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Candle charts for financial technical analysis

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Abstract. Technical analysis is an important part of financial industry, research, and teaching. The methodology has two parts: i) calculation of the individual tools and ii) visual representations. In this article, I provide a community-contributed command, `candlechart`, to draw the most common technical analysis charts. My intent is to draw these charts similarly to industry examples. The popular candle price chart is combined with charts for volume, moving-average convergence divergence, relative strength index, and Bollinger bands.

Keywords: gr0076, `candlechart`, technical analysis, candle chart, volume, moving-average convergence divergence, relative strength index, Bollinger bands

1 Introduction

Technical analysis is one of the important financial forecasting methods. Popular tools for such analysis are based on moving averages, mean reversion, standard deviation, and volume. Common tools include moving-average convergence divergence (MACD), relative strength index (RSI), and Bollinger bands. In this article, I provide a community-contributed command, `candlechart`, to visually represent these common technical analysis tools.

Financial literature includes many studies to test the validity and forecasting ability of technical analysis (for example, Scott, Carr, and Cremonie [2016]; Blume, Easley, and O'Hara [1994]; and Neftci [1991]). Many studies cover specific tools and their forecasting powers. For instance, Bollinger bands are evaluated by Leung and Chong (2003) and Lento, Gradojevic, and Wright (2007), while MACD and RSI are evaluated by Chong and Ng (2008).

Researchers used to believe that returns were not predictable and that they followed a random walk (for example, Fama [1965]). However, many researchers now believe that returns may be predictable (for example, Campbell and Yogo [2006]). Accordingly, many researchers argue that common technical analysis may help to predict returns and identify price patterns (for example, Gehrig and Menkhoff [2006] and Leigh, Purvis, and Ragusa [2002]). This change in a fundamental cornerstone of financial theory leads many to readdress the importance of forecasting and technical analysis.

Investor behavior is one of the reasons that returns can be predicted (for instance, herd behavior by Bikhchandani and Sharma [2000]). Thus, instead of trying to find new analysis tools, researchers focus on self-fulfilling prophecies (that is, Azariadis [1981]). Technical analysis tools that are common and popular are likely to have sufficient people

to believe in their predictions. These believers will fulfill the prophecies. For instance, investors who believe in Bollinger bands would become bearish every time the price breaks above the upper band. Similarly, people who believe in Fibonacci retracement will become more cautious around 23.6%, 38.2%, and 61.8% support and resistance levels. These levels will become like magnets, oscillating the price for multiple days if a sufficient number of traders believe in this technical analysis tool.

In this article, I focus primarily on the visual representations of the most common and popular financial technical analysis tools. This content is applicable for industry professionals, researchers, and students. Stata has community-contributed commands to download financial prices (that is, `fetchyahooquotes` by Dicle and Levendis [2011]) and option prices (that is, `fetchyahooptions` by Dicle [2013]) and to calculate technical analysis tools (that is, `tftools` by Dicle and Levendis [2017]). This article complements these efforts with visual representation of technical analysis tools as it is common in financial forecasting practice.

2 Technical analysis charts: candlechart

2.1 Title

`candlechart` draws technical analysis charts for financial securities with daily high, low, open, and close prices.

2.2 Syntax

```
candlechart namelist [if] [in] [, price volume macd rsi bollinger
    keep_charts down_color(string) up_color(string) chart_options(string)
    combined_chart_options(string) tftools_rsi_options(string)
    tftools_macd_options(string) tftools_bb_options(string) ]
```

namelist is the symbol of the security to be used for the technical analysis charts. We suggest downloading the data with the community-contributed `fetchyahooquotes` command (Dicle and Levendis 2011). Updated versions of `fetchyahooquotes` can be installed in Stata from our servers. When you download financial securities with the command `fetchyahooquotes`, security symbols (ticker codes) are used. `candlechart` uses the same symbols for the securities (for example, the symbol for Apple Inc. is AAPL).

2.3 Description

`candlechart` draws charts for the most common financial technical analysis tools. Charts are intended to be similar, in their appearance, to the industry examples. This makes it easier for traders to conduct their usual technical analysis using `candlechart`.

Most online technical charting tools cannot accommodate conditional statements, data manipulation, elimination of outliers, redefinitions, and amendments. `candlechart` is a series of `twoway` charts that are very familiar to most Stata users. The open-source nature of Stata commands allows users to change these charts based on their own technical analysis preferences.

A candle within a candle chart has two parts: the line and the body. The line represents the daily high at the top and daily low at the bottom. The body represents the daily open and daily close. If the daily close is higher than the daily open, then the top of the body is the daily close, the bottom of the body is the daily open, and the body is usually filled with green. If the daily close is lower than the daily open, then the top of the body is the daily open, the bottom of the body is the daily close, and the body is usually filled with red.

`candlechart` is intended to draw financial charts. Thus, it actually does not involve any financial calculations. The community-contributed command `tftools` is used for this purpose. All calculations within `tftools` are provided by Dicle and Levendis (2017) and include Bollinger bands, MACD, and RSI.

2.4 Options

`price` includes a price chart to the combined technical analysis charts.

`volume` includes a volume chart to the combined technical analysis charts.

`macd` includes an MACD chart to the combined technical analysis charts.

`rsi` includes an RSI chart to the combined technical analysis charts.

`bollinger` includes Bollinger bands to the price chart.

`keep_charts` keeps the individual charts in memory. If specified, a list of chart names is provided.

`down_color(string)` is the color to fill the down candles. The default is `down_color(red)`.

`up_color(string)` is the color to fill the up candles. The default is `up_color(green)`.

`chart_options(string)` includes the `twoway` chart options for individual technical analysis charts. The overall technical analysis chart is a combination of possibly four charts: `price`, `volume`, `macd`, and `rsi`. Each of these charts is combined into one. With the `chart_options()` option, users can specify the `twoway` chart options for these individual charts.

`combined_chart_options(string)` includes the `graph combine` options for the combined technical analysis charts. The four individual analysis charts are combined into one using the `graph combine` command. With the `combined_chart_options()` option, users can specify the `graph combine` options for the overall combined chart.

`tftools_rsi_options(string)` passes options to the internally run `tftools rsi` command.

`tftools_macd_options(string)` passes options to the internally run `tftools macd` command.

`tftools_bb_options(string)` passes options to the internally run `tftools bollinger` command.

2.5 Installation and updates

To install the software associated with this article as it existed when the article was published, type

```
net install http://www.stata-journal.com/software/sj19-1/gr0076/
```

Updated versions of the software may be available from our servers. To install from there, type

```
net install "http://researchata.com/stata/026/candlechart.pkg"
```

`candlechart` requires the installation of `tftools` (Dicle and Levendis 2017) for financial technical analysis tools and their calculations. The current version of `tftools` can be installed from our servers.

```
net install "http://researchata.com/stata/210/tftools.pkg"
```

`fetchyahooquotes` is strongly suggested for downloading security prices (Dicle and Levendis 2011). The current version of `fetchyahooquotes` can be installed from our servers.

```
net install "http://researchata.com/stata/203/fetchyahooquotes.pkg"
```

`candlechart` is written assuming data structure provided by `fetchyahooquotes`. To accommodate multiple symbols within the data, `fetchyahooquotes` adds symbols to each variable name (for example, `adjclose_AAPL`). Accordingly, several variables are required by `candlechart`, and their variable names should include symbols: for example, `adjclose_AAPL` (adjusted, for splits and dividends, closing price of the day); `open_AAPL` (opening price of the day); `close_AAPL` (closing price of the day); `high_AAPL` (high price of the day); `low_AAPL` (low price of the day); and `volume_AAPL` (volume of the day). `candlechart` requires daily time-series data.

2.6 Usage

► Example

Candle chart for AAPL:

```
fetchyahooquotes AAPL, freq(d) chg(ln) start(01may2017) end(10december2017) ///
    field(o c h l v)
generate obs=_n
tsset obs
replace volume_AAPL = volume_AAPL/1000000
candlechart AAPL if month(date)>7
```



Figure 1. Candle chart for AAPL

Figure 1 shows the candle chart for AAPL. For each candle, there is a body and a line. The top of the line is the daily high. The bottom of the line is the daily low. For a trading day when AAPL closed above the open, i) the body will be gray and ii) the top of the body will be the close of the day, while the bottom of the body will be the open of the day. For a trading day when AAPL closed below the open, i) the body will be black and ii) the top of the body will be the open of the day, while the bottom of the body will be the close of the day.

◀

► Example

Price and volume charts for AAPL:

```
clear all
fetchyahoohquotes AAPL, freq(d) chg(ln) start(01may2017) end(10december2017) ///
    field(o c h l v)
generate obs=_n
tsset obs
replace volume_AAPL = volume_AAPL/1000000
candlechart AAPL if month(date)>7, price volume
```

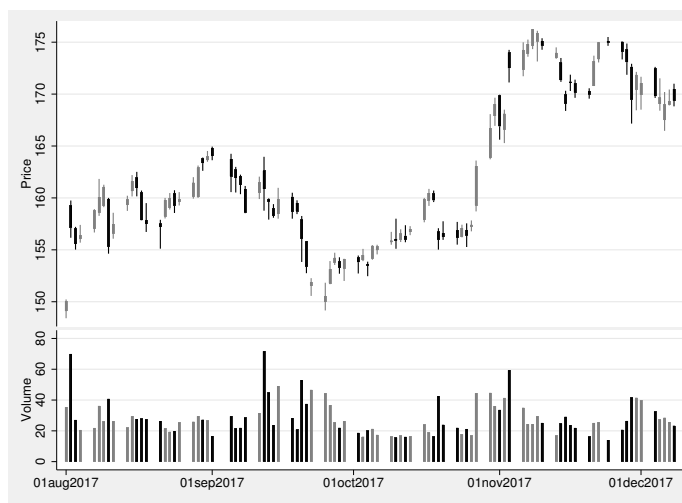


Figure 2. Price and volume charts for AAPL

Figure 2 shows the price candle chart along with the daily volume. Many technical analysis tools incorporate volume into their calculations.

◀

► Example

Technical analysis charts for AAPL:

```
clear all
fetchyahoquotes AAPL, freq(d) chg(ln) start(01may2017) end(10december2017) ///
    field(o c h l v)
generate obs=_n
tsset obs
replace volume_AAPL = volume_AAPL/1000000
candlechart AAPL if month(date)>7, price volume macd rsi bollinger
```

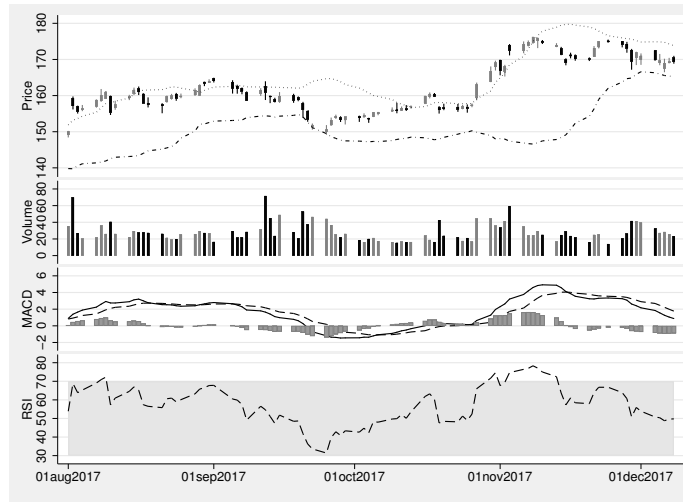


Figure 3. All four technical analysis charts for AAPL

Figure 3 shows all four technical analysis tools. For the Bollinger bands, it is common to conclude that the price that is above or below the Bollinger bands will revert to mean. Because the current price is within the Bollinger bands, this tool does not provide us with a signal. There is no extraordinary volume or lack thereof. Thus, volume also does not provide any signal for AAPL. For the MACD, the signal lines are reverting back to the mean, and both MACD lines are too close together. MACD also does not provide us with any meaningful signal. Finally, for the RSI, it is within the 30–70 band and does not provide us with a signal.

◀

► Example

Usage of the chart options:

```
clear all
fetchyahoohquotes AAPL, freq(d) chg(ln) start(01may2017) end(10december2017) ///
    field(o c h l v)
generate obs=_n
tsset obs
replace volume_AAPL = volume_AAPL/1000000
candlechart AAPL if month(date)>7, price volume macd rsi bollinger ///
    chart_options(ylabel(,angle(horizontal) format(%5.0fc)) ///
    xlabel(, angle(vertical) format(%td)) scale(.50)) ///
    combined_chart_options(title(Technical analysis charts for AAPL, size(3)))
```

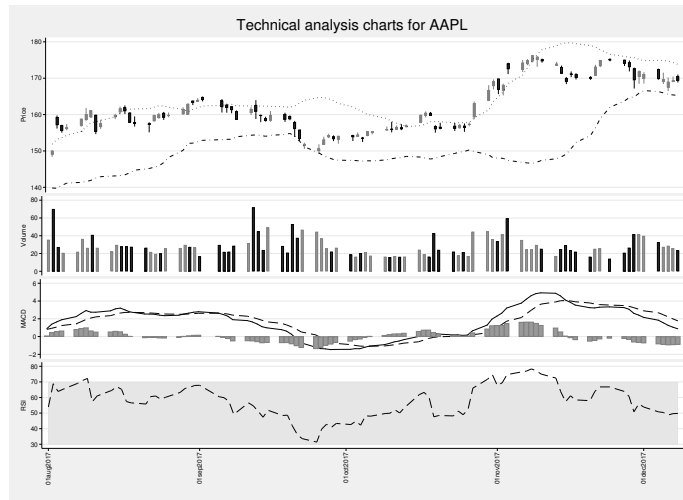


Figure 4. All four technical analysis charts for AAPL with chart options

Figure 4 shows all four technical analysis tools with chart options. Notice the chart title and the vertical x -axis labels. By using the `scale()` chart option, users can enhance the overall outlook of the charts when using long time series.

◀

3 Conclusion

Technical analysis is a significant part of financial forecasting. It is popular and gaining in momentum as technology advances. Fundamental changes in our understanding of return predictability also raises the popularity of technical analysis. Visual representation of technical analysis tools are available through most industry software. Stata is common among finance professionals, academics, and students. I provided a community-contributed command, `candlechart`, to draw technical analysis tool charts in a familiar way. While I include charts for the most common analysis tools, the

open-source nature of Stata commands allows users to extend the application. Previous community-contributed commands enable Stata users to download security prices directly to Stata and calculate technical analysis tools. `candlechart` complements this ongoing effort to conduct financial analysis and financial research with Stata.

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