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How are TradingView's Exponential Moving Average (EMA) and Relative Moving Average (RMA) different?

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Summary

TradingView's Exponential Moving Average (EMA) and Relative Moving Average (RMA) are calculated in almost the same way. But they do differ in one aspect. Let's take a closer look at how these two moving averages compare.

Formula comparison

To see why the EMA and RMA are much alike, let's consider their formulas. That also shows the one thing in which they differ.

TradingView calculates the Exponential Moving Average (EMA) as follows:

$$\text{EMA} = \text{alpha} * \text{source} + (1 - \text{alpha}) * \text{EMA}[1]$$

$$\text{alpha} = \frac{2}{\text{length} + 1}$$

And for the Relative Moving Average (RMA) TradingView uses this formula:

$$\text{RMA} = \text{alpha} * \text{source} + (1 - \text{alpha}) * \text{RMA}[1]$$

$$\text{alpha} = \frac{1}{\text{length}}$$

As we can tell, both formulas are much alike. Their only difference is the `alpha` variable. Let's see what that one is about.

'Alpha' value comparison

Both the EMA and RMA use an `alpha` variable in their formula. This variable determines how much weight the most recent price gets. It tells what impact the last value has on the moving average's entire value.

The EMA calculates that `alpha` with: `2 / (length + 1)`. The RMA, on the other hand, uses `1 / length`. This makes RMA's `alpha` roughly half of what the EMA uses.

To better see their difference, let's compare `alpha` values for various moving average lengths:

Length	EMA alpha	Last price weight	RMA alpha	Last price weight
5	0.333	33.3%	0.200	20.0%
10	0.182	18.2%	0.100	10.0%
15	0.125	12.5%	0.067	6.7%
20	0.095	9.5%	0.050	5.0%
25	0.077	7.7%	0.040	4.0%
30	0.065	6.5%	0.033	3.3%

35	0.056	5.6%	0.029	2.9%
40	0.049	4.9%	0.025	2.5%

For any moving average length from 5 to 40 bars, the table above shows that EMA uses a higher `alpha` value than RMA does. So what does that mean?

Both EMA and RMA calculate their average by taking the previous bar value and increasing that with the current bar's value. How much of the current value the average uses depends on `alpha`.

Because EMA has a higher `alpha` value than RMA, the EMA gives more weight to the last price. In fact, the weight EMA uses can be almost double of what RMA uses (see table above).

As a result, the EMA responds faster to changes in price. Because its current value uses more recent data than the RMA does.

Example formulas

Let's make the above more practical. Say we have a 40-bar moving average whose previous bar value was 26.00. The stock now closed up at 26.50. With these variables, what value do the EMA and RMA have?

The current EMA value is 26.0256:

$$\begin{aligned}\text{EMA} &= \text{alpha} * \text{source} + (1 - \text{alpha}) * \text{EMA}[1] \\ &= \frac{2}{\text{length}+1} * \text{source} + (1 - \frac{2}{\text{length}+1}) * \text{EMA}[1] \\ &= \frac{2}{40-1} * 26.50 + (1 - \frac{2}{40-1} * 26) \\ &= 0.051 * 26.50 + 0.9487 * 26 \\ &= 26.0256\end{aligned}$$

And the RMA is 26.0125:

$$\begin{aligned}\text{RMA} &= \text{alpha} * \text{source} + (1 - \text{alpha}) * \text{RMA}[1] \\ &= \frac{1}{\text{length}} * \text{source} + (1 - \frac{1}{\text{length}}) * \text{RMA}[1] \\ &= \frac{1}{40} * 26.50 + (1 - \frac{1}{40} * 26) \\ &= 0.025 * 26.50 + 0.975 * 26 \\ &= 26.0125\end{aligned}$$

These formulas show two interesting things:

- For the same moving average length, the EMA gives the last price a weight of 5.1% and uses 94.87% of the previous bar's value. The RMA, however, only gives the latest value a weight of 2.5% (and uses 97.5% of the old value). This makes the last price only half as important for the RMA.
- Because the EMA gives more importance to the last value, it increases faster in response to the higher close. Both moving averages had a value of 26.00 on the previous bar. When the stock closed higher, the EMA increased to 26.025 while the RMA increased a little less to 26.0125.

With more weight assigned to the last value, the EMA responds faster to changes in price direction than the RMA does. The drawback is that, when the market moves sideways, the EMA generates more noise than the RMA.

Example script

Let's also make a comparison with code. The indicator below plots an Exponential Moving Average and Relative Moving Average. Both use the same data and length. We have the code spot where the close crossed the EMA or RMA.

When both averages generate a signal at the same time, we show that confirmed signal with a green background. If price crosses the RMA, but not the EMA, we use a blue background. And when there's an EMA cross, but no RMA one, we paint the bar's background orange. These different colours quickly show which signal happened first.

The indicator's full code is:

```
//@version=5
indicator(title="RMA versus EMA", overlay=true)

// Inputs
avgData   = input.source(close, title="Average Data Source")
emaLength = input.int(20, title="EMA Length")
rmaLength = input.int(20, title="RMA Length")

// Calculate both moving averages with the same data and length
emaValue = ta.ema(avgData, emaLength)
rmaValue = ta.rma(avgData, rmaLength)

// Plot both averages on the chart
plot(rmaValue, color=color.blue, linewidth=2, title="RMA")
plot(emaValue, color=color.orange, linewidth=2, title="EMA")

// See if prices crossed the moving average
rmaCross = ta.cross(close, rmaValue)
emaCross = ta.cross(close, emaValue)

// When both averages have a cross signal on the same bar, make
// background green. Else when just one triggers, make background
// the same colour as that average's plot colour.
backgroundColour = if rmaCross and emaCross
    color.new(color.green, 75)
else if rmaCross
    color.new(color.blue, 80)
else if emaCross
    color.new(color.orange, 80)

bgcolor(backgroundColour)
```

We first configure the indicator with the `indicator()` function. That names the script and places it on top of the chart's instrument.

Then we make three inputs. The first is a source input (`input.source()`). This one configures which data the moving averages calculate on. Two integer inputs (`input.int()`) set the EMA and RMA length.

Then we calculate both moving averages:

```
// Calculate both moving averages with the same data and length
emaValue = ta.ema(avgData, emaLength)
rmaValue = ta.rma(avgData, rmaLength)
```

The `ta.ema()` function calculates the Exponential Moving Average. It processes the `avgData` input variable, which defaults to close prices. Its length is the `emaLength` input variable, which has a standard value of `20`.

To get the Relative Moving Average we call the `ta.rma()` function. This one also processes the `avgData` variable. Its length is `rmaLength`, the input variable with a period of `20`.

With the averages computed the `plot()` function shows both on the chart. The EMA appears in blue (`color.blue`) whereas the RMA uses orange (`color.orange`).

The `ta.cross()` function next looks if the bar's close crossed over or under the RMA. Then the function sees if such a cross happened with the EMA.

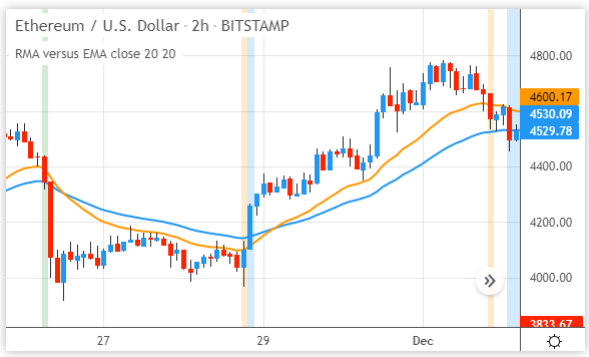
We evaluate the outcome of those crosses with a cascaded if statement. That decides which background colour to use. First we look if both crosses happened at the same time (`and`). If that's so, we use a transparent green (`color.green`) as the background colour.

If there wasn't a simultaneous signal, we look if only the RMA generated a signal. If that's the case we pick blue as the background (the same colour as the RMA line). Otherwise the third `if` condition looks if there's an EMA signal. If so, we use the EMA line colour for the background (orange).

Then, on the last line of code, the `bgcolor()` function applies the chosen colour to the chart's background.

Example chart

Here's how the above indicator looks on the chart:



The EMA shows as an orange line while the RMA uses a blue line. We straight away see that the EMA responds quicker than the RMA. But let's consider the signals too.

The chart starts with a green background signal. That's a bar where the EMA and RMA both generated a signal at the same time.

In the chart's middle there's an orange background. The EMA generated a signal there whereas the RMA did not. The next bar has a blue background: the RMA triggered a signal (but the EMA did not). So here the RMA responded one bar later.

The right part of the chart has another orange background (EMA) first. Now it takes three bars before the RMA generates its signal (blue background) too.

As we can tell from this, the EMA responds faster than the RMA does. Give the indicator a try yourself and experience how different settings change the script's signals.

Summary

- The formula's for TradingView's Exponential Moving Average (EMA) and Relative Moving Average (RMA) are much alike.
- Their only difference is how much weight they give the most recent value. The EMA can give that value twice as much importance than the RMA does.
- That makes the EMA quicker to respond to price changes. (But, as a consequence, also a bit more noisy.)

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Relative average (RMA)

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Symmetrical average (SWMA)

About me

Hi there, I'm Jos! On TradingCode I combine my passion for programming with my interest in financial markets.

I write about things I've learned to help others succeed. Trading is challenging enough already; hopefully, I can help you with the programming part.

I wrote my first TradingView script back in 2014. In the time since I coded hundreds of indicators and strategies in Pine Script.

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How to colour specific TradingView bars with Pine Script code? Updated

What services can automate TradingView trading?

Calculate the Exponential Moving Average (EMA) in TradingView's Pine Script

Which time zone do TradingView variables and functions use?

How does a chart's time zone setting affect TradingView scripts?

Countdown a TradingView real-time bar: minutes *and* seconds till the price bar closes

Countdown a TradingView real-time bar: seconds *or* minutes till the price bar closes

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