Will the price go up or down?

Predicting financial data
Apple Computer Stock Prices
Outline

• Open-high-low-close plots and trading bands

• Time series forecasting

• Using classification methods to pick winners and losers
Querying Stock Prices

Ticker symbol: AAPL  Start date: June  1  2015  Daily

Execute Query  Return

Query returned 252 records.

Current data file: otep5ok43qw5xrdox_AAPL_Daily.sgd  Display Data  Edit Data

<table>
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<th>Variable</th>
<th>Comment</th>
<th>Nonmissing Values</th>
<th>Numeric Values</th>
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Open-High-Low-Close Plots

Open-High-Low-Close Plot
MA (span=20), Bollinger bands (2.0 sigma)

Date: 5/27/2016
Open: 99.44
High: 100.47
Low: 99.25
Close: 100.34

Upper: 108.86
Smooth: 94.73
Lower: 80.59

%b: 0.70
BW: 0.30
Bollinger Bands

• First calculates a moving average (simple MA or EWMA).

• Calculates standard deviation from variation of data around the moving average.

• Plots trading bands at ±2σ.
Buy-Sell Indicators

(1) Location within bands

\[ \%b = \frac{X_t - \text{lowerband}}{\text{upperband} - \text{lowerband}} \]

(2) Bandwidth

\[ BW = \frac{\text{upperband} - \text{lowerband}}{\text{smoothedvalue}} \]
Bandwidth

• Useful for identifying “The Squeeze”, where very low volatility is a signal that something is about to change.

• Breakout from the trading range followed by a sharp expansion of BW is a sign of a sustainable trend.

• Look for changes in the direction that a band is moving.
Automatic Forecasting

[Image of a dialog box for Automatic Forecasting. The dialog box includes options for selecting data columns (Close, Date, etc.), setting the sampling interval, and specifying seasonality and trading days adjustment. There are also options for sorting column names, setting the number of forecasts, and withholding for validation.]
# Analysis Options

## Automatic Forecasting Options

### Models to Include
- Random Walk
- Random Walk with Drift
- Mean
- Linear Trend
- Quadratic Trend
- Exponential Trend
- S-Curve
- Moving Average
- Simple Exp. Smoothing
- Brown's Linear Exp. Smoothing
- Holt's Linear Exp. Smoothing
- Quadratic Exp. Smoothing
- Winters' Exp. Smoothing
- ARIMA: Optimize Model Order
- MA Terms (q)
  - Nonseasonal: 2
  - Seasonal: 0
- AR Terms (p)
  - Nonseasonal: 2
  - Seasonal: 0
- Fix q at p-1
- Include constant

### Optimize Parameters
- Optimize Parameters

### Method Selection Criterion
- Akaike Information Criterion (AIC)
- Hannan-Quinn Criterion (HQC)
- Schwarz Bayesian Inf. Criterion (SBIC)
- Mean Squared Error (MSE)
- Mean Absolute Error (MAE)
- Mean Abs. Percentage Error (MAPE)

### Adjustments...
- Parameters...
- Estimation...
- Input series...
A Random Walk Down Wall Street
Residual ACF
Classification Problem

• Suppose we divide stocks into 2 groups: those that have done well and those that haven’t.

• Can we use data regarding each company to predict which companies belong to each group?

• Statgraphics has 2 procedures for classification:
  – Discriminant analysis
  – Bayesian neural network classifier
### Apple Inc. (AAPL)

**Consumer Goods | Electronic Equipment | USA**

<table>
<thead>
<tr>
<th>Index</th>
<th>DJIA S&amp;P 500</th>
<th>P/E</th>
<th>11.17</th>
<th>EPS (ttm)</th>
<th>8.99</th>
<th>Insider Own</th>
<th>0.10%</th>
<th>Shs Outstanding</th>
<th>5.48B</th>
<th>Perf Week</th>
<th>5.39%</th>
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<td>10.99</td>
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<td>Insider Trans</td>
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<td>Shs Float</td>
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<td>PEG</td>
<td>1.21</td>
<td>EPS next Q</td>
<td>1.59</td>
<td>Int Own</td>
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<td>Short Float</td>
<td>1.02%</td>
<td>Perf Quarter</td>
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<td>Sales</td>
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<td>P/S</td>
<td>2.42</td>
<td>EPS this Y</td>
<td>42.80%</td>
<td>Intra Trans</td>
<td>-2.16%</td>
<td>Short Ratio</td>
<td>1.42</td>
<td>Perf Half Y</td>
<td>-14.00%</td>
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<tr>
<td>Book/sh</td>
<td>23.66</td>
<td>P/B</td>
<td>4.24</td>
<td>EPS next Y</td>
<td>10.24%</td>
<td>ROA</td>
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<td>Target Price</td>
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<td>Perf Year</td>
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<td>P/C</td>
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<td>ROE</td>
<td>40.20%</td>
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<td>Perf YTD</td>
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<td>33.60%</td>
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<td>Quick Ratio</td>
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<td>Volume</td>
<td>27,900,407</td>
<td>Change</td>
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</table>

**Note:** Finviz.com provides financial data and charts for Apple Inc. (AAPL). The data includes market capitalization, earnings, dividends, and other financial highlights. The chart shows the stock price movements and technical indicators over time.
Sample Data

- George Dyson followed 19 stocks and saved metrics weekly between 6/23/2013 and 6/30/2014.

- During this period, DJIA increased by 12.9% and the NASDAQ increased by 29.5%.

- 4 of the 19 stocks increased by more than 40%.

- It is interesting to ask which of the various metrics would have been most useful in picking the big winners.
Discriminant Analysis

“A method used in statistics, pattern recognition and machine learning to find a linear combination of features that characterizes or separates two or more classes of objects or events.”

\[ D_j = d_{j1}Z_1 + d_{j2}Z_2 + \ldots + d_{jp}Z_p \]
Discriminant Analysis
Analysis Options

Discriminant Analysis Options

- **Fit**
  - All Variables
  - Forward Selection
  - Backward Selection

- **Stepwise**
  - F-to-Enter: 4.0
  - F-to-Remove: 4.0
  - Max. Steps: 50

- **Display**
  - Final Model Only
  - All Steps
### Discriminant Analysis

**Classification variable:** Winner  
**Independent variables:**
- P/E
- PEG
- ROA
- ROE
- ROI
- RSI
- Recom

**Number of complete cases:** 19  
**Number of groups:** 2

<table>
<thead>
<tr>
<th>Discriminant Function</th>
<th>Eigenvalue</th>
<th>Relative Percentage</th>
<th>Canonical Correlation</th>
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Stepwise Selection

**Discriminant Analysis**
Classification variable: Winner
Independent variables:
- P/E
- PEG
- ROA
- ROE
- ROI
- RSI
- Recom

Number of complete cases: 19
Number of groups: 2

<table>
<thead>
<tr>
<th>Discriminant Function</th>
<th>Eigenvalue</th>
<th>Relative Percentage</th>
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<th>Chi-Square</th>
<th>DF</th>
<th>P-Value</th>
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<td>0.440547</td>
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</table>

Stepwise regression
Method: forward selection
F-to-enter: 4.0
F-to-remove: 4.0

**Step 0:**
0 variables in the model.

**Step 1:**
Adding variable ROA with F-to-enter = 12.0804
1 variables in the model.
Wilks' lambda = 0.584585. Approximate F = 12.0804 with P-value = 0.0029

**Step 2:**
Adding variable Recom with F-to-enter = 5.23127
2 variables in the model.
Wilks' lambda = 0.440547. Approximate F = 10.1593 with P-value = 0.0014

Final model selected.
## Classification Table

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<th>Predicted</th>
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Percent of cases correctly classified: 100.00%
## Classification Results

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<th>Ticker</th>
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<th>Squared Distance</th>
<th>Prob.</th>
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* = incorrectly classified.
A Final Graph