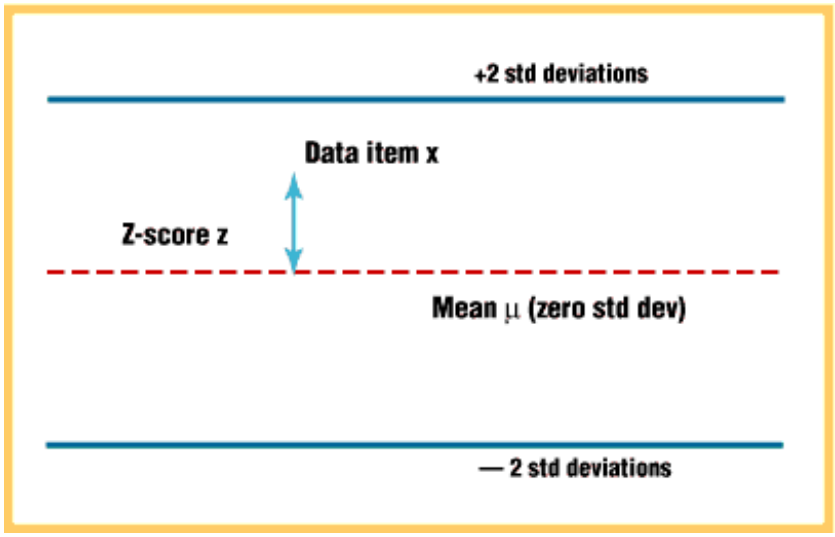
Z-Score Indicator

premium.working-money.com/wm/display.asp

While researching for my math class, I came across *z*-score and its definition. Suddenly, references to "mean" and "standard deviation" suggested a possible relation with the well-known Bollinger Bands. Is there any other way to look at these bands? Can trades be made using *z*-score as an indicator? I decided to find out. In this article, I will try to respond to these questions.
The *z*-score (*z*) for a data item *x* measures the distance (in standard deviations σ) and *direction* of the item from its mean (μ):

A value of zero indicates that the data item *x* is equal to the mean μ, while positive or negative values show that the data item is above (x>μ) or below (x<μ) the mean, respectively. Values of +2 and -2 show that the data item is two standard deviations above or below the chosen mean, respectively, and over 95.5% of all data items are contained within these two horizontal references (see Figure 1).

$$z = \frac{x - \mu}{\sigma}$$



> **Figure 1:** *Z*-score indicator. Over 95.5% of all data are contained within + and -2 standard deviations.

CALCULATION OF Z-SCORE

How can you apply this formula to stock prices? If you substitute *x* with the closing price *C*, the mean μ with simple moving average (SMA) of *n* periods (*n*), and σ with the standard deviation of closing prices for *n* periods, the above formula becomes:

(Computation of *z*-score, using Excel and MetaStock, for a series of closing prices, is explained in the sidebar, "*Z*-score calculation.")

$$z-\text{score}=\frac{C-\text{SMA}(n)}{\text{StdDev}(C,n)}$$

HOW TO USE THE Z-SCORE INDICATOR

Once the indicator is defined, the question is "What is the relationship between *z*-score and the well-known Bollinger Bands?" While Bollinger Bands applied to closing prices are displayed as *D* standard deviations above and below the mean, *z*-score shows *how far* the current closing price is from these bands.

Figure 2 displays Bollinger Bands for closing prices (20 periods and two standard deviations) and *z*-score for 20 days applied to the daily chart of the Dow Jones Industrial Average (DJIA).

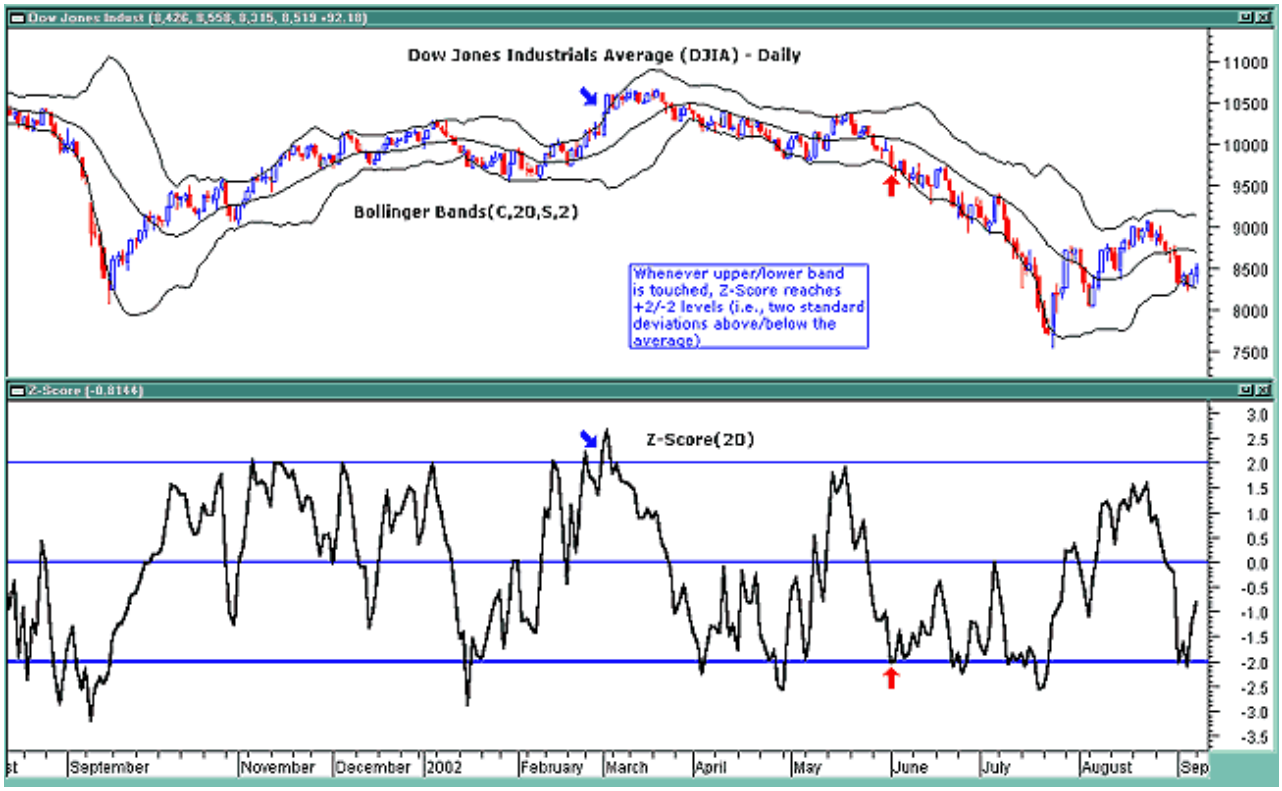


Figure 2: Bollinger Bands and *z*-score. When prices touch the bands, the z-score reaches +2 or -2 standard deviation levels.

As expected, whenever the price touches the top band, the *z*-score reaches the +2. Conversely, when price touches the lower band, the *z*-score reaches -2 standard deviation levels.

In Figure 3 (top chart) you see the *z*-score indicator applied to the Nasdaq composite index. The horizontal levels at +2, 0, -2 offer a clear picture of expected resistance and support levels, as they are equivalent with top Bollinger Band, moving average, and bottom Bollinger Band, respectively.

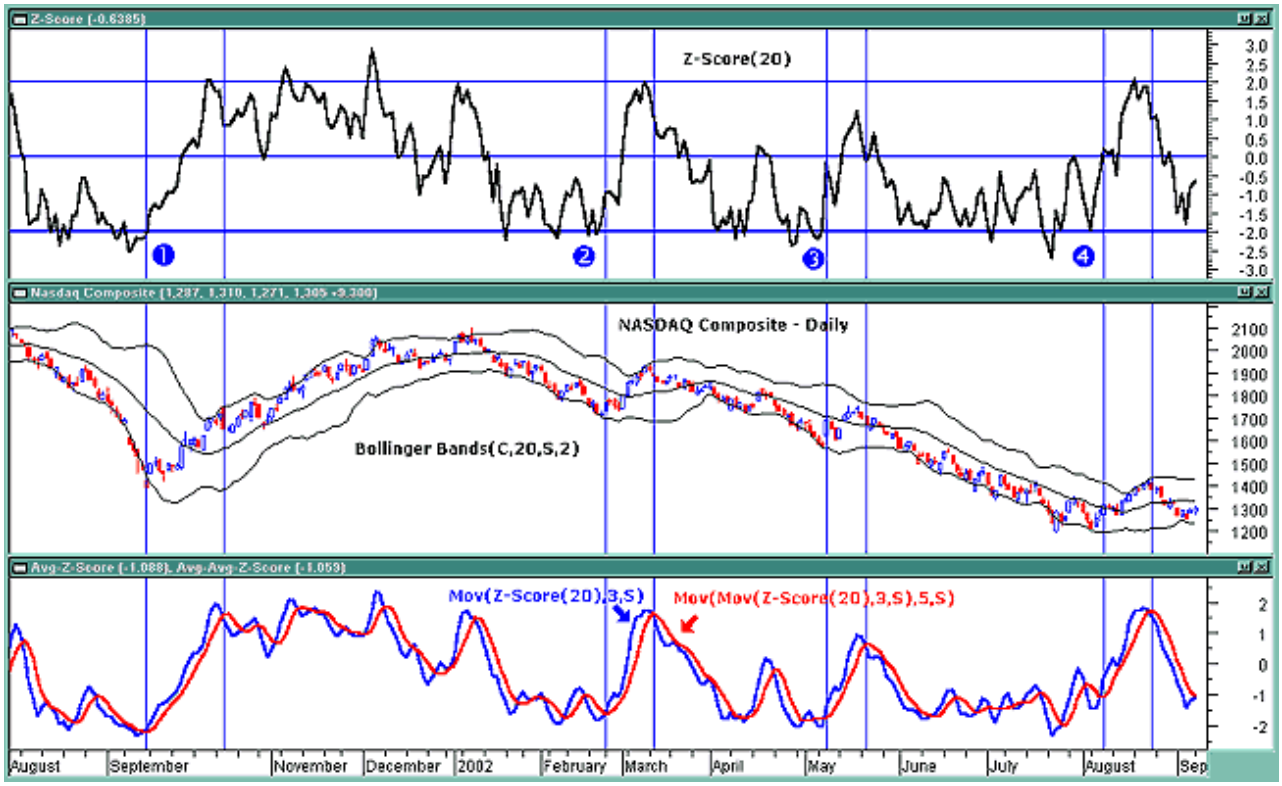


Figure 3: Smoothing the *z*-score. This can result in very profitable trades.

Z-score applied to closing prices is an irregular curve that can be smoothed by applying moving averages. In Figure 3 (bottom chart), a simple three-day moving average has been applied to the *z*-score (20), and a simple five-day moving average is applied to the resulting average.

As you can see, good long tradable moves took place at:

·Point 1 (09/21/01 10/17/01)

·Point 2 (2/25/02 3/12/02)

·Point 3 (5/8/02 5/21/02)

·Point 4 (8/8/02 8/23/02)

when the three-day simple moving average crossed above the five-day simple moving average of the three-day simple moving average. Note there are some good shorting opportunities initiated when the three-day simple moving average crossed below the five-day simple moving average of the three-day simple moving average (3/12/02, 04/22/02, 5/21/02, and 8/23/02).

CONCLUSIONS

The *z*-score indicator is not new, but its use can be seen as a supplement to Bollinger Bands. It offers a simple way to assess the position of the price *vis-à-vis* its resistance and support levels expressed by the Bollinger Bands. In addition, crossings of *z*-score

averages may signal the start or the end of a tradable trend. Traders may take a step further and look for stronger signals by identifying common crossing points of *z*-score, its average, and average of average.

In order to improve performance, traders can use different periods for the bandstogether with other periods for the moving averages.

> *Veronique Valcu is a senior at the American School of Paris, France, with an interest in the financial markets.*

REFERENCES

Achelis, Steven B. [1995]. *Technical Analysis From A To Z,* Irwin Publishing.
Elder, Alexander [1993]. *Trading For A Living*, John Wiley & Sons.

Evens, Stuart P. [1999]. "Bollinger Bands," *Technical Analysis of* STOCKS & COMMODITIES, Volume 17: March.

Murphy, John J [1999]. *Technical Analysis Of Financial Markets*, New York Institute of Finance.

www.bollingerbands.com

www.animatedsoftware.com, Internet Glossary of Statistical Terms

www.thinkquest.org, ThinkQuest: Internet Challenge Library

TC2000 (data), MetaStock (Equis International)

SIDEBAR: Z-SCORE CALCULATION

The *Z*-score formula applied to closing prices is

$$z-\text{score}=\frac{\text{Close}-\text{SMA (Close,'n' periods)}}{\text{StdDeviation(Close, 'n' periods)}}$$

In this example, *n* = 20 days, but other periods can be used.

Here is the calculation written for an Excel spreadsheet where *n* = 20 periods (daily bars).
Closing prices are shown in column B for the Nasdaq Composite between July 1 and August 30, 2002.

In cell C21, compute the simple moving average for the first 20 closing prices:

=Sum(B2:B21)/20

In cell D21, the use of the Excel function STDEVP (standard deviation) defines the standard deviation of closing prices for the first 20 days:

=STDEVP(B2:B21)

In cell E21, insert the *Z*-score formula as:

=((B21-C21)/D21).

Copy formulas in C21, D21, and E21 down to the bottom of the last row of the columns. The final *Z*-score results appear in column E. Values in this column can be plotted easily to visualize the *Z*-score indicator.

You can download the spreadsheet here.

To create the same indicator using MetaStock 6.52, select Indicator Builder from Tools, select "New," assign "*Z*-score" as Name and enter the following code:

Periods:=Input("Enter Periods",5,21,20); {number of periods used, in this case 20}

a := (C-Mov(C,Periods,S))/ Stdev(C,Periods) ; {define Z-Score }

a; {plot Z-Score}

Press OK to save this code. You are now ready to apply this indicator to any selected chart. *V.V.*

Current and past articles from *Working Money, The Investors' Magazine,* can be found at Working-Money.com.