Technical Analysis using Bollinger Bands

QF 302 - Spring 2019

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Introduction to Bollinger Bands

- Useful tool for analyzing trend strength & monitoring when a reversal may be occurring
- Three bands:
  - Moving average of the price
  - Two standard deviations above moving average
  - Two standard deviations below moving average
- Movement above and below these bands signal buy or sell strategies to traders
- Bands contract and widen with volatility

- Upper band - level that is statistically high or expensive
- Lower band - level that is statistically low or cheap
- Bollinger bandwidth correlates to the volatility of the market

Data Prep

- Price data imported from SHIFT for a basket of 5 stocks
  - AAPL, AMZN, BP, COP, XOM
- Bollinger bands are calculated using a window of 10 periods
  - 10-period Moving Average of stock prices
  - 10-period Standard Deviation of stock prices
  - Upper and Lower Bands = MA ± 2 * StDev
  - Upper and Lower Mid Bands = MA ± StDev

Trading Strategy

Utilizing the Bollinger bands created, we are able to formulate buy/sell signals for a momentum strategy that our algorithm will trade off of.

- Long:
  - Last Price $\in$ [Upper Mid, Upper Band]
- Neutral:
  - Last Price $\in$ [Lower Mid, Upper Mid]
- Short:
  - Last Price $\in$ [Lower Mid, LowerBand]

Enter Long Position

Enter Neutral Position

Enter Short Position

Bollinger Bands

Position	Signal
Long	1
Neutral	0
Short	-1

Trade predefined blocks of shares

```
# Define variables to track the portfolio's P&L and portfolio value
portfolio_pnl = 0
portfolio_value = 1000000

# For each ticker
for ticker in stocks:
    # Filter the initial data to the current ticker
    fltr = BS_spread["Ticker"] == ticker

    # Calculate the bollinger bands for that stock with a window of 10 periods
    df = get_bollinger_bands(BS_spread[fltr], 10).reset_index()

    # Plot the bollinger bands
    plot_bollinger_bands(df, ticker)

    # Calculate the number of shares to buy/sell at a time
    n_shares = round((portfolio_value / len(stocks)) / df.loc[0, "Last"], 0)

    # Calculate the signal from the previously defined logic
    df = get_signal(df)

    # Trade based on that signal and record the point-in-time P&L
    df = get_pnl(df, n_shares)

    # Calculate the total P&L for this stock
    total_pnl = round(df.loc[df.shape[0] - 1, "PnL"], 2)

    # Add that P&L to the total portfolio
    portfolio_pnl += total_pnl

    # Plot that ish
    cols1 = ["PnL"]
    cols2 = ["Signal", "signal change"]

    # visualize $$$
    ax1 = df[cols1].plot(title = ticker + " Strategy P&L = $" + str(total_pnl), figsize=(12, 7))
    ax2 = df[cols2].plot(title = "Signal and Signal Change", figsize=(12, 7))
```

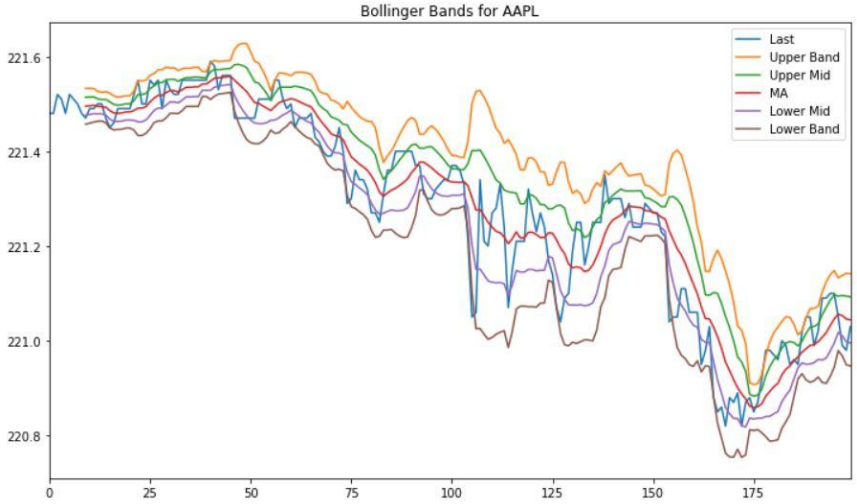
Strategy Execution

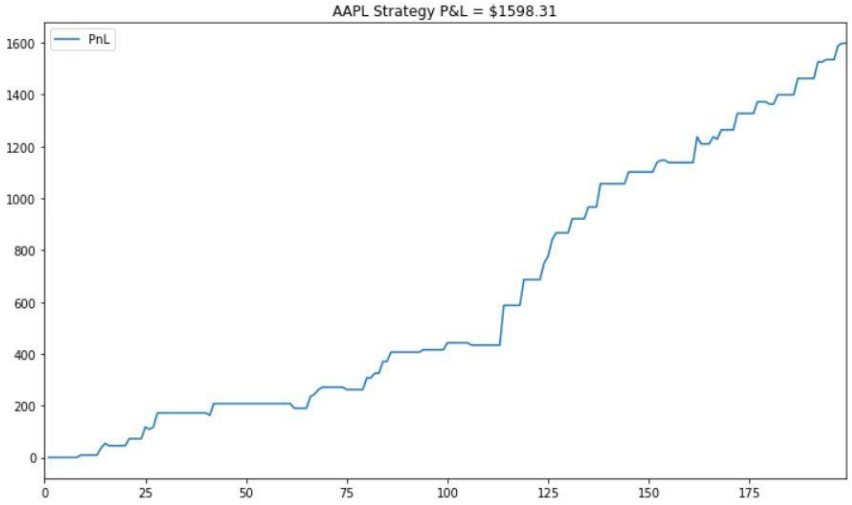
1. Calculate Bollinger Bands
2. Estimate # shares to trade
3. Calculate the signal
4. Execute trades using the signal and produce P&L
5. Summarize data

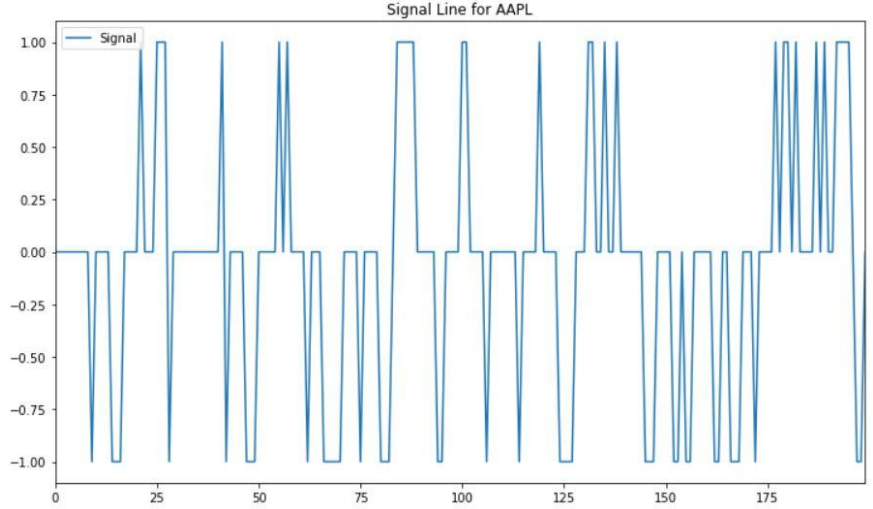
Results

- Assume a portfolio of $1,000,000
  - Divide equally across all stocks
- Long/Short blocks of shares at a time
  - Makes decision every 3 seconds
- 0.63% return in 10 minutes

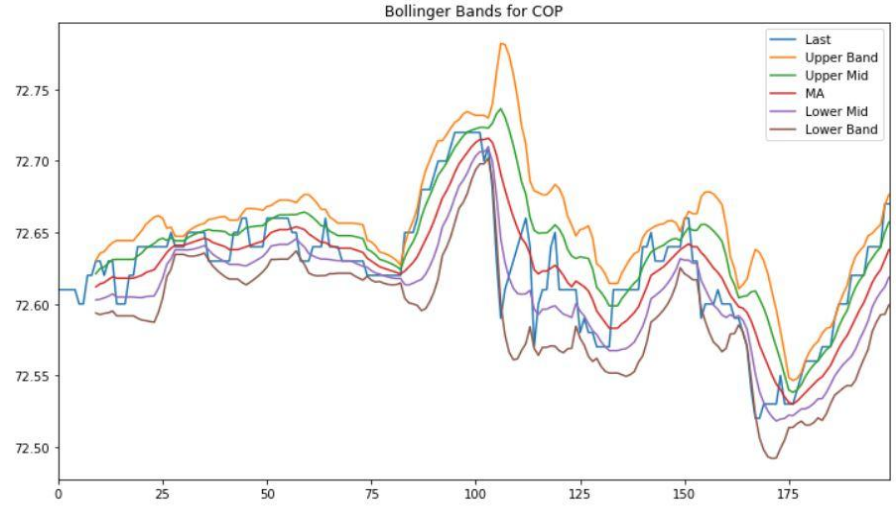
	Profit/Loss
AAPL	$1,598.31
AMZN	$1,763.62
BP	$361.28
COP	$1,404.54
XOM	$1,156.67
Total	**$6,284.42**

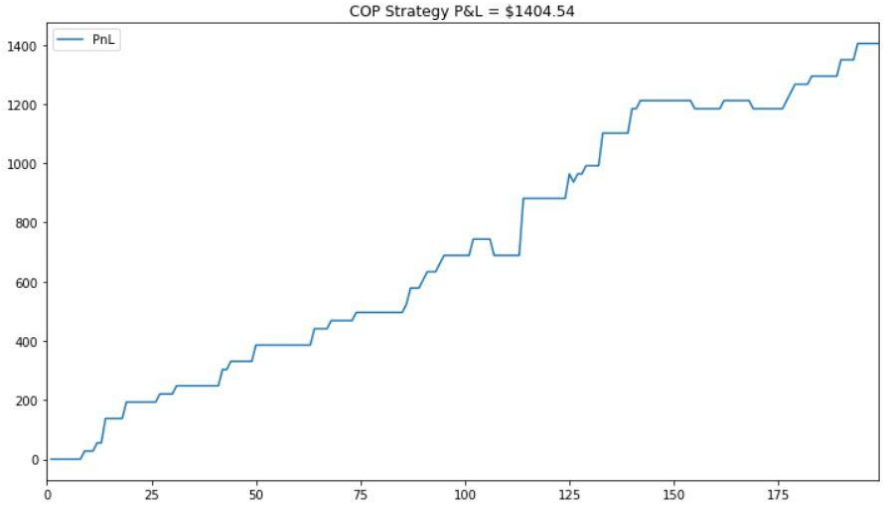

Bollinger Bands for AAPL
Last
Upper Band
Upper Mid
MA
Lower Mid
Lower Band
221.6
221.4
221.2
221.0
220.8
0
25
50
75
100
125
150
175

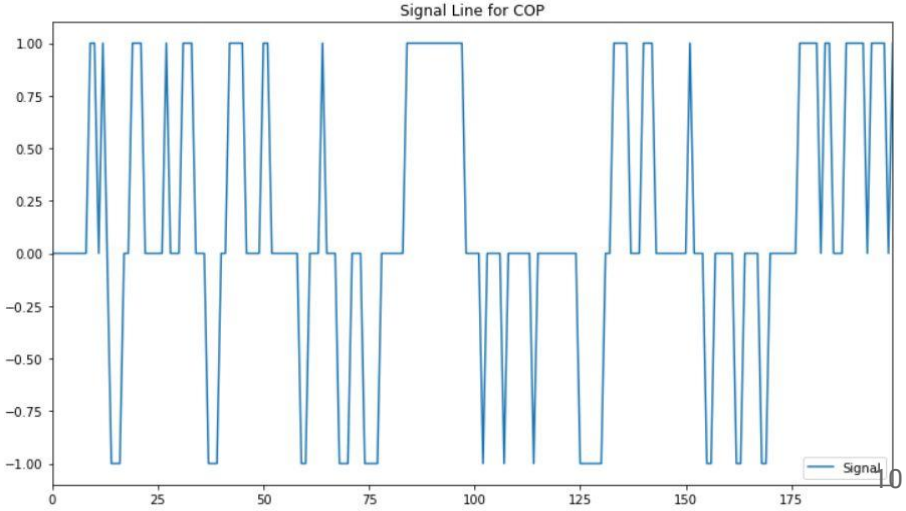

AAPL Strategy P&L = $1598.31
PnL
1600
1400
1200
1000
800
600
400
200
0
0
25
50
75
100
125
150
175


Signal Line for AAPL
Signal
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
25
50
75
100
125
150
175

ConocoPhillips







Conclusion

- Our approach to a Bollinger band trading strategy proves to be profitable in a market simulation for our basket of stocks
- Our strategy is very active in the market throughout the trading period
- Future work:
  - Expand to a larger basket of stocks or a more diverse portfolio
  - Test strategy over longer time frame
  - Test/Deploy strategy in a real market environment

Questions?