Computational Investment

What I achieved in this project:

1. Assess and Optimize a Portfolio.
2. Event Studies.
3. Build a Market Simulator.
4. Event Study into Simulator.
5. Technical Indicators and Implement Bollinger Bands.
6. Events Study with Technical Indicators .
7. An Operating Trading System and Back Tester.

How I do this project:

Coursera

Georgia Tech

Online Learning Platform

python™

pandas

Open Source Python Modules

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1. Assess and Optimize a Portfolio

Best one: Highest Sharpe Ratio

↑

Test each allocations of the 4 stocks

↑

Build up a portfolio with 4 stocks from S&P 500

Technical Highlights:

1. Buy and Hold Strategy, not rebalancing.
2. Optimization algorithm: gradient descent.
3. The allocations are in 10% increments.

Input portfolio

```
Start Date: January 1, 2011
End Date: December 31, 2011
Symbols: ['AAPL', 'GLD', 'GOOG', 'XOM']
```

↓

Output of the Portfolio Optimizer

```
Optimal Allocations: [0.4, 0.4, 0.0, 0.2]
Highest Sharpe Ratio: 1.02828403099
Volatility(stdev of daily return): 0.010146706765 4
Average of Daily Return: 0.00065726102001
Cumulative Return: 1.16487261965
```

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2. Event Studies

Input:

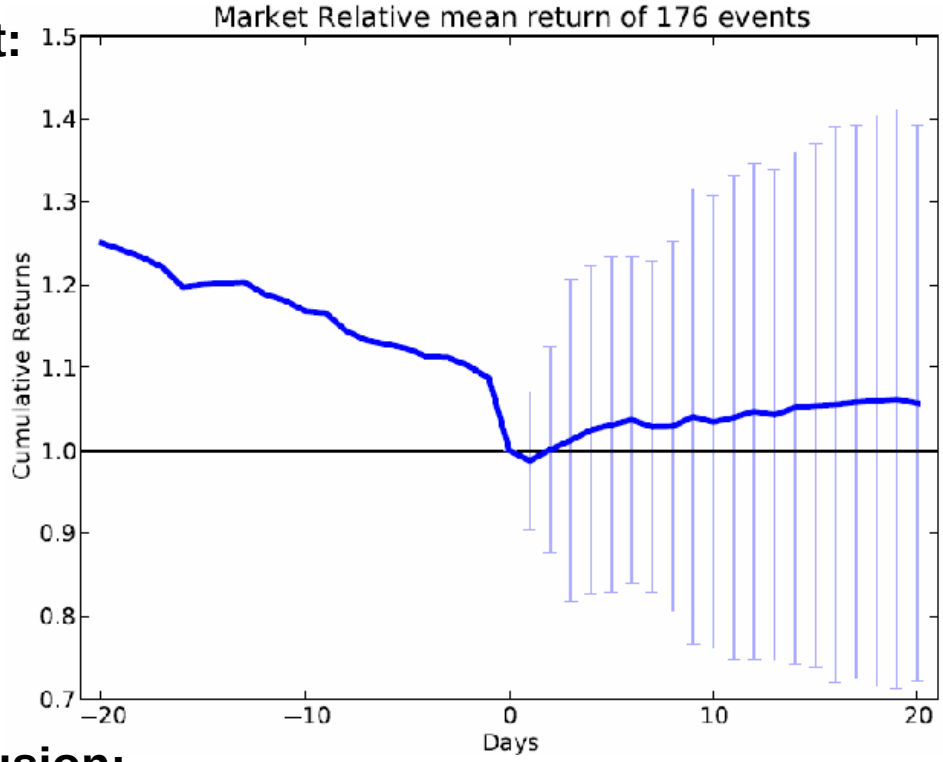
Event: $5.0 event.

If price[t-1]>=5.0 and price[t]<5.0 Then event[t]=1

Stocks: S&P500 of 2012.

Date Range:1st Jan,2008 to 31st Dec, 2009

Output:



Conclusion:

1. 176 events are found.
2. Investment strategy based on Event Study is possible.

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3. Build a Market Simulator

Market simulator:

1. Accept trading orders
2. Keep track of a portfolio's value
3. Assess the performance of that portfolio.

Trading orders:

a file of orders organized like this: Year, Month, Day, Symbol, Buy or Sell, Number of shares

Trading orders in this case:

2011,1,14,AAPL,Buy,1500
2011,1,19,AAPL,Sell,1500
2011,1,19,IBM,Buy,4000
2011,1,31,GOOG,Buy,1000
2011,2,4,XOM,Sell,4000
2011,2,11,XOM,Buy,4000
2011,3,2,GOOG,Sell,1000
2011,3,2,IBM,Sell,2200
2011,6,2,IBM,Sell,3300
2011,5,23,IBM,Buy,1500
2011,6,10,AAPL,Buy,1200
2011,8,9,GOOG,Buy,55
2011,8,11,GOOG,Sell,55
2011,12,14,AAPL,Sell,1200

Start day → (2011, 1, 14, 1000000.0) ← Start value

```
(2011, 1, 18, 988300.0)
(2011, 1, 19, 985600.0)
(2011, 1, 20, 986040.0)
(2011, 1, 21, 984880.0)
(2011, 1, 24, 1000920.0)
(2011, 1, 25, 1007960.0)
(2011, 1, 26, 1006400.0)
(2011, 1, 27, 1006520.0)
(2011, 1, 28, 999280.0)
(2011, 1, 31, 1010120.0)
(2011, 2, 1, 1026880.0)
(2011, 2, 2, 1026840.0)

(2011, 11, 28, 1073892.6)
(2011, 11, 29, 1070400.6)
(2011, 11, 30, 1081164.6)
(2011, 12, 1, 1088004.6)
(2011, 12, 2, 1090116.6)
(2011, 12, 5, 1094076.6)
(2011, 12, 6, 1091616.6)
(2011, 12, 7, 1089396.6)
(2011, 12, 8, 1091268.6)
(2011, 12, 9, 1094808.6)
(2011, 12, 12, 1092672.6)
(2011, 12, 13, 1089060.6)
```

End day → (2011, 12, 14, 1078752.6) ← End value

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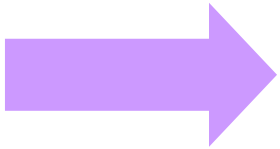
4. Event Study into Simulator

Integrate the previous two programs: Generate the **Trading Orders** based on event study and test the **Trading Orders or Trading Strategy** with **Market Simulator**.

- Starting cash: $50,000
- Start date: 1 January 2008
- End date: 31 December 2009
- When the 5$ event occurs, buy 100 shares of the equity on that day.
- Sell automatically 5 trading days later.
- Experiment 2: Devise your own event and trading strategy.

Orders

```
(2009, 3, 9, 'AES', 'Buy', 100)
(2009, 3, 16, 'AES', 'Sell', 100)
(2008, 9, 15, 'AIG', 'Buy', 100)
(2008, 9, 22, 'AIG', 'Sell', 100)
(2008, 9, 24, 'AIG', 'Buy', 100)
(2008, 10, 1, 'AIG', 'Sell', 100)
(2009, 3, 2, 'AIV', 'Buy', 100)
(2009, 3, 9, 'AIV', 'Sell', 100)
(2009, 3, 5, 'AIV', 'Buy', 100)
(2009, 3, 12, 'AIV', 'Sell', 100)
(2009, 3, 30, 'AIV', 'Buy', 100)
(2009, 4, 6, 'AIV', 'Sell', 100)
(2008, 7, 10, 'AMD', 'Buy', 100)
(2008, 7, 17, 'AMD', 'Sell', 100)
(2008, 7, 18, 'AMD', 'Buy', 100)
(2008, 7, 25, 'AMD', 'Sell', 100)
(2008, 9, 17, 'AMD', 'Buy', 100)
(2008, 9, 24, 'AMD', 'Sell', 100)
(2008, 9, 22, 'AMD', 'Buy', 100)
```



Values of portfolio

Start day → `(2008, 1, 2, 50000.0)` ← Start value

```
(2008, 1, 3, 50000.0)
(2008, 1, 4, 49982.0)
(2008, 1, 7, 49997.0)
(2008, 1, 8, 49983.0)
(2008, 1, 9, 49971.0)
(2008, 1, 10, 49953.0)
(2008, 1, 11, 49953.0)
(2008, 1, 14, 49953.0)

(2009, 12, 17, 54653.0)
(2009, 12, 18, 54821.0)
(2009, 12, 21, 54781.0)
(2009, 12, 22, 54806.0)
(2009, 12, 23, 54826.0)
(2009, 12, 24, 54836.0)
(2009, 12, 28, 54824.0)
(2009, 12, 29, 54824.0)
```

End day → `(2009, 12, 30, 54824.0)` ← End value

Evaluation of portfolio

```
Sharpe Ratio of Portfolio: 0.527865227084
Total Return of Portfolio: 1.09648
```

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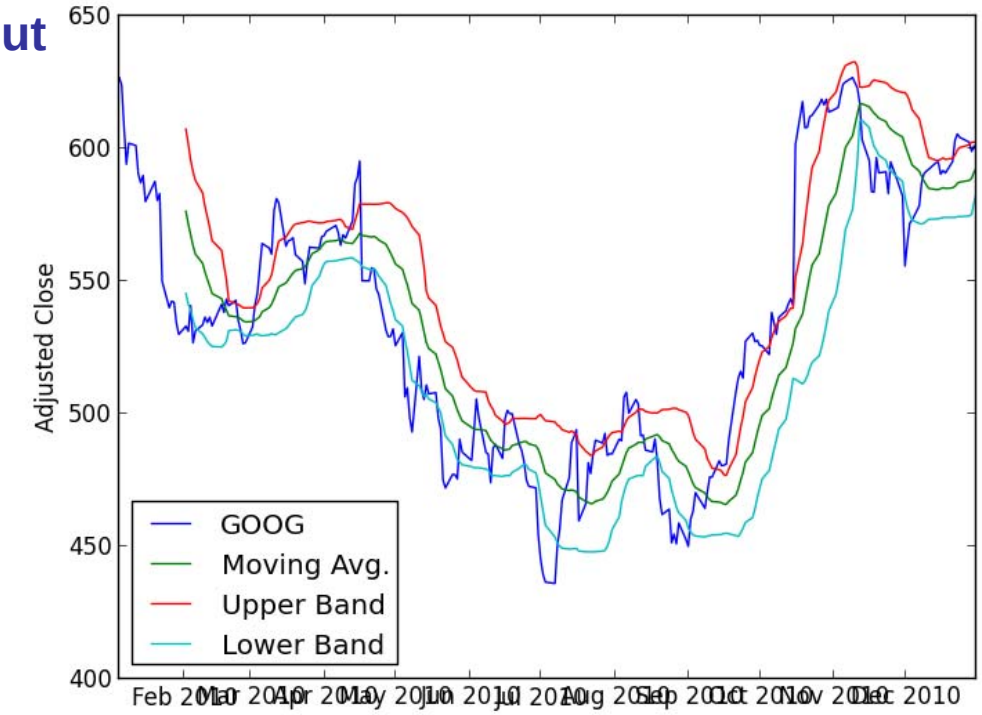
5. Technical Indicators and Implement Bollinger Bands.

1. Implement Bollinger bands as an indicator using 20 days look back and showing the rolling mean, the stock price, the upper (mean + 1stdev) and lower bands (mean -1stdev)
2. Output the indicator value in a range of -1 to 1.

Input

- Symbol: GOOG
- Startdate: 1 Jan 2010
- Enddate: 31 Dec 2010
- 20 period lookback

Output



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6. Events Study with Technical Indicators .

Input:

Event based on Bollinger bands.

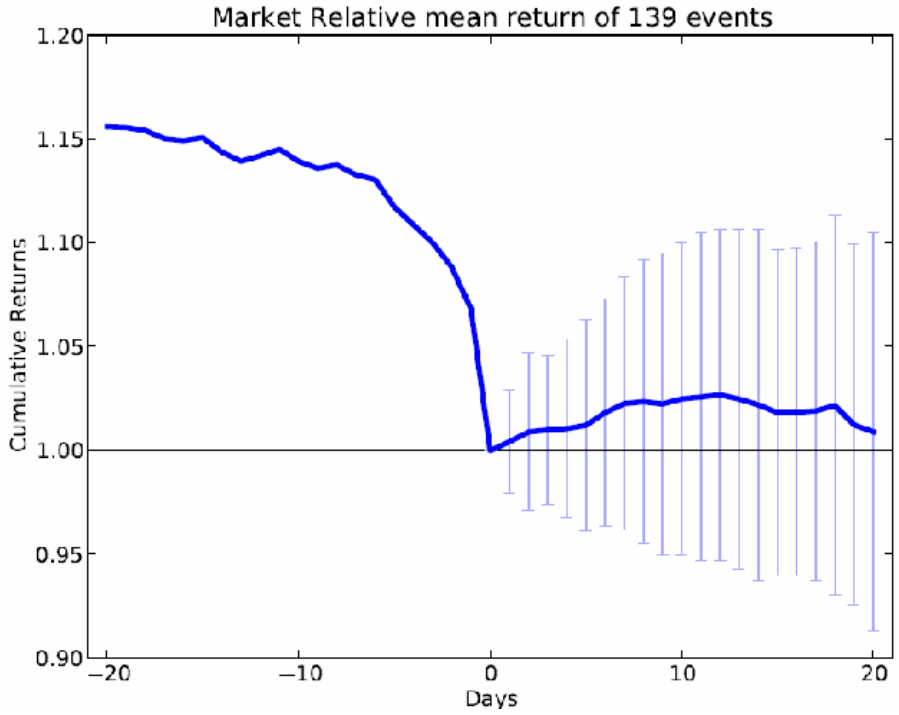
- *Bollinger value for the equity today <= -2.0*
- *Bollinger value for the equity yesterday >= -2.0*
- *Bollinger value for SPY today >= 1.4*

Stocks: S&P500 of 2012.

Date Range:1st Jan,2008 to 31st Dec, 2009

20 days look back for Bollinger bands.

Output:



Conclusion:

1. 139 events are found.
2. Investment strategy based on Event Study is possible.

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7. An Operating Trading System and Back Tester.

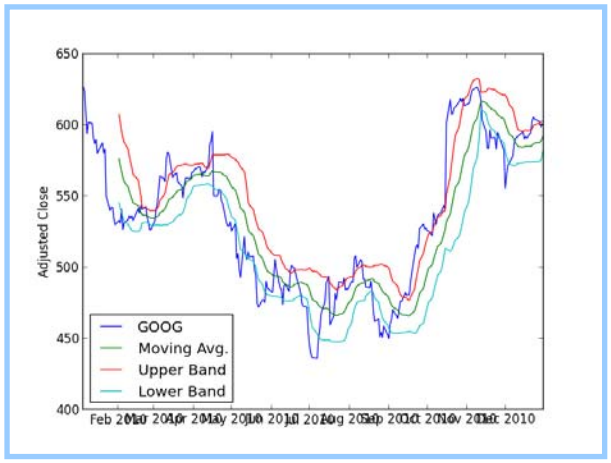
An Operating Trading System and Back Tester

Event Study based on Bollinger bands

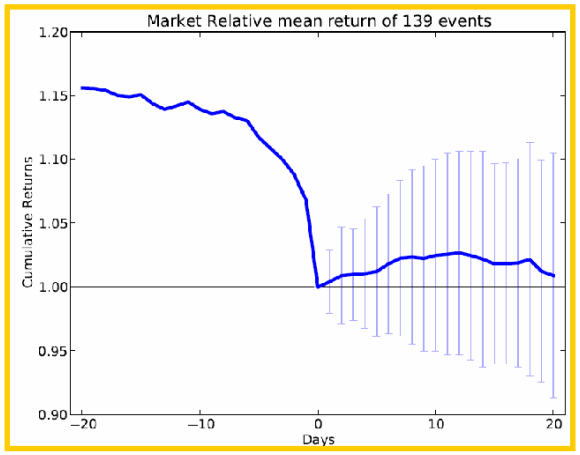
Event Study into Market Simulator

Implement of Bollinger bands

Build a Market Simulator



Bollinger bands



Event Study

```
2009, 4, 3, ABT, Buy, 100
2009, 4, 13, ABT, Sell, 100
2009, 9, 22, ACE, Buy, 100
2009, 9, 29, ACE, Sell, 100
2009, 8, 28, ACN, Buy, 100
2009, 9, 4, ACN, Sell, 100
2008, 8, 5, ADM, Buy, 100
2008, 8, 12, ADM, Sell, 100
2008, 2, 27, ADSK, Buy, 100
2008, 3, 5, ADSK, Sell, 100
2009, 11, 18, ADSK, Buy, 100
```

Trading Orders

Evaluation of portfolio

```
Sharpe Ratio: 0.641253987791
Total Return: 1.05644
```

Future work

What’s next:

Use machine learning to realize algorithm trading, for example to predict the stock price of tomorrow.