Analysis of AAII Shadow Screen

12/16/2012

Since AAII regularly publishes results and analysis of its Shadow Stock Screen (SSS), and since I use their database to create stock screens, I decided to do an independent analysis of the Shadow Stock Screen. In addition, my purpose is to use comparable metrics to compare it to screens I have developed, and to see if I could improve upon the screen's parameters. Some readers may use this report to decide whether or not to invest using the SSS. Others may choose from my adaptations. Others still may be more interested in learning from or critiquing the methodology displayed.

AAII reports returns with an assumed purchase at the beginning of each month and holding for the month. The same or different positions may be purchased for the next month. The analysis here presumes a holding period of one year, adds liquidity restrictions and limits outlier returns.

Here are the SSS criteria as published in the AAII data service, Stock Investor Pro (SIP).

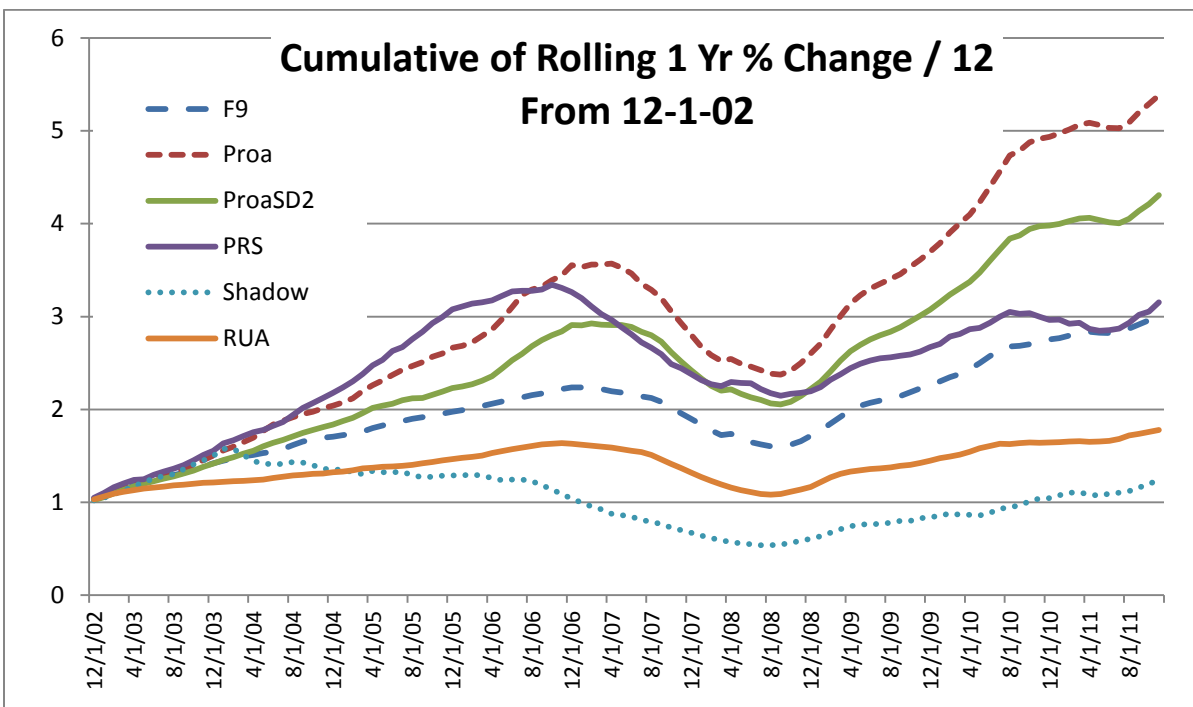| AAII Shadow Stock Criteria				
	Abbreviation	**Field**	**Operator**	**Parameter**
	price	Price	>	$4
And	epscon_12m	Earnings per Share-Continuing Operations 12 months	>	0
And	epscon_q1	Earnings per Share-Continuing Operations Last Quarter	>	0
And	pbvps	Price / Book Value	<	0.8
And	mktcap	Market Cap last quarter	>=	17 m
And	mktcap	Market Cap last quarter	<=	200 m
And	smg_desc	Sector	Not =	Financial
And	psps	Price / Sales	<	1.2
And	adr	ADR/ADS Stock	No	
And	exch	Exchange	Not =	OTC

Methodology

The data used for this analysis and comparison is more limited than the full data set supplied by SIP. Stocks with limited liquidity are removed. These are stocks trading fewer than a daily average of 5,000 shares over the past ten days, and stocks with an average daily dollar trading of less than $500,000 over the past three months. The Piotroski Return on Assets (Proa) that I have developed and to which I compare the SSS requires a share price of $1, while the SSS has a minimum share price of $4. Over the Counter stocks are removed from all analyses.

In addition, the returns are calculated with the outlier returns capped at the five percentile and ninety-five percentile levels. The extreme returns of the few stocks above and below these levels distorts the averages, and are unlikely to be repeated when implementing the screen with a relatively small number of stocks. The average percent change for the year following the aggregate of each month's selections for the SSS is 35.1% for the 108 months, while for the capped dataset it is 23.5%. (While the capped average of all selections is 23.5%, the average of monthly returns is only 3.0%. The discrepancy is a function of monthly count distribution.)

The analysis was monthly for rolling twelve month percent change beginning 12/31/2002 and running through 11/30/2011 for 108 months.

The analysis is subject to an unknown survivorship bias in that positions not found in the SIP dataset one year later from which to draw the return data are excluded. Some of these positions may have been acquired at a premium and some may have gone bankrupt or merely changed their symbol and legal status. The survivorship bias might be considered more significant for the SSS given the small cap nature of the screen with a market cap between 17 and 200 million.

Selection Count Findings

The monthly counts or number of stocks meeting the SSS criteria are usually low and inconsistent. Forty one percent of all the stocks selected occurred during the nine months between September of 2008 and May of 2009 (average 32). Other than this market period the average count was 4.2, with several months not having any selections. A screen with a low single digit number of selections generally will lack statistical reliability. When searching through historical data for profitable criteria, the more limiting the criteria the higher the returns and the less likely the returns will be replicated when the screen is deployed.

Since March of 2009 marks a dramatic change in the nature of the market, looking since then the Proa has had an average count of 35 while the SSS has had an average count of 5. The minimum for Proa has been 15 while SSS has had several months with 0, 1, 2, or 3.

Screen Criteria Count

I begin my analyses after default exclusions relative to price, liquidity and exchanges, as described above. After that, I find that productive screens rarely have more than four or five criteria. The combination of more criteria than that tends to produce coincidental returns that are difficult to replicate. On the face of it, looking at a screen with eight additional criteria is suspect.

Return Findings

Summary statistics comparing four screens against the Russell 3000 (RUA) market benchmark are given in the table below. While every effort has been made to provide accurate computations, many steps are involved in evolving the data and accuracy cannot be guaranteed.

Screens	
F-9	Piotroski f score of 9 as provided by *Stock Investor Pro*
Proa	Piotroski f score, return on assets and other variables
PRS	Piotroski f score, relative strength and other variables
Shadow	The Shadow Stock Screen criteria from SIP
RUA	Russell 3000 market benchmark

	Average of ret_Cap_52w					StdDev of ret_Cap_52w				Count of ret_Cap_52w			
	F-9	Proa	PRS	Shadow	RUA	F-9	Proa	PRS	Shadow	F-9	Proa	PRS	Shadow
Grand Total	11.8	23.3	16.5	24	6.6	33.2	39.6	41.7	49.9	3,314	2,152	1,285	702
Avg of Months	12.5	19.1	13.1	3.0	6.6	27.1	33.1	34.0	35.1	30.7	19.9	11.9	6.9
SD of Months	19.8	26.0	25.9	37.3	18.5	5.2	9.1	9.1	16.9	7.7	12.8	5.3	9.3
SD/Avg	1.6	1.4	2.0	12.4	2.8	0.19	0.28	0.27	0.48	0.3	0.6	0.4	1.4
Percent Negative	16%	16%	23%	33%	19%								

Cumulative of Rolling 1 Yr % Change / 12 From 12-1-02

Arithmetic charts can be misleading. The drawdown for Proa appears to be more than for RUA while actually it is slightly less (33.5% to 33.8%). Also, if we take the same data and begin the chart at the lowest point above, we get a very different looking chart.

Cumulative of Rolling 1 Yr % Change / 12 From 9-1-2008
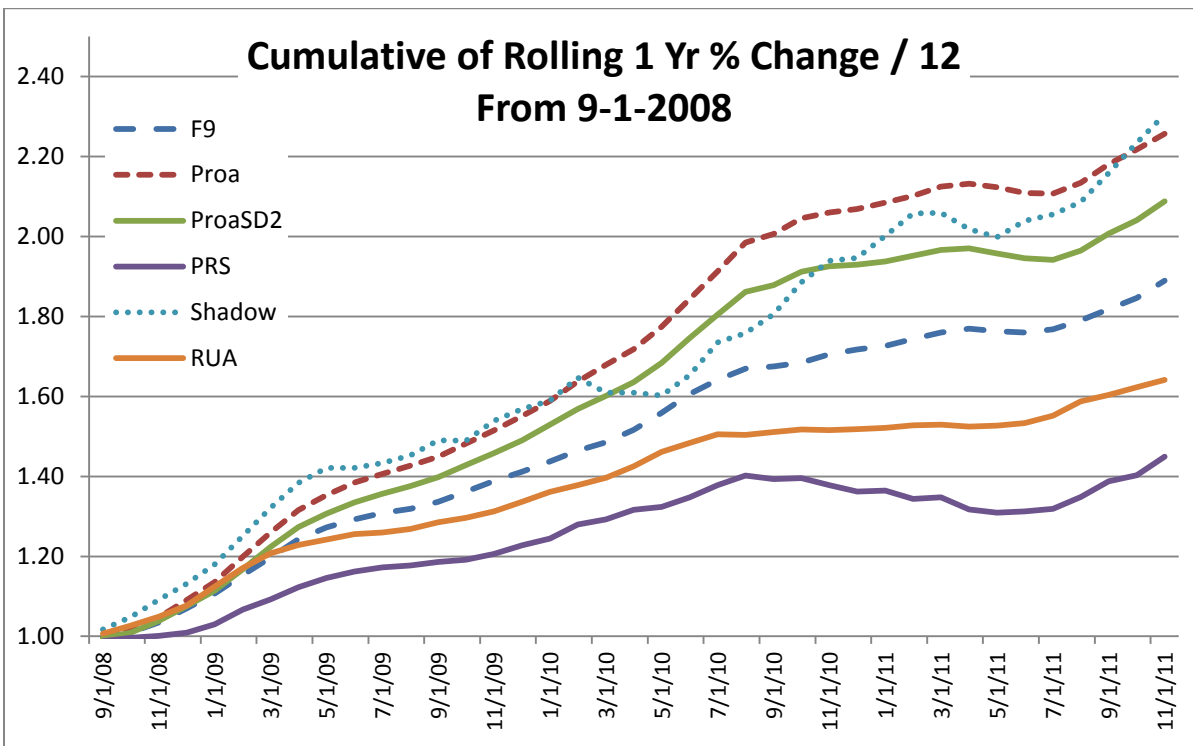
Monthly details for counts, standard deviations and percent of price change are supplied at the end of this document as an appendix.

Refinement of SSS Criteria by Sequentially Deleting or Editing each Variable

One approach to testing or refining a screen such as the SSS is subtract a variable and see what it does to the count and rate of return results. Then put the variable back and test another variable. In this way one can see which variables are doing the work, and which variables are contributing very little or even subtracting from the desired results.

A shortcoming of this initial exploration is that it examines all records that meet the criteria, regardless of the distribution by month. If only two records with very low returns occur in a given month, the returns for that month will be very low even if in the average of all records those two records will have a minimal impact. In this case the monthly average will be low while the average of all records will be much higher.

This approach may tell us which variables are having a minimal or even negative impact on results, and we might then choose to not use that variable. However, it doesn't tell us anything about alternative variables to use, or how to adjust variable parameters unless we begin a process changing and testing a series of variable values. Even then, we don't have any indication of statistical validity.

AAII Shadow Stock Criteria					When removed		Difference	
	Symbol	Field	Operator	Parameter	Count	% Chg	Count	% Chg
	pbvps	Price / Book Value	<	0.8	4804	10.8	85%	118%
And	epscon_q1	Earnings per Share-Cont Oper Q1	>	0	1161	16.8	40%	40%
And	smg_desc	Sector	Not =	Financial	895	17.7	22%	33%
And	mktcap	Market Cap last quarter	>=	17 m	3190	20.1	78%	17%
And	mktcap	Market Cap last quarter	<=	200 m				
And	epscon_12m	Earnings per Share-Cont Oper 12m	>	0	874	22.0	20%	7%
And	psps	Price / Sales	<	1.2	779	22.3	10%	5%
And	adr	ADR/ADS Stock	No		717	23.1	2%	2%
And	price	Price	>	$4	1010	28.6	31%	-18%
And	exch	Exchange	Not =	OTC	Default value			
Complete					700	23.5		

The table above gives the counts and returns without each variable. The variables are then sorted by the last column of impact the variable has on price change. Most of the work is being done by price to book value, followed by earnings per share from continuing operations for the last quarter. Eliminating financial stocks improved returns by 33% while only reducing the count by 22%. Market cap is a questionable variable since it cost us 78% of our count while only improving performance by 17%. The remaining variable had minimal impact on either counts or returns, except for the price floor at $4 which actually subtracted 18% from our results.

Based on this analysis, we can eliminate the price >$4 variable, but that still gives only 1010 records. Even if evenly divided between the 107 months, that is only 9.4 records per month – not enough. Remember that we have two principal problems with this screen. The counts are too low and the variance by month of both count and return is too high.

What would it look like if we eliminated all the variables below market cap? That gives us a count of 14.6 per month and an even slightly better average return, 24.1%. However, when we break these out by month, some months have counts over 100 and several months are in single digits, including counts of 3, 3, and 4 in the last year. The average of monthly returns is 5.4%, hardly adequate when the Russell 3000 was 6.5%. The standard deviation of monthly price change is 32.8, which when divided by return is 6.0%. I would want to look further.

Refinement of SSS Criteria using Data Mining

The question remains as to whether we can advantageously delete or change parameters on some of the criteria in SSS. What might we do to get a higher and more consistent count and therefore more consistent returns?

Another approach was to import into a data mining tool the 379,000 records containing the screen variables and the percent change for 4, 13, 26 and 52 weeks, although this analysis only explored the 52 week returns. The software divides each variable into deciles and then explores the returns and standard deviations within each decile. If two or more adjacent deciles have similar values, they are combined. The table below shows the best results for different variables and their respective values or parameters. The variables are ordered according to their statistical significance. The minimum significance is .01. So the first variable carves out a subset of the whole, and then each successive variable carves out a subset of the superseding variable in a hierarchical fashion. Because of the interaction effects, the result of a variable when applied to a subset in combination with other variables might be very different than if the variable were applied to the entire dataset.

In the log table below, the top section records the screen variables applied to the dataset as described above. However, it doesn't approximate the SSS because the lowest decile for price is at $15.16 while the SSS is at $4. The lowest decile for market cap is $1,162 million while the SSS is between 17 and 200 million. Therefore, the lower section of the table gives results for importing data already filtered by the $4 price and 17-200 million market cap.

Shadow Variables only, 107 months capped											
Variables in subsuming	Notes	SSS >	<	Range >	<	% Chg	SD	N	N/Month	N %	SD/Ret
All						5.53	38.6	379,137	3,543		7.0
Sector					Financials	2.0	31.2	69,158	646	18%	15.6
	Overall, the lowest sector but very volatile. One period of 40 months with returns of 15.4%.										
Sector					Non-Financials	6.3	40.0	309,979	2,897	82%	6.3
pbvps	5cells, bowl		0.8		4.22	7.8	39.4	232,056	2,169	61%	5.1
psps			1.2		9.61	9.6	39.1	221,430	2,069	58%	4.1
epscon_12m	7 cells, M	0		-2.87	-6.94	16.0	48.1	5,101	48	1%	3.0
mktcap		17	200		2333	18.7	49.8	3,981	37	1%	2.7
epscon_q1		0		-11.49	-6.09	31.7	53.4	478	4	0%	1.7
price			4		15.16	17.8	50.8	3,237	30	1%	2.9
price	lowest cell is $15.16; linear 6 cells, cheaper having better returns; Discard for now.										
mktcap	lowest cell				1162	8.3	43.0	115,823	1,082	31%	5.2
				1161.8	10604	9.0	35.7	80,976	757	21%	4.0
ADR					TRUE	10.4	38.9	17,584	164	5%	3.7
ADR			FALSE		FALSE	8.1	39.2	203,846	1,905	54%	4.8
Dataset no financials, mkt cap 17-200 and price >4						3.1	47.3	22,266	208	100%	15.2
psps	5 cells linear		1.2		1.7	7.8	47.9	11,961	112	54%	6.1
mktcap		17	200	74.1	128.1	10.6	50.0	3,021	28	14%	4.7
epscon_12m	3 cell bowl		0		-0.04	13.7	52.1	975	9	4%	3.8
epscon_12m			0	0.88		14.2	52.0	706	7	3%	3.7
epscon_12m	forced		0	0.88	-0.04	13.9	52.0	1,680	16	8%	3.8
epscon_q1	4 cellzig zag		0		-0.57	18.8	55.4	266	2	1%	2.9
epscon_q1			0	-0.01	1.12	11.3	48.7	1,877	18	8%	4.3
pbvps			0.8		1.43	17.0	49.5	809	8	4%	2.9
	Fairly even monthly counts except more in 2008 & 2009.										
pbvps					1.43	10.1	48.5	6,016	56	27%	4.8
epscon_q1	5 cell W		0	-0.01	1.12	11.8	47.3	3,435	32	15%	4.0
mktcap		17	200	17	128.1	16.9	49.3	974	9	4%	2.9
pbvps	forced		0.8		2.74	6.6	46.4	14,043	131	63%	7.0
psps			1.2		3.39	8.3	46.8	12,226	114	55%	5.7
mktcap		17	200	74.1	128.1	11.4	49.0	3,010	28	14%	4.3
epscon_12m	3 cell bowl		0	0.88	-0.04	15.3	50.8	1,636	15	7%	3.3
	Fairly even monthly counts except lower counts and returns last nine months.										

While the format of the table makes more sense to me than it probably does to you since I have evolved its structure, the heart of it is that working from the complete data set I came up with one

screen that had average returns of 18.7% and an average count of 37, or an average return of 31.7% and an average count of 4. Starting with the market cap of 17-200m and the price > $4, the last screen in the table has an average return of 12.3% and an average count of 15.

	Entire Period				October 2008 and on			
	SSS	SSS 15.3	Proa	RUA	SSS	SSS 15.3	Proa	RUA
Avg of All	23.5	15.2	26.6					
Monthly Avg	2.9	10.7	36.1	6.5	31.0	26.8	36.1	15.7
St Dev	37.5	30.4	14.3	18.6	23.9	30.5	13.9	13.3
Coefficient	13.1	2.8	0.4	2.9	0.8	1.1	0.4	0.9

The distinction is quite striking between the average of all stocks over the 107 months that meet a screen's criteria, and the monthly average. In implementation, it is the average for each month which determines your gains unless one were to invest in the same size position for each stock regardless of whether the screen called for forty positions or four. With such variable cash demands, one would have to either find alternatives investments for when the screen had a lower count, do all ones investing from a line of credit, or bear the cost of cash sitting not invested.

Conclusions

This analysis is based on holding the selected stocks one year. In practice, SSS has a whole other set of rather complex selling criteria which are not considered in this analysis. The success reporting in using the SSS may have more to do with the selling criteria than the buying which has been our focus. Our preselected liquidity constraints may have detracted from the adequacy of the screen, as may have our capping off the outliers.

The opportunity to use a common set of data and do a comparison analysis against another screen confirms my choice to use the other screen.

Appendix. Detail of Monthly Data

Date	Average of ret_Cap_52w					StdDev of ret_Cap_52w				Count of ret_Cap_52w			
	F-9	Proa	PRS	Shadow	RUA	F-9	Proa	PRS	Shadow	F-9	Proa	PRS	Shadow
12/31/02	40	37	59	20	35	31	29	33	39	11	9	7	10
1/31/03	41	46	59	34	39	24	31	31	49	17	25	10	12
2/28/03	51	53	67	41	36	34	33	21	48	22	17	5	13
3/31/03	44	46	44	45	23	33	32	36	51	28	23	6	13
4/30/03	33	43	38	48	18	32	35	38	48	22	18	5	8
5/31/03	29	30	6	34	18	29	32	27	49	37	19	3	10
6/30/03	26	28	46	42	11	27	28	33	44	35	22	7	6
7/31/03	25	33	32	34	9	30	31	42	38	29	23	8	7
8/31/03	23	25	28	22	12	29	33	38	44	42	24	6	8
9/30/03	25	36	35	50	8	32	35	31	55	43	23	7	6
10/31/03	27	34	42	44	11	26	29	55	61	29	17	6	4
11/30/03	35	46	51	37	10	29	26	42	79	36	18	6	3
12/31/03	29	39	34	27	5	26	24	52	75	37	16	9	3
1/31/04	24	46	61	60	6	30	28	39		42	14	6	1
2/28/04	19	33	25		5	31	32	51		35	11	11	
3/31/04	18	34	33	-51	5	29	22	45	15	32	12	15	2
4/30/04	13	36	28	-61	8	24	29	42		35	10	15	1
5/31/04	16	51	18	-38	6	25	18	35	35	36	10	16	4
6/30/04	10	47	29	-27	15	18	16	46	37	30	9	10	4
7/31/04	26	27	27	-9	13	25	28	29	41	27	11	10	6
8/31/04	31	26	51	16	13	34	26	37	49	29	20	16	7
9/30/04	27	22	45	-6	9	30	29	39	45	29	21	11	4
10/31/04	17	15	31	-10	8	33	28	44	46	35	19	14	3
11/30/04	14	22	31	-31	4	32	40	43	42	41	14	17	2
12/31/04	7	16	32	-11	11	30	36	45		46	16	16	1
1/31/05	13	20	33		9	26	41	42		32	12	16	
2/28/05	11	27	35	-25	12	19	37	47	52	22	10	13	2
3/31/05	16	45	41	-21	16	21	35	40	36	32	10	21	4
4/30/05	26	33	47	45	8	28	52	41	62	22	14	25	7
5/31/05	19	27	29	-15	8	29	36	44	27	31	15	26	2
6/30/05	17	31	45	10	3	33	36	45	70	29	13	19	3
7/31/05	14	28	19	-49	7	34	35	46		24	15	17	1
8/31/05	14	21	38	-31	8	27	26	36	52	23	11	14	3
9/30/05	11	19	35	-22	14	26	27	37	43	27	10	16	5
10/31/05	18	29	38	22	12	25	30	34	17	24	7	17	4
11/30/05	7	16	27	10	14	26	36	40	23	29	9	12	3
12/31/05	12	28	33	3	12	23	29	38	22	33	11	11	2
1/31/06	12	10	13		10	21	24	42		29	8	8	
2/28/06	15	17	12	11	9	20	18	28	2	24	10	10	2
3/31/06	11	31	4	-13	12	21	22	35	21	39	9	6	2
4/30/06	13	30	9	-24	20	18	24	34	33	31	8	12	3
5/31/06	15	46	18	-22	18	18	38	31	26	30	11	13	4
6/30/06	15	52	18	7	14	18	33	34	39	33	9	13	6
7/31/06	10	51	3	1	13	23	21	39	35	38	8	10	5
8/31/06	14	22	0	-45	14	22	48	35		27	6	10	1
9/30/06	10	12	4	-45	13	27	45	43		29	7	13	1
10/31/06	18	24	20	-41	5	30	39	44		39	7	10	1
11/30/06	9	19	-12	-57	3	28	50	37		44	10	15	1
12/31/06	9	38	-17	-52	-5	31	49	38		44	9	17	1
1/31/07	0	-8	-25		-6	30	51	40		39	8	13	
2/28/07	1	10	-32	-61	-8	27	61	20	0	27	9	14	2
3/31/07	-10	0	-32	-41	-7	27	54	22	29	45	11	11	2
4/30/07	-13	3	-25	-61	-8	26	60	25		39	13	9	1
5/31/07	-8	-15	-32	-22	-14	24	51	26	55	31	9	8	2
6/30/07	-15	-22	-32	-23	-12	26	51	22	54	30	10	8	2
7/31/07	-8	-38	-37	-50	-12	37	26	15	16	34	9	11	2

Date	Average of ret_Cap_52w					StdDev of ret_Cap_52w				Count of ret_Cap_52w			
	F-9	Proa	PRS	Shadow	RUA	F-9	Proa	PRS	Shadow	F-9	Proa	PRS	Shadow
8/31/07	-9	-24	-25	-28	-23	35	46	19	35	33	11	10	2
9/30/07	-24	-33	-31	-41	-38	25	24	24	30	34	12	5	4
10/31/07	-32	-52	-50	-57	-40	22	10	14	6	30	11	2	7
11/30/07	-39	-51	-22	-42	-39	21	20	43	22	37	14	8	8
12/31/07	-37	-51	-31	-45	-40	22	21	33	28	37	14	5	5
1/31/08	-38	-55	-33	-57	-45	20	8	28	8	34	10	6	3
2/29/08	-42	-40	-23	-45	-40	17	47	29	24	29	10	5	6
3/31/08	-33	-29	-11	-58	-37	20	27	9	5	32	9	5	6
4/30/08	9	10	25	-44	-35	31	46	22	23	23	8	3	9
5/31/08	-36	-25	-5	-35	-28	17	35	11	6	21	9	3	3
6/30/08	-28	-15	-2	-34	-22	20	41	29	26	20	7	5	9
7/31/08	-16	-19	-33	-15	-21	16	26	32	24	22	9	4	8
8/31/08	-16	-18	-24	3	-9	18	26	20	52	18	8	6	7
9/30/08	-3	-6	-15	0	8	25	26	21	29	17	14	8	10
10/31/08	15	21	11	30	24	29	36	26	33	18	15	15	31
11/30/08	29	41	6	49	25	38	39	18	37	22	22	12	49
12/31/08	41	50	9	38	32	31	39	31	41	20	22	15	47
1/31/09	41	49	25	44	53	23	36	33	40	22	25	18	48
2/28/09	50	67	43	68	49	30	30	36	34	28	26	25	36
3/31/09	46	61	29	68	38	29	33	32	32	36	36	23	35
4/30/09	45	53	33	60	21	26	35	35	42	32	43	18	18
5/31/09	29	34	25	36	13	28	34	35	38	42	58	21	12
6/30/09	19	28	16		13	27	34	20		41	55	18	
7/31/09	15	19	11	11	4	26	37	20	43	36	49	14	12
8/31/09	10	18	5	23	9	24	39	34	52	33	51	20	7
9/30/09	16	19	9	32	16	24	32	32	41	36	55	14	4
10/30/09	23	27	6	5	11	29	32	28	27	35	53	12	7
11/30/09	23	27	14	48	15	35	34	35	34	34	50	12	6
12/31/09	20	28	22	55	22	37	32	33	34	32	51	12	3
1/31/10	21	29	16	42	22	34	31	42	21	29	45	10	4
2/28/10	23	37	35	28	15	30	33	45		25	31	10	1
3/31/10	17	30	12	-42	16	25	27	44	10	24	31	15	2
4/30/10	26	28	22		25	33	29	41		15	28	11	
5/31/10	33	39	7	2	30	35	33	41	17	19	34	17	4
6/30/10	36	47	22	37	19	32	34	45	36	21	32	18	9
7/31/10	26	45	27	82	17	23	30	28	11	29	32	17	4
8/31/10	21	45	21	20	-1	26	30	31	45	29	26	15	8
9/30/10	4	13	-8	34	6	24	34	37	36	30	30	19	3
10/31/10	7	23	2	46	5	21	39	37	33	29	25	17	4
11/30/10	15	9	-15	16	-1	23	30	25	12	38	32	16	3
12/31/10	8	5	-14	5	2	24	34	29	12	38	30	17	2
1/31/11	6	9	2	34	2	24	35	30	61	29	31	11	2
2/28/11	12	10	-18	34	5	32	34	34	42	39	30	10	5
3/31/11	11	13	3	11	1	30	35	39	51	46	29	7	5
4/30/11	6	4	-27	0	-4	28	31	29	56	49	26	5	6
5/31/11	-5	-5	-8	33	2	29	28	13		34	22	6	1
6/30/11	-2	-8	3	25	5	27	30	40	8	35	26	6	3
7/29/11	5	-1	6	9	15	37	33	37	19	25	28	10	3
8/31/11	15	15	27	11	28	31	34	35	16	25	31	18	5
9/30/11	19	26	35	37	12	32	37	37	49	30	30	15	8
10/31/11	19	20	13	57	14	36	33	34	56	20	22	13	3
11/30/11	28	21	39	20	14	29	29	44	20	17	15	18	3