

Lecture № 12 Mathematical analysis

In this lecture we will familiarize ourselves with tools of analysis referred to as the mathematical method. These tools were obtained as a result of conducting various mathematical actions with a market price and were named technical indicators of the market. Earlier indicators were calculated and put on the graph manually, but with computer technology and programming development, computers began to do this work, and indicators are considered computer analysis tools increasingly.

An indicator is a result of mathematical calculations based on price and/or volume indicators, or a combination of both. The values obtained are used for forecasting price changes. There is a considerable quantity of technical indicators in the world - over 1000.

Prior to learning about indicators we should consider the concept of divergence. Divergence is rightly considered the strongest signal in the technical analysis. It is formed when there is a discrepancy between the prices and the indications on the chart. When prices rise to a new maximum and the indicator chart stops at a lower rate, a bearish divergence is formed (figure 1).

The bearish divergence between the indicator and the prices specifies a weakness of the market's top and signals a high probability of a tendency reversal.

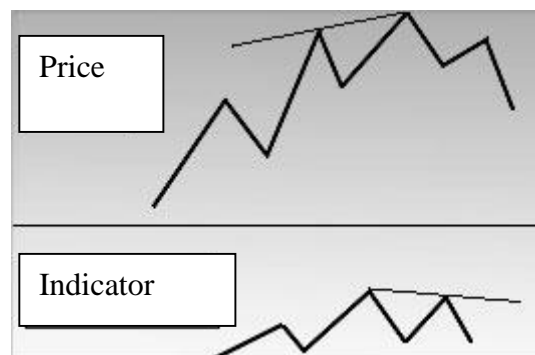


Figure 1. The schematic image of a bearish divergence

If the prices fall to a new minimum and the indicator chart shows a rate higher than the previous one, a bullish divergence is formed (figure 2).

A bullish divergence between the indicator and the prices denotes the descending tendency's weakness and signals the probability for the beginning of growth.

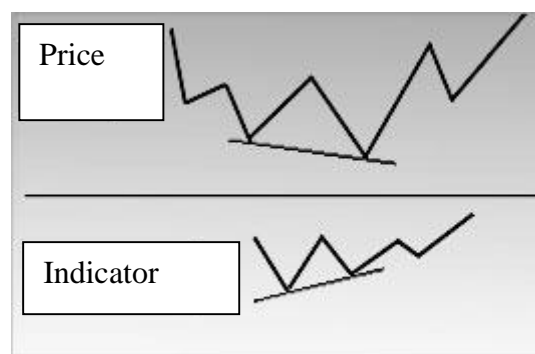


Figure2. The schematic image of bullish divergence

Generally all indicators can be divided in two groups - trend indicators and oscillators. Let's consider indicators referred to trends.

The Moving Average indicator is the most frequently used indicator in technical analysis. The moving average is counted within a certain period. The smaller the period, the more probable false signals are. The longer the period, the lower the moving average sensitivity is.

Variants of moving averages:

1. Simple Moving Average.
2. Weighted Moving Average.
3. Exponential Moving Average.

The moving average value (MA) concerns a category of analytical tools which follow the tendency. Its purpose consists in defining the new tendency beginning time and also warning about its end or turn. MAs are intended for tendencies tracing in the process of their development; they can be considered as the curved trend lines. However, MA is not intended for market movements forecasting like graphic analysis is because it always follows the market dynamics instead of advancing them. This indicator does not predict the prices dynamics but only reacts to them. It always follows the market price movements and signals the new tendency beginning but only after it has appeared. MA construction is a special method of price indicators smoothing. Really, at the average of price indicators their curve considerably smoothes out, and it is easier to observe the tendency of market development. However, already in their nature the MA lags behind the market dynamics. Short-term MAs transfer the movement of the prices more precisely than permanent long MAs. The application of short MAs allows for a reduced time lag, however, eliminating it completely using MAs is impossible. In the lateral markets it is more expedient to use short MAs, and on trends long ones are more effective, as they are less sensitive.

Simple Moving Average

The simple MA or average arithmetic value is calculated by the following formula:

$$MA = \frac{\sum_{i=1}^n P_i}{n},$$

where P_i is the price on the i -th day, and n is the moving average order.

This type of MA is widely used by the majority of technical analysts. However, some analysts dispute its advantages, putting forward two basic arguments. The first argument is that the analysis takes into account only the time interval covered by this MA. The second argument is that the simple MA actually equalizes the importance of each day's prices. For example, using a ten-day moving average, the identical weight of 10% is assigned to the last and first days, as well as to all other days of the period. A five-day MA, in turn, means that the day average price weight is equal to 20%. At the same time some analysts believe that a later price indicator should have a greater value. This argument is quite logical, as during the new tendency a simple MA takes more time for a turn and signal giving than for a weighted MA (considered below).

Weighted Moving Average

To solve the 'specific weight' problem of the prices average values some analysts use weighed moving averages (WMA). They are calculated by the following formula:

$$WMA = \frac{\sum_{i=1}^n P_i * W_i}{\sum_{i=1}^n W_i},$$

where W_i is the weight of i -th component (price).

The weight assigned to the prices in the above mentioned formula can be chosen randomly. In general, the choice of prices weight depends on the dynamics character of the active investigated. Weight can increase linearly, exponentially or otherwise. In case of a linearly-weighed MA, $W_i=i$.

Exponential Moving Average

The Exponential Moving Average (EMA) has a more difficult construction than WMAs or simple MAs which allows the EMA to eliminate two of the disadvantages of simple MAs. First, the EMA attaches much more importance to the last days' indicators. Therefore, it is weighed. Although a smaller weight is given to the previous prices dynamics, during calculation all prices data for the whole period of the equity market operation is used. The formula of this MA type of calculation is more difficult and looks as follows:

$$EMA_t = EMA_{t-1} + (k * (P_t - EMA_{t-1})),$$

where t is today, $t-1$ is yesterday, $k=2 / (n+1)$, where n is the MA order.

Despite the EMA having no disadvantages inherent to simple MAs, it is not the best of the three MAs. Below the efficiency of every MA will be shown via testing.

Analysis rules

The general rules of MA analysis are the following:

1. The most important signal showing a trend direction is the general direction of MA movement. In an ascending MA it is necessary to adhere to the bull market and to work on increase. It is necessary to buy when the prices fall to the MA level, putting Stop Loss (SL) below the previous minimum, and to move it as soon as the prices close above the previous level. In a descending MA it is necessary to speculate for a fall, opening short positions when the prices jump up to the MA level or slightly above. In that case SL should be placed slightly above the previous crest and dynamically move it in case the bear trend resumes.
2. The second signal is the intersection of the MA and the price graph. Such a signal is strong for the outlined bull market if the MA crosses the price chart on top with a positive incline and the price chart also has a significant incline. In case the MA and the price chart intersect at a negative incline of the former and an insignificant positive or negative incline of the latter, it is a weaker signal on the outlined bull trend, and it is necessary to receive an

acknowledgement of future dynamics from an additional signal. There are similar signals for the outlined bear market, but with the inverse arrangement of the MA inclination and price chart.

3. The third signal is an MA reverse at the minimum or maximum value. If the MA is located under the price chart and has a local minimum while the price chart has a positive inclination, the average forces a signal about the bull direction of the market and about an upwards position opening. If the chart has no positive inclination, there is a very weak signal for its confirmation - it is necessary to use three additional signals.

These rules may be used on the trend markets. On a market without a clear trend the corresponding graph will have bends. Attempting to filter these bends mechanically leads, as a rule, to the loss of useful signals.



Figure 3. There are three types of moving averages on the chart. The intersection of the chart by the price at the bottom gives a signal for buying.

- simple moving average
- exponential moving average
- weighted moving average

MACD (Moving Average Convergence/Divergence)

The moving average convergence/divergence (MACD) is a dynamic indicator following the tendency. It shows a correlation between two moving averages of the same price. The MACD indicator is formed as a difference between two exponential moving averages (EMA) with the periods in 12 and 26 days by default. In order to identify the favorable moments to buy or sell, the so-called signal line is put on the MACD graph - 9 EMAs from the MACD line with smoothing by the default 9.

During the calculation of the histogram the EMA with the bigger order (26) is deducted from the EMA with a smaller order (12), and then from the result obtained a 9-day EMA is deducted from the difference between the EMA with order 12 and the EMA with order 26:

$$MACD = EMA(P, 12) - EMA(P, 26) - EMA[(EMA(P, 12) - EMA(P, 26))9],$$

where P is the price, and $EMA(P, n)$ is the EMA with n order.

The obviousness and efficiency of these two MA analysis methods have won it a great popularity among modern analysts. MACD shows the best results in analysis on time intervals from a day or more. It is necessary to be more careful in MACD analysis for periods less than a day. Periods less than an hour also contain information but may include many false signals.

MACD is most effective in conditions when the market fluctuates with big amplitudes in the trading range. The most commonly used MACD signals are intersections, overbought/oversold conditions and divergences.

All MACD signals can be divided into three categories based on the degree of their value:

Trade on MACD intersections

The simplest way of MACD usage is trade on the intersections of its basic components. Signals to buy are generated when the histogram crosses the zero line at the bottom, while signals to sell occur in the contrary situation. It is necessary to warn that in most cases mechanical trades on each MACD intersection give frequent jerks that lead to considerable losses. It is necessary to avoid narrow trading ranges that prove destructive for the indicator. Try to buy when the signal to buy is generated almost at the zero line level. In most cases it is preceded by a strong bullish trend. If the similar signal is generated at a much lower reference line level, the trend will be very weak. At the MACD histogram analysis it is possible to gather additional information. So, if the bar (histogram column) is much lower than the reference line level and there comes a situation when each subsequent bar gradually decreases in size, it is necessary to take into consideration moment reduction. Reflecting the moment indicator, the histogram gives the previous signals.

Divergence

Divergence is the second way of MACD usage. Divergence itself is a very effective form of technical research and MACD is not an exception. Divergence appears when the direction of the price movement is diametrically opposite to the direction of MACD lines. This signal is more useful for the indication of the trend's continuation after the correction than as a signal of trend reversal. Anyway, it is better not to jump the gun but wait until the divergence reaches steadier states. Otherwise you will feel sorry if you turn out to be at the opposite side of a strong trend.

Overbought/oversold

The third known MACD usage is market overbought/oversold analysis. This instrument allows with a specified degree of accuracy to set the points where market is subjective to reversals. If MACD reaches the points of extremum placed at the opposite sides from the reference line, it means that the market is oversold or overbought. Considering this type of signals, one ought to set the points of extremum empirically; they can be different for each instrument.

When a bar graph reaches this critical zone, any intersection with the signal line generates the signal for buying or selling. Intersections that appeared before the level of extremum can be ignored, so the majority of twitching will be avoided. Such levels can be determined as a result of simple investigation for any market which is in a wide trading

congestion with huge price fluctuations. Signals appearing in the medium zone of the MACD graph can be accepted only if another proven indicator confirms that trading will be held along the trend direction. Obviously, such an indicator is some kind of oscillator. It should be remembered that MACD is better used as a long-term instrument of following the trend, not as a short-term trading timer.



Pic. 4. Bullish divergence at the MACD predicted trend reverse; a breakthrough of the null line gave the signal for buying.

ADX (Average Directional Movement Index)

The Average Directional Movement Index (ADX) is a Directional system (DS) which was developed by J. Welles Wilder in the middle of the 1970s and then was further developed by other analysts. DS is used for the determination of market trend forces. The rates of directional indicators (+DI and -DI) are used for calculation of ADX indications. For DS construction it is necessary to go through several steps:

1. Determine the directional movement (DM) by comparing the current and yesterday's price range, the distance between the maximum and the minimum. The directional movement is the major part of the current price range which is out of yesterday's range.
2. Determine the true range (TR) of the market. It is always a positive number, the maximum of three:
 - Distance between the current maximum and minimum.
 - Distance between the current maximum and yesterday's closing price.
 - Distance between the current minimum and yesterday's closing price.
3. Calculate the daily directional indexes (+DI and -DI). They help to compare different markets by evaluating their directional movement as a percent of the true range of every market. Every DI is a positive number: +DI is equal to 0, if there is no directional movement downwards; -DI is equal to 0, if there is no directional movement upwards.

$$+DI = \frac{+DM}{TR} \qquad -DI = \frac{-DM}{TR}$$

4. Calculate the smoothed directional lines. Smoothed +DI and –DI are constructed with the help of EMA with an exponent part 13. There appear two indicating smoothed lines: a positive and a negative one. The correlation between the positive and negative lines determines the tendencies on the market. Based on the actions taken, we can calculate the ADX. This component of DS shows when it is better to follow the trend. ADX measures the scope between directional lines +DI and –DI. ADX is calculated by the following formula:

$$ADX = EMA\left(\left(\frac{+DI - |-DI|}{+DI + |-DI|}\right), 13\right)$$

This index helps to estimate the strength of a trend. If the ADX rises, it indicates that the market trend becomes stronger. At this time it is better to make deals only in the trend direction. When the ADX falls, it means that the trend is very weak. At this moment the signals given by oscillators have a great value. The role of directional analysis is tracing the changes in the mass optimism and pessimism estimating the capability of bulls and bears to take prices out of the previous days' price range. If today's maximum price is higher than yesterday's one, the market becomes more optimistic. And vice versa, if today's minimum price is lower than yesterday's one, the market becomes pessimistic.

During the DI analysis, the following signals appear:

1. If the +DI line is above the –DI line, it indicates the general upwards dynamics of the trend. If the +DI line is lower than the –D line, then a downtrend dominates the market.
2. If the lines diverge, the dynamics of the trend gain strength; if the lines converge, then the trend weakens or prepares for a reversal.

There are several rules of trading using DS:

1. Buy when +DI exceeds –DI, sell when –DI exceeds +DI. The most favorable conditions for buying are when +DI and ADX are above –DI, and the ADX rises. This indicates the uptrend's consolidation. And vice versa, it is better to sell when –DI and ADX are higher than +DI, and the ADX rises.
2. An ADX decrease shows that the market becomes less directed. When ADX goes down or passes under both of the lines of the DS, it means the market is calm. In this situation it is not recommended to use the DS method.

The best signal given by the DS appears after the ADX falls below both lines, then goes up above them. In this case you should anticipate the appearance of a new bearish or bullish market. When the ADX rises for 4 points, for instance, from 18 to 22, from its bottom point under both of the lines of the DS you can say for sure a new trend is beginning. You should buy if +DI is higher, setting the defensive stops below the very last bottom. If –DI is higher, then you should act similarly.

Picture above: An ADX graph rising confirmed the continuation of the uptrend which was indicated in the beginning by the ascent of the +DI line, and gave a signal to buy.

Bollinger Bands

Bollinger Bands are similar to the moving average envelopes. However, the difference between them is that bounds of the envelopes are above and under the curve of moving averages at a fixed (put into percentage) distance, while the bounds of Bollinger

bands are constructed on the basis of distances which are equal to a certain quantity of standard divergences. The value of the standard divergence depends on volatility, so bands control their width: it increases during market instability and decreases during stable periods. Bollinger Bands are usually drawn on the price chart, but they can be drawn on the indicator chart as well. Everything said below applies to the bands drawn on price charts. As is the case with moving average envelopes, the interpretation of Bollinger bands is based upon the fact that prices usually stay in the range of the upper and the bottom bounds of a band. A peculiarity of Bollinger Bands is their varying width which depends on the price volatility. In periods of considerable price changes (i.e. high volatility) bands widen, making space for prices. In periods of stagnation (i.e. low volatility) bands converge, keeping the prices within the bounds.

Characteristics of Bollinger bands:

1. Sudden price changes usually occur after the band's stagnation indicating diminishing volatility.
2. If prices transcend the band bounds, then the current trend will continue.
3. If after the peaks and cavities outside the band, the peaks and cavities inside the band follow, then a trend reversal is likely.
4. Price movement starting from one of the band's bounds usually reaches the opposite bound. This observation is useful for forecasting of the price targets.

Oscillators

Momentum and ROC

Oscillator Momentum estimates the value of price changes for a certain period.

Formula for calculation:

$$MOM = C - C_n$$

The Rate of Change (ROC) is the second simplest way to apply the oscillator methods. Its difference from Momentum consists in the calculation of its rate: it is estimated not as a discrepancy, but as a quotient from the division of today's closing price by the closing price x of days ago. The general formula looks like this:

$$ROC = \frac{P_t}{P_x} 100\%$$

Where P_t is today's closing price and P_x is the closing price of x days ago.

Momentum and ROC look similar on the chart and apply almost equally. The difference is only in the scale of rates: there is the number 50 in ROC instead of a 0 line, and instead of positive and negative values, fluctuation occur above or below 50. Momentum and ROC determine the acceleration of a trend – whether it is speeding up or down. These indicators have an anticipating character, reaching the maximum before the trend reaches it, and the minimum before the prices fall to their lowest level.

When the oscillators are reaching new maximums it is safe to keep long positions, and vice versa. Reaching more maximums, the oscillator signals that the trend is speeding up, and most probably this situation will continue. When a lower peak is reached, the uptrend weakens and you should be ready for a trend reversal. The analogical reasoning holds true for minimums in a downtrend. The above-mentioned oscillators have the same disadvantages as

simple MAs – they react twice at the data of each day: when they enter the window and when they exit it.

When these oscillators reach a new maximum, it indicates an increase in optimism on the market: prices will most probably rise. If prices go up but the rates of oscillators go down, the price maximum is near; it is time to get profit from long positions and be ready for its reversal. The opposite situation can happen too.

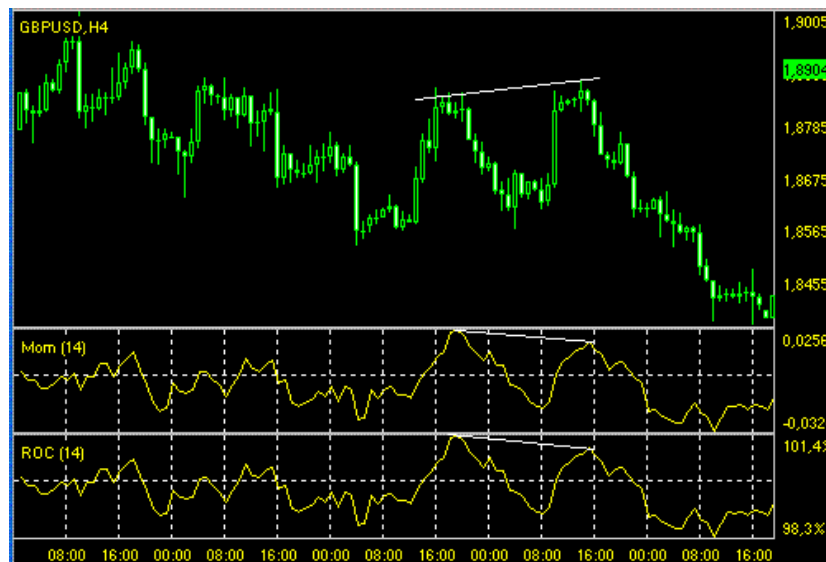
You should be very careful when using the leading indicators:

1. Buy during an uptrend when the oscillator (having fallen below the zero line) starts to rise. This reflects the slowdown of the trend. Sell in a downtrend when the oscillator rises above the zero line and then starts falling.
2. A new indicator's maximum indicates a high bulls' energy; due to this the market may reach a greater maximum. In this case you may hold a long position with a relative safety. A number of downwards maximums determine the bulls' mood weakening and the position should be immediately reversed. The opposite approach is used in the case of a downtrend.
3. The change of the oscillator trend line often anticipates the change of the prices trend line for one-two days. That is why if a change in the leading indicator line takes place you should be ready to reverse the position. The oscillator reaches an overbought state when it has reached a higher level in comparison with the previous index. An overbought state shows an extremely high level when the oscillator is ready to turn down. The overbought state of the market is characterized by a situation where bulls do not want to buy or their opportunities to buy run out and they cannot raise prices to a new high. At that point we may observe a slowdown and that the prices do not have a severe bullish trend. Due to the fact that bulls cannot raise prices to the new level and the prices dynamics for n days has a positive slope an oscillator turns down and after some time breaks the border of the oversold area. This is a signal that the trend will reverse. By analogy, an oversold state takes place when the oscillator reaches a lower value than the previous ones. The oscillator is ready to start rising. Overbought and oversold levers are indicated on charts by horizontal supporting lines. The rule is to place the oscillator so it spends no more than 5% of the time outside the zone limited by these lines. The lines should cross the highest tops and troughs of the oscillator for the last six months. Their position should be corrected every 3 months. The oscillator may stay in the overbought zone for several weeks when a new uptrend starts and gives an early signal to sell. When we have a downtrend the oscillator stays in the oversold zone, mistakenly advising to buy. In such situations you should analyze the trend indicators. Like the already described indicators, the oscillators give the best signals when they are different from the prices. Bullish divergence takes place when prices rise up to the new top while the oscillator does not change its position. This situation shows that prices are rising by inertia and bulls are played out. The opposite situation occurs during a bearish divergence. It should be mentioned that triple divergences are possible for oscillators and the signals from such divergences are stronger.

The main methods of using the speed oscillator:

1. As an oscillator which follows a trend like the MACD. In this case a signal to buy occurs if an indicator forms a trough and starts to rise; a signal to sell – when it reaches a top and turns down. For a more detailed determination of the oscillator's reverse moments it is possible to use its short moving average.

2. Extremely high or low oscillator values presuppose the continuation of the current trend. Thus, if an oscillator reaches extremely high values and then turns down we should expect a further rise in the prices. In any event, you should not hurry to close or open a position before the prices confirm the oscillator signal.
3. As a leading indicator. This method is based on the assumption that the final stage of the uptrend is usually accompanied by the rapid prices' growth (because everybody believes in the growth continuation); a bearish market closing is usually accompanied by their rapid fall (because everybody tries to leave the market).



Pic.6 Registration MOM and ROC are very similar, the possibility of a change in direction is determined after the upper borders of the interval are reached. Divergence became a strong signal for the confirmation of the trend change.

RSI (Relative Strength Index) is a financial technical analysis momentum oscillator measuring the velocity and magnitude of directional price movement by comparing upward and downward close-to-close movements. The RSI ranges from 0 to 100. One of the popular methods of RSI analysis lies in the search for divergence when a price generates a new maximum and the RSI does not manage to overcome the level of its previous maximum. Such a difference indicates the possibility of the prices reversal. If the RSI turns down and falls below its trough, it completes “a failure swing.” The failure swing is considered a confirmation of an impending reversal.

Ways to use Relative Strength Index for chart analysis:

1. Tops and bottoms

The Relative Strength Index usually tops above 70 and bottoms below 30. It usually forms these tops and bottoms before the underlying price chart.

2. Chart Formations

The RSI often forms chart patterns (such as head and shoulders or triangles) that may or may not be visible on the price chart. A failure swing takes place when the RSI rises above the previous maximum or falls below the previous minimum.

3. Support and Resistance levels

The Relative Strength Index shows, sometimes more clearly than prices themselves, the levels of support and resistance.

4. Divergences

As we discussed above, divergences occur when the price reaches a new maximum (or minimum) that is not confirmed by a new maximum (or minimum) in the Relative Strength Index. Prices correction takes place in the direction of the RSI.

In June 1978 Welles Wilder introduced the **Relative Strength Index (RSI)**, which is a widespread oscillator. The RSI is one of the most popular and famous oscillator methods. There is not only a standard oscillator analysis set, but also graphical analysis with the support, resistance and tendency lines described above.

The formula for the oscillator amount calculations is the following:

$$RSI = 100 - [100/(1+RS)]; \quad RS = AUx/ADx$$

X – the number of days;

AU – an average amount of the above-closed prices for x days;

AD - an average amount of the below-closed prices for x days;

This oscillator determines the strength of bullish and bearish moods, tracing the price changes during a given period. The RSI is situated in an area from 0 to 100. The two control levels (the higher bottom control level is above 70, the lower bottom control level is below 30) are placed on the chart with the help of horizontal markers. However, some shifting of the lines is possible in the strong trend markets: in strong bullish markets they may be at levels from 40 to 80; in strong bearish markets – from 20 to 60. Three signal types of RSI are known. These are divergence, chart models, and levels.

The bullish type of divergence gives signals for buying. A **bullish divergence** occurs when the prices reach a new low but the RSI does not. It is better to buy when the RSI starts rising from this minimum and to place a stopping point below the level of the last lowest price. The signal for buying will be especially strong if the penultimate minimum RSI occurs under the lowest supporting line and the last minimum above the line. In case of a bearish divergence, we face the reversed situation. The buy signal is strong if the penultimate RSI top is above the top of the supporting line and the last peak is under the supporting line. Among all indicators, it is the RSI that classical graphical methods work best with. The dynamic of the RSI chart advances prices dynamic for several days, giving us grounds for building suppositions about their further behavior. Thus, the trend line RSI is changing two days before the price.

The rules for analysis of the trend line's RSI are the following: when the RSI chart breaks the trend line's RSI below the bottom, place a buy order. In the opposite situation when the RSI chart breaks the trend line RSI above, place a sell order. When the RSI rises above the top support line we may speak about the bulls' strength but at the same time such a situation characterizes the market as overbought and ready for selling. On the contrary, when the RSI falls under the bottom support line we speak about the bears' strength, the market is oversold and in a while traders start to buy. Holding a long position backed up by an overbought one signals that the RSI is reasonable only if there is a weekly uptrend.

One important peculiarity connected with the usage of oscillators should be mentioned. Any strong trend directed down or up usually makes oscillators assume critical values rather quickly. In such cases it is early to conclude that the market is overbought or oversold: such a mistake may lead to a premature closing of a profitable position. For example, during an uptrend the market may remain overbought for a long period of time. However, if the oscillator value is in the top critical position it does not mean that you should eliminate all deals or open a short deal during the uptrend. The first occurrence of the oscillator value in the overbought or oversold area usually is just a warning. A more important signal which requires attention is the second appearance of the curve in the critical area. In case it does not prove a further rise or fall of the prices and the oscillator curve forms a double top or bottom, we have to state possible divergence and take certain measures in order to protect our positions. If a curve turns to the other side and breaks the level of the previous peak or fall, the divergence signal is proved. In such situations it is worth using stop orders, placing their levels right up close to the current prices level.



Pic.7 Indicator chat supported by a strong bullish divergence left an overbought area and gave a signal to buy.

Stochastics Oscillator

Developed by George C. Lane in the late 1950s, the Stochastic Oscillator is one of the most popular oscillators in technical analysis. The oscillator is a curve fluctuating in the range 0-100. It is considered that quotations are not stable if the oscillator rises higher than 70 pips or falls below 30 pips. The stochastic oscillator buy signal is generated when it moves from below to above 20 percent, while the sell signal is generated when it moves from above to below 80 percent. Sometimes a simple moving average is drawn at a chat of the stochastics oscillator. This is one of the most widespread methods of technical analysis. With this method the price movement in a selected period is revealed. There are two simple moving

averages - short and long - that are calculated, and then the average from the short period is deducted from the average from the long period.

Formula:

$$OSC = SMA(P,m) - SMA(P,n)$$

Actually, this formula shows a cross of moving averages, and that is why this indicator may be classified as part of the oscillator methods. However, one competent edition considers it as an oscillator. The authors think that by using this indicator they eliminate all short-term price fluctuations and long-term trends. For instance, while trading with one-hour prices' fluctuations averaging in one hour are considered a short period in order not to watch shorter fluctuations. A time lag of one day may be taken as a long period. Information about the average level which differs one day from another is lost. However, this disadvantage is compensated by the indicator's visualization. Positive overrated oscillator values mean that the price is excessively increased towards a long-term trend and give a signal to buy. High negative values signal to sell.

Classical oscillator signals are the bullish divergence and the bearish convergence. The crossing of the oscillator of the zero line from the bottom is a signal to buy if it is a confirmed bullish trend (an oscillator reverse towards trend dynamics placed below the zero line is considered to be the earliest signal). The crossing of the oscillator of the zero line from the top is a signal for buying if it is a confirmed bearish trend. The earliest signal is the indicator's reverse located above the zero line. This is a trend signal. A signal against the trend is a reversal of the oscillator from the overbought and oversold areas. This indicator is based on the principle that in an upward trading market the prices tend to close near their high, while in a downward trading market prices tend to close near their low. Stochastics compares the current closing prices with recent low and high prices on a chart. The stochastics indicator is plotted as two lines, %K and %D. The latter is more important and according to its dynamic we may judge upon the most significant changes in the market. The %K line is more sensitive than the %D. Mathematically, the %K line looks like this:

$$\%K = 100 * [Ct - L5 / H5 - L5]$$

C = the most recent closing price

L5 = the low of the previous five trading sessions

H5 = the highest price traded in the same 5-day period.

The formula allows traders to calculate the place of the last closing price for a certain period of time. If the value is above 70% then the closing price is near the upper bound of the range; if it is below 30% then the closing price is near the lower bound. The %D is a 3-period moving average of %K.

The formula for the more important %D line looks like this:

$$\%D = 100 * CL3 / HL3$$

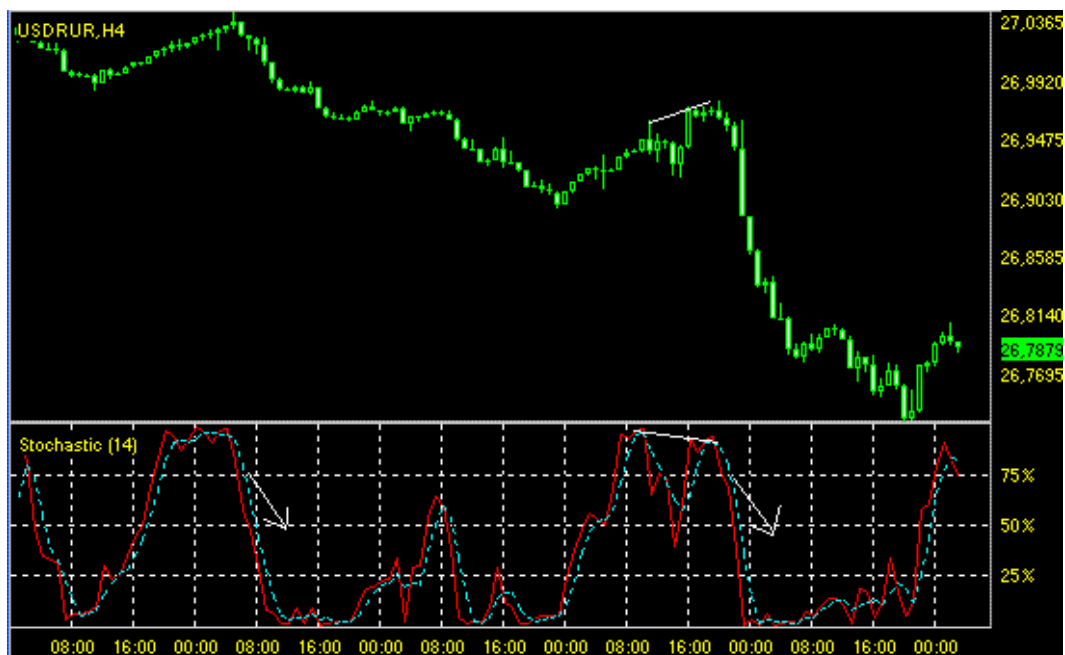
CL3 – three-day sum (Ct-L5);

HL3 – three-day sum (H5-L5).

According to the above formulas two lines are drawn which fluctuate from 0 to 100. The K line is drawn as a continuous line, while the slower D line is drawn dotted.

Such stochastic lines are called fast. Some traders prefer to use slow stochastic lines. In this case the formulas for both lines are changed. The %K line is calculated according to the formula for %D, and %D as CC divided to %K. The stochastic oscillator shows the ability of the bulls or bears to close the market near the upper or lower range border. If bulls raise prices during the day but cannot close them near the maximum, the stochastic lines start to decrease. This gives a signal to buy. A divergence between the line %D and the price which takes place when the line appears in the oversold or overbought area is an important signal. These areas begin beyond the pale of the horizontal lines, which are determined by lines 70 and 30. The most important signals for buying or selling occur when the line B is in the area from 10 to 15 and from 85 to 90. The stochastic gives three types of signals:

1. The strongest signals for buying or selling occur when a divergence takes place between the prices and indicators. Bullish divergence appears when line %D is above 70 and forms two falling tops and prices continue to rise. The line %D is under 30 and forms a double upward bottom and prices continue to fall when we have a bearish divergence. If all these factors exist, the final signal (to buy or to sell) is registered when the K line crosses the %D line after the latter has already changed its moving direction. In other words, the intersection should be to the right of the extreme point of line %D. Thus, the signal to buy is more important in the bottom area, if the line K during its rise crosses the line %D after the line %D has already turned upwards. The signal to buy is more significant in the top area if the line %D reverses and starts moving downwards before K crosses it. The importance of the intersection is higher if both lines move in one direction.
2. Another signal is when an indicator occurs in the oversold or overbought area. If we have a weekly bullish trend and the daily stochastic lines fall below the bottom line, make a buy order establishing a protective stop at the level of the previous button. For the opposite situation make an order to sell. The stochastic lines' extreme form very often allows us to judge about the possible rise strength. In case of a narrow minimum the bears' strength is low and we may expect a strong rise. The opposite conclusions may be drawn if the minimum is wide and deep. The same conclusions may be drawn regarding the maximums of the stochastic lines.
3. The next signal is the direction of the price chart and the stochastic line ratio. The stochastic confirms short-term trends when both of its lines have the same direction. Most probably the upward trend will continue if both prices and stochastic rise. If the prices are moving and both stochastic lines rise, the short-term trend will likely continue.



Pic.8 Pay attention to how reliably the stochastic indicates signals to buy for the pair USD/RUR. The intersection of the line %D by the line %K and further moving downwards from the overbought area give perfect signals to buy (work only in the trend direction).

Helpful information for the users of the SuperForex MetaTrader4 terminal

A number of indicators of technical analysis are used by the program:

Average Directional Movement

One of the most frequently used technical indicators which allow traders to identify the trend (tendency of the price change). J. Welles Wilder pays a lot of attention to this indicator in his book *New Concepts in Technical Trading Systems*.

Bollinger Bands

Bollinger Bands are an indicator that allows users to compare volatility and relative price levels over a period of time. A band plotted two standard deviations away from a simple moving average. Because standard deviation is a measure of volatility, Bollinger bands adjust themselves to the market conditions. When the markets become more volatile, the bands widen (move further away from the average), while during less volatile periods, the bands contract (move closer to the average). The tightening of the bands is often used by technical traders as an early indication that the volatility is about to increase sharply.

This is one of the most popular technical analysis techniques. The closer the prices move to the upper band, the more overbought the market; the closer the prices move to the lower band, the more oversold the market.

Commodity Channel Index

This technical indicator is used for measuring price deviations of the financial asset from the average value. If the index value is high, a price is considered to be overstated; if the index value is low, a price is considered to be understated.

DeMarker

It shows the difference between the current and previous bar – if the maximum of the previous bar is higher, the difference is registered. If the maximum of the previous bar is lower or equal to the current maximum the difference remains zero. The DeMarker indicator fluctuates from 0 to 100. The turn of the prices downwards is expected if the parameter of the indicator moves above a mark 70. The turn of the prices upwards is expected if the indicator moves below a mark 30.

Envelope

This indicator of technical analysis is formed by the two lines of the moving averages - one is shifted upwards, another downwards. Moving Average Envelopes serve as an indicator of overbought or oversold conditions, visual representations of the price trend, and an indicator of price breakouts.

Moving Average

Moving averages are one of the most popular and easy to use tools available to the technical analyst. The calculation of the moving average is made within a certain selected period. The greater the period, the less is the possibility for false signals and sensitivity of the moving average.

MACD (Moving Average Convergence Divergence)

A trend-following momentum indicator that shows the relationship between two moving averages of prices. The MACD is calculated by subtracting the 26-day exponential moving average (EMA) from the 12-day EMA. A nine-day EMA of the MACD called the "signal line" is then plotted on top of the MACD, functioning as a trigger for buy and sell signals.

Momentum

This is a technical indicator that is designed to identify the speed (or strength) of a price movement. Usually, the momentum indicator compares the most recent closing price to a previous closing price, but it can also be used on other indicators such as moving averages.

Oscillator

The oscillator is calculated as the difference of the moving averages from long and short periods.

Parabolic SAR

This indicator is built on the price chart. By implication this indicator is an analogue of the moving average, but PSAR moves with a greater acceleration and is able to change its position relative to the price. If a price crosses the PSAR lines, the indicator turns and the next values of the indicator are placed opposite the price. The maximum or minimum price for the previous period will serve as the reference point. The indicator's turn is a signal which indicates that a trend either stops or reverses.

Rate of Change (ROC)

The Rate of Change (ROC) indicator is a very simple yet effective momentum oscillator that measures the percent change in price from one period to the next. The ROC calculation compares the current price with the price from previous periods. Intervals from a minute to a month may be taken as periods.

Relative Strength Index

The RSI is an indicator of the price change speed. This indicator is characterized by the price change for a certain period of time - it shows the strength of the price. It calculates the average values of the price increase and decrease.

Standard Deviation

This indicator shows the magnitude of the price variability for a certain period of time. Standard deviation is calculated according to a simple formula: it is the square root of the variance.

Stochastic Oscillator

The Stochastic Oscillator compares the current price with the price range for a certain period. This indicator is represented by two lines.

William's Percent Range

Williams' Percent Range Technical Indicator (%R) is a dynamic technical indicator, which determines whether the market is overbought or oversold. It has an upside-down scale.

For the most precise technical analysis users have the opportunity to export data for further analysis in the specialized systems of the technical analysis Omega Tradestation and Metastock.

Test

1. What is a technical indicator?
2. What groups are technical indicators divided into?
3. What is the most efficient (strongest) signal in technical analysis? Explain the structure of this signal.
4. Describe trading signals of the stochastic indicator.
5. Under what MACD signals should long positions be opened?
6. What does the ADX chart show?