approach
- don't start trading yet

- Let's wrap up technical analysis now. So to review, technical indicators are really heuristics that represent someone's interpretation or hunch of how a statistical approach to previous prices and volume might suggest future price movement.
- The particular examples that I've provided here are my approach. So if you go look up, for instance, on John Bollinger's website how to use Bollinger Bands, you might discover his approach is slightly different. I showed you specifically how I have found them to be useful in the past.
- Finally, lots of times when people get exposed to technical analysis they get really excited and they want to run off and start trading.
- Well, hold your horses, there's a lot more to learn. So stick with it, and we'll see you in the next lesson.