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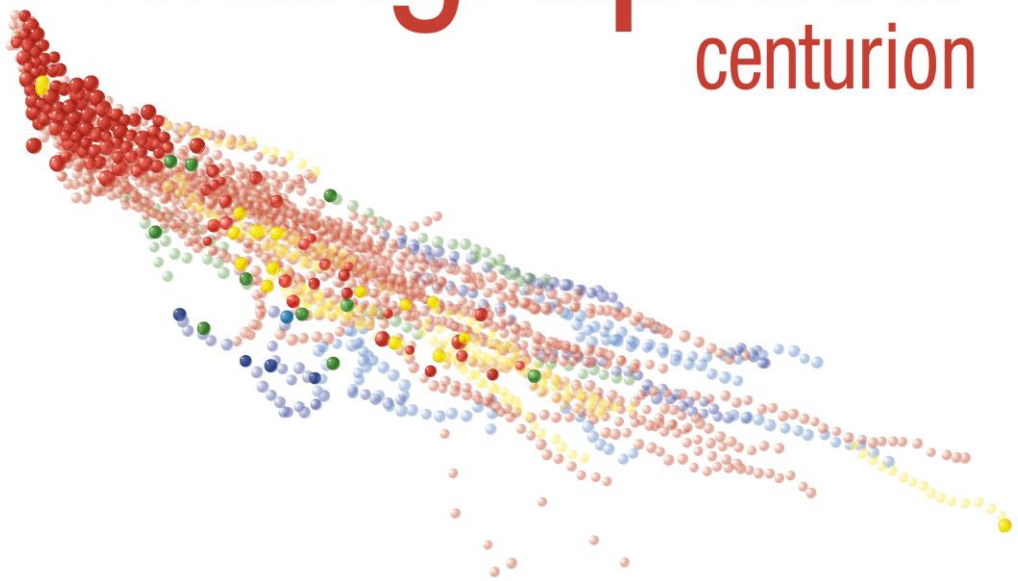
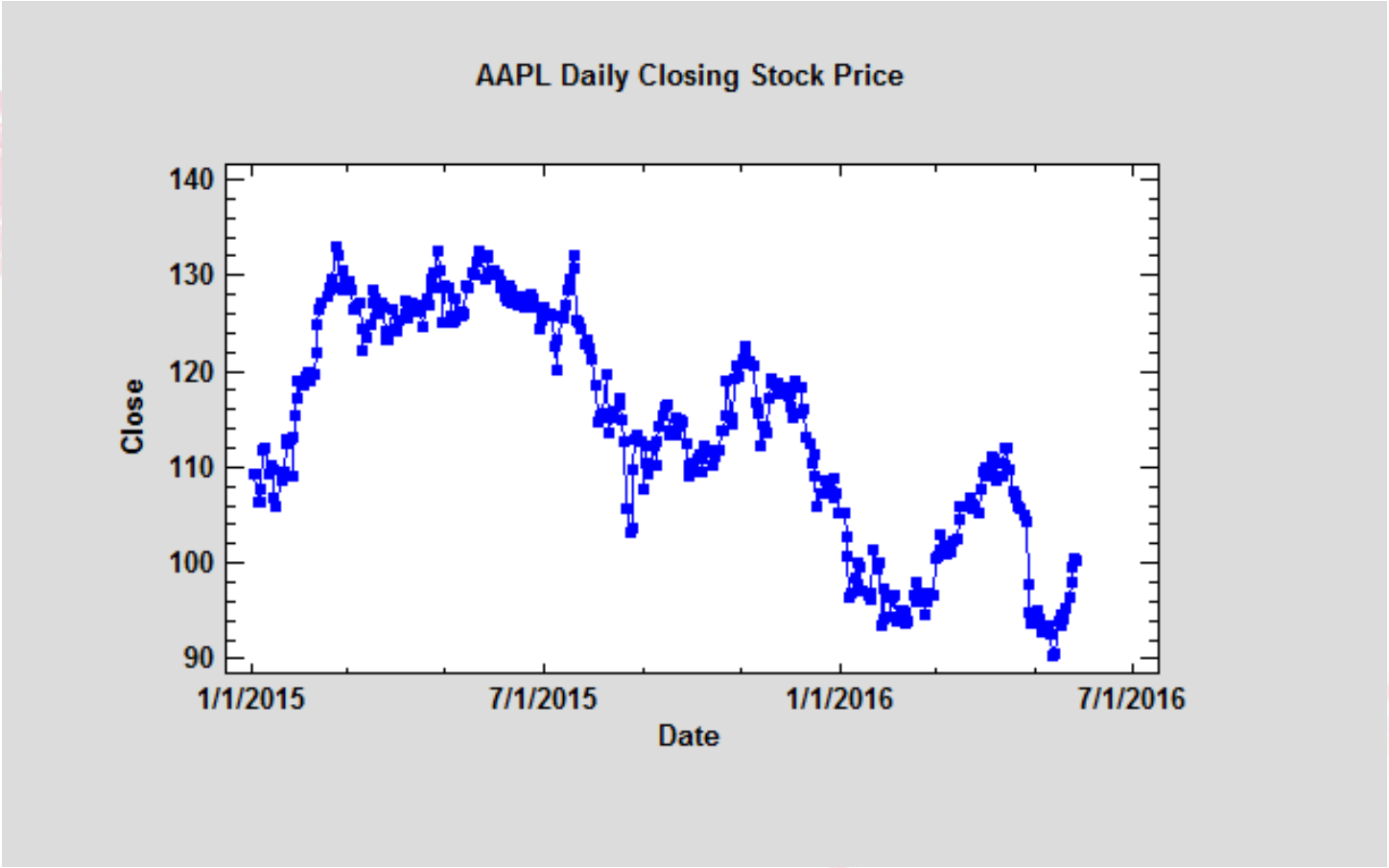


Will the price go up or down?

Predicting financial data

Apple Computer Stock Prices



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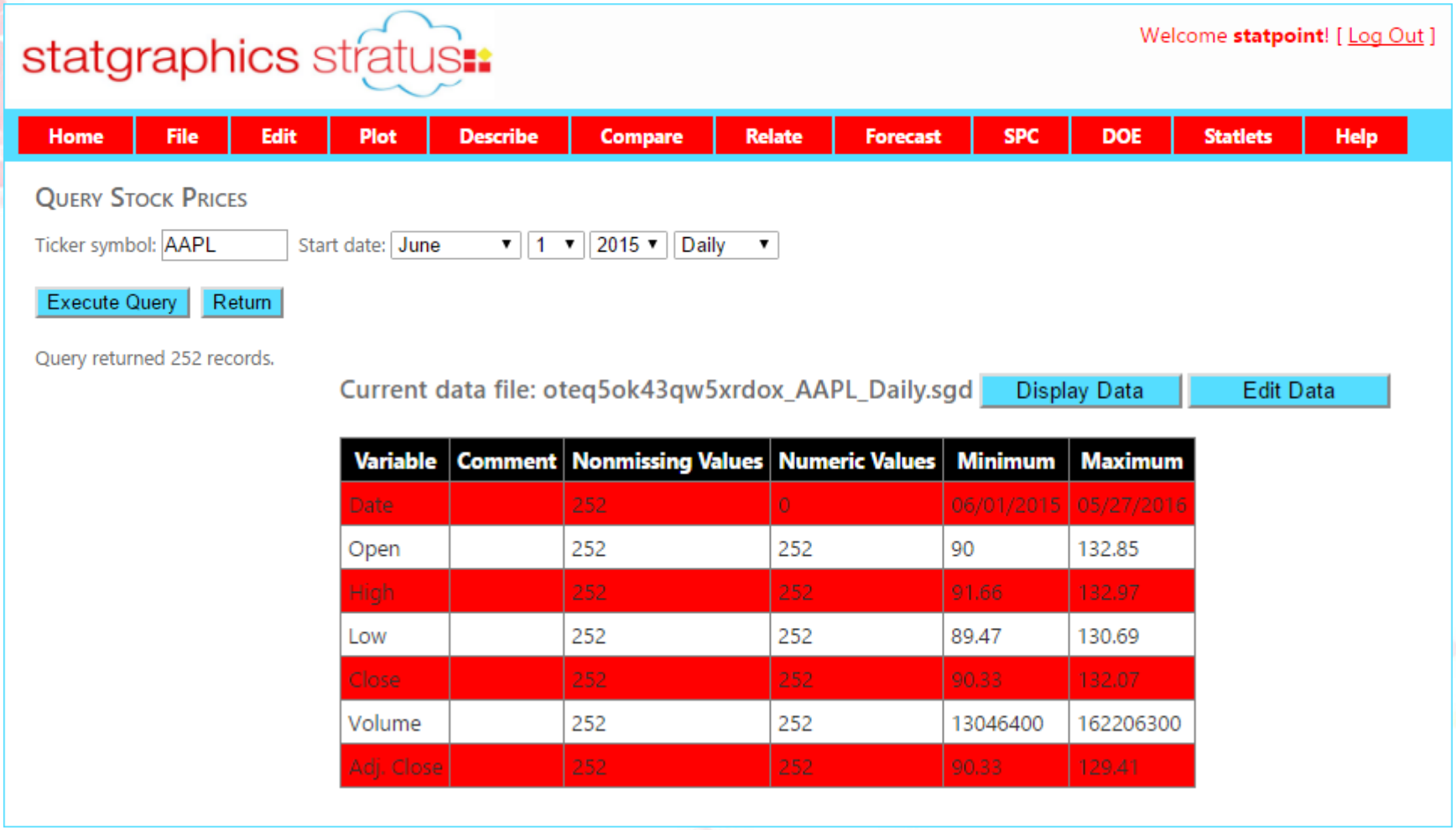
Outline

- Open-high-low-close plots and trading bands
- Time series forecasting
- Using classification methods to pick winners and losers

Querying Stock Prices



Variable	Comment	Nonmissing Values	Numeric Values	Minimum	Maximum
Date		252	0	06/01/2015	05/27/2016
Open		252	252	90	132.85
High		252	252	91.66	132.97
Low		252	252	89.47	130.69
Close		252	252	90.33	132.07
Volume		252	252	13046400	162206300
Adj. Close		252	252	90.33	129.41

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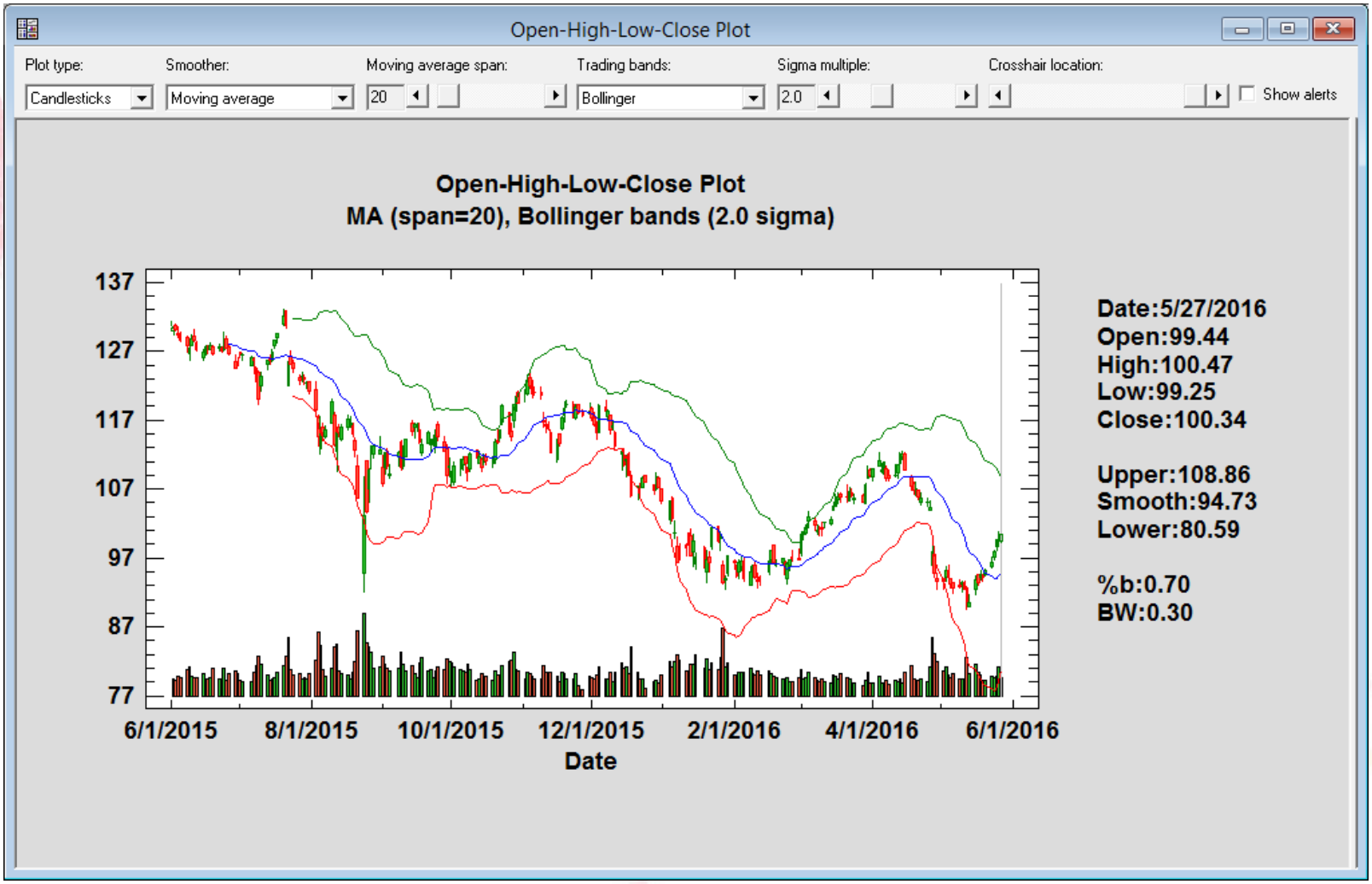
Open-High-Low-Close Plots



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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 $\pm 2\sigma$.

Buy-Sell Indicators

(1) Location within bands

$$\%b = \frac{X_t - lowerband}{upperband - lowerband}$$

(2) Bandwidth

$$BW = \frac{upperband - lowerband}{smoothedvalue}$$

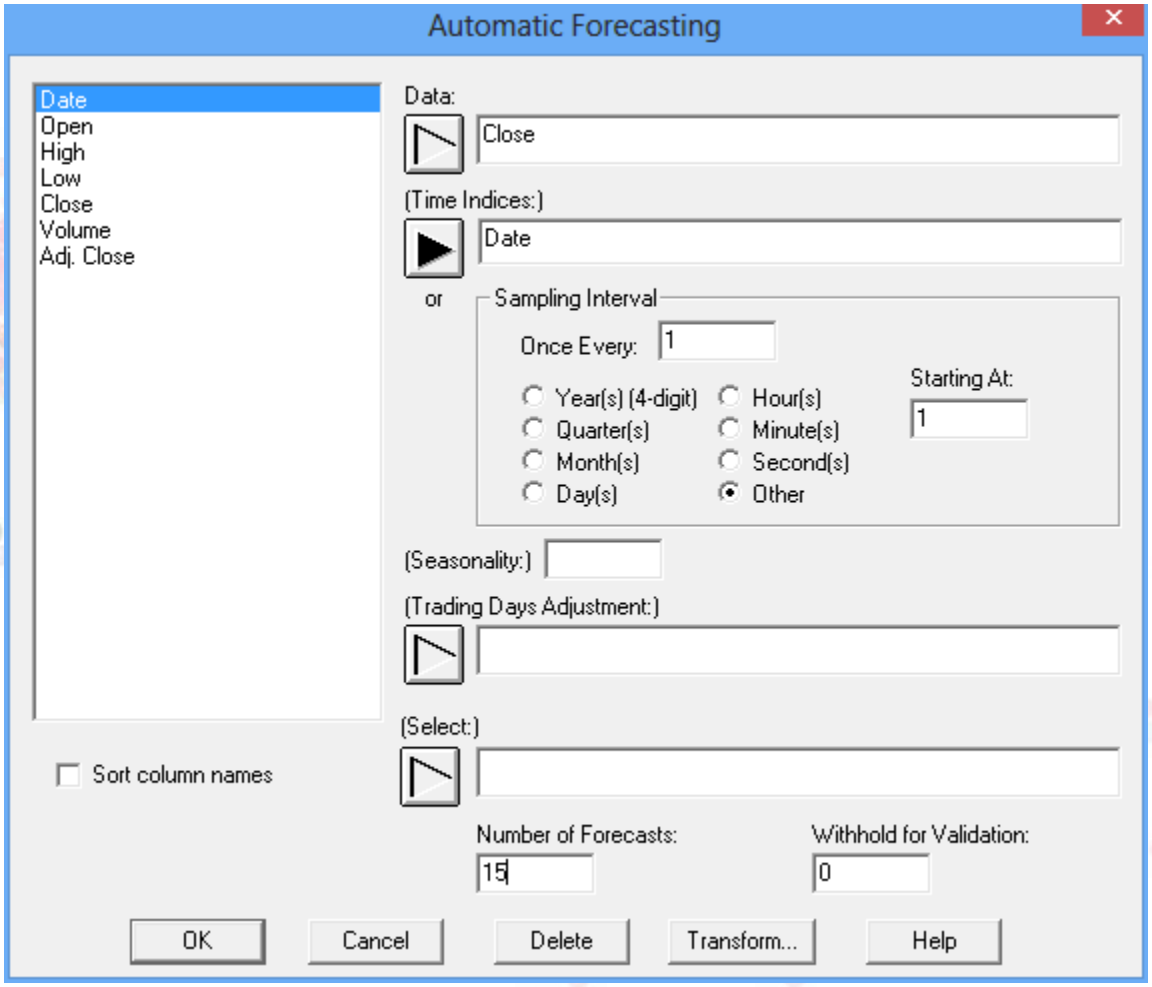
Bandwidth

- 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



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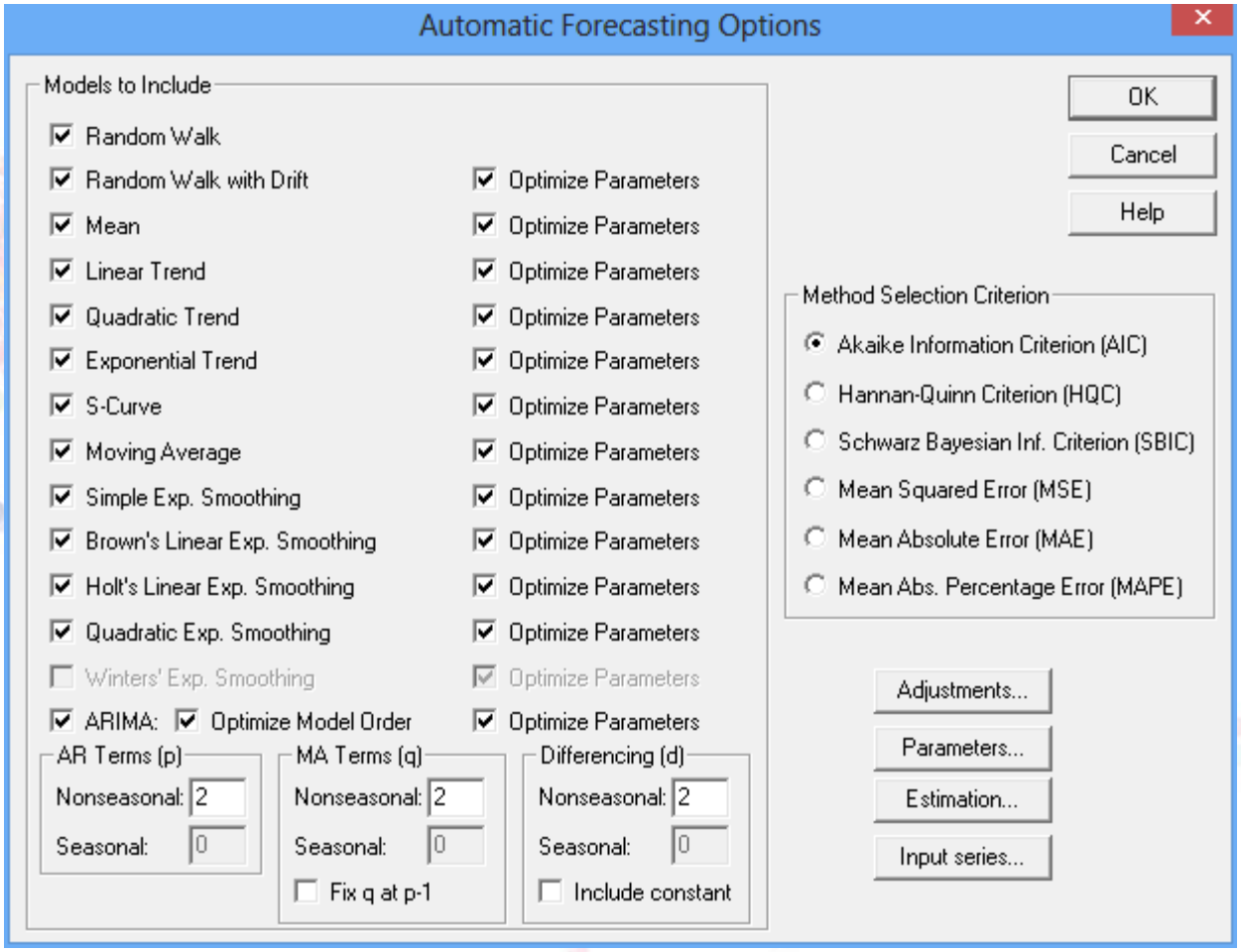
Analysis Options



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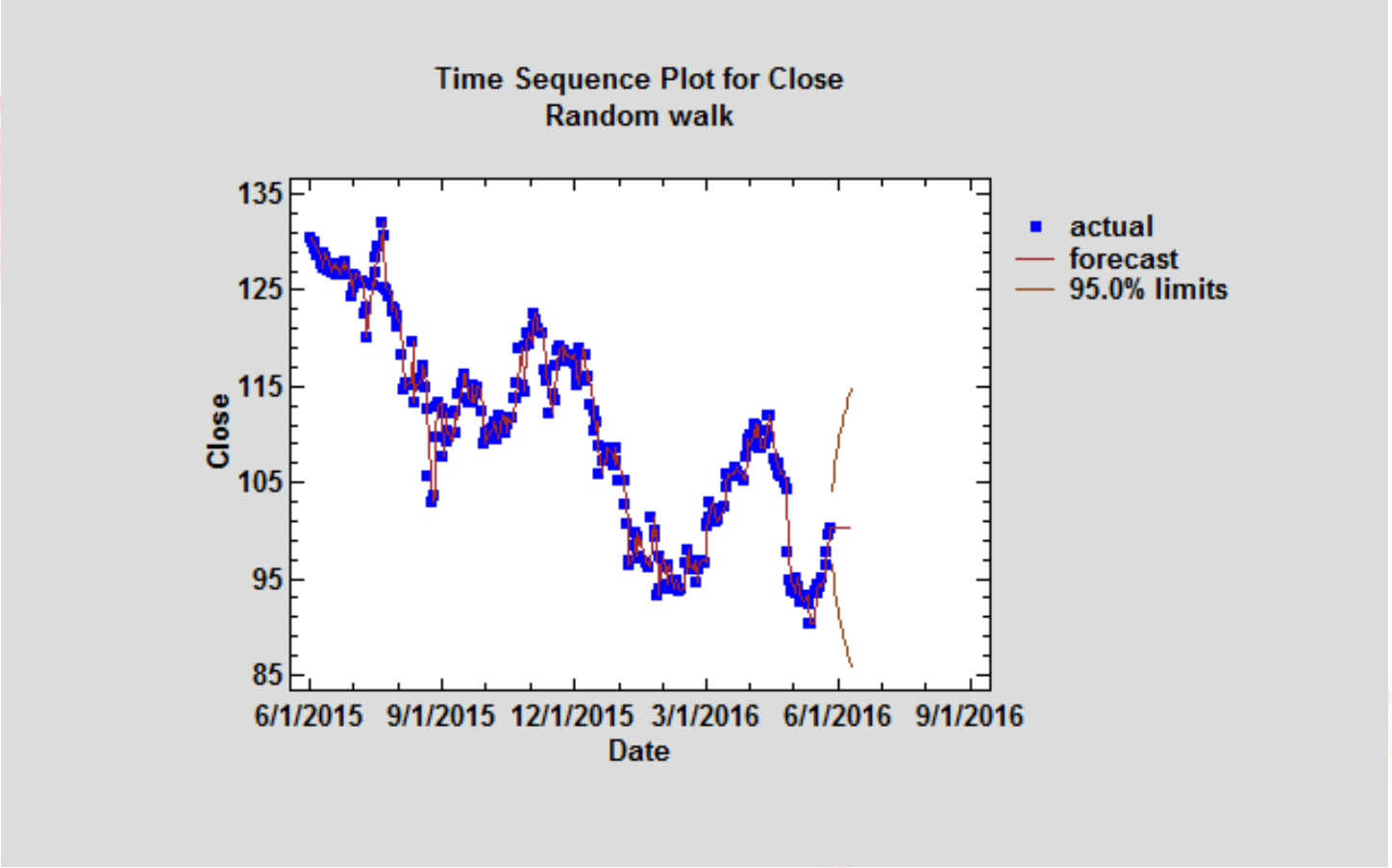
A Random Walk Down Wall Street



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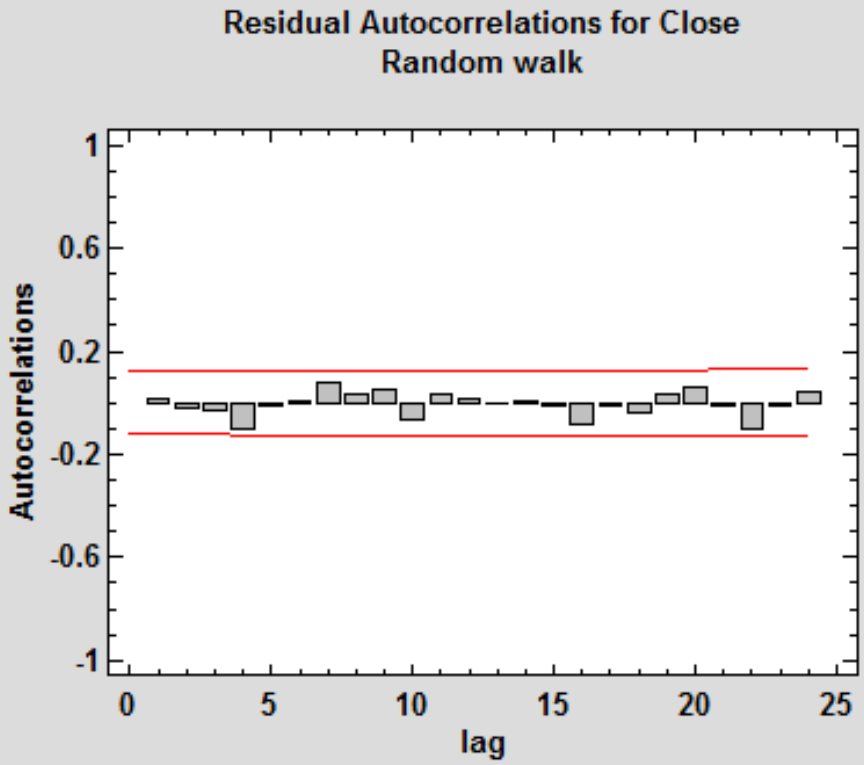
Residual ACF



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

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Apple Inc.

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financial highlights | statements

Index	DJIA S&P500	P/E	11.17	EPS (ttm)	8.99	Insider Own	0.10%	Shs Outstand	5.48B	Perf Week	5.39%
Market Cap	549.99B	Forward P/E	10.99	EPS next Y	9.13	Insider Trans	-11.52%	Shs Float	5.47B	Perf Month	6.47%
Income	50.68B	PEG	1.21	EPS next Q	1.39	Inst Own	58.70%	Short Float	1.02%	Perf Quarter	4.42%
Sales	227.54B	P/S	2.42	EPS this Y	42.80%	Inst Trans	-2.16%	Short Ratio	1.42	Perf Half Y	-14.00%
Book/sh	23.66	P/B	4.24	EPS next Y	10.24%	ROA	17.40%	Target Price	125.42	Perf Year	-21.40%
Cash/sh	10.09	P/C	9.95	EPS next 5Y	9.23%	ROE	40.20%	52W Range	89.47 - 130.30	Perf YTD	-3.56%
Dividend	2.28	P/FCF	12.71	EPS past 5Y	33.60%	ROI	28.30%	52W High	-23.93%	Beta	1.00
Dividend %	2.27%	Quick Ratio	1.20	Sales past 5Y	29.10%	Gross Margin	39.80%	52W Low	10.78%	ATR	1.99
Employees	110000	Current Ratio	1.30	Sales Q/Q	-12.80%	Oper. Margin	29.40%	RSI (14)	54.06	Volatility	1.58% 1.79%
Optionable	Yes	Debt/Eq	0.61	EPS Q/Q	-18.40%	Profit Margin	22.30%	Rel Volume	0.79	Prev Close	100.35
Shortable	Yes	LT Debt/Eq	0.53	Earnings	Apr 26 AMC	Payout	23.00%	Avg Volume	39.21M	Price	99.12
Recom	1.80	SMA20	4.72%	SMA50	-2.38%	SMA200	-6.20%	Volume	27,986,407	Change	-1.23%

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Sample Data

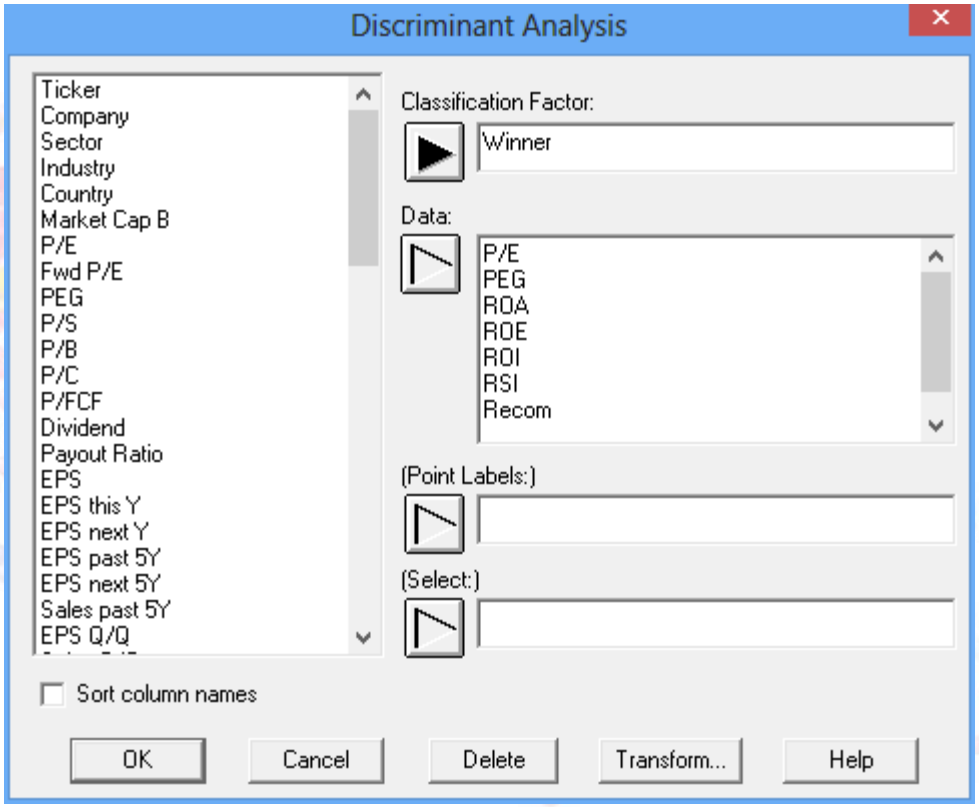
- George Dyson followed 19 stocks and saved metrics weekly between 6/23/2013 and 6/30/2014.
- During this period, DJIA increased by 12.9% and the NASDAQ increased by 29.5%.
- 4 of the 19 stocks increased by more than 40%.
- It is interesting to ask which of the various metrics would have been most useful in picking the big winners.

Discriminant Analysis

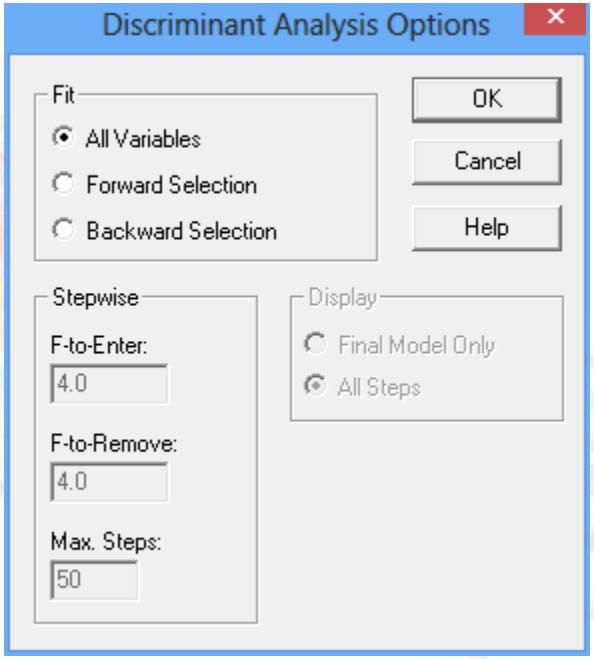
"A method used in statistics, pattern recognition and machine learning to find a linear combination of features that characterizes or separates two or more classes of objects or events."

$$D_j = d_{j1}Z_1 + d_{j2}Z_2 + \ldots + d_{jp}Z_p$$

Discriminant Analysis



Analysis Options



Analysis Summary

Discriminant Analysis

Classification variable: Winner

Independent variables:

- P/E
- PEG
- ROA
- ROE
- ROI
- RSI
- Recom

Number of complete cases: 19

Number of groups: 2

Discriminant Function	*Eigenvalue*	*Relative Percentage*	*Canonical Correlation*
1	1.76781	100.00	0.79919

Functions Derived	*Wilks Lambda*	*Chi-Square*	*DF*	*P-Value*
1	0.361296	13.7438	7	0.0559

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

Discriminant Function	*Eigenvalue*	*Relative Percentage*	*Canonical Correlation*
1	1.26991	100.00	0.74797

Functions Derived	*Wilks Lambda*	*Chi-Square*	*DF*	*P-Value*
1	0.440547	13.1158	2	0.0014

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.
Wilk's 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.
Wilk's lambda = 0.440547 Approximate F = 10.1593 with P-value = 0.0014

Final model selected.

Classification Table

Classification Table

Actual	*Group*	*Predicted*	*Winner*
Winner	*Size*	*0*	*1*
0	15	15	0
		(100.00%)	(0.00%)
1	4	0	4
		(0.00%)	(100.00%)

Percent of cases correctly classified: 100.00%

Classification Results

Ticker	*Actual*	*Highest*	*Highest*	*Squared*		*2nd Highest*	*2nd Highest*	*Squared*	
Row	*Group*	*Group*	*Value*	*Distance*	*Prob.*	*Group*	*Value*	*Distance*	*Prob.*
AAPL	1	1	39.3449	0.202009	0.9040	0	37.1019	4.68802	0.0960
CAT	0	0	36.2028	0.00331931	0.9633	1	32.9353	6.53838	0.0367
CRR	0	0	59.8327	0.737715	0.9965	1	54.1688	12.0655	0.0035
CSX	0	0	40.0233	0.0203704	0.9779	1	36.232	7.60305	0.0221
CVS	0	0	25.4194	0.86997	0.7270	1	24.44	2.82884	0.2730
EBAY	0	0	25.9281	1.29571	0.6087	1	25.4862	2.1796	0.3913
FCX	0	0	40.5321	0.00394949	0.9628	1	37.2782	6.51165	0.0372
GE	0	0	35.2136	0.117037	0.9868	1	30.901	8.74234	0.0132
GOOG	0	0	38.0681	0.658321	0.7853	1	36.7713	3.25178	0.2147
HAL	1	1	22.1894	1.6282	0.5205	0	22.1075	1.79193	0.4795
HON	0	0	33.0605	0.283072	0.8836	1	31.0334	4.33719	0.1164
KORS	1	1	36.0387	5.25966	0.9999	0	26.6242	24.0888	0.0001
MDT	0	0	44.7765	0.00114344	0.9654	1	41.4468	6.66065	0.0346
ORCL	0	0	42.0864	0.477447	0.8336	1	40.4749	3.70048	0.1664
PG	0	0	40.9277	0.0496099	0.9446	1	38.0919	5.72121	0.0554
SLB	1	1	25.793	0.322548	0.8736	0	23.8598	4.189	0.1264
SYK	0	0	44.6352	0.000542328	0.9701	1	41.1562	6.95865	0.0299
T	0	0	57.2891	3.55984	0.9998	1	48.9378	20.2625	0.0002
WFC	0	0	45.9688	1.50954	0.9987	1	39.3382	14.7708	0.0013
AAPL now		1	30.9496	0.162259	0.9141	0	28.5847	4.89217	0.0859
FB now		1	23.5262	1.02685	0.6832	0	22.7576	2.56417	0.3168

* = incorrectly classified.

A Final Graph