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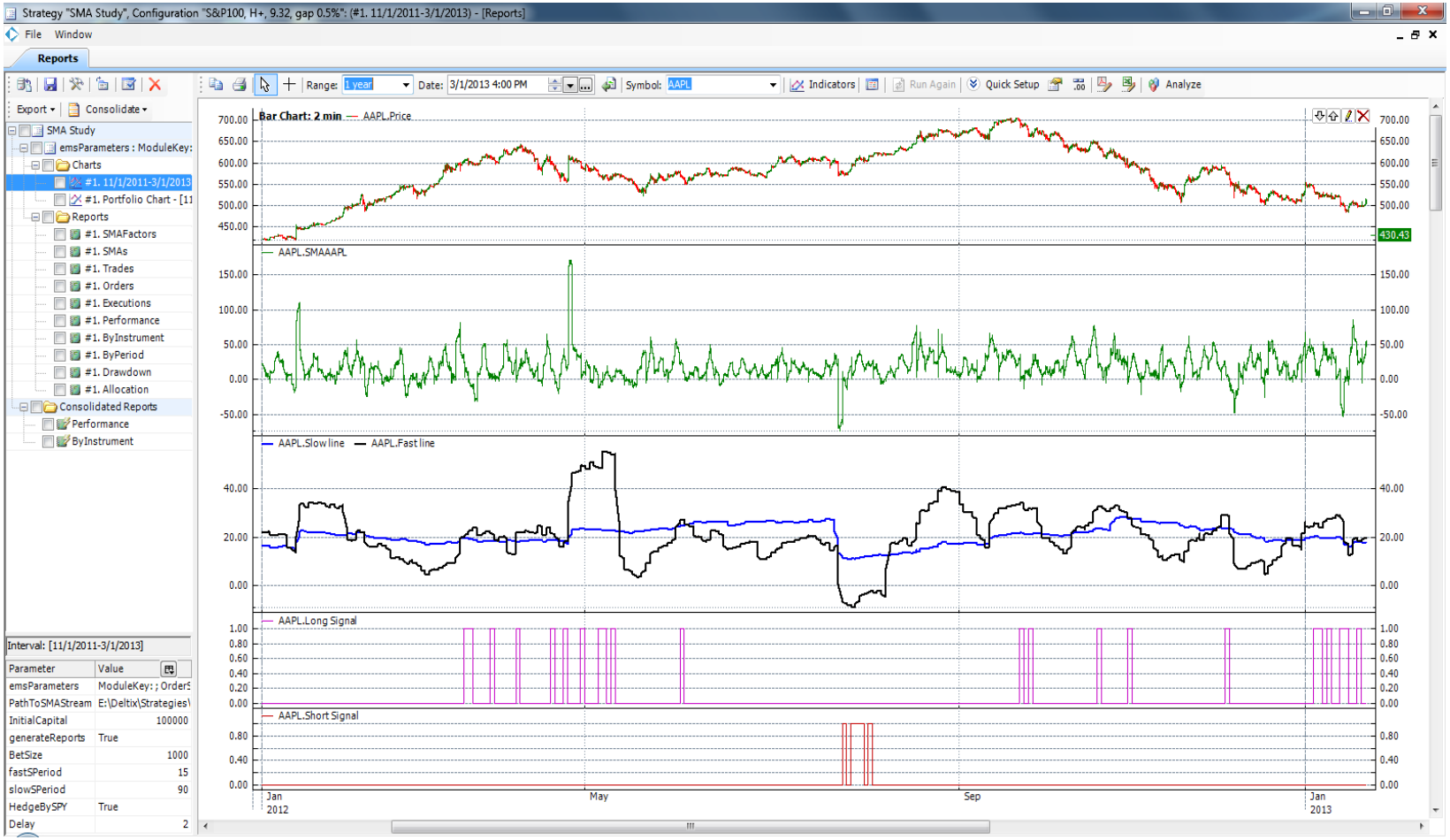
Using Twitter Sentiment in Automated Trading Strategy

The Main Question

Is it possible to use Twitter as the sole source of trading signals?



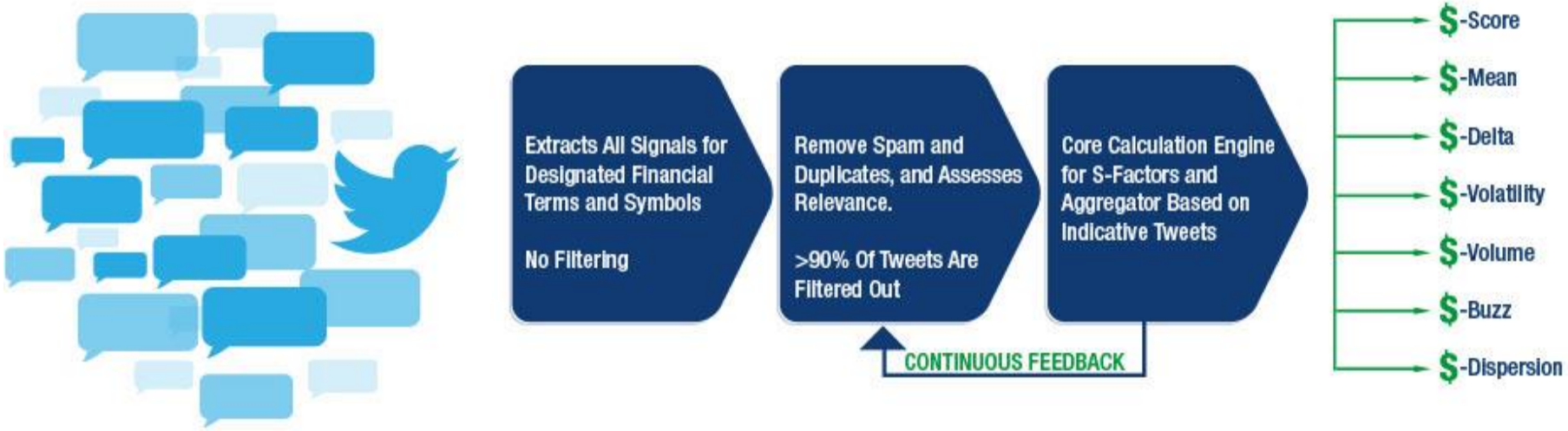
Overall methodology

- **Sources of data:**
  - Twitter-based sentiment feed from the Chicago firm, Social Market Analytics (SMA)
  - Historical price tick data for 100 liquid US equities (IDC)

- **Technology – Deltix QuantOffice/QuantServer software:**
  - TimeBase
  - QuantOffice

- **Major steps of the research:**
  - Creation of the initial setup
  - Analysis of SMA sentiment data
  - Analysis of trends of sentiment data
  - Validation of the main hypothesis that sentiment trends could be used for the generation of profitable trading signals
  - Creation and backtesting of a simple breakout strategy with opening signals generated by sentiment trends

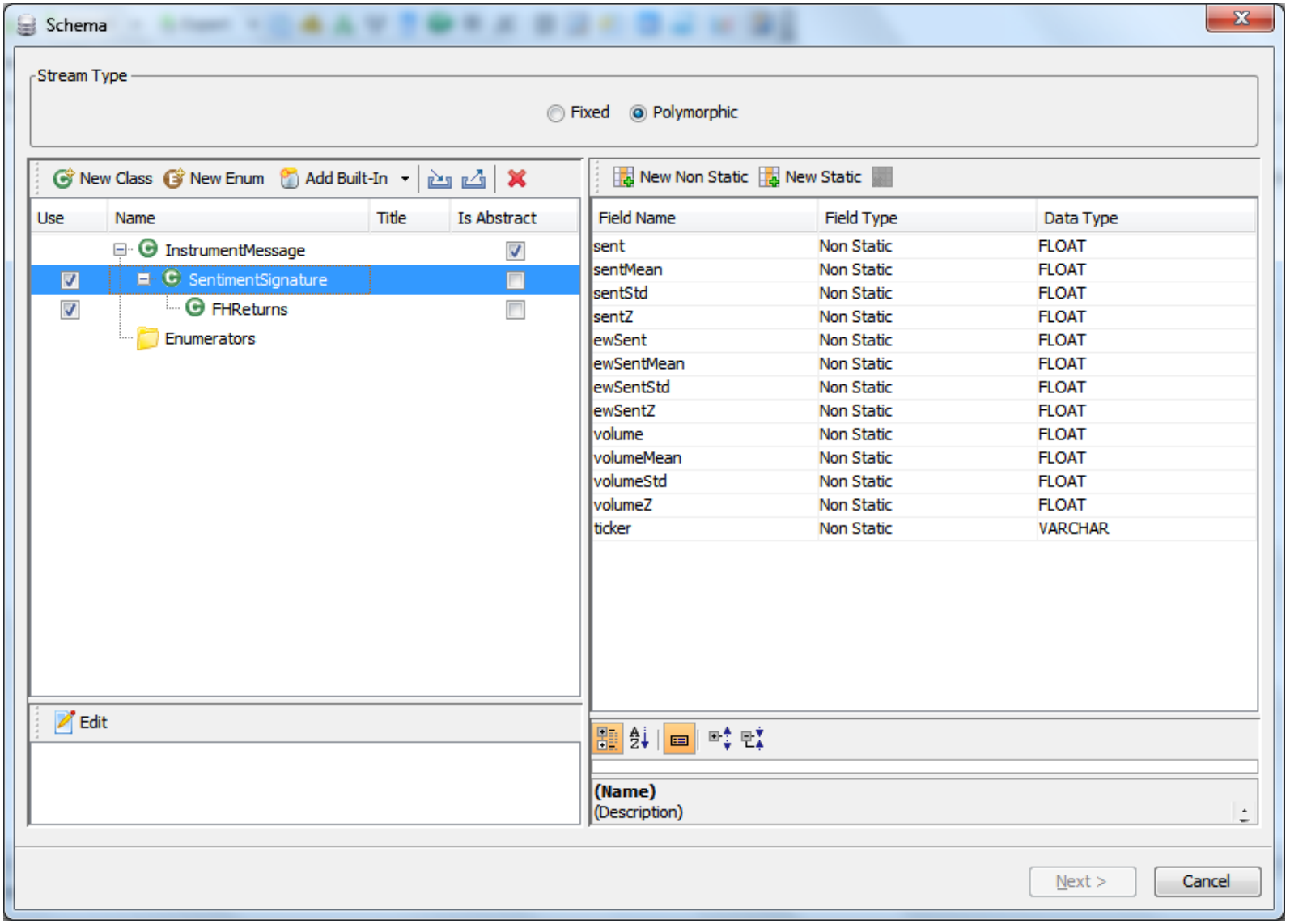
Social Market Analytics (SMA) Data



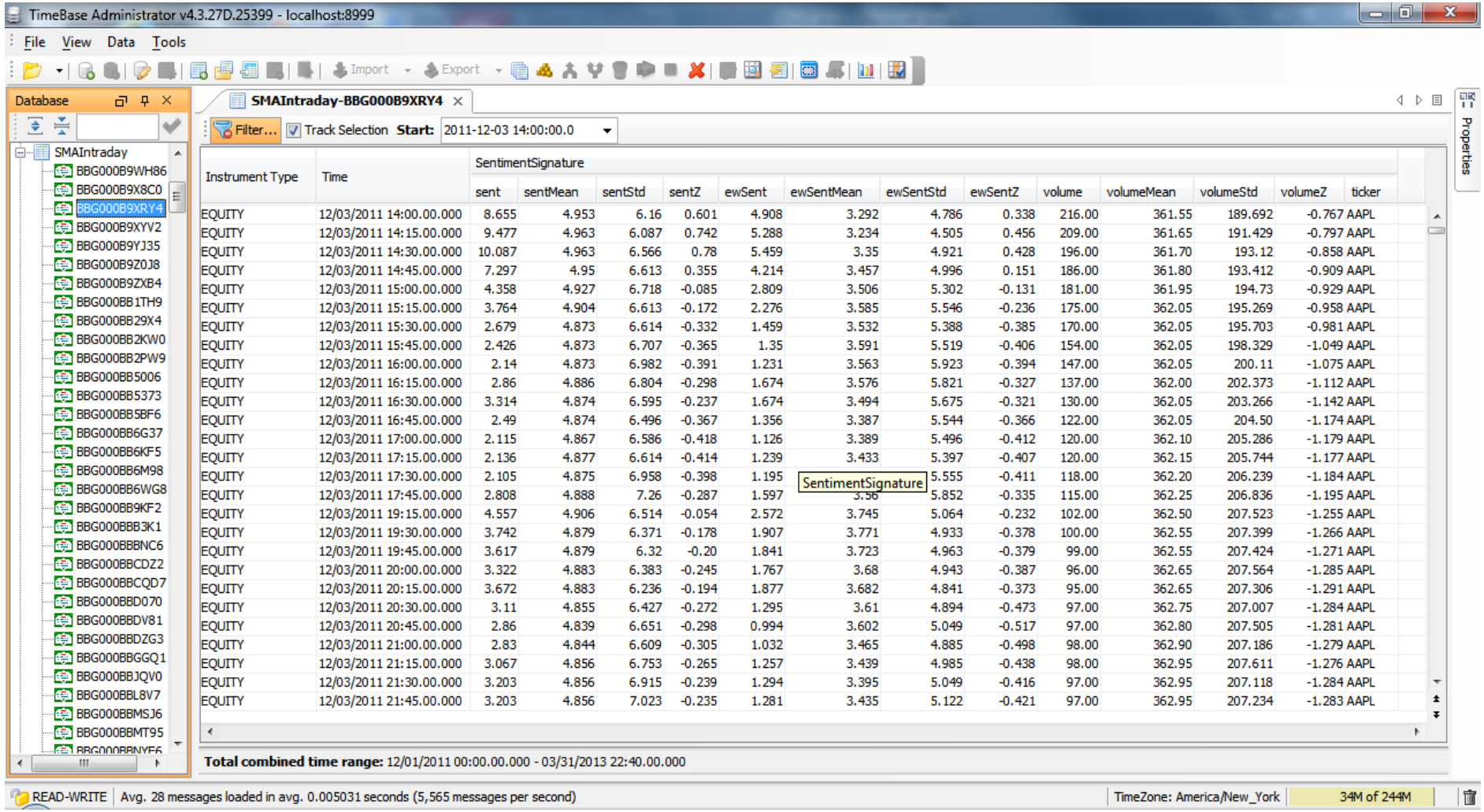
- SMA computes S-Factors on all U.S. securities that have sufficient and relevant social media data (*curated data*)

- Positive S-Score levels are associated with favorable market sentiment, while negative levels are unfavorable

SMA Data Schema in TimeBase



SMA Data Stream in DCS TimeBase



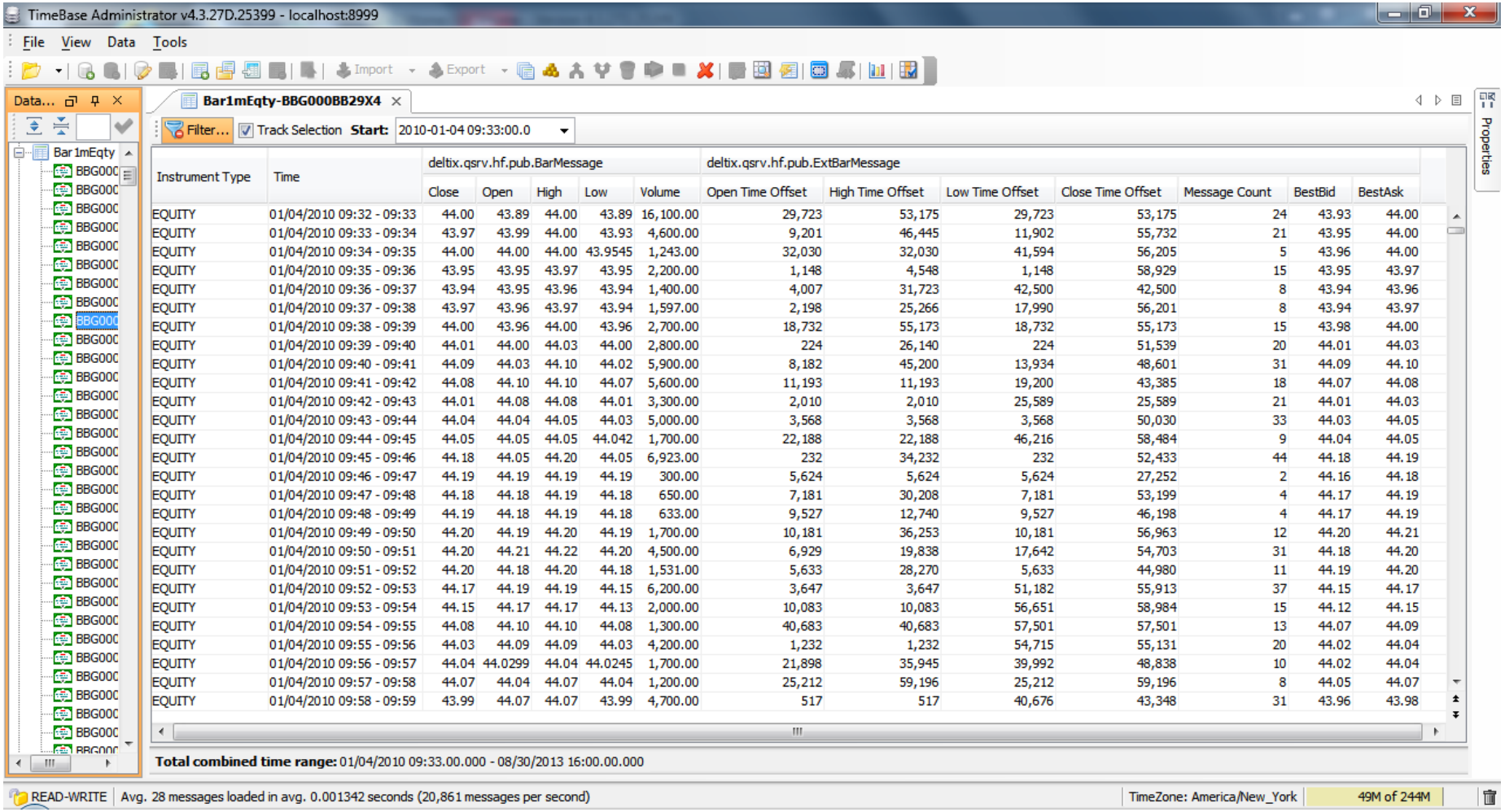
Instrument Type	Time	SentimentSignature												
		sent	sentMean	sentStd	sentZ	ewSent	ewSentMean	ewSentStd	ewSentZ	volume	volumeMean	volumeStd	volumeZ	ticker
EQUITY	12/03/2011 14:00.00.000	8.655	4.953	6.16	0.601	4.908	3.292	4.786	0.338	216.00	361.55	189.692	-0.767	AAPL
EQUITY	12/03/2011 14:15.00.000	9.477	4.963	6.087	0.742	5.288	3.234	4.505	0.456	209.00	361.65	191.429	-0.797	AAPL
EQUITY	12/03/2011 14:30.00.000	10.087	4.963	6.566	0.78	5.459	3.35	4.921	0.428	196.00	361.70	193.12	-0.858	AAPL
EQUITY	12/03/2011 14:45.00.000	7.297	4.95	6.613	0.355	4.214	3.457	4.996	0.151	186.00	361.80	193.412	-0.909	AAPL
EQUITY	12/03/2011 15:00.00.000	4.358	4.927	6.718	-0.085	2.809	3.506	5.302	-0.131	181.00	361.95	194.73	-0.929	AAPL
EQUITY	12/03/2011 15:15.00.000	3.764	4.904	6.613	-0.172	2.276	3.585	5.546	-0.236	175.00	362.05	195.269	-0.958	AAPL
EQUITY	12/03/2011 15:30.00.000	2.679	4.873	6.614	-0.332	1.459	3.532	5.388	-0.385	170.00	362.05	195.703	-0.981	AAPL
EQUITY	12/03/2011 15:45.00.000	2.426	4.873	6.707	-0.365	1.35	3.591	5.519	-0.406	154.00	362.05	198.329	-1.049	AAPL
EQUITY	12/03/2011 16:00.00.000	2.14	4.873	6.982	-0.391	1.231	3.563	5.923	-0.394	147.00	362.05	200.11	-1.075	AAPL
EQUITY	12/03/2011 16:15.00.000	2.86	4.886	6.804	-0.298	1.674	3.576	5.821	-0.327	137.00	362.00	202.373	-1.112	AAPL
EQUITY	12/03/2011 16:30.00.000	3.314	4.874	6.595	-0.237	1.674	3.494	5.675	-0.321	130.00	362.05	203.266	-1.142	AAPL
EQUITY	12/03/2011 16:45.00.000	2.49	4.874	6.496	-0.367	1.356	3.387	5.544	-0.366	122.00	362.05	204.50	-1.174	AAPL
EQUITY	12/03/2011 17:00.00.000	2.115	4.867	6.586	-0.418	1.126	3.389	5.496	-0.412	120.00	362.10	205.286	-1.179	AAPL
EQUITY	12/03/2011 17:15.00.000	2.136	4.877	6.614	-0.414	1.239	3.433	5.397	-0.407	120.00	362.15	205.744	-1.177	AAPL
EQUITY	12/03/2011 17:30.00.000	2.105	4.875	6.958	-0.398	1.195	3.56	5.555	-0.411	118.00	362.20	206.239	-1.184	AAPL
EQUITY	12/03/2011 17:45.00.000	2.808	4.888	7.26	-0.287	1.597	3.56	5.852	-0.335	115.00	362.25	206.836	-1.195	AAPL
EQUITY	12/03/2011 19:15.00.000	4.557	4.906	6.514	-0.054	2.572	3.745	5.064	-0.232	102.00	362.50	207.523	-1.255	AAPL
EQUITY	12/03/2011 19:30.00.000	3.742	4.879	6.371	-0.178	1.907	3.771	4.933	-0.378	100.00	362.55	207.399	-1.266	AAPL
EQUITY	12/03/2011 19:45.00.000	3.617	4.879	6.32	-0.20	1.841	3.723	4.963	-0.379	99.00	362.55	207.424	-1.271	AAPL
EQUITY	12/03/2011 20:00.00.000	3.322	4.883	6.383	-0.245	1.767	3.68	4.943	-0.387	96.00	362.65	207.564	-1.285	AAPL
EQUITY	12/03/2011 20:15.00.000	3.672	4.883	6.236	-0.194	1.877	3.682	4.841	-0.373	95.00	362.65	207.306	-1.291	AAPL
EQUITY	12/03/2011 20:30.00.000	3.11	4.855	6.427	-0.272	1.295	3.61	4.894	-0.473	97.00	362.75	207.007	-1.284	AAPL
EQUITY	12/03/2011 20:45.00.000	2.86	4.839	6.651	-0.298	0.994	3.602	5.049	-0.517	97.00	362.80	207.505	-1.281	AAPL
EQUITY	12/03/2011 21:00.00.000	2.83	4.844	6.609	-0.305	1.032	3.465	4.885	-0.498	98.00	362.90	207.186	-1.279	AAPL
EQUITY	12/03/2011 21:15.00.000	3.067	4.856	6.753	-0.265	1.257	3.439	4.985	-0.438	98.00	362.95	207.611	-1.276	AAPL
EQUITY	12/03/2011 21:30.00.000	3.203	4.856	6.915	-0.239	1.294	3.395	5.049	-0.416	97.00	362.95	207.118	-1.284	AAPL
EQUITY	12/03/2011 21:45.00.000	3.203	4.856	7.023	-0.235	1.281	3.435	5.122	-0.421	97.00	362.95	207.234	-1.283	AAPL

(*) SMA data is updated every 15 minutes

Historical Price Data

Raw tick data from IDC is aggregated to 1-min “extended” bars.

BBO data was used during subsequent backtesting of SMA trading strategy



Instrument Type	Time	deltix.qsrv.hf.pub.BarMessage					deltix.qsrv.hf.pub.ExtBarMessage						
		Close	Open	High	Low	Volume	Open Time Offset	High Time Offset	Low Time Offset	Close Time Offset	Message Count	BestBid	BestAsk
EQUITY	01/04/2010 09:32 - 09:33	44.00	43.89	44.00	43.89	16,100.00	29,723	53,175	29,723	53,175	24	43.93	44.00
EQUITY	01/04/2010 09:33 - 09:34	43.97	43.99	44.00	43.93	4,600.00	9,201	46,445	11,902	55,732	21	43.95	44.00
EQUITY	01/04/2010 09:34 - 09:35	44.00	44.00	44.00	43.9545	1,243.00	32,030	32,030	41,594	56,205	5	43.96	44.00
EQUITY	01/04/2010 09:35 - 09:36	43.95	43.95	43.97	43.95	2,200.00	1,148	4,548	1,148	58,929	15	43.95	43.97
EQUITY	01/04/2010 09:36 - 09:37	43.94	43.95	43.96	43.94	1,400.00	4,007	31,723	42,500	42,500	8	43.94	43.96
EQUITY	01/04/2010 09:37 - 09:38	43.97	43.96	43.97	43.94	1,597.00	2,198	25,266	17,990	56,201	8	43.94	43.97
EQUITY	01/04/2010 09:38 - 09:39	44.00	43.96	44.00	43.96	2,700.00	18,732	55,173	18,732	55,173	15	43.98	44.00
EQUITY	01/04/2010 09:39 - 09:40	44.01	44.00	44.03	44.00	2,800.00	224	26,140	224	51,539	20	44.01	44.03
EQUITY	01/04/2010 09:40 - 09:41	44.09	44.03	44.10	44.02	5,900.00	8,182	45,200	13,934	48,601	31	44.09	44.10
EQUITY	01/04/2010 09:41 - 09:42	44.08	44.10	44.10	44.07	5,600.00	11,193	11,193	19,200	43,385	18	44.07	44.08
EQUITY	01/04/2010 09:42 - 09:43	44.01	44.08	44.08	44.01	3,300.00	2,010	2,010	25,589	25,589	21	44.01	44.03
EQUITY	01/04/2010 09:43 - 09:44	44.04	44.04	44.05	44.03	5,000.00	3,568	3,568	3,568	50,030	33	44.03	44.05
EQUITY	01/04/2010 09:44 - 09:45	44.05	44.05	44.05	44.042	1,700.00	22,188	22,188	46,216	58,484	9	44.04	44.05
EQUITY	01/04/2010 09:45 - 09:46	44.18	44.05	44.20	44.05	6,923.00	232	34,232	232	52,433	44	44.18	44.19
EQUITY	01/04/2010 09:46 - 09:47	44.19	44.19	44.19	44.19	300.00	5,624	5,624	5,624	27,252	2	44.16	44.18
EQUITY	01/04/2010 09:47 - 09:48	44.18	44.18	44.19	44.18	650.00	7,181	30,208	7,181	53,199	4	44.17	44.19
EQUITY	01/04/2010 09:48 - 09:49	44.19	44.18	44.19	44.18	633.00	9,527	12,740	9,527	46,198	4	44.17	44.19
EQUITY	01/04/2010 09:49 - 09:50	44.20	44.19	44.20	44.19	1,700.00	10,181	36,253	10,181	56,963	12	44.20	44.21
EQUITY	01/04/2010 09:50 - 09:51	44.20	44.21	44.22	44.20	4,500.00	6,929	19,838	17,642	54,703	31	44.18	44.20
EQUITY	01/04/2010 09:51 - 09:52	44.20	44.18	44.20	44.18	1,531.00	5,633	28,270	5,633	44,980	11	44.19	44.20
EQUITY	01/04/2010 09:52 - 09:53	44.17	44.19	44.19	44.15	6,200.00	3,647	3,647	51,182	55,913	37	44.15	44.17
EQUITY	01/04/2010 09:53 - 09:54	44.15	44.17	44.17	44.13	2,000.00	10,083	10,083	56,651	58,984	15	44.12	44.15
EQUITY	01/04/2010 09:54 - 09:55	44.08	44.10	44.10	44.08	1,300.00	40,683	40,683	57,501	57,501	13	44.07	44.09
EQUITY	01/04/2010 09:55 - 09:56	44.03	44.09	44.09	44.03	4,200.00	1,232	1,232	54,715	55,131	20	44.02	44.04
EQUITY	01/04/2010 09:56 - 09:57	44.04	44.0299	44.04	44.0245	1,700.00	21,898	35,945	39,992	48,838	10	44.02	44.04
EQUITY	01/04/2010 09:57 - 09:58	44.07	44.04	44.07	44.04	1,200.00	25,212	59,196	25,212	59,196	8	44.05	44.07
EQUITY	01/04/2010 09:58 - 09:59	43.99	44.07	44.07	43.99	4,700.00	517	517	40,676	43,348	31	43.96	43.98

Parameters of setup

- **Intraday SMA Data from 1 Dec 2011 till 31 March 2013:**
  - More than 16 million messages
  - Used a subset of data for 100 most liquid US equities

- **Historical Price Data:**
  - The entire DCS data set contains more than 300 million1-min extended bars which covers 750 most liquid equities and ETFs from Jan 2010 until today.
  - Used a subset of data for 100 most liquid US equities from Dec 2011 until April 2013 – around 20 million bars

SMA trends and signal discovery

- The original idea to use actual SMA scores to predict intraday price movements of liquid US equities failed to generate the stable trading signals (probably Twitter data already takes into account price movements of equities and instead of predicting, confirms the fact of price movements)

- We decided to focused on studying trends of SMA data in combination with overnight price gaps.

- The basic “moving average cross-over” technique was applied to SMA data and yielded promising results

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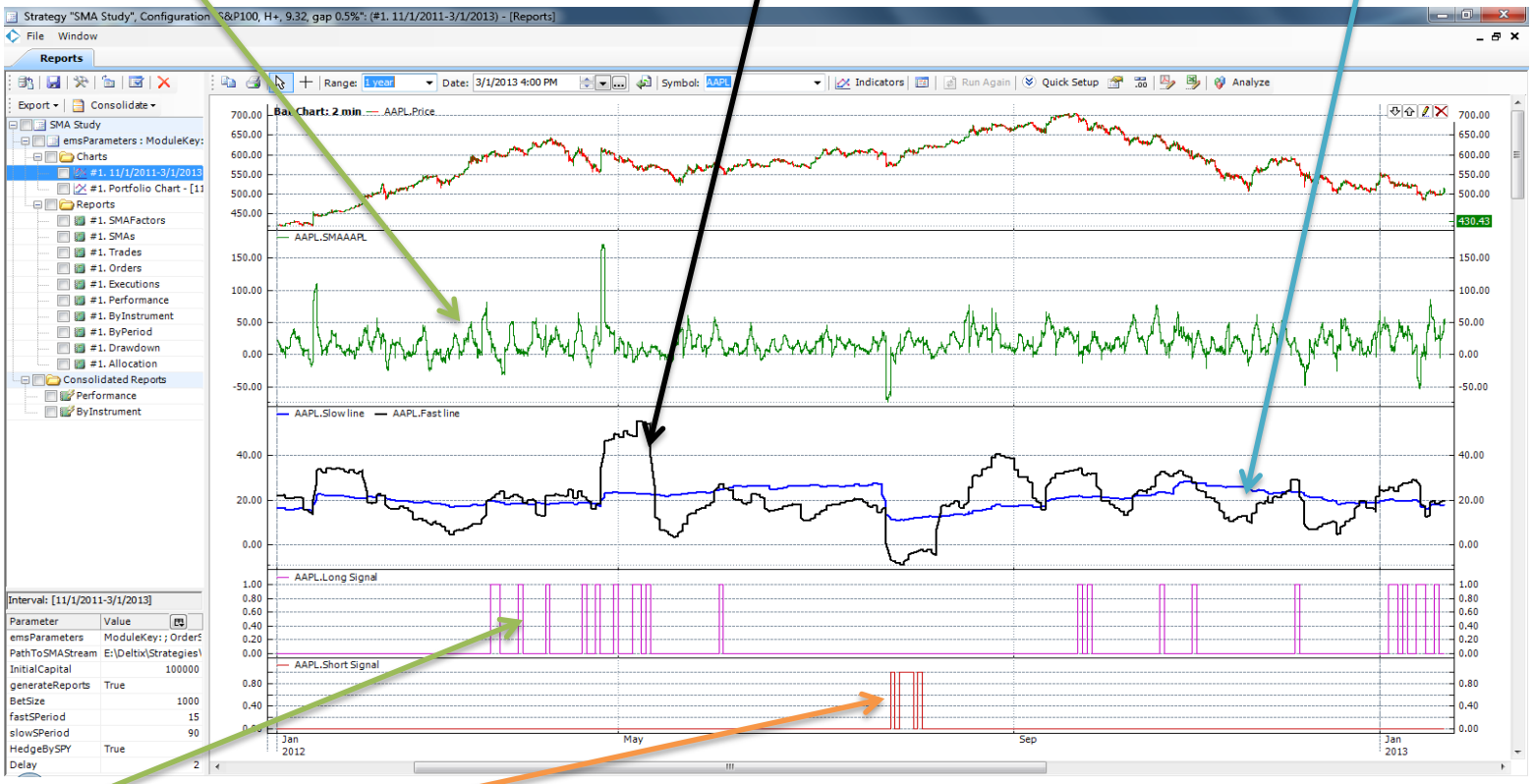
SMA “cross-over and daily gap” signals

SMA sentiment curve

“**fast**” moving average (15 days)

“**slow**” MA (90 days)

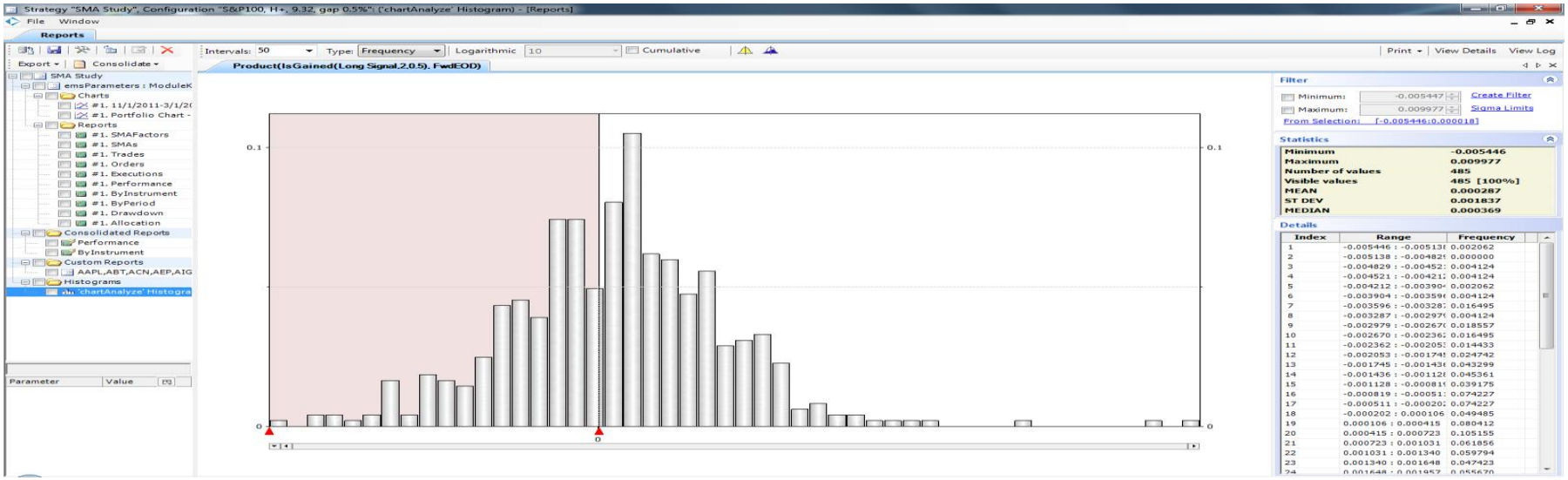


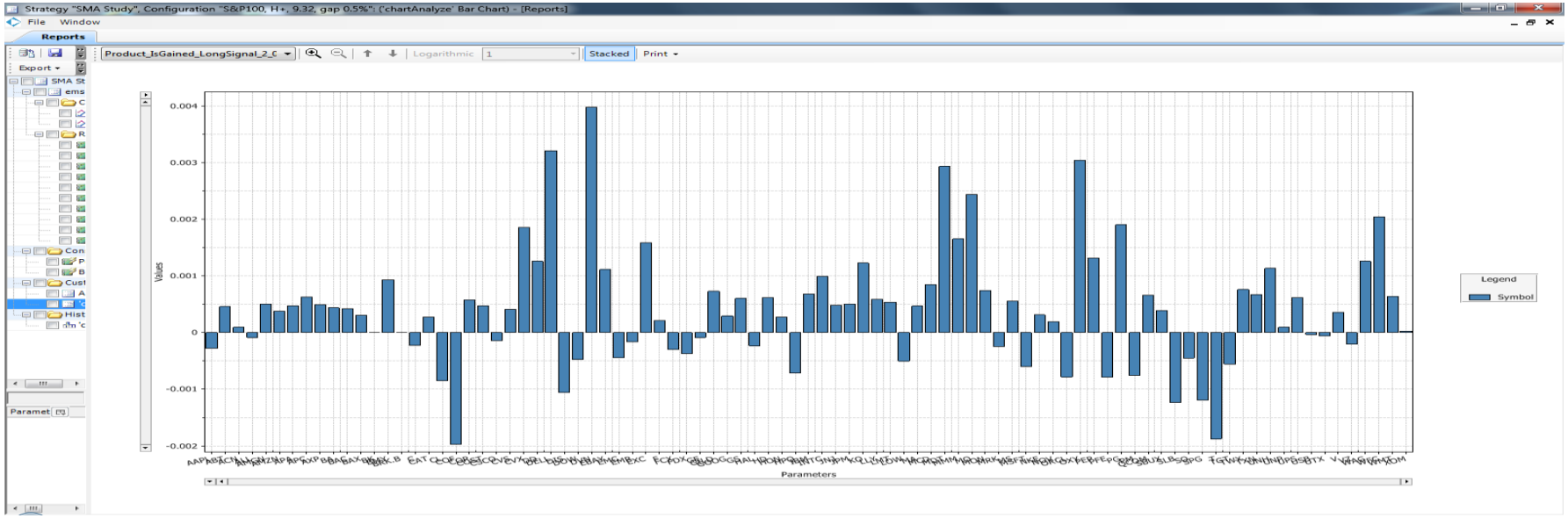
“**buy**” and “**sell**” trading signals based on the “SMA cross-over” and “overnight price gap” rules

Forward (EOD) return assessment for JPM

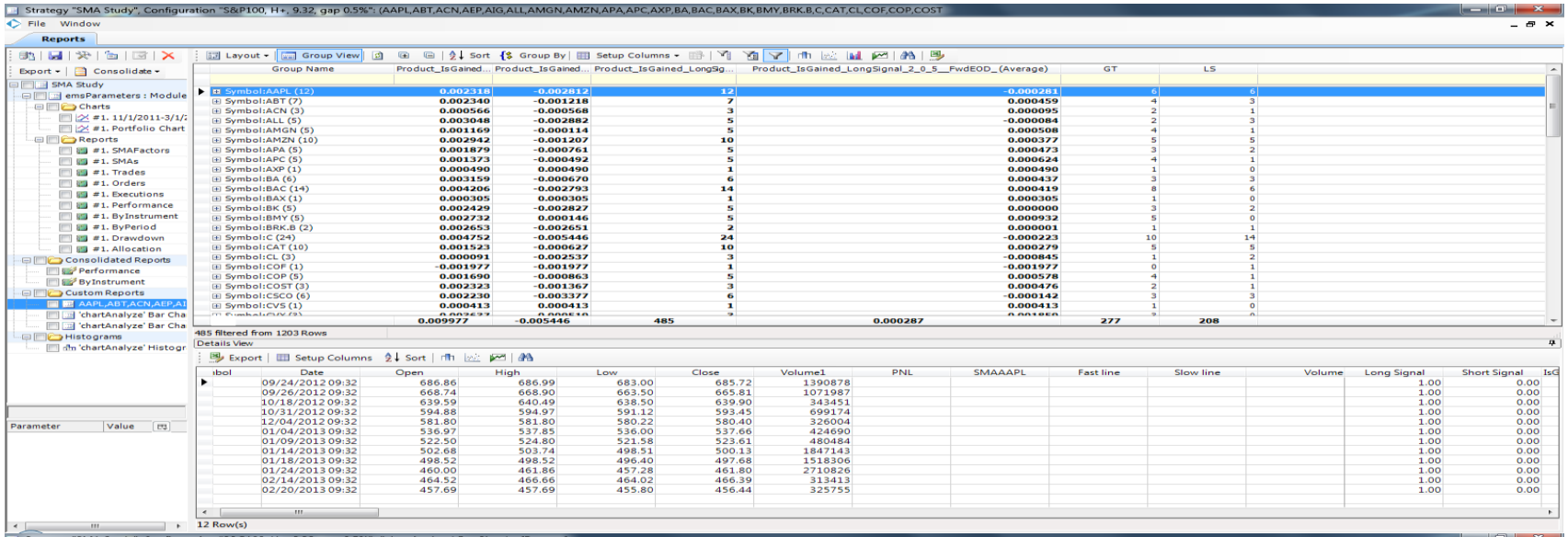
Forward (EOD) return assessment for BAC

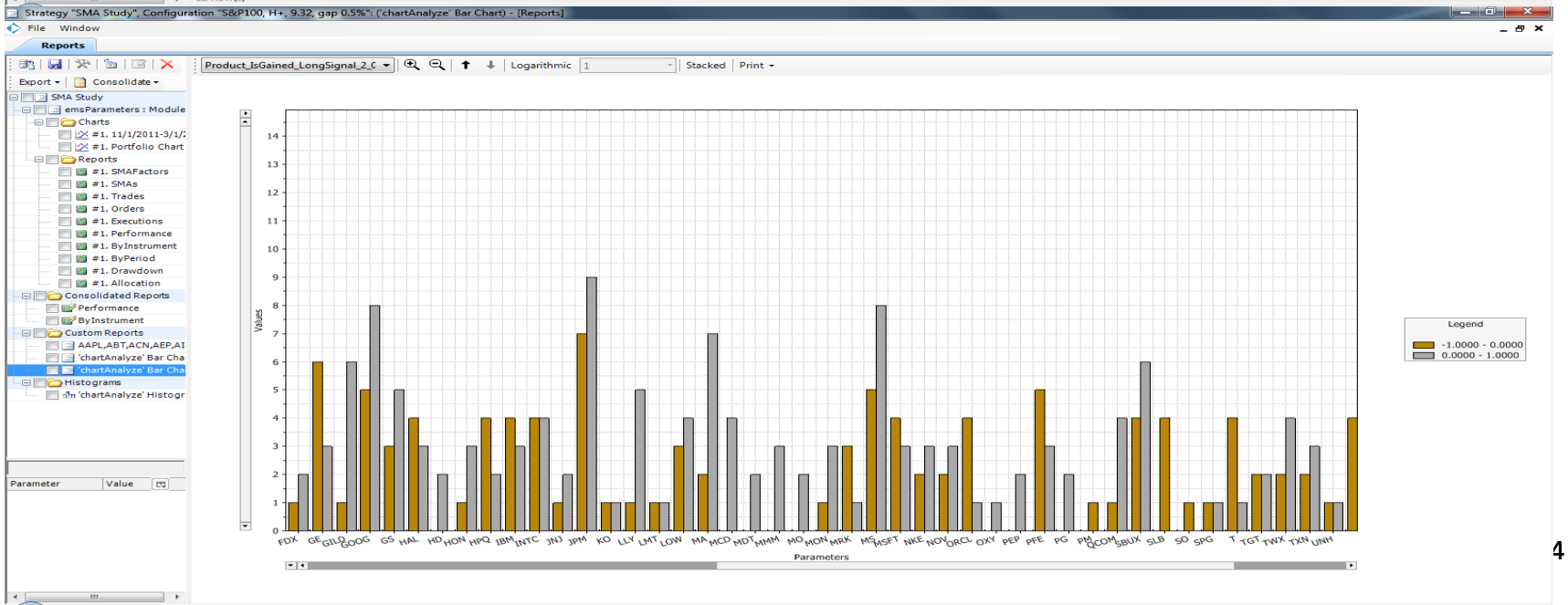
Forward return distributions for all equities





Positive and Negative Signals (277/208)





Simple Trading Strategy:
cross-over of SMA and daily price gaps

We would like to use the “SMA cross-over with daily price gap” rule as a foundation for a simple trading strategy.

```
goLong  = smaFast[0] > smaSlow[0] && smaFast[0] >= 1 &&
                                    DayOpenPrice <= 0.995 * prevDayClose;
goShort = smaFast[0] < smaSlow[0] && smaFast[0] <= -1 &&
                                    DayOpenPrice >= 1.005 * prevDayClose;
```

We will examine four difference scenarios:

1) we will generate the opening signal either at 9:30 or 9:32 and
2) we will hedge our positions by SPY or not.

The strategy does not have overnight positions. They all are closed at the end of the trading session.

The order execution is done using relatively conservative BBO mode –
buy by best ask price and sell by best bid price
The lot size for all trades is 10,000 USD.

Open Position at day open without hedging

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Parameter	All Trades	Long Trades	Short Trades
Net Profit/Loss	3,601.19	3,768.95	-167.77
Total Profit	9,058.92	8,316.09	742.82
Total Loss	-5,457.73	-4,547.14	-910.59
Cumulated Profit %	3.60%	3.77%	-0.17%
Max Drawdown	-338.39	-338.39	-206.71
Max Drawdown %	-0.33%	-0.33%	-0.21%
Max Drawdown Date	4-May-2012	4-May-2012	3-Aug-2012
Return/Drawdown Ratio	10.64	11.14	-0.81
Drawdown Days %	62.46%	60.66%	89.79%
Max Drawdown Duration	36	40	299
CAGR	2.80%	2.93%	-0.13%
Sharpe Ratio	3.31	3.53	-0.73
Annualized Volatility	0.85	0.83	0.18
Sortino Ratio	6.17	6.69	-0.93
UPI	1.81	2.31	-0.05
Information Ratio	3.31	3.53	-0.73
Optimal f	388.54	422.1	-404.48
All Trades #	1598	1449	149
Profitable Trades Ratio	0.58	0.59	0.49
Winning Trades #	922	849	73
Losing Trades #	676	600	76
Average Trade	2.25	2.6	-1.13
Average Winning Trade	9.83	9.8	10.18
Average Losing Trade	-8.07	-7.58	-11.98
Avg. Win/ Avg. Loss Ratio	1.22	1.29	0.85
Average Profit per Share	0.08	0.1	-0.03
Max Conseq. Winners	21	20	7
Max Conseq. Losers	20	20	7

Open Position at day open with hedging

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Parameter	All Trades	Long Trades	Short Trades
Net Profit/Loss	2,089.43	3,819.76	-1,730.33
Total Profit	11,376.36	8,610.22	2,766.13
Total Loss	-9,286.93	-4,790.47	-4,496.46
Cumulated Profit %	2.09%	3.82%	-1.73%
Max Drawdown	-126.02	-382.58	-1,730.33
Max Drawdown %	-0.12%	-0.37%	-1.73%
Max Drawdown Date	4-May-2012	7-Nov-2012	1-Mar-2013
Return/Drawdown Ratio	16.58	9.98	-1
Drawdown Days %	63.36%	61.86%	89.79%
Max Drawdown Duration	39	41	299
CAGR	1.63%	2.97%	-1.35%
Sharpe Ratio	3.72	3.55	-2.04
Annualized Volatility	0.44	0.84	0.66
Sortino Ratio	8.31	6.7	-2.71
UPI	2.28	2.02	-0.06
Information Ratio	3.72	3.55	-2.04
Optimal f	845.22	421.79	-307.84
All Trades #	1842	1499	343
Profitable Trades Ratio	0.55	0.58	0.43
Winning Trades #	1020	872	148
Losing Trades #	822	627	195
Average Trade	1.13	2.55	-5.04
Average Winning Trade	11.15	9.87	18.69
Average Losing Trade	-11.3	-7.64	-23.06
Avg. Win/ Avg. Loss Ratio	0.99	1.29	0.81
Average Profit per Share	0.04	0.1	-0.12
Max Conseq. Winners	12	20	5
Max Conseq. Losers	16	20	11

Open Position at 9:32 without hedging

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Parameter	All Trades	Long Trades	Short Trades
Net Profit/Loss	3,668.97	3,861.32	-192.34
Total Profit	8,788.86	8,073.09	715.77
Total Loss	-5,119.88	-4,211.77	-908.11
Cumulated Profit %	3.67%	3.86%	-0.19%
Max Drawdown	-339.28	-339.28	-200.74
Max Drawdown %	-0.33%	-0.33%	-0.20%
Max Drawdown Date	4-May-2012	4-May-2012	21-Feb-2013
Return/Drawdown Ratio	10.81	11.38	-0.96
Drawdown Days %	62.46%	59.76%	89.79%
Max Drawdown Duration	42	42	299
CAGR	2.85%	3.00%	-0.15%
Sharpe Ratio	3.31	3.55	-0.84
Annualized Volatility	0.87	0.85	0.18
Sortino Ratio	6.6	7.22	-1.05
UPI	1.77	2.13	-0.06
Information Ratio	3.31	3.55	-0.84
Optimal f	380.3	415.71	-466.28
All Trades #	1599	1450	149
Profitable Trades Ratio	0.57	0.58	0.48
Winning Trades #	915	843	72
Losing Trades #	684	607	77
Average Trade	2.29	2.66	-1.29
Average Winning Trade	9.61	9.58	9.94
Average Losing Trade	-7.49	-6.94	-11.79
Avg. Win/ Avg. Loss Ratio	1.28	1.38	0.84
Average Profit per Share	0.08	0.1	-0.04
Max Conseq. Winners	21	20	7
Max Conseq. Losers	20	20	10

Open Position at 9:32 with hedging

Parameter	All Trades	Long Trades	Short Trades
Net Profit/Loss	1,711.99	3,900.98	-2,188.99
Total Profit	10,922.18	8,352.47	2,569.72
Total Loss	-9,210.19	-4,451.49	-4,758.71
Cumulated Profit %	1.71%	3.90%	-2.19%
Max Drawdown	-171.73	-414.77	-2,188.99
Max Drawdown %	-0.17%	-0.40%	-2.19%
Max Drawdown Date	13-Dec-2012	8-Nov-2012	1-Mar-2013
Return/Drawdown Ratio	9.97	9.41	-1
Drawdown Days %	66.67%	60.96%	89.79%
Max Drawdown Duration	39	42	299
CAGR	1.33%	3.03%	-1.71%
Sharpe Ratio	3.3	3.56	-2.5
Annualized Volatility	0.41	0.86	0.68
Sortino Ratio	7.19	7.21	-3.1
UPI	1.51	1.87	-0.07
Information Ratio	3.3	3.56	-2.5
Optimal f	812.9	414.81	-367.24
All Trades #	1844	1500	344
Profitable Trades Ratio	0.55	0.58	0.44
Winning Trades #	1019	867	152
Losing Trades #	825	633	192
Average Trade	0.93	2.6	-6.36
Average Winning Trade	10.72	9.63	16.91
Average Losing Trade	-11.16	-7.03	-24.78
Avg. Win/ Avg. Loss Ratio	0.96	1.37	0.68
Average Profit per Share	0.03	0.1	-0.15
Max Conseq. Winners	19	20	5
Max Conseq. Losers	17	20	9

Side-by-side comparison of 4 strategies

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	SP100, H-, gap 0.5%	S&P100, H+, gap 0.5%	S&P100, H-, 9.32, gap 0.5%	S&P100, H+, 9.32, gap 0.5%
Hedging	FALSE	TRUE	FALSE	TRUE
Average Profit per Share	0.08	0.04	0.08	0.03
Information Ratio	3.31	3.72	3.31	3.3
Net Profit/Loss	3,601.19	2,089.43	3,668.97	1,711.99
Total Profit	9,058.92	11,376.36	8,788.86	10,922.18
Total Loss	-5,457.73	-9,286.93	-5,119.88	-9,210.19
Cumulated Profit %	3.60%	2.09%	3.67%	1.71%
Max Drawdown	-338.39	-126.02	-339.28	-171.73
Max Drawdown %	-0.33%	-0.12%	-0.33%	-0.17%
Max Drawdown Date	4-May-2012	4-May-2012	4-May-2012	13-Dec-2012
Return/Drawdown Ratio	10.64	16.58	10.81	9.97
Drawdown Days %	62.46%	63.36%	62.46%	66.67%
Max Drawdown Duration	36	39	42	39
CAGR	2.80%	1.63%	2.85%	1.33%
Sharpe Ratio	3.31	3.72	3.31	3.3
Annualized Volatility	0.85	0.44	0.87	0.41
Sortino Ratio	6.17	8.31	6.6	7.19
UPI	1.81	2.28	1.77	1.51
Information Ratio	3.31	3.72	3.31	3.3
Optimal f	388.54	845.22	380.3	812.9
All Trades #	1598	1842	1599	1844
Profitable Trades Ratio	0.58	0.55	0.57	0.55
Winning Trades #	922	1020	915	1019
Losing Trades #	676	822	684	825
Average Trade	2.25	1.13	2.29	0.93
Average Winning Trade	9.83	11.15	9.61	10.72
Average Losing Trade	-8.07	-11.3	-7.49	-11.16
Avg. Win/ Avg. Loss Ratio	1.22	0.99	1.28	0.96
Average Profit per Share	0.08	0.04	0.08	0.03

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Summary

- Empirical analysis shows that trading signals based on cross-over of fast and slow moving averages of SMA sentiment data generate reliable intraday forward returns

- A simple intraday strategy based on these signals has alpha potential and is a candidate for further research

- Additional refinement techniques based on the time of entry and hedging could be applied to optimize the performance of the original idea