Appendix A   Function Profiles

A function profile provides a similar style of information to a scattergram, except it allows for greater depth of detail. Effectively, a function profile tests the value of some variable at every observation, and tracks the change in another variable after a defined period of time. It then plots a graph of one variable versus the other. The technique is useful when the range of the variable being tested falls within reasonably fixed boundaries. As an example, it would not be useful to examine a function profile of trading volume, as the variable has too wide a range. However, it could be useful to examine a function profile of the series created by dividing $Volume_t$ by $Volume_{t-1}$, as this has a smaller range, and a reasonably clear interpretation.

To allow for useful testing of the inputs to the technical neural network, the data sampled covered the entire range of in-sample training data. This effectively allowed a preview of whether the variable being supplied as an input to the technical neural network could be expected to be useful or not, and it is essentially no different to scattergramming inputs to assess causality. Like a scattergram, the interpretation of a function profile concerns the pattern being visually established. For a function profile to be interpreted as being significant, it must meet the same general criteria as a scattergram, namely, it must display some significance pattern, and there must be a 'reasonable' number of data points involved in the various significance areas of the pattern. These points are considered in further detail, as the function profiles and their interpretations follow. Function profiles were built for each technical category referred to in Table 2-1. A function profile extends the ability provided by a scattergram, as it can effectively graph several output timeframes at once. As the input timeframes for the neural network have already been established, the same timeframes are used to calculate the returns spectrum which is graphed as the outputs. To assess how the influence of the technical variables decay over time, it was decided to produce the function profiles graphing gross returns to the specified variables after 3 days, 6 days, 9 days, 12 days, and 15 days.

To assess the significance of the function profile graphs, it is necessary to consider the data that created them. The function profile graphs, and the data that created them are supplied here for each technical variable assessed, and then the data is interpreted. In the tables that follow, the following terms are used:

- the first line in each table, named 'overall', shows the total number of observations made,
- '% Return' is the average return over all observations,
- '%Obs' is the percentage of observations that fell into this category,
- 'Pct of Overall % Return' is a simple metric which can be used to show whether a given category row has outperformed or underperformed the average return over all observations.

It is calculated as follows:

$$PctofOverall\%Return = \frac{100 \times (CR - AVCR)}{AVCR}$$

where

CR = the % Return for the category row

AVCR = the % Return for the 'overall' row

Equation A-1 Formula for Pct of Overall Return

For a technical variable to be accepted as an input to the neural networks, the following three requirements had to be met:

1. the function profile graph appeared to show some degree of significance (assessed with respect to 'Pct of Overall % Return'),
2. each category contributing to the significant area of the function profile had a 'reasonable' number of observations (assessed with respect to '%Obs' column),

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3. the significant area of the function profile had a 'reasonably' consistent interpretation in each of the five timeframes

A.1   *Function Profile: Moving Average of Price Ratio*

Support was found in Table 2-1 for the use of moving averages of price. As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether moving averages of price might prove useful to the neural network. Rather than allow the neural network access to the actual moving average values of price, and to bound the ranges for the function profile, the ratio of the two relevant price moving averages is tested, namely, SMA(close,3) / SMA(close,15). The values of 3 and 15 are chosen to correspond with the previous timeframes used to represent short-term and long-term horizons (see section 3.7.1.3). This function profile is presented below.
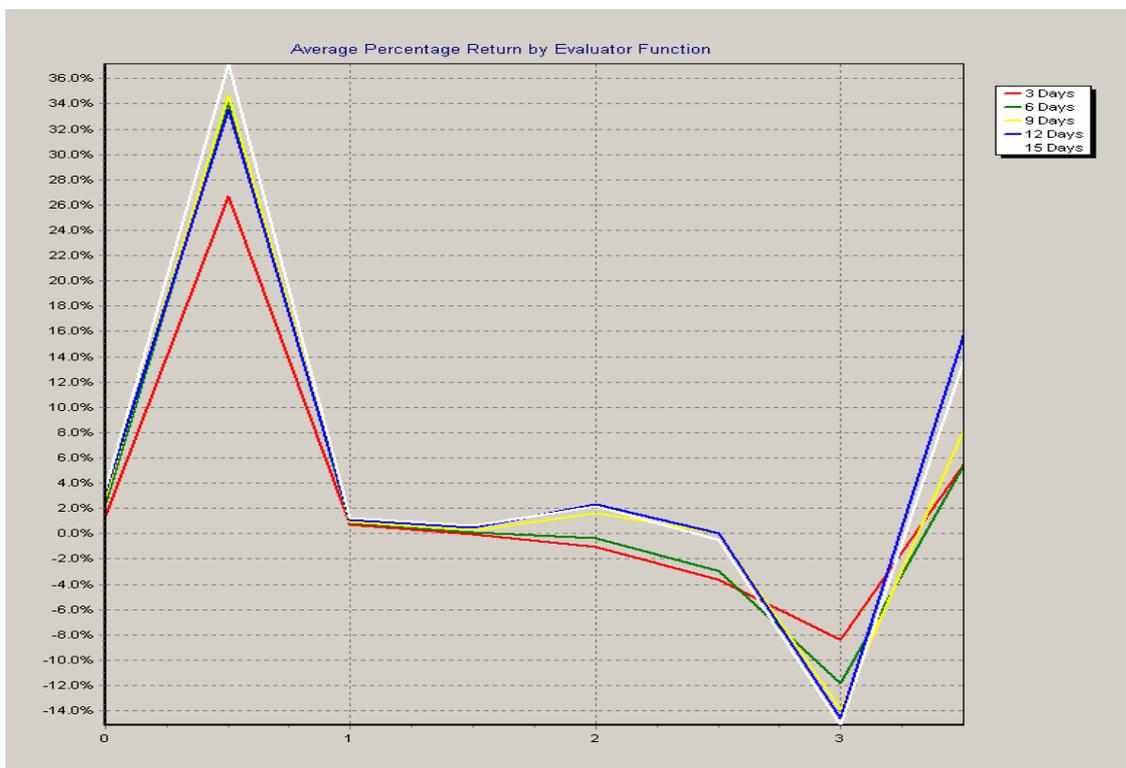

Figure A-1 Function Profile of SMA(close,3) / SMA(close,15)

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Table A-1 through Table A-5 details the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,280,626	0.37	100.000	
0.00	0	0.00	0.000	-100.00
0.50	819	26.58	0.064	7,083.78
1.00	707,323	0.69	55.233	86.49
1.50	569,733	-0.06	44.489	-116.22
2.00	2,457	-1.05	0.192	-383.78
2.50	213	-3.69	0.017	-1,097.30
3.00	65	-8.41	0.005	-2,372.97
3.50	16	5.48	0.001	1,381.08

Table A-1 3 day returns to the Moving Average of Price Ratio

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,276,786	0.53	100.000	
0.00	0	0.00	0.000	-100.00
0.50	811	34.02	0.064	6,318.87
1.00	705,348	0.85	55.244	60.38
1.50	567,888	0.09	44.478	-83.02
2.00	2,445	-0.39	0.191	-173.58
2.50	213	-2.96	0.017	-658.49
3.00	65	-11.87	0.005	-2,339.62
3.50	16	5.40	0.001	918.87

Table A-2 6 day returns to the Moving Average of Price Ratio

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,272,946	0.68	100.000	
0.00	0	0.00	0.000	-100.00
0.50	806	34.40	0.063	4,958.82
1.00	703,338	0.96	55.253	41.18
1.50	566,084	0.28	44.470	-58.82
2.00	2,424	1.65	0.190	142.65
2.50	213	0.03	0.017	-95.59
3.00	65	-13.90	0.005	-2,144.12
3.50	16	8.12	0.001	1,094.12

Table A-3 9 day returns to the Moving Average of Price Ratio

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Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	*1,269,106*	*0.82*	*100.000*	
0.00	0	0.00	0.000	-100.00
0.50	797	33.33	0.063	3,964.63
1.00	701,434	1.07	55.270	30.49
1.50	564,194	0.45	44.456	-45.12
2.00	2,387	2.40	0.188	192.68
2.50	213	-0.01	0.017	-101.22
3.00	65	-14.57	0.005	-1,876.83
3.50	16	15.67	0.001	1,810.98

Table A-4 12 day returns to the Moving Average of Price Ratio

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	*1,265,266*	*0.97*	*100.000*	
0.00	0	0.00	0.000	-100.00
0.50	781	36.97	0.062	3,711.34
1.00	699,622	1.21	55.294	24.74
1.50	562,208	0.63	44.434	-35.05
2.00	2,361	2.35	0.187	142.27
2.50	213	-0.49	0.017	-150.52
3.00	65	-15.15	0.005	-1,661.86
3.50	16	13.56	0.001	1,297.94

Table A-5 15 day returns to the Moving Average of Price Ratio

Whilst the function profile graph appears to show high returns from the left end of the graph, decreasing to the right, the number of observations that support many of the categories is too small for interest. However, the values for the Function Value labeled 1.00 (which encompasses the actual range 0.50 < Moving Average of Price Ratio <= 1.00), and the Function Value labeled 1.5 (which encompasses the actual range 1.00 < Moving Average of Price Ratio <= 1.50) contain over 99.5% of the total observations. These two categories are highlighted in each of the tables above. These two categories have a consistent interpretation in each of the five timeframes, namely that the range 0.50 < Moving Average of Price Ratio <= 1.00 consistently outperforms the average of all observations, whilst the range 1.00 < Moving Average of Price Ratio <= 1.50 consistently underperforms the average of all observations.

In summary, all three requirements for the inclusion of this technical variable, Moving Average of Price Ratio have been met.

Thus, the Moving Average of Price Ratio is included as a valid neural network input.

A.2 Function Profile: ATR(3)

Support was found in Table 2-1 for the use of the technical variable Average True Range (ATR). As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether ATR(3) might prove useful to the neural network. The function profile for ATR(3) is presented below.
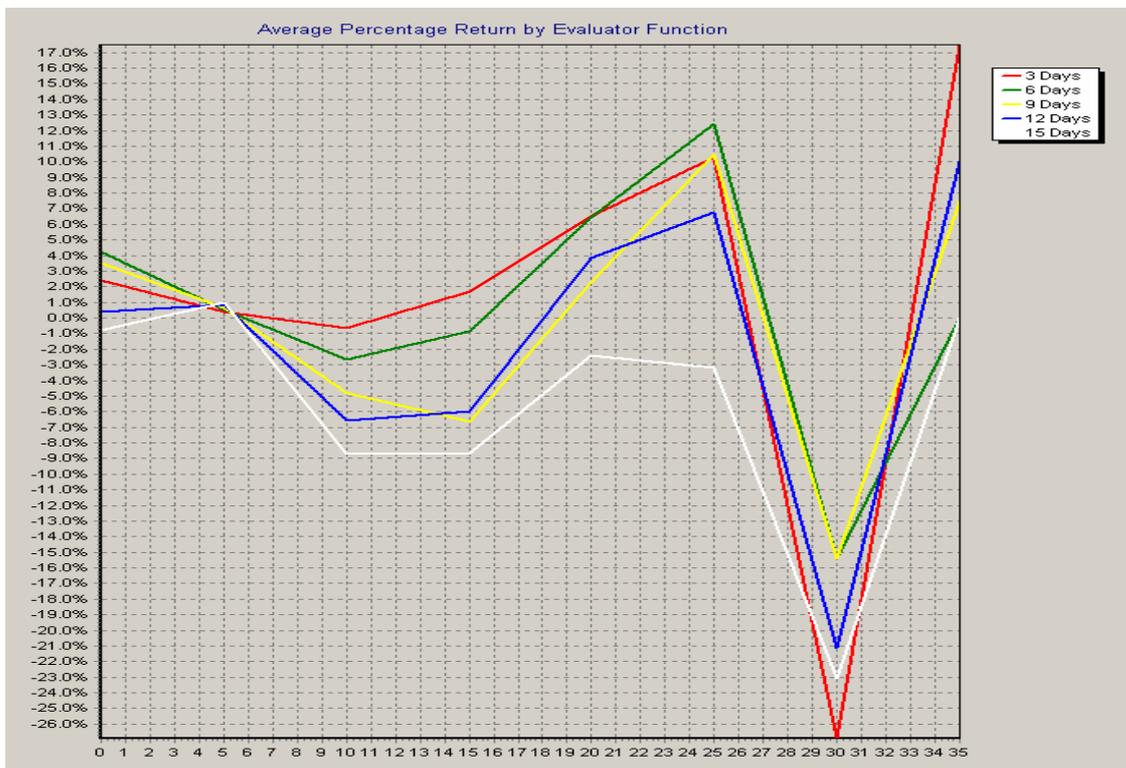

Figure A-2 Function Profile of ATR(3)

Table A-6 through Table A-10 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,295,992	0.38	100.000	
0.00	216	3.05	0.017	702.63
5.00	1,295,282	0.38	99.945	0.00
10.00	399	-0.61	0.031	-260.53
15.00	73	1.16	0.006	205.26
20.00	16	4.44	0.001	1,068.42
25.00	4	3.22	0.000	747.37
30.00	1	-26.92	0.000	-7,184.21
35.00	1	17.50	0.000	4,505.26

Table A-6 3 day returns to ATR(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,292,152	0.55	100.000	
0.00	216	5.90	0.017	972.73
5.00	1,291,443	0.55	99.945	0.00
10.00	398	-2.72	0.031	-594.55
15.00	73	-1.35	0.006	-345.45
20.00	16	3.52	0.001	540.00
25.00	4	1.30	0.000	136.36
30.00	1	-15.39	0.000	-2,898.18
35.00	1	0.00	0.000	-100.00

Table A-7 6 day returns to ATR(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,288,312	0.70	100.000	
0.00	216	8.29	0.017	1,084.29
5.00	1,287,605	0.70	99.945	0.00
10.00	396	-4.87	0.031	-795.71
15.00	73	-6.51	0.006	-1,030.00
20.00	16	0.47	0.001	-32.86
25.00	4	-0.43	0.000	-161.43
30.00	1	-15.39	0.000	-2,298.57
35.00	1	7.49	0.000	970.00

Table A-8 9 day returns to ATR(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,284,472	0.85	100.000	
0.00	216	11.37	0.017	1,237.65
5.00	1,283,766	0.85	99.945	0.00
10.00	395	-6.81	0.031	-901.18
15.00	73	-5.93	0.006	-797.65
20.00	16	2.26	0.001	165.88
25.00	4	0.00	0.000	-100.00
30.00	1	-21.15	0.000	-2,588.24
35.00	1	10.00	0.000	1,076.47

Table A-9 12 day returns to ATR(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,280,632	1.00	100.000	
0.00	216	15.16	0.017	1,416.00
5.00	1,279,927	1.00	99.945	0.00
10.00	394	-9.07	0.031	-1,007.00
15.00	73	-8.67	0.006	-967.00
20.00	16	-2.64	0.001	-364.00
25.00	4	-6.91	0.000	-791.00
30.00	1	-23.07	0.000	-2,407.00
35.00	1	0.00	0.000	-100.00

Table A-10 15 day returns to ATR(3)

Whilst the function profile graph appears to show mixed results, it is clear from inspection of the tables that over 99.9% of data in all timeframes falls into Function Value labeled 5.00 (which encompasses the actual range 0.00 < ATR(3) <= 5.00). It is also clear that this range has exactly the same %return as the %return for the overall observations, and it can be concluded that there is no benefit to be gained by including this technical variable as an input to the neural network.

Thus, ATR(3) is rejected as a valid neural network input.

A.3   Function Profile: ATR(15)

Support was found in Table 2-1 for the use of the technical variable Average True Range (ATR). As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether

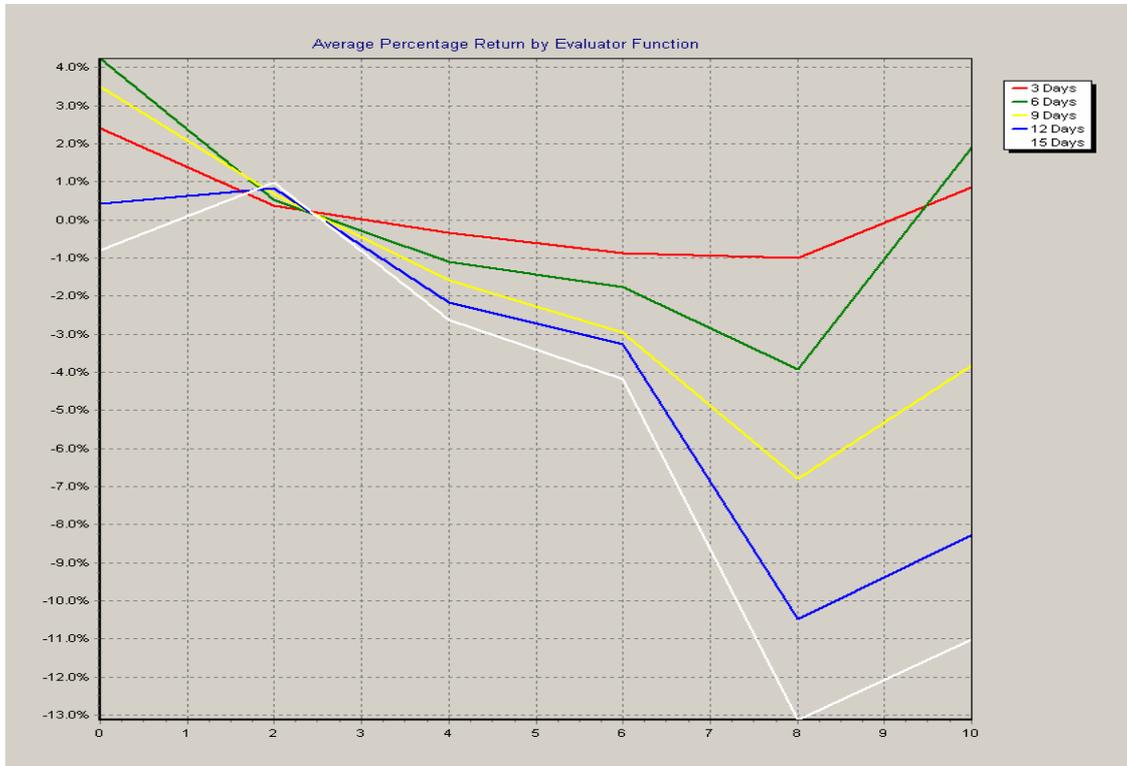ATR(15) might prove useful to the neural network. The function profile for ATR(15) is presented below.

Figure A-3 Function Profile of ATR(15)

Table A-11 through Table A-15 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,280,611	0.37	100.000	
0.00	28	2.42	0.002	554.05
2.00	1,277,766	0.37	99.778	0.00
4.00	2,132	-0.33	0.166	-189.19
6.00	426	-0.86	0.033	-332.43
8.00	189	-0.99	0.015	-367.57
10.00	70	0.85	0.005	129.73

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Table A-11 3 day returns to ATR(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,276,771	0.53	100.000	
0.00	28	4.24	0.002	700.00
2.00	1,273,929	0.54	99.777	1.89
4.00	2,132	-1.10	0.167	-307.55
6.00	423	-1.77	0.033	-433.96
8.00	189	-3.92	0.015	-839.62
10.00	70	1.90	0.005	258.49

Table A-12 6 day returns to ATR(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,272,931	0.68	100.000	
0.00	28	3.50	0.002	414.71
2.00	1,270,092	0.68	99.777	0.00
4.00	2,132	-1.59	0.167	-333.82
6.00	420	-2.95	0.033	-533.82
8.00	189	-6.78	0.015	-1,097.06
10.00	70	-3.82	0.005	-661.76

Table A-13 9 day returns to ATR(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,269,091	0.82	100.000	
0.00	28	0.43	0.002	-47.56
2.00	1,266,255	0.83	99.777	1.22
4.00	2,132	-2.17	0.168	-364.63
6.00	417	-3.27	0.033	-498.78
8.00	189	-10.48	0.015	-1,378.05
10.00	70	-8.28	0.006	-1,109.76

Table A-14 12 day returns to ATR(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,265,251	0.97	100.000	
0.00	28	-0.80	0.002	-182.47
2.00	1,262,418	0.98	99.776	1.03
4.00	2,132	-2.63	0.169	-371.13
6.00	414	-4.17	0.033	-529.90
8.00	189	-13.13	0.015	-1,453.61
10.00	70	-11.00	0.006	-1,234.02

Table A-15 15 day returns to ATR(15)

Whilst the function profile graph appears to show higher returns for smaller values of ATR(15), it is clear from inspection of the tables that over 99% of data in all timeframes falls into Function Value labeled 2.00 (which encompasses the actual range 0.00 < ATR(15) <= 2.00). It is also clear that this range has virtually the same %return as the %return for the overall observations, and it can be concluded that there is no benefit to be gained by including this technical variable as an input to the neural network.

Thus, ATR(15) is rejected as a valid neural network input.

A.4   Function Profile: The ratio ATR(3) / ATR(15)

Support was found in Table 2-1 for the use of the technical variable Average True Range (ATR).   As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether the ratio ATR(3) / ATR(15) might prove useful to the neural network. The function profile for the ratio ATR(3) / ATR(15) is presented below.
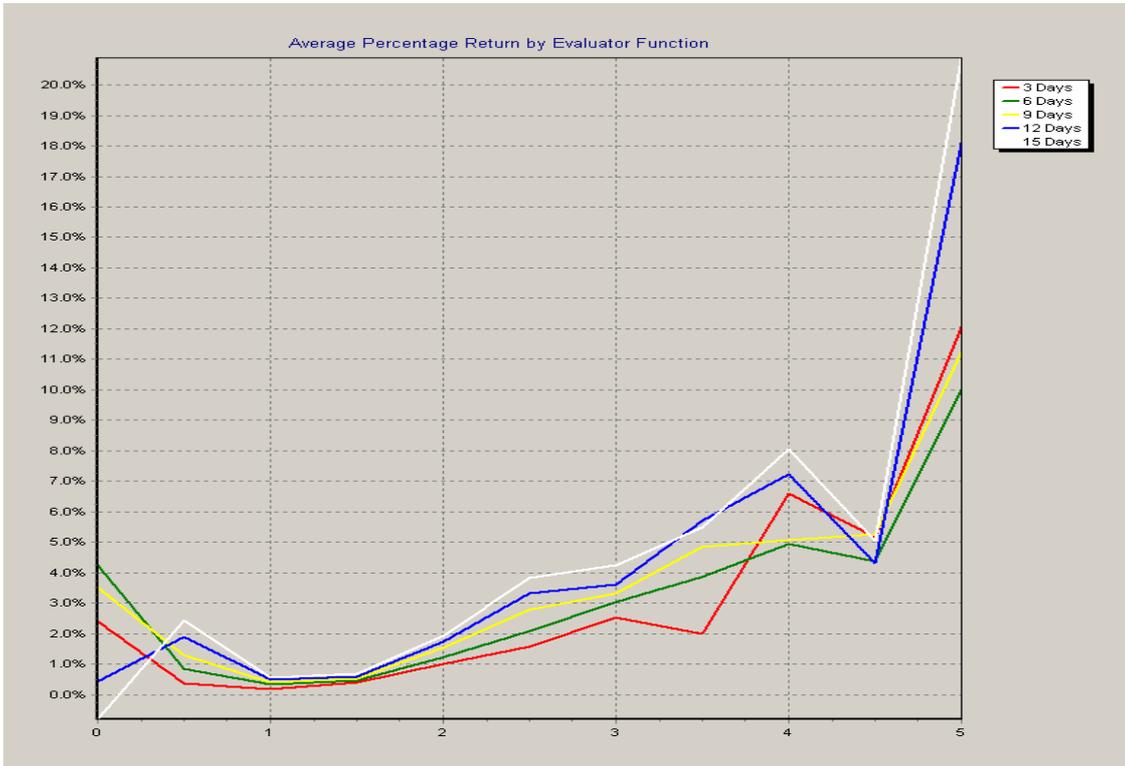
Figure A-4 Function Profile of the ratio ATR(3) / ATR(15)

Table A-16 through Table A-20 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,280,633	0.37	100.000	
0.00	28	2.42	0.002	554.05
0.50	146,470	0.38	11.437	2.70
1.00	599,104	0.19	46.782	-48.65
1.50	426,309	0.41	33.289	10.81
2.00	87,406	1.00	6.825	170.27
2.50	16,493	1.57	1.288	324.32
3.00	3,520	2.49	0.275	572.97
3.50	843	1.97	0.066	432.43
4.00	297	6.31	0.023	1,605.41
4.50	113	5.23	0.009	1,313.51
5.00	50	12.05	0.004	3,156.76

Table A-16 3 day returns to the ratio ATR(3) / ATR(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,276,793	0.53	100.000	
0.00	28	4.24	0.002	700.00
0.50	145,784	0.83	11.418	56.60
1.00	597,361	0.33	46.786	-37.74
1.50	425,231	0.48	33.305	-9.43
2.00	87,157	1.22	6.826	130.19
2.50	16,425	2.09	1.286	294.34
3.00	3,507	2.97	0.275	460.38
3.50	841	3.79	0.066	615.09
4.00	296	4.99	0.023	841.51
4.50	113	4.42	0.009	733.96
5.00	50	10.00	0.004	1,786.79

Table A-17 6 day returns to the ratio ATR(3) / ATR(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,272,953	0.68	100.000	
0.00	28	3.50	0.002	414.71
0.50	145,103	1.30	11.399	91.18
1.00	595,657	0.41	46.793	-39.71
1.50	424,119	0.54	33.318	-20.59
2.00	86,886	1.52	6.826	123.53
2.50	16,373	2.74	1.286	302.94
3.00	3,491	3.31	0.274	386.76
3.50	837	4.92	0.066	623.53
4.00	296	4.78	0.023	602.94
4.50	113	5.31	0.009	680.88
5.00	50	11.25	0.004	1,554.41

Table A-18 9 day returns to the ratio ATR(3) / ATR(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,269,113	0.82	100.000	
0.00	28	0.43	0.002	-47.56
0.50	144,421	1.88	11.380	129.27
1.00	594,000	0.49	46.804	-40.24
1.50	422,959	0.61	33.327	-25.61
2.00	86,633	1.71	6.826	108.54
2.50	16,307	3.33	1.285	306.10
3.00	3,478	3.59	0.274	337.80
3.50	832	5.83	0.066	610.98
4.00	294	6.79	0.023	728.05
4.50	111	4.34	0.009	429.27
5.00	50	18.08	0.004	2,104.88

Table A-19 12 day returns to the ratio ATR(3) / ATR(15)

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Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	*1,265,273*	*0.97*	*100.000*	
0.00	28	-0.80	0.002	-182.47
0.50	143,796	2.44	11.365	151.55
1.00	592,344	0.57	46.816	-41.24
1.50	421,778	0.70	33.335	-27.84
2.00	86,357	1.90	6.825	95.88
2.50	16,229	3.82	1.283	293.81
3.00	3,463	4.22	0.274	335.05
3.50	825	5.58	0.065	475.26
4.00	294	8.12	0.023	737.11
4.50	110	5.08	0.009	423.71
5.00	49	20.89	0.004	2,053.61

Table A-20 15 day returns to the ratio ATR(3) / ATR(15)

Whilst the function profile graph appears to show lower returns from the left end of the graph, increasing to the right, the number of observations that support some of the categories are too small for interest. However, there are a consistently high number of observations in each of the rows highlighted.   These rows all have a consistent interpretation in the range 0.50 < ratio ATR(3) / ATR(15) <= 2.5, namely, that increasing values of this ratio are directly related to increasing %return in all timeframes.   There appears to be a significant exception concerning the very low values of this ratio, namely the range 0.00 < ratio ATR(3) / ATR(15) <= 0.5, which also shows outperformance in all timeframes.

In summary, all three requirements for the inclusion of this technical variable, ratio of ATR(3) / ATR(15) have been met.

Thus, the ratio of ATR(3) / ATR(15) is included as a valid neural network input.

A.5   Function Profile: Moving Average of Volume Ratio

Support was found in Table 2-1 for the use of moving averages of volume. As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether these moving averages of volume might prove useful to the neural network. Rather than allow the neural network access to

the actual moving average values of volume, and to bound the ranges for the function profile, the ratio of the two relevant volume moving averages is tested, namely, SMA(volume,3) / SMA(volume,15). This function profile is presented below.
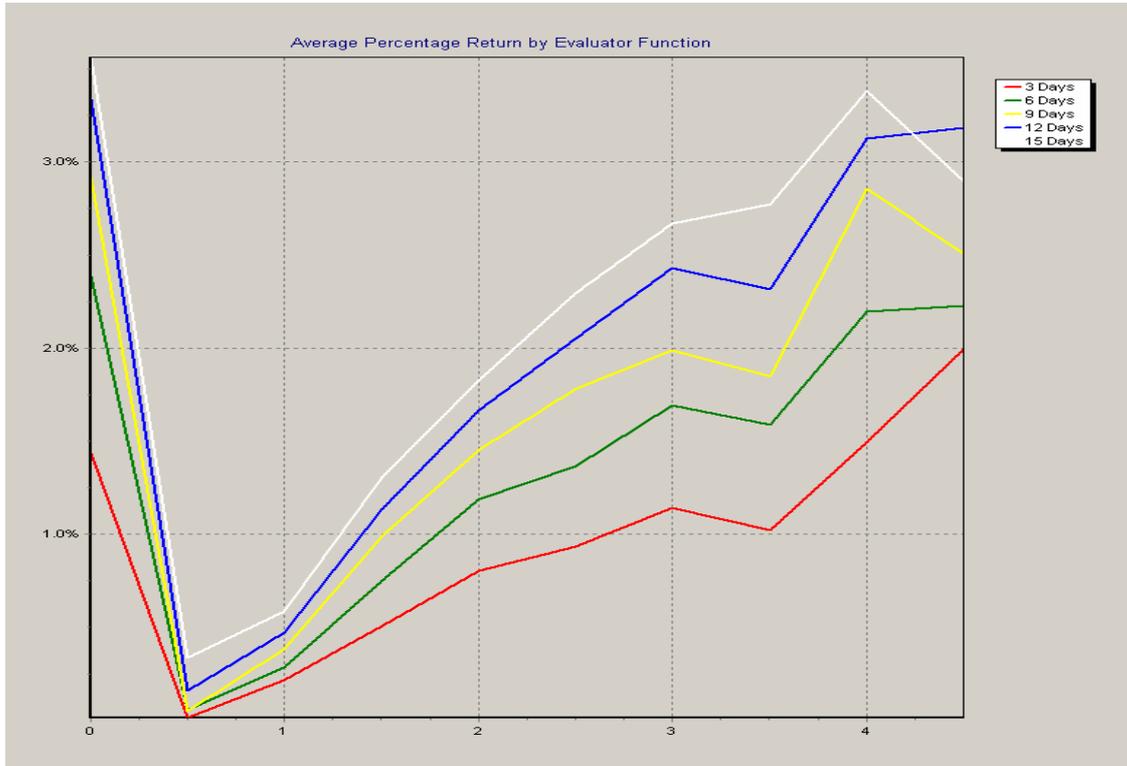

Figure A-5 Function Profile of SMA(volume,3) / SMA(volume,15)

Table A-21 through Table A-25 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,278,703	0.36	100.000	
0.00	3	35.51	0.000	9,763.89
0.50	308,474	0.02	24.124	-94.44
1.00	458,445	0.22	35.852	-38.89
1.50	272,442	0.50	21.306	38.89
2.00	125,842	0.80	9.841	122.22
2.50	58,278	0.92	4.558	155.56
3.00	27,962	1.13	2.187	213.89
3.50	14,497	1.01	1.134	180.56
4.00	8,184	1.48	0.640	311.11
4.50	4,576	2.01	0.358	458.33

Table A-21 3 day returns to the Moving Average of Volume Ratio

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,274,870	0.53	100.000	
0.00	3	90.98	0.000	17,066.04
0.50	307,253	0.06	24.101	-88.68
1.00	457,100	0.28	35.855	-47.17
1.50	271,769	0.75	21.317	41.51
2.00	125,524	1.18	9.846	122.64
2.50	58,119	1.35	4.559	154.72
3.00	27,909	1.68	2.189	216.98
3.50	14,459	1.58	1.134	198.11
4.00	8,167	2.20	0.641	315.09
4.50	4,567	2.21	0.358	316.98

Table A-22 6 day returns to the Moving Average of Volume Ratio

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,271,044	0.67	100.000	
0.00	3	66.29	0.000	9,794.03
0.50	306,168	0.05	24.088	-92.54
1.00	455,610	0.38	35.845	-43.28
1.50	271,088	0.98	21.328	46.27
2.00	125,244	1.45	9.854	116.42
2.50	57,978	1.77	4.561	164.18
3.00	27,827	1.97	2.189	194.03
3.50	14,425	1.84	1.135	174.63
4.00	8,148	2.88	0.641	329.85
4.50	4,553	2.45	0.358	265.67

Table A-23 9 day returns to the Moving Average of Volume Ratio

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,267,213	0.82	100.000	
0.00	3	79.17	0.000	9,554.88
0.50	305,176	0.16	24.082	-80.49
1.00	454,207	0.46	35.843	-43.90
1.50	270,327	1.13	21.332	37.80
2.00	124,896	1.67	9.856	103.66
2.50	57,801	2.04	4.561	148.78
3.00	27,755	2.42	2.190	195.12
3.50	14,386	2.31	1.135	181.71
4.00	8,120	3.14	0.641	282.93
4.50	4,542	3.12	0.358	280.49

Table A-24 12 day returns to the Moving Average of Volume Ratio

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Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,263,383	0.97	100.000	
0.00	3	70.92	0.000	7,211.34
0.50	304,240	0.33	24.081	-65.98
1.00	452,859	0.58	35.845	-40.21
1.50	269,507	1.30	21.332	34.02
2.00	124,516	1.82	9.856	87.63
2.50	57,638	2.28	4.562	135.05
3.00	27,669	2.65	2.190	173.20
3.50	14,337	2.76	1.135	184.54
4.00	8,093	3.40	0.641	250.52
4.50	4,521	2.89	0.358	197.94

Table A-25 15 day returns to the Moving Average of Volume Ratio

The function profile graph appears to show lower returns from the left end of the graph, increasing to the right, an observation that is reasonably consistent in all five timeframes. As the highlighted area in each table contains over 99% of available observations, all three requirements for the inclusion of this technical variable, the Moving Average of Volume ratio have been met.

Thus, the Moving Average of Volume ratio is included as a valid neural network input.

A.6 Function Profile: ADX(3)

Support was found in Table 2-1 for the use of ADX (Average Directional Index). As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether ADX(3) might prove useful to the neural network. This function profile is presented below.
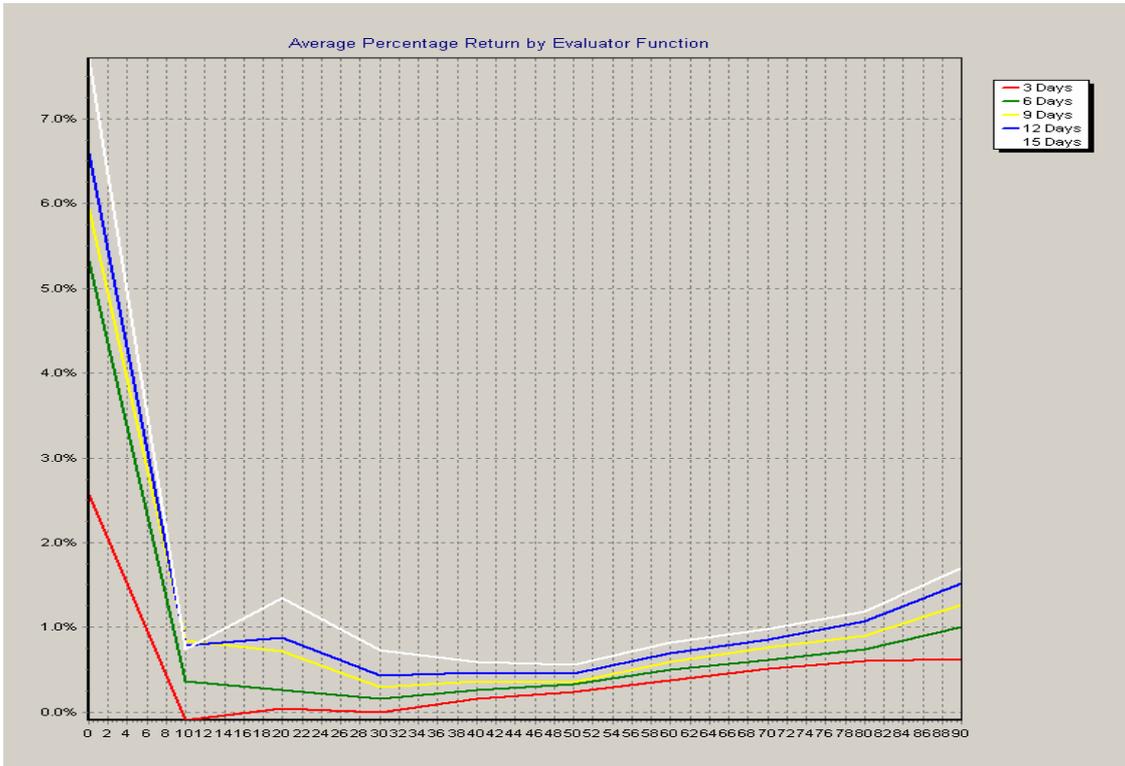
Figure A-6 Function Profile of ADX(3)

Table A-26 through Table A-30 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,208,020	0.32	100.000	
0.00	481	2.57	0.040	703.13
10.00	3,789	-0.17	0.314	-153.13
20.00	25,491	0.04	2.110	-87.50
30.00	109,598	0.00	9.073	-100.00
40.00	217,592	0.16	18.012	-50.00
50.00	249,145	0.23	20.624	-28.13
60.00	218,116	0.37	18.056	15.63
70.00	168,387	0.51	13.939	59.38
80.00	124,081	0.61	10.271	90.63
90.00	91,340	0.62	7.561	93.75

Table A-26 3 day returns to ADX(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,204,519	0.46	100.000	
0.00	481	5.33	0.040	1,058.70
10.00	3,777	0.31	0.314	-32.61
20.00	25,373	0.24	2.106	-47.83
30.00	109,265	0.16	9.071	-65.22
40.00	216,915	0.26	18.008	-43.48
50.00	248,402	0.33	20.623	-28.26
60.00	217,485	0.49	18.056	6.52
70.00	167,948	0.62	13.943	34.78
80.00	123,775	0.74	10.276	60.87
90.00	91,098	1.00	7.563	117.39

Table A-27 6 day returns to ADX(3)

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Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,201,020	0.58	100.000	
0.00	481	5.95	0.040	925.86
10.00	3,770	0.78	0.314	34.48
20.00	25,275	0.69	2.104	18.97
30.00	108,926	0.29	9.069	-50.00
40.00	216,245	0.36	18.005	-37.93
50.00	247,681	0.35	20.623	-39.66
60.00	216,873	0.59	18.057	1.72
70.00	167,489	0.76	13.946	31.03
80.00	123,425	0.90	10.277	55.17
90.00	90,855	1.26	7.565	117.24

Table A-28 9 day returns to ADX(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,197,529	0.71	100.000	
0.00	481	6.60	0.040	829.58
10.00	3,762	0.73	0.314	2.82
20.00	25,187	0.86	2.103	21.13
30.00	108,545	0.43	9.064	-39.44
40.00	215,606	0.46	18.004	-35.21
50.00	246,975	0.46	20.624	-35.21
60.00	216,269	0.69	18.060	-2.82
70.00	167,047	0.85	13.949	19.72
80.00	123,066	1.08	10.277	52.11
90.00	90,591	1.52	7.565	114.08

Table A-29 12 day returns to ADX(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,194,011	0.86	100.000	
0.00	481	7.72	0.040	797.67
10.00	3,750	0.75	0.314	-12.79
20.00	25,103	1.33	2.102	54.65
30.00	108,187	0.73	9.061	-15.12
40.00	214,883	0.58	17.997	-32.56
50.00	246,246	0.56	20.623	-34.88
60.00	215,698	0.82	18.065	-4.65
70.00	166,602	0.97	13.953	12.79
80.00	122,753	1.19	10.281	38.37
90.00	90,308	1.70	7.563	97.67

Table A-30 15 day returns to ADX(3)

The function profile graph appears to show a definite trend of increased returns with increased values of the variable ADX(3), and the exception range $0.00 < ADX(3) <= 10$ has too few observations for interest. However, the range $10.00 < ADX(3) <= 20$ appears to be associated with underperformance in the short term (3 and 6 days), then appears to change to become associated with overperformance as the timeframe lengthens (9, 12 and 15 days). However, the general trend of increasing ADX(3) being associated with increasing returns is consistent over all timeframes, with the exception already noted.

As the highlighted area in each table contains over 99% of available observations, all three requirements for the inclusion of this technical variable, ADX(3) have been met.

Thus, ADX(3) is included as a valid neural network input.

A.7   *Function Profile: ADX(15)*

Support was found in Table 2-1 for the use of ADX (Average Directional Index). As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether ADX(15) might prove useful to the neural network. This function profile is presented below.

Figure A-7 Function Profile of ADX(15)

Table A-31 through Table A-35 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,280,049	0.37	100.000	
0.00	160	1.00	0.012	170.27
10.00	49,505	0.51	3.867	37.84
20.00	514,309	0.28	40.179	-24.32
30.00	418,634	0.26	32.705	-29.73
40.00	190,320	0.43	14.868	16.22
50.00	72,668	0.89	5.677	140.54
60.00	24,882	1.02	1.944	175.68
70.00	6,848	1.25	0.535	237.84
80.00	1,784	1.93	0.139	421.62
90.00	939	2.56	0.073	591.89

Table A-31 3 day returns to ADX(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,276,211	0.53	100.000	
0.00	160	2.78	0.013	424.53
10.00	49,351	0.88	3.867	66.04
20.00	512,736	0.41	40.176	-22.64
30.00	417,474	0.34	32.712	-35.85
40.00	189,767	0.63	14.870	18.87
50.00	72,426	1.33	5.675	150.94
60.00	24,777	1.84	1.941	247.17
70.00	6,807	1.93	0.533	264.15
80.00	1,775	2.43	0.139	358.49
90.00	938	4.21	0.073	694.34

Table A-32 6 day returns to ADX(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,272,371	0.67	100.000	
0.00	160	4.64	0.013	592.54
10.00	49,204	1.20	3.867	79.10
20.00	511,186	0.54	40.176	-19.40
30.00	416,312	0.42	32.719	-37.31
40.00	189,178	0.74	14.868	10.45
50.00	72,209	1.65	5.675	146.27
60.00	24,661	2.47	1.938	268.66
70.00	6,760	2.71	0.531	304.48
80.00	1,766	3.02	0.139	350.75
90.00	935	5.30	0.073	691.04

Table A-33 9 day returns to ADX(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,268,531	0.82	100.000	
0.00	160	4.53	0.013	452.44
10.00	49,078	1.44	3.869	75.61
20.00	509,619	0.70	40.174	-14.63
30.00	415,167	0.48	32.728	-41.46
40.00	188,599	0.83	14.868	1.22
50.00	71,948	1.97	5.672	140.24
60.00	24,545	3.11	1.935	279.27
70.00	6,727	3.10	0.530	278.05
80.00	1,756	3.84	0.138	368.29
90.00	932	7.44	0.073	807.32

Table A-34 12 day returns to ADX(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,264,691	0.97	100.000	
0.00	160	5.82	0.013	500.00
10.00	48,931	1.90	3.869	95.88
20.00	508,115	0.87	40.177	-10.31
30.00	413,989	0.55	32.734	-43.30
40.00	188,003	0.91	14.866	-6.19
50.00	71,682	2.26	5.668	132.99
60.00	24,445	3.75	1.933	286.60
70.00	6,694	3.48	0.529	258.76
80.00	1,746	3.65	0.138	276.29
90.00	926	9.40	0.073	869.07

Table A-35 15 day returns to ADX(15)

The function profile graph appears to show a definite trend of increased returns with increased values of the variable ADX(15). The range $0.00 < ADX(15) <= 10$ appears to be associated with overperformance in all timeframes, and the trend of increasing values of ADX(15) associated with increasing returns is reasonably consistent in all timeframes in the ranges $10 < ADX(15) <= 60$.

As the highlighted area in each table contains over 99% of available observations, all three requirements for the inclusion of this technical variable, ADX(15) have been met.

Thus, ADX(15) is included as a valid neural network input.

A.8 Function Profile: ratio ADX(3) / ADX(15)

Support was found in Table 2-1 for the use of ADX (Average Directional Index). As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether the ratio of ADX(3) / ADX(15) might prove useful to the neural network. This function profile is presented below.
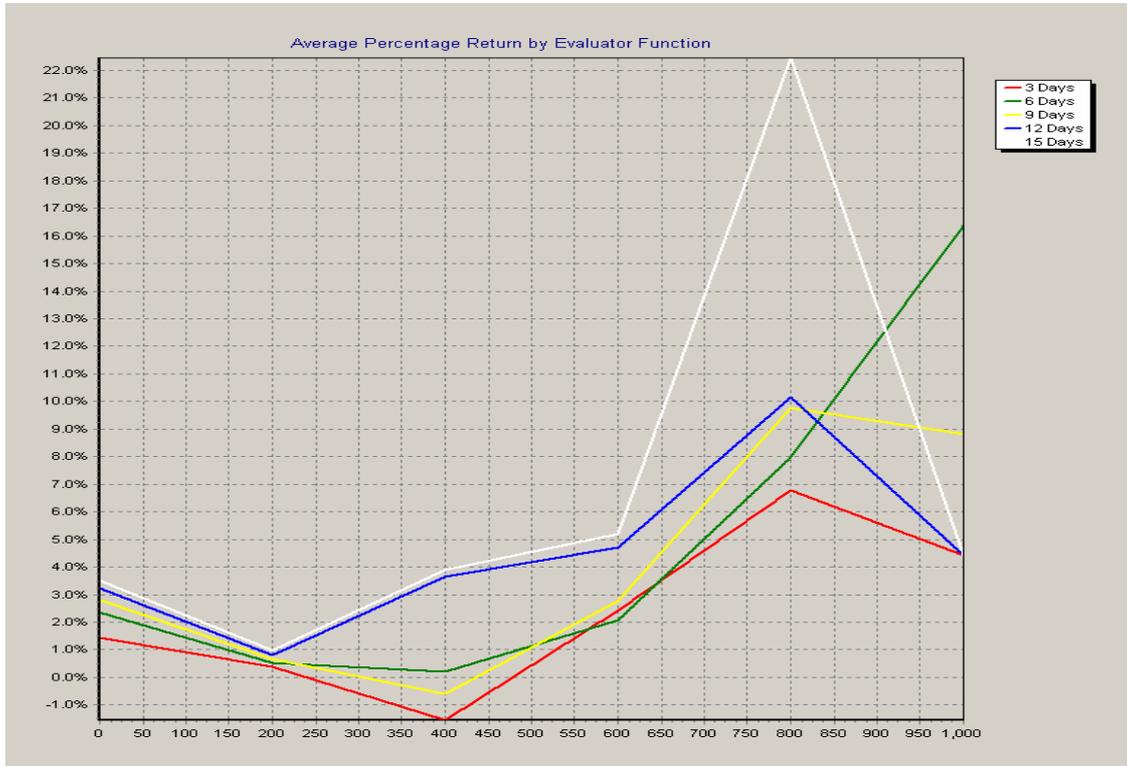
Figure A-8 Function Profile of ratio ADX(3) / ADX(15)

Table A-36 through Table A-40 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,280,632	0.37	100.000	
0.00	160	1.00	0.012	170.27
200.00	1,280,408	0.37	99.983	0.00
400.00	30	-1.55	0.002	-518.92
600.00	21	2.44	0.002	559.46
800.00	7	6.79	0.001	1,735.14
1000.00	2	4.41	0.000	1,091.89
1200.00	4	3.86	0.000	943.24

Table A-36 3 day returns to ratio ADX(3) / ADX(15)

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Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,276,792	0.53	100.000	
0.00	160	2.78	0.013	424.53
200.00	1,276,568	0.53	99.982	0.00
400.00	30	0.21	0.002	-60.38
600.00	21	2.08	0.002	292.45
800.00	7	7.98	0.001	1,405.66
1000.00	2	16.37	0.000	2,988.68
1200.00	4	11.15	0.000	2,003.77

Table A-37 6 day returns to ratio ADX(3) / ADX(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,272,952	0.68	100.000	
0.00	160	4.64	0.013	582.35
200.00	1,272,728	0.68	99.982	0.00
400.00	30	-0.60	0.002	-188.24
400.00	21	2.76	0.002	305.88
600.00	7	9.78	0.001	1,338.24
800.00	2	8.82	0.000	1,197.06
1000.00	4	10.44	0.000	1,435.29

Table A-38 9 day returns to ratio ADX(3) / ADX(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,269,112	0.82	100.000	
0.00	160	4.53	0.013	452.44
200.00	1,268,888	0.82	99.982	0.00
400.00	30	3.65	0.002	345.12
600.00	21	4.70	0.002	473.17
800.00	7	10.16	0.001	1,139.02
1000.00	2	4.41	0.000	437.80
1200.00	4	10.19	0.000	1,142.68

Table A-39 12 day returns to ratio ADX(3) / ADX(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,265,272	0.97	100.000	
0.00	160	5.82	0.013	500.00
200.00	1,265,048	0.97	99.982	0.00
400.00	30	3.90	0.002	302.06
600.00	21	5.20	0.002	436.08
800.00	7	22.46	0.001	2,215.46
1000.00	2	4.41	0.000	354.64
1200.00	4	12.20	0.000	1,157.73

Table A-40 15 day returns to ratio ADX(3) / ADX(15)

Whilst the function profile graph appears to show higher values of the ratio ADX(3) / ADX(15) related to higher returns, it is clear from inspection of the tables that over 99% of data in all timeframes falls into Function Value labeled 200.00 (which encompasses the actual range 0.00 < ratio ADX(3) / ADX(15) <= 200.00). It is also clear that this range has exactly the same %return as the %return for the overall observations, and it can be concluded that there is no benefit to be gained by including this technical variable as an input to the neural network.

Thus, the ratio ADX(3) / ADX(15) is rejected as a valid neural network input.

A.9   *Function Profile: STOCHK(3)*

Support was found in Table 2-1 for the use of StochK (Stochastic). As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether STOCHK(3) might prove useful to the neural network. This function profile is presented below.
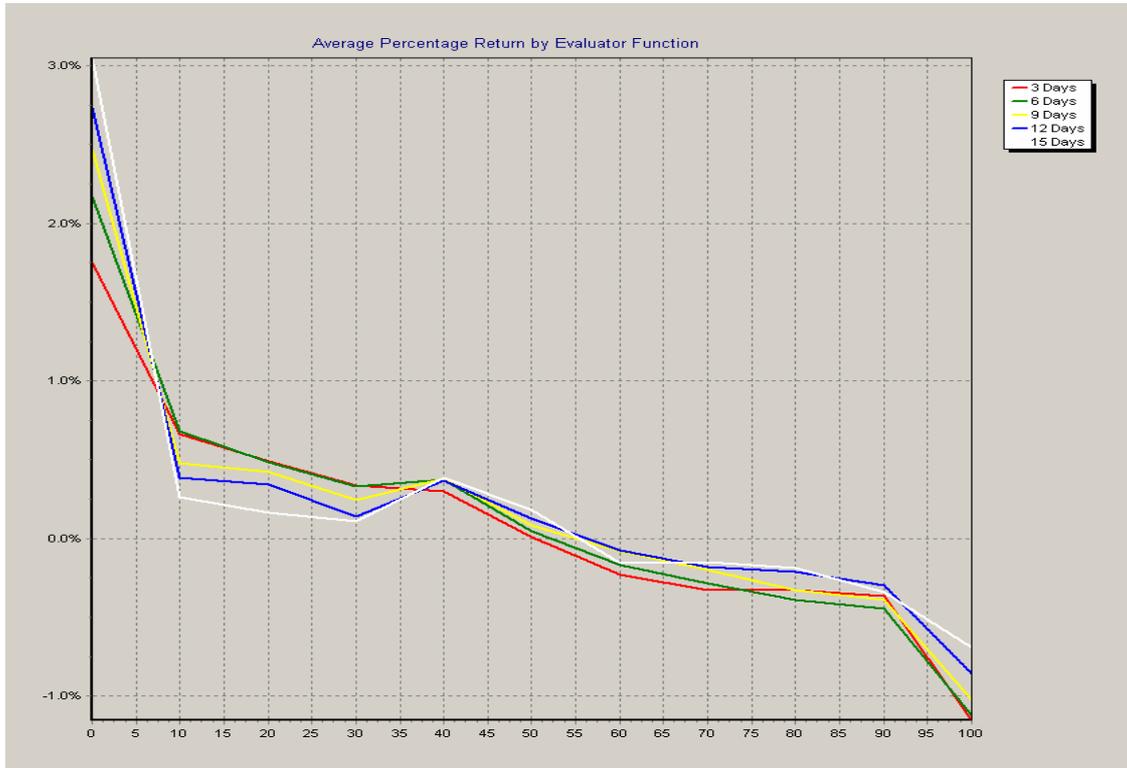
Figure A-9 Function Profile of StochK(3)

Table A-41 through Table A-45 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,295,993	0.38	100.000	
0.00	498,346	1.75	38.453	360.53
10.00	17,062	0.66	1.317	73.68
20.00	46,944	0.49	3.622	28.95
30.00	47,439	0.33	3.660	-13.16
40.00	64,623	0.30	4.986	-21.05
50.00	82,180	0.01	6.341	-97.37
60.00	49,194	-0.23	3.796	-160.53
70.00	60,554	-0.33	4.672	-186.84
80.00	50,523	-0.33	3.898	-186.84
90.00	43,088	-0.37	3.325	-197.37
100.00	336,040	-1.15	25.929	-402.63

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Table A-41 3 day returns to StochK(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,292,153	0.55	100.000	
0.00	496,647	2.17	38.436	294.55
10.00	17,044	0.68	1.319	23.64
20.00	46,857	0.48	3.626	-12.73
30.00	47,341	0.33	3.664	-40.00
40.00	64,469	0.37	4.989	-32.73
50.00	81,992	0.05	6.345	-90.91
60.00	49,091	-0.17	3.799	-130.91
70.00	60,407	-0.28	4.675	-150.91
80.00	50,386	-0.39	3.899	-170.91
90.00	42,976	-0.44	3.326	-180.00
100.00	334,943	-1.12	25.921	-303.64

Table A-42 6 day returns to StochK(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,288,313	0.70	100.000	
0.00	494,899	2.47	38.415	252.86
10.00	17,006	0.48	1.320	-31.43
20.00	46,764	0.42	3.630	-40.00
30.00	47,218	0.25	3.665	-64.29
40.00	64,322	0.38	4.993	-45.71
50.00	81,795	0.09	6.349	-87.14
60.00	48,963	-0.08	3.801	-111.43
70.00	60,270	-0.20	4.678	-128.57
80.00	50,272	-0.32	3.902	-145.71
90.00	42,879	-0.39	3.328	-155.71
100.00	333,925	-1.02	25.920	-245.71

Table A-43 9 day returns to StochK(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,284,473	0.85	100.000	
0.00	493,157	2.74	38.394	222.35
10.00	16,944	0.39	1.319	-54.12
20.00	46,635	0.34	3.631	-60.00
30.00	47,087	0.14	3.666	-83.53
40.00	64,141	0.37	4.994	-56.47
50.00	81,610	0.13	6.354	-84.71
60.00	48,862	-0.07	3.804	-108.24
70.00	60,121	-0.18	4.681	-121.18
80.00	50,157	-0.21	3.905	-124.71
90.00	42,801	-0.30	3.332	-135.29
100.00	332,958	-0.86	25.922	-201.18

Table A-44 12 day returns to StochK(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,280,633	1.00	100.000	
0.00	491,573	3.05	38.385	205.00
10.00	16,908	0.26	1.320	-74.00
20.00	46,522	0.17	3.633	-83.00
30.00	46,970	0.11	3.668	-89.00
40.00	63,972	0.39	4.995	-61.00
50.00	81,394	0.18	6.356	-82.00
60.00	48,740	-0.16	3.806	-116.00
70.00	59,973	-0.15	4.683	-115.00
80.00	50,037	-0.18	3.907	-118.00
90.00	42,683	-0.34	3.333	-134.00
100.00	331,861	-0.69	25.914	-169.00

Table A-45 15 day returns to StochK(3)

The function profile graph appears to show high returns from the left end of the graph, decreasing to the right. All observations are included within the highlighted area, and the interpretation is consistent across all timeframes, namely, that increasing values of StochK(3) relate to decreasing returns.

All three requirements for the inclusion of this technical variable, STOCHK(3) have been met.

Thus, STOCHK(3) is included as a valid neural network input.

A.10   *Function Profile: STOCHK(15)*

Support was found in Table 2-1 for the use of StochK (Stochastic). As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether STOCHK(15) might prove useful to the neural network. This function profile is presented below.
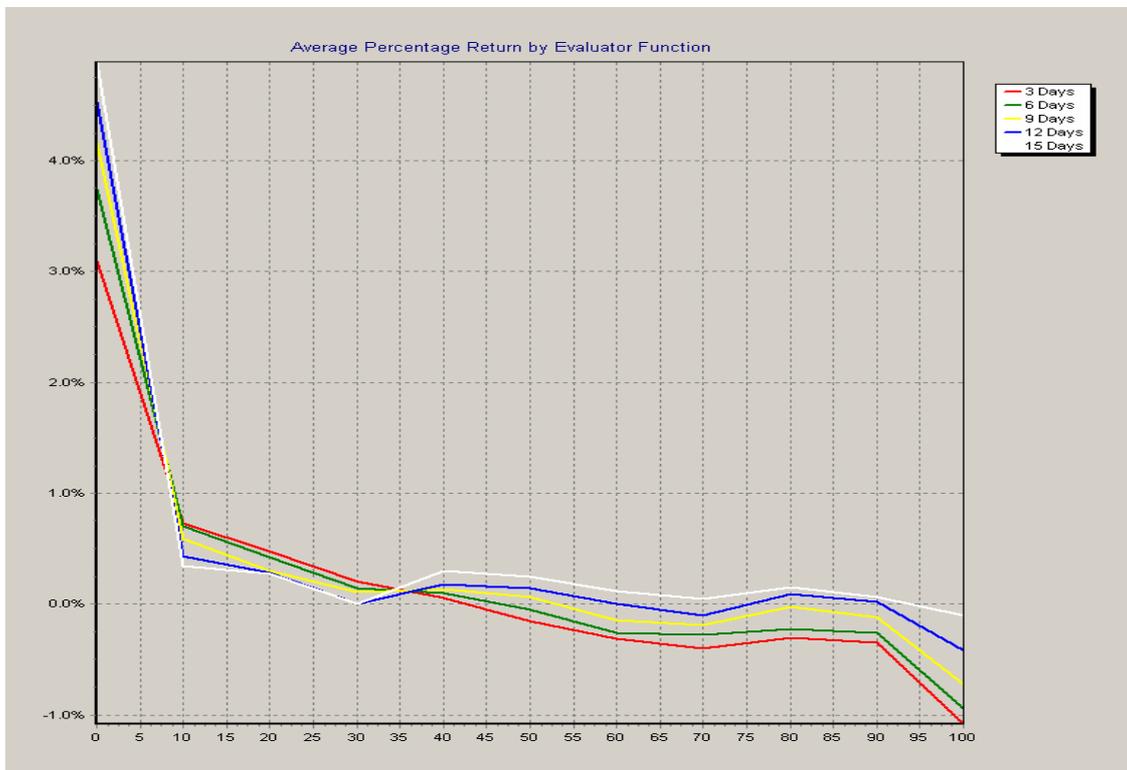

Figure A-10 Function Profile of StochK(15)

Table A-46 through Table A-50 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,280,633	0.37	100.000	
0.00	230,239	3.08	17.979	732.43
20.00	146,570	0.56	11.445	51.35
40.00	218,297	0.12	17.046	-67.57
60.00	217,216	-0.22	16.962	-159.46
80.00	197,919	-0.35	15.455	-194.59
100.00	270,392	-0.85	21.114	-329.73

Table A-46 3 day returns to StochK(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,276,793	0.53	100.000	
0.00	229,454	3.72	17.971	601.89
20.00	146,268	0.51	11.456	-3.77
40.00	217,684	0.12	17.049	-77.36
60.00	216,575	-0.14	16.962	-126.42
80.00	197,375	-0.25	15.459	-147.17
100.00	269,437	-0.72	21.103	-235.85

Table A-47 6 day returns to StochK(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,272,953	0.68	100.000	
0.00	228,668	4.13	17.964	507.35
20.00	145,909	0.39	11.462	-42.65
40.00	217,067	0.12	17.052	-82.35
60.00	216,003	-0.03	16.969	-104.41
80.00	196,783	-0.11	15.459	-116.18
100.00	268,523	-0.52	21.094	-176.47

Table A-48 9 day returns to StochK(15)

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Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,269,113	0.82	100.000	
0.00	227,957	4.50	17.962	448.78
20.00	145,497	0.33	11.464	-59.76
40.00	216,470	0.10	17.057	-87.80
60.00	215,384	0.08	16.971	-90.24
80.00	196,217	-0.01	15.461	-101.22
100.00	267,588	-0.27	21.085	-132.93

Table A-49 12 day returns to StochK(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,265,273	0.97	100.000	
0.00	227,294	4.86	17.964	401.03
20.00	145,157	0.30	11.472	-69.07
40.00	215,862	0.16	17.061	-83.51
60.00	214,758	0.19	16.973	-80.41
80.00	195,618	0.10	15.461	-89.69
100.00	266,584	-0.04	21.069	-104.12

Table A-50 15 day returns to StochK(15)

The function profile graph appears to show high returns from the left end of the graph, decreasing to the right. All observations are included within the highlighted area, and the interpretation is consistent across all timeframes, namely, that increasing values of StochK(15) relate to decreasing returns.

All three requirements for the inclusion of this technical variable, STOCHK(15) have been met.

Thus, STOCHK(15) is included as a valid neural network input.

A.11 Function Profile: STOCHK(3) / STOCHK(15)

Support was found in Table 2-1 for the use of StochK (Stochastic). As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether the ratio STOCHK(3) / STOCHK(15) might prove useful to the neural network. This function profile is presented below.
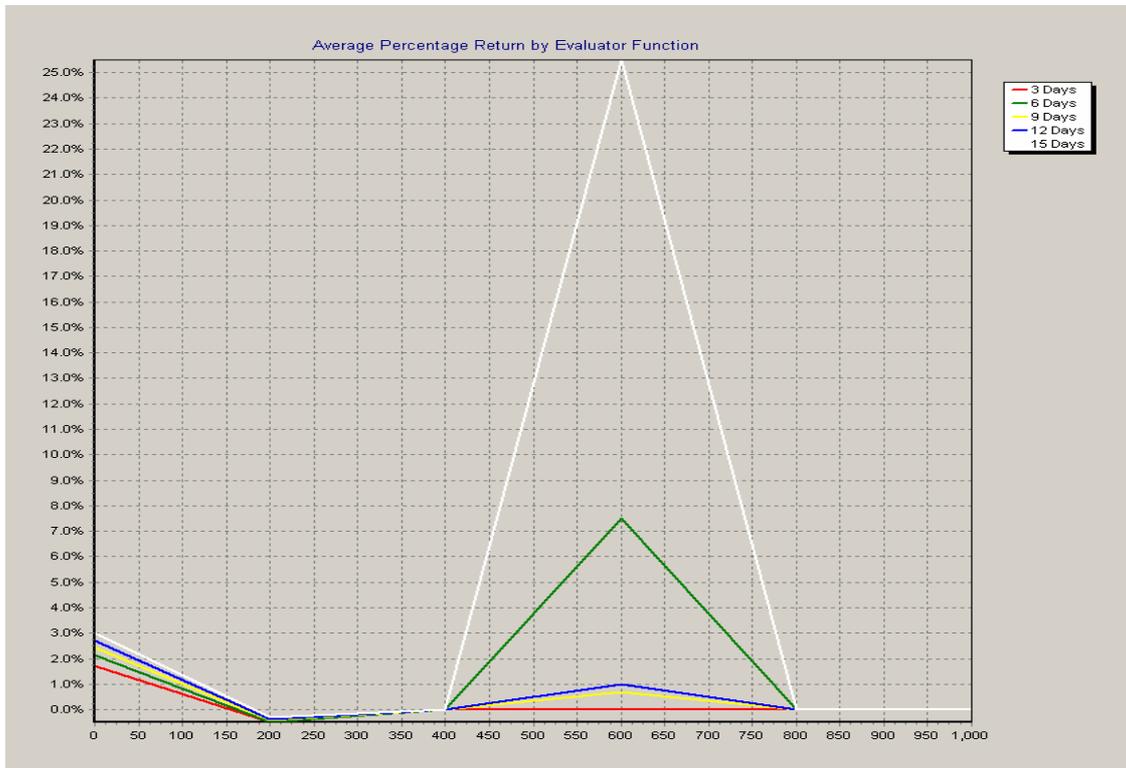
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Figure A-11 Function Profile of StochK(3) / StochK(15)

Table A-51 through Table A-55 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,280,631	0.37	100.000	
0.00	492,994	1.74	38.496	370.27
200.00	787,636	-0.49	61.504	-232.43
400.00	0	0.00	0.000	-100.00
600.00	1	0.00	0.000	-100.00
800.00	0	0.00	0.000	-100.00
1000.00	0	0.00	0.000	-100.00

Table A-51 3 day returns to StochK(3) / StochK(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,276,791	0.53	100.000	
0.00	491,295	2.15	38.479	305.66
200.00	785,495	-0.48	61.521	-190.57
400.00	0	0.00	0.000	-100.00
600.00	1	7.50	0.000	1,315.09
800.00	0	0.00	0.000	-100.00
1000.00	0	0.00	0.000	-100.00

Table A-52 6 day returns to StochK(3) / StochK(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,272,951	0.68	100.000	
0.00	489,547	2.44	38.458	258.82
200.00	783,403	-0.43	61.542	-163.24
400.00	0	0.00	0.000	-100.00
600.00	1	0.70	0.000	2.94
800.00	0	0.00	0.000	-100.00
1000.00	0	0.00	0.000	-100.00

Table A-53 9 day returns to StochK(3) / StochK(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,269,111	0.82	100.000	
0.00	487,805	2.71	38.437	230.49
200.00	781,305	-0.36	61.563	-143.90
400.00	0	0.00	0.000	-100.00
600.00	1	1.00	0.000	21.95
800.00	0	0.00	0.000	-100.00
1000.00	0	0.00	0.000	-100.00

Table A-54 12 day returns to StochK(3) / StochK(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,265,271	0.97	100.000	
0.00	486,221	3.02	38.428	211.34
200.00	779,049	-0.30	61.572	-130.93
400.00	0	0.00	0.000	-100.00
600.00	1	25.50	0.000	2,528.87
800.00	0	0.00	0.000	-100.00
1000.00	0	0.00	0.000	-100.00

Table A-55 15 day returns to StochK(3) / StochK(15)

The function profile graphs are consistent in all timeframes, and clearly indicate that values of 0.00, that is, when the ratio could not be calculated, clearly show a tendency to overperformance, whilst values in the range 0.00 < ratio StochK(3) / StochK(15) <= 200 clearly show a tendency towards underperformance.

All three requirements for the inclusion of this technical variable, the ratio STOCHK(3) / STOCHK(15) have been met.

Thus, this ratio is included as a valid neural network input.

A.12   Function Profile: MOM(3)

Support was found in Table 2-1 for the use of momentum. As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether momentum might prove useful to the neural network. This function profile for 3 day momentum is presented below.
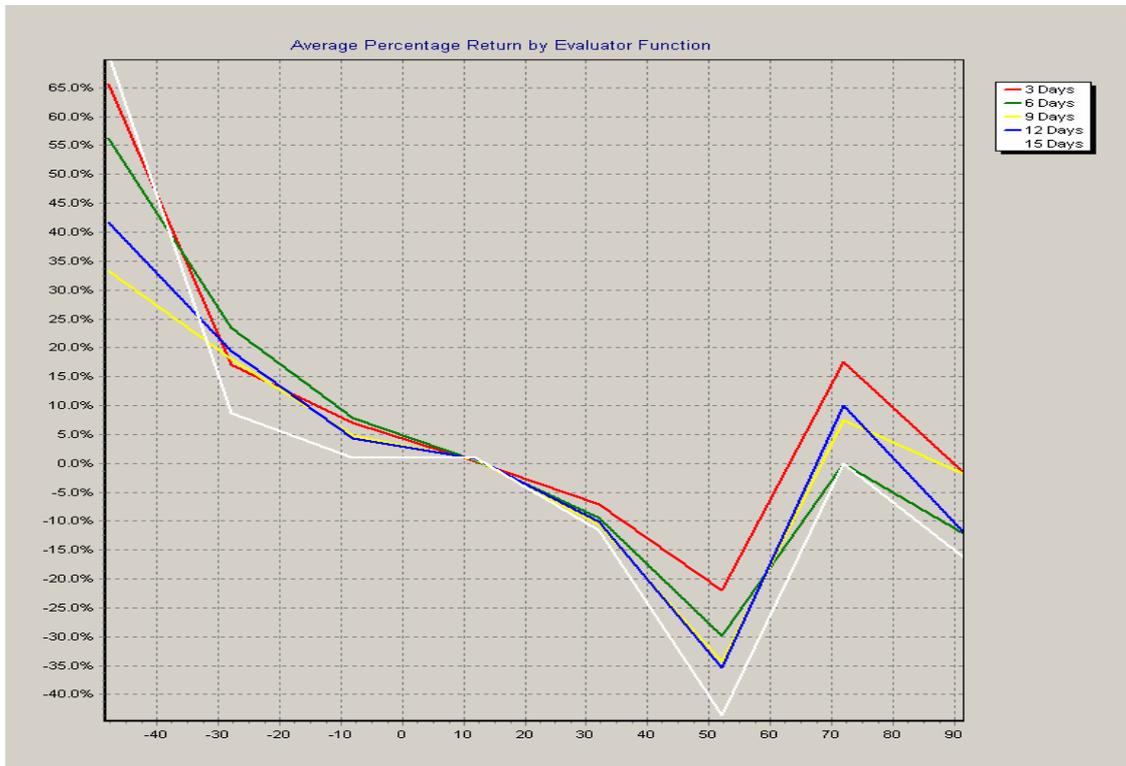
Figure A-12 Function Profile of MOM(3)

Table A-56 through Table A-60 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,295,991	0.38	100.000	
-40.00	5	43.13	0.000	11,250.00
-20.00	36	14.38	0.003	3,684.21
0.00	831,880	0.88	64.189	131.58
20.00	464,040	-0.51	35.806	-234.21
40.00	27	-8.45	0.002	-2,323.68
60.00	2	-18.05	0.000	-4,850.00
80.00	1	17.50	0.000	4,505.26

Table A-56 3 day returns to MOM(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,292,151	0.55	100.000	
-40.00	5	39.37	0.000	7,058.18
-20.00	36	23.94	0.003	4,252.73
0.00	829,445	1.13	64.191	105.45
20.00	462,635	-0.49	35.803	-189.09
40.00	27	-14.12	0.002	-2,667.27
60.00	2	-31.94	0.000	-5,907.27
80.00	1	0.00	0.000	-100.00

Table A-57 6 day returns to MOM(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,288,311	0.70	100.000	
-40.00	5	25.32	0.000	3,517.14
-20.00	35	18.19	0.003	2,498.57
0.00	826,956	1.30	64.189	85.71
20.00	461,285	-0.37	35.805	-152.86
40.00	27	-16.59	0.002	-2,470.00
60.00	2	-36.11	0.000	-5,258.57
80.00	1	7.49	0.000	970.00

Table A-58 9 day returns to MOM(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,284,471	0.85	100.000	
-40.00	5	35.44	0.000	4,069.41
-20.00	35	13.33	0.003	1,468.24
0.00	824,367	1.46	64.179	71.76
20.00	460,034	-0.24	35.815	-128.24
40.00	27	-17.41	0.002	-2,148.24
60.00	2	-31.95	0.000	-3,858.82
80.00	1	10.00	0.000	1,076.47

Table A-59 12 day returns to MOM(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,280,631	1.00	100.000	
-40.00	5	49.96	0.000	4,896.00
-20.00	35	3.24	0.003	224.00
0.00	821,984	1.64	64.186	64.00
20.00	458,577	-0.13	35.809	-113.00
40.00	27	-19.85	0.002	-2,085.00
60.00	2	-58.05	0.000	-5,905.00
80.00	1	0.00	0.000	-100.00

Table A-60 15 day returns to MOM(3)

Whilst the function profile graph appears to show high returns from the left end of the graph, decreasing to the right, the number of observations that support many of the categories is too small for interest. However, the values for the category rows of 0.00 and 20.00 have large numbers of observations, and appear very promising. These areas are highlighted in the tables above. The majority of observations fall into these two categories, and the data for all timeframes supports the conclusion that returns for the first category outperforms the overall return for all observations, and the returns for the second category underperforms the overall returns for all observations.

Thus, it is expected that the 3 day momentum will be useful to the neural network, as its interpretation is consistent across all the timeframes shown.

Thus, this ratio is included as a valid neural network input.

A.13 Function Profile: MOM(15)

Support was found in Table 2-1 for the use of momentum. As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether momentum might prove useful to the neural network. This function profile for 15 day momentum is presented below.
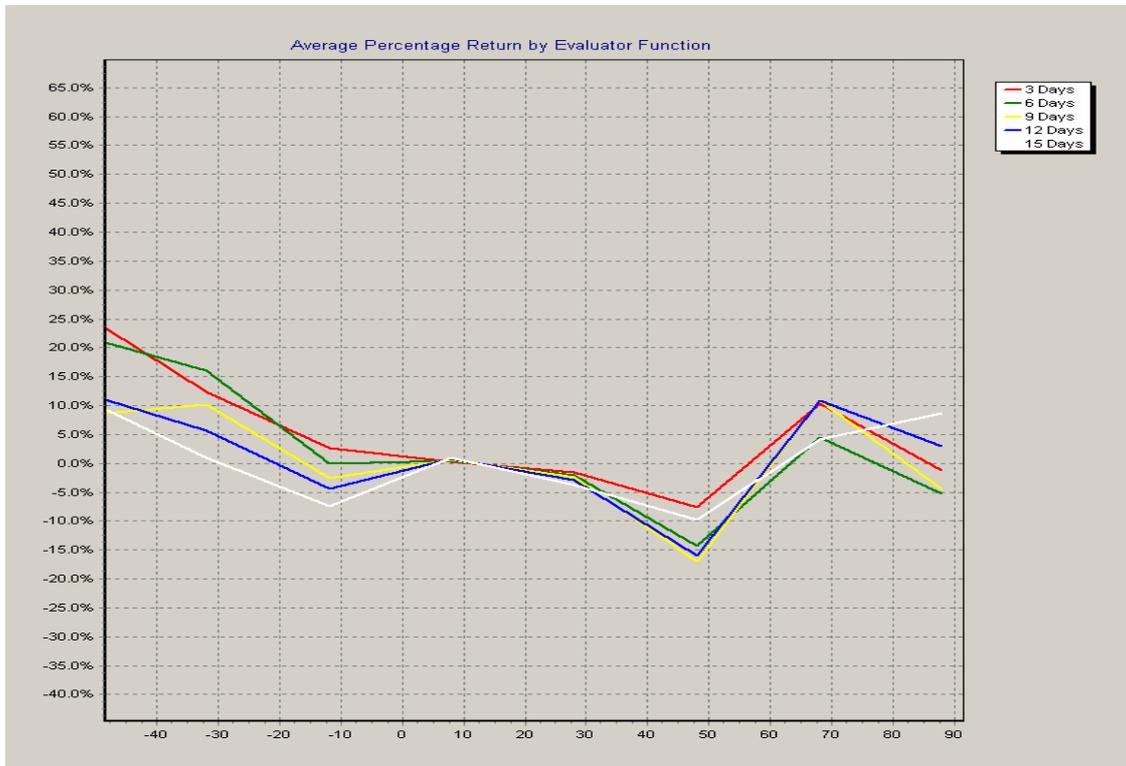
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Figure A-13 Function Profile of MOM(15)

Table A-61 through Table A-65 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,280,632	0.37	100.000	
-60.00	5	22.15	0.000	5,886.49
-40.00	23	25.46	0.002	6,781.08
-20.00	134	4.48	0.010	1,110.81
0.00	756,224	0.74	59.051	100.00
20.00	524,115	-0.18	40.926	-148.65
40.00	116	-2.95	0.009	-897.30
60.00	1	-21.87	0.000	-6,010.81
80.00	10	3.19	0.001	762.16
100.00	4	-9.57	0.000	-2,686.49

Table A-61 3 day returns to MOM(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,276,792	0.53	100.000	
-60.00	5	24.88	0.000	4,594.34
-40.00	23	23.52	0.002	4,337.74
-20.00	134	2.35	0.010	343.40
0.00	754,058	0.93	59.059	75.47
20.00	522,441	-0.04	40.918	-107.55
40.00	116	-5.26	0.009	-1,092.45
60.00	1	-18.76	0.000	-3,639.62
80.00	10	-1.34	0.001	-352.83
100.00	4	-8.98	0.000	-1,794.34

Table A-62 6 day returns to MOM(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,272,952	0.68	100.000	
-60.00	5	12.25	0.000	1,701.47
-40.00	23	13.97	0.002	1,954.41
-20.00	134	-3.23	0.011	-575.00
0.00	751,927	1.06	59.070	55.88
20.00	520,732	0.13	40.907	-80.88
40.00	116	-6.06	0.009	-991.18
60.00	1	-12.51	0.000	-1,939.71
80.00	10	1.21	0.001	77.94
100.00	4	-8.50	0.000	-1,350.00

Table A-63 9 day returns to MOM(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,269,112	0.82	100.000	
-60.00	5	20.80	0.000	2,436.59
-40.00	23	14.83	0.002	1,708.54
-20.00	134	-6.35	0.011	-874.39
0.00	749,859	1.19	59.085	45.12
20.00	518,960	0.29	40.892	-64.63
40.00	116	-7.25	0.009	-984.15
60.00	1	-62.51	0.000	-7,723.17
80.00	10	5.80	0.001	607.32
100.00	4	-11.10	0.000	-1,453.66

Table A-64 12 day returns to MOM(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,265,272	0.97	100.000	
-60.00	5	16.50	0.000	1,601.03
-40.00	23	12.55	0.002	1,193.81
-20.00	134	-9.54	0.011	-1,083.51
0.00	747,894	1.35	59.109	39.18
20.00	517,085	0.43	40.867	-55.67
40.00	116	-6.41	0.009	-760.82
60.00	1	-25.00	0.000	-2,677.32
80.00	10	7.81	0.001	705.15
100.00	4	-10.55	0.000	-1,187.63

Table A-65 15 day returns to MOM(15)

Whilst the function profile graph appears to show higher returns from the left end of the graph, decreasing to the right, the number of observations that support many of the categories is too small for interest. However, the values for the category rows of 0.00 and 20.00 have large numbers of observations, and appear very promising. These areas are highlighted in the tables above, and their interpretation is consistent with the previous function profiles concerning MOM(3). The majority of observations fall into these two categories, and the data for all timeframes supports the conclusion that returns for the first category outperforms the overall return for all observations, and the returns for the second category underperforms the overall returns for all observations.

Thus, it is expected that the 15 day momentum will be useful to the neural network, as its interpretation is consistent across all the timeframes shown.

Thus, 15 day momentum is included as a valid neural network input.

A.14　　　Function Profile: MOM(3) / MOM(15)

Support was found in Table 2-1 for the use of momentum. As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function

profile can be used to show whether the ratio of MOM(3) to MOM(15) might prove useful to the neural network. This function profile is presented below.
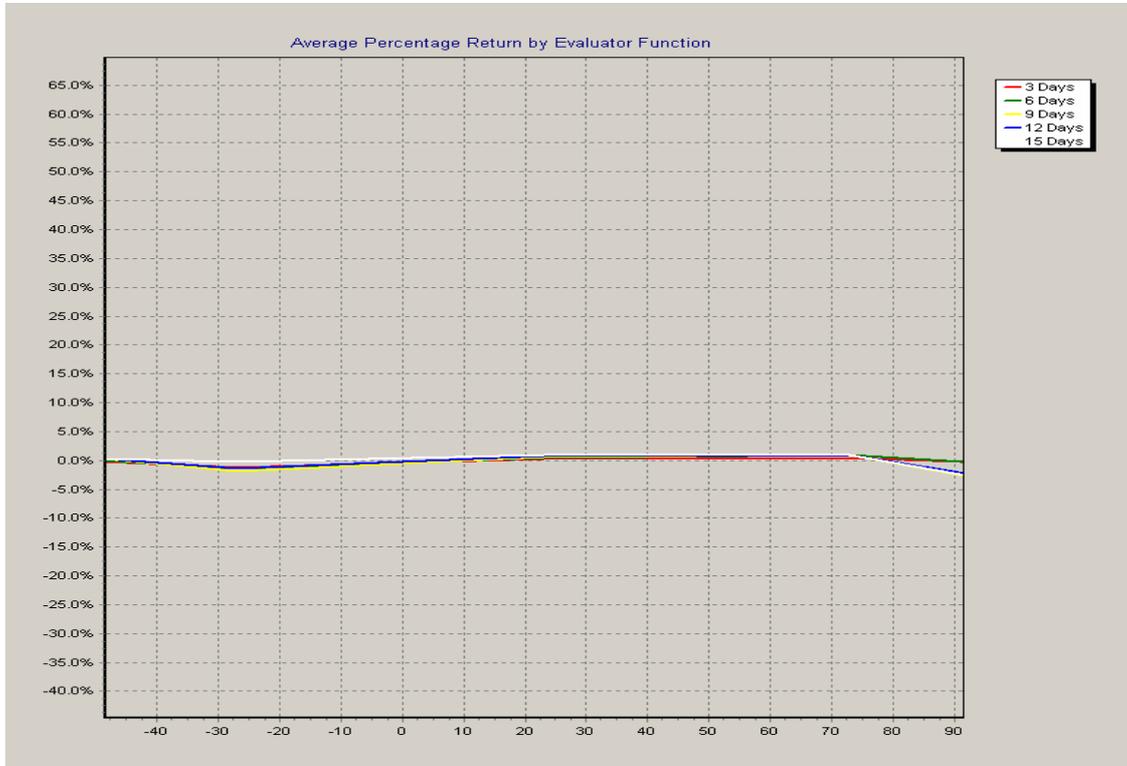

Figure A-14 Function Profile of ratio MOM(3) / MOM(15)

Table A-66 through Table A-70 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,280,632	0.37	100.000	
-150.00	1	35.37	0.000	9,459.46
-100.00	5	1.36	0.000	267.57
-50.00	23	-1.11	0.002	-400.00
0.00	674,373	0.13	52.659	-64.86
50.00	606,195	0.63	47.336	70.27
100.00	34	1.34	0.003	262.16
150.00	1	3.88	0.000	948.65
200.00	0	0.00	0.000	-100.00

Table A-66 3 day returns to ratio MOM(3) / MOM(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,276,792	0.53	100.000	
-150.00	1	43.23	0.000	8,056.60
-100.00	5	0.66	0.000	24.53
-50.00	23	-0.66	0.002	-224.53
0.00	672,157	0.33	52.644	-37.74
50.00	604,572	0.76	47.351	43.40
100.00	33	3.80	0.003	616.98
150.00	1	-13.36	0.000	-2,620.75
200.00	0	0.00	0.000	-100.00

Table A-67 6 day returns to ratio MOM(3) / MOM(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,272,952	0.68	100.000	
-150.00	1	10.04	0.000	1,376.47
-100.00	5	2.84	0.000	317.65
-50.00	23	-3.63	0.002	-633.82
0.00	669,952	0.52	52.630	-23.53
50.00	602,937	0.85	47.365	25.00
100.00	33	2.99	0.003	339.71
150.00	1	-47.41	0.000	-7,072.06
200.00	0	0.00	0.000	-100.00

Table A-68 9 day returns to ratio MOM(3) / MOM(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,269,112	0.82	100.000	
-150.00	1	3.06	0.000	273.17
-100.00	5	2.77	0.000	237.80
-50.00	23	-3.14	0.002	-482.93
0.00	667,759	0.71	52.616	-13.41
50.00	601,290	0.94	47.379	14.63
100.00	33	2.51	0.003	206.10
150.00	1	-31.03	0.000	-3,884.15
200.00	0	0.00	0.000	-100.00

Table A-69 12 day returns to ratio MOM(3) / MOM(15)

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Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,265,272	0.97	100.000	
-150.00	1	-37.99	0.000	-4,016.49
-100.00	5	-0.13	0.000	-113.40
-50.00	23	-1.43	0.002	-247.42
0.00	665,518	0.92	52.599	-5.15
50.00	599,691	1.03	47.396	6.19
100.00	33	3.76	0.003	287.63
150.00	1	-35.34	0.000	-3,743.30
200.00	0	0.00	0.000	-100.00

Table A-70 15 day returns to ratio MOM(3) / MOM(15)

This ratio supplements the basic information provided by MOM(3) and MOM(15), by providing a way for the neural network to consider how changes in the short term timeframe relate to changes in the longer term timeframe. The majority of observations fall into two categories, and the data for all timeframes supports the conclusion that returns for the first category underperforms the overall return for all observations, and the returns for the second category overperforms the overall returns for all observations.

Thus, it is expected that the ratio of 3 day momentum to 15 day momentum will be useful to the neural network, as its interpretation is consistent across all the timeframes shown.

Thus, this ratio is included as a valid neural network input.

A.15 Function Profile: RSI(3)

Support was found in Table 2-1 for the use of RSI (Relative Strength Index). As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether 3 day RSI might prove useful to the neural network. This function profile for 3 day RSI is presented below.
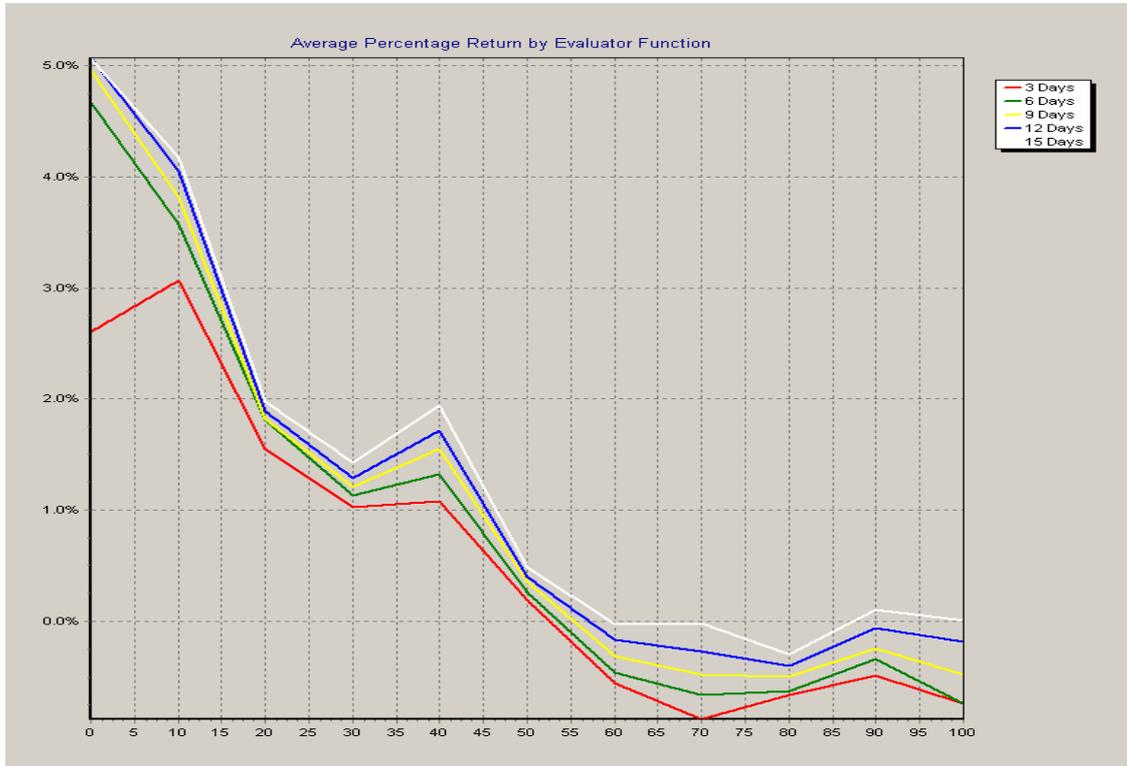
Figure A-15 Function Profile of RSI(3)

Table A-71 through Table A-75 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,295,993	0.37	100.000	
0.00	1,196	2.61	0.092	605.41
10.00	113,254	3.05	8.739	724.32
20.00	112,477	1.54	8.679	316.22
30.00	138,699	1.02	10.702	175.68
40.00	185,323	1.07	14.300	189.19
50.00	149,479	0.19	11.534	-48.65
60.00	147,619	-0.55	11.390	-248.65
70.00	148,262	-0.87	11.440	-335.14
80.00	111,799	-0.66	8.627	-278.38
90.00	91,655	-0.49	7.072	-232.43
100.00	96,230	-0.73	7.425	-297.30

Table A-71 3 day returns to RSI(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,292,153	0.53	100.000	
0.00	1,196	4.69	0.093	784.91
10.00	112,999	3.55	8.745	569.81
20.00	112,199	1.80	8.683	239.62
30.00	138,301	1.14	10.703	115.09
40.00	184,728	1.31	14.296	147.17
50.00	149,121	0.26	11.541	-50.94
60.00	147,215	-0.46	11.393	-186.79
70.00	147,725	-0.65	11.432	-222.64
80.00	111,420	-0.62	8.623	-216.98
90.00	91,332	-0.34	7.068	-164.15
100.00	95,917	-0.72	7.423	-235.85

Table A-72 6 day returns to RSI(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,288,313	0.70	100.000	
0.00	1,196	4.98	0.093	611.43
10.00	112,714	3.80	8.749	442.86
20.00	111,924	1.81	8.688	158.57
30.00	137,930	1.21	10.706	72.86
40.00	184,135	1.53	14.293	118.57
50.00	148,718	0.36	11.544	-48.57
60.00	146,790	-0.31	11.394	-144.29
70.00	147,192	-0.47	11.425	-167.14
80.00	111,048	-0.48	8.620	-168.57
90.00	91,033	-0.26	7.066	-137.14
100.00	95,633	-0.46	7.423	-165.71

Table A-73 9 day returns to RSI(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	*1,284,473*	*0.85*	*100.000*	
0.00	1,196	5.11	0.093	501.18
10.00	112,456	4.02	8.755	372.94
20.00	111,612	1.87	8.689	120.00
30.00	137,509	1.29	10.705	51.76
40.00	183,556	1.70	14.290	100.00
50.00	148,251	0.40	11.542	-52.94
60.00	146,417	-0.16	11.399	-118.82
70.00	146,683	-0.26	11.420	-130.59
80.00	110,720	-0.39	8.620	-145.88
90.00	90,761	-0.08	7.066	-109.41
100.00	95,312	-0.16	7.420	-118.82

Table A-74 12 day returns to RSI(3)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	*1,280,633*	*1.00*	*100.000*	
0.00	1,196	5.10	0.093	410.00
10.00	112,257	4.15	8.766	315.00
20.00	111,349	1.96	8.695	96.00
30.00	137,184	1.43	10.712	43.00
40.00	182,983	1.93	14.288	93.00
50.00	147,754	0.48	11.538	-52.00
60.00	145,999	-0.02	11.401	-102.00
70.00	146,187	0.00	11.415	-100.00
80.00	110,319	-0.29	8.614	-129.00
90.00	90,431	0.09	7.061	-91.00
100.00	94,974	0.03	7.416	-97.00

Table A-75 15 day returns to RSI(3)

The function profile clearly shows higher returns associated with lower values of RSI(3), and lower returns associated with higher values of RSI(3). With the exception of the zero category, all other categories contain significant observations, and the interpretation is consistent in all timeframes.

Thus, it is expected that RSI(3) will be useful to the neural network, as its interpretation is consistent across all timeframes investigated.

Thus, RSI(3) is included as a valid neural network input.

A.16 Function Profile: RSI(15)

Support was found in Table 2-1 for the use of RSI (Relative Strength Index). As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether 15 day RSI might prove useful to the neural network. This function profile for 15 day RSI is presented below.
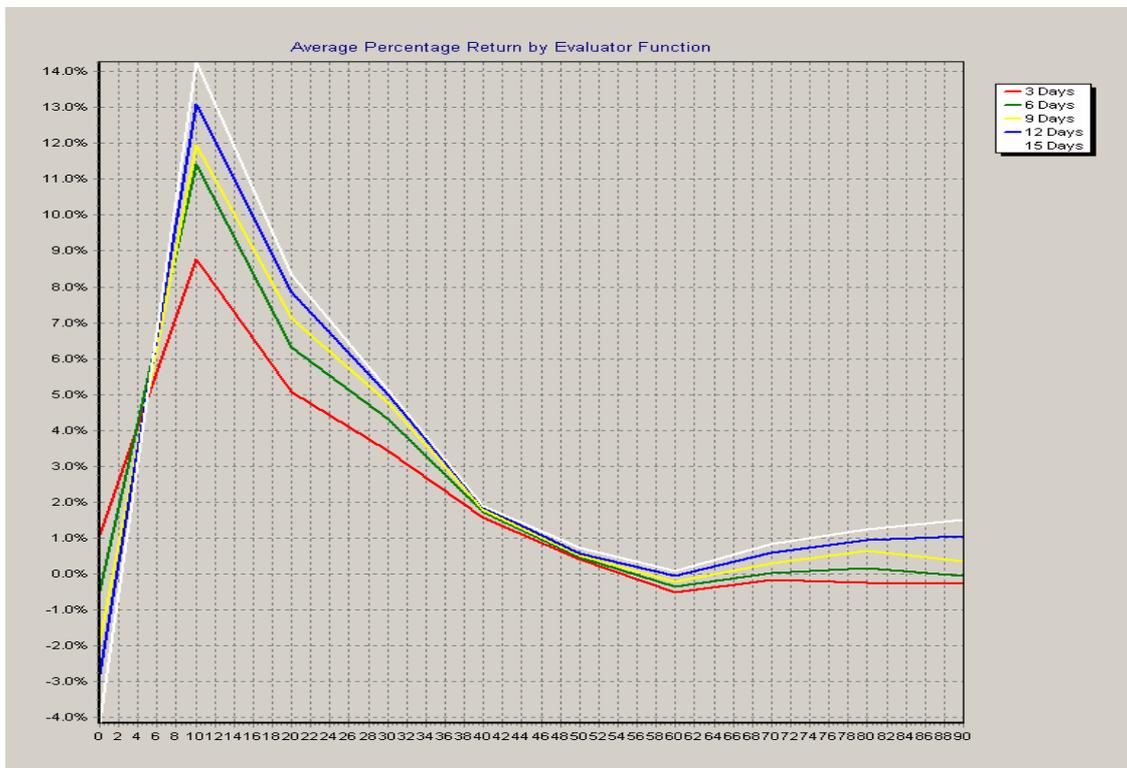

Figure A-16 Function Profile of RSI(15)

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Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,279,276	0.37	100.000	
0.00	115	1.08	0.009	191.89
10.00	1,087	8.70	0.085	2,251.35
20.00	6,881	5.08	0.538	1,272.97
30.00	46,304	3.42	3.620	824.32
40.00	201,095	1.56	15.719	321.62
50.00	447,513	0.40	34.982	8.11
60.00	362,991	-0.50	28.375	-235.14
70.00	157,196	-0.17	12.288	-145.95
80.00	46,397	-0.24	3.627	-164.86
90.00	9,697	-0.27	0.758	-172.97

Table A-76 through Table A-80 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,279,276	0.37	100.000	
0.00	115	1.08	0.009	191.89
10.00	1,087	8.70	0.085	2,251.35
20.00	6,881	5.08	0.538	1,272.97
30.00	46,304	3.42	3.620	824.32
40.00	201,095	1.56	15.719	321.62
50.00	447,513	0.40	34.982	8.11
60.00	362,991	-0.50	28.375	-235.14
70.00	157,196	-0.17	12.288	-145.95
80.00	46,397	-0.24	3.627	-164.86
90.00	9,697	-0.27	0.758	-172.97

Table A-76 3 day returns to RSI(15)

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Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,275,439	0.53	100.000	
0.00	115	-0.49	0.009	-192.45
10.00	1,087	11.28	0.085	2,028.30
20.00	6,873	6.32	0.539	1,092.45
30.00	46,217	4.29	3.624	709.43
40.00	200,743	1.72	15.739	224.53
50.00	446,211	0.44	34.985	-16.98
60.00	361,625	-0.36	28.353	-167.92
70.00	156,648	0.03	12.282	-94.34
80.00	46,252	0.15	3.626	-71.70
90.00	9,668	-0.06	0.758	-111.32

Table A-77 6 day returns to RSI(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,271,600	0.70	100.000	
0.00	115	-1.92	0.009	-374.29
10.00	1,087	11.72	0.085	1,574.29
20.00	6,861	7.13	0.540	918.57
30.00	46,123	4.76	3.627	580.00
40.00	200,366	1.77	15.757	152.86
50.00	444,925	0.49	34.989	-30.00
60.00	360,266	-0.21	28.332	-130.00
70.00	156,114	0.31	12.277	-55.71
80.00	46,105	0.66	3.626	-5.71
90.00	9,638	0.33	0.758	-52.86

Table A-78 9 day returns to RSI(15)

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Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,267,764	0.82	100.000	
0.00	115	-2.80	0.009	-441.46
10.00	1,086	13.03	0.086	1,489.02
20.00	6,853	7.86	0.541	858.54
30.00	46,049	4.98	3.632	507.32
40.00	199,935	1.84	15.771	124.39
50.00	443,713	0.56	35.000	-31.71
60.00	358,915	-0.05	28.311	-106.10
70.00	155,554	0.59	12.270	-28.05
80.00	45,939	0.96	3.624	17.07
90.00	9,605	1.04	0.758	26.83

Table A-79 12 day returns to RSI(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,263,931	0.98	100.000	
0.00	115	-4.16	0.009	-524.49
10.00	1,086	14.31	0.086	1,360.20
20.00	6,846	8.34	0.542	751.02
30.00	45,951	5.11	3.636	421.43
40.00	199,562	1.89	15.789	92.86
50.00	442,521	0.71	35.011	-27.55
60.00	357,600	0.10	28.293	-89.80
70.00	154,908	0.83	12.256	-15.31
80.00	45,765	1.26	3.621	28.57
90.00	9,577	1.51	0.758	54.08

Table A-80 15 day returns to RSI(15)

The function profile clearly shows higher returns associated with lower values of RSI(15), and lower returns associated with higher values of RSI(15). There are more outliers than in the case of RSI(3), however, this interpretation is consistent when outliers are ignored.

Thus, it is expected that RSI(15) will be useful to the neural network, as its interpretation is consistent across all timeframes investigated.

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Thus, RSI(15) is included as a valid neural network input.

A.17   *Function Profile: RSI(3) / RSI(15)*

Support was found in Table 2-1 for the use of RSI (Relative Strength Index). As the timeframes to be used for the neural network have already been established as 3 days and 15 days, a function profile can be used to show whether the ratio of 3 day RSI to 15 day RSI might prove useful to the neural network. This function profile for this is presented below.
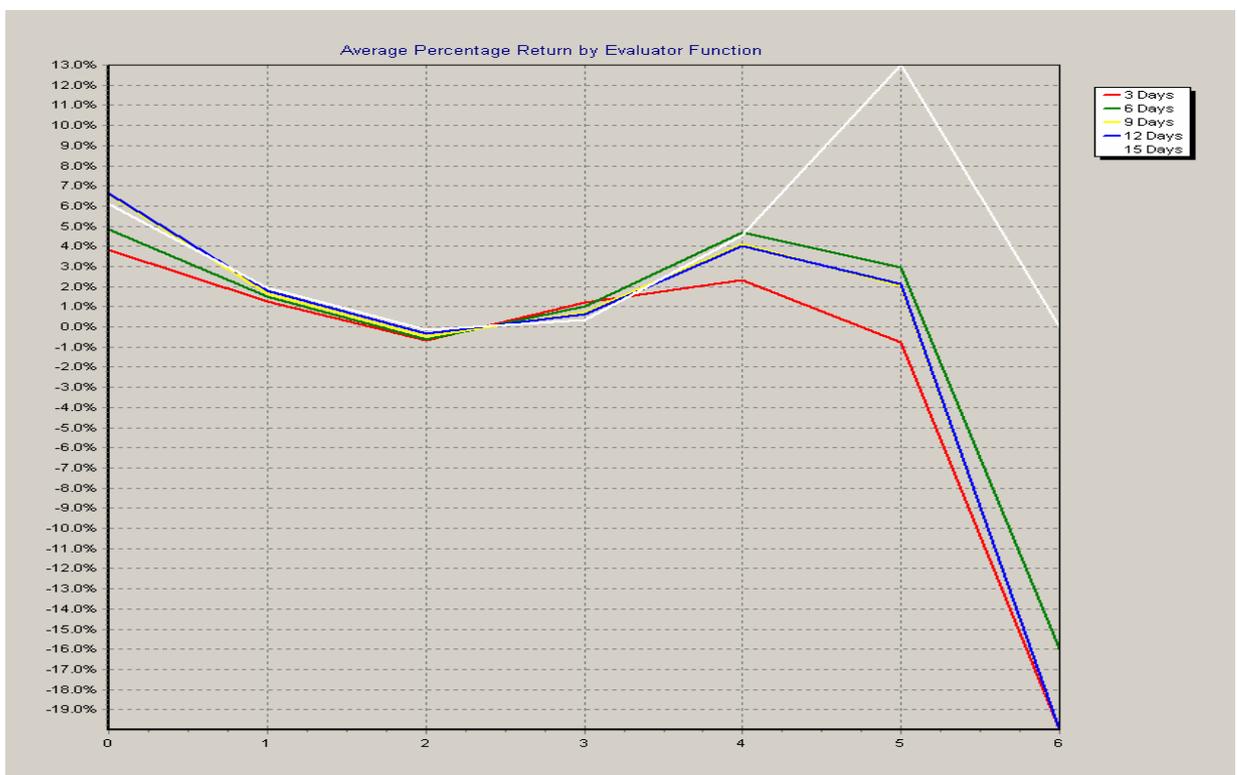

Figure A-17 Function Profile of ratio RSI(3) / RSI(15)

Table A-81 through Table A-85 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,280,632	0.37	100.000	
0.00	123	3.81	0.010	929.73
1.00	689,283	1.24	53.824	235.14
2.00	585,514	-0.67	45.721	-281.08
3.00	5,553	1.20	0.434	224.32
4.00	145	2.31	0.011	524.32
5.00	13	-0.77	0.001	-308.11
6.00	1	-20.00	0.000	-5,505.41

Table A-81 3 day returns to ratio RSI(3) / RSI(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,276,792	0.53	100.000	
0.00	123	4.83	0.010	811.32
1.00	687,318	1.49	53.832	181.13
2.00	583,660	-0.61	45.713	-215.09
3.00	5,534	1.00	0.433	88.68
4.00	143	4.71	0.011	788.68
5.00	13	2.95	0.001	456.60
6.00	1	-16.00	0.000	-3,118.87

Table A-82 6 day returns to ratio RSI(3) / RSI(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,272,952	0.68	100.000	
0.00	123	6.59	0.010	869.12
1.00	685,297	1.65	53.835	142.65
2.00	581,860	-0.48	45.710	-170.59
3.00	5,516	0.74	0.433	8.82
4.00	142	4.10	0.011	502.94
5.00	13	2.03	0.001	198.53
6.00	1	-20.00	0.000	-3,041.18

Table A-83 9 day returns to ratio RSI(3) / RSI(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,269,112	0.82	100.000	
0.00	123	6.63	0.010	708.54
1.00	683,178	1.79	53.831	118.29
2.00	580,159	-0.32	45.714	-139.02
3.00	5,496	0.61	0.433	-25.61
4.00	142	3.99	0.011	386.59
5.00	13	2.15	0.001	162.20
6.00	1	-20.00	0.000	-2,539.02

Table A-84 12 day returns to ratio RSI(3) / RSI(15)

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,265,272	0.97	100.000	
0.00	123	6.07	0.010	525.77
1.00	681,268	1.94	53.844	100.00
2.00	578,255	-0.16	45.702	-116.49
3.00	5,470	0.36	0.432	-62.89
4.00	142	4.55	0.011	369.07
5.00	13	13.00	0.001	1,240.21
6.00	1	0.00	0.000	-100.00

Table A-85 15 day returns to ratio RSI(3) / RSI(15)

In each of the timeframes, there are two categories which have significant numbers of observations. The interpretation of these categories is consistent also, category 1.00 (containing 0 < RSI(3) / RSI(15) <= 1) is associated with overperformance, whilst category 2.00 (containing 1 < RSI(3) / RSI(15) <= 2) is associated with underperformance.

Thus, it is expected that RSI(3) / RSI(15) will be useful to the neural network, as its interpretation is consistent across all timeframes investigated.

Thus, RSI(3) / RSI(15) is included as a valid neural network input.

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A.18 Function Profile: MACD(close)

Support was found in Table 2-1 for the use of MACD (Moving Average Convergence and Divergence). The calculation of MACD does not allow for the input of parameter lengths, rather its parameter lengths are predefined. For this reason, there are not two different sizes of MACD or a ratio between those sizes to test. This function profile for the standard MACD variable is presented below.
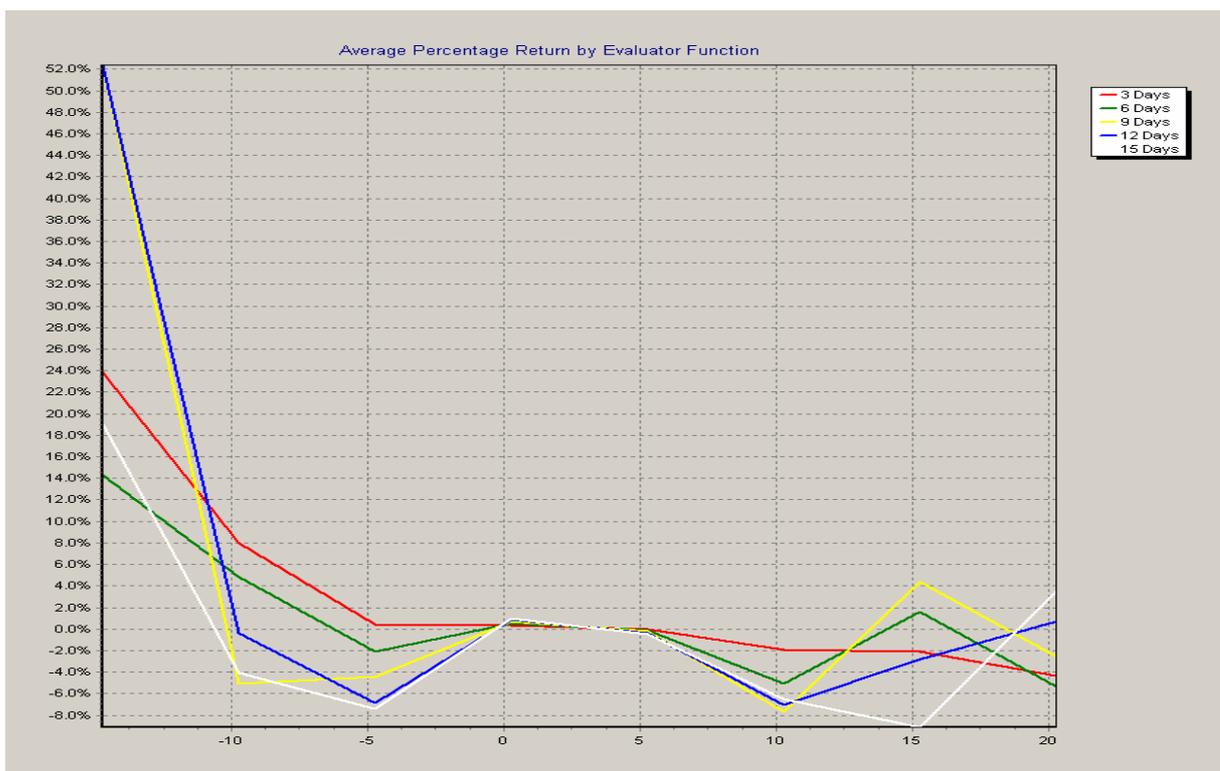

Figure A-18 Function Profile of MACD

Table A-86 through Table A-90 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,266,548	0.36	100.000	
-10.00	33	9.41	0.003	2,513.89
-5.00	189	-0.69	0.015	-291.67
0.00	701,497	0.55	55.387	52.78
5.00	564,699	0.13	44.586	-63.89
10.00	103	-1.92	0.008	-633.33
15.00	18	-1.55	0.001	-530.56
20.00	9	-5.63	0.001	-1,663.89

Table A-86 3 day returns to MACD

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,262,708	0.53	100.000	
-10.00	33	4.97	0.003	837.74
-5.00	189	-3.93	0.015	-841.51
0.00	699,818	0.68	55.422	28.30
5.00	562,538	0.34	44.550	-35.85
10.00	103	-5.09	0.008	-1,060.38
15.00	18	0.53	0.001	0.00
20.00	9	-5.14	0.001	-1,069.81

Table A-87 6 day returns to MACD

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,258,868	0.67	100.000	
-10.00	33	-0.87	0.003	-229.85
-5.00	189	-7.01	0.015	-1,146.27
0.00	698,157	0.76	55.459	13.43
5.00	560,359	0.56	44.513	-16.42
10.00	103	-8.10	0.008	-1,308.96
15.00	18	2.88	0.001	329.85
20.00	9	0.72	0.001	7.46

Table A-88 9 day returns to MACD

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,255,028	0.81	100.000	
-10.00	33	2.01	0.003	148.15
-5.00	189	-9.49	0.015	-1,271.60
0.00	696,534	0.85	55.499	4.94
5.00	558,142	0.77	44.472	-4.94
10.00	103	-7.71	0.008	-1,051.85
15.00	18	-3.30	0.001	-507.41
20.00	9	3.97	0.001	390.12

Table A-89 12 day returns to MACD

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	1,251,188	0.97	100.000	
-10.00	33	-2.42	0.003	-349.48
-5.00	189	-10.86	0.015	-1,219.59
0.00	694,893	0.96	55.539	-1.03
5.00	555,943	0.98	44.433	1.03
10.00	103	-6.66	0.008	-786.60
15.00	18	-9.52	0.001	-1,081.44
20.00	9	2.86	0.001	194.85

Table A-90 15 day returns to MACD

The two categories of MACD which contain significant observations are consistent across all timeframes. The interpretation of these categories are also consistent across all timeframes, with the exception of the 15 days timeframe. In all other timeframes, the category labeled 0.00 (which contains observations -5 < MACD <= 0) is associated with overperformance, while the category labeled 5.00 (which includes observations 0 < MACD <= 5) is associated with underperformance. This interpretation is only narrowly reversed for the 15 day timeframe.

It is expected that MACD will be useful to the neural network. Thus, MACD is included as a valid neural network input.

A.19   *Function Profile: Lowest Price Ratio*

There was no specific support for this new ratio in any of the trading literature, and it was created as a result of reviewing many published practitioner trading strategies. From reviewing many trading articles, it was clear that most strategies appeared to focus on one of two main approaches to picking stocks, namely dip-buying, or strength-buying.

Dip-buying strategies attempt to evaluate whether the price offered in the market for a stock is abnormally low by some measure, and the structure of these strategies is to buy the stock with a tight stop loss and a tight profit target, and await mean reversion. As an example, a strategy might buy a stock if the price fell by more than a fixed number of standard deviations of its normal daily trading range.

Strength-buying strategies attempt to capture price breakouts, which occur when the price of a stock suddenly climbs. Often these strategies also use a way to determine what the 'normal' price of the stock is, and wait for a significant break upwards from that price. Broadly, the structure of these strategies is to have a tight stop loss, and either a trailing stop, or a stop based on volatility.

Logically, it seems plausible that stocks near their long-time low are probably best suited for dip-buying, whilst stocks near their long-time high are probably best suited for strength-buying.

For this reason, the two new variables 'Lowest Price Ratio' and 'Highest Price Ratio' were created. These are to allow the neural network to gauge the position of the current price relative to its long-time high and low prices.
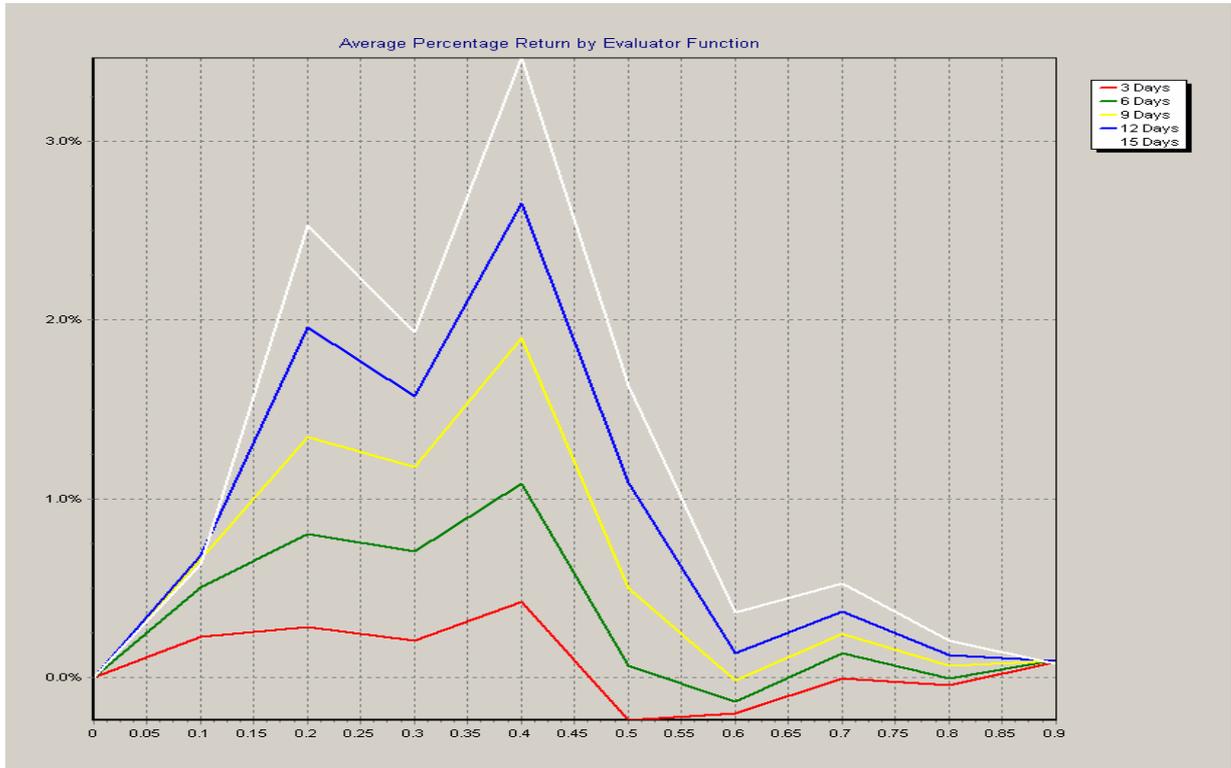
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Figure A-19 Function Profile of the Lowest Price Ratio

Table A-91 through Table A-95 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	784,389	0.01	100.000	
0.00	0	0.00	0.000	-100.00
0.10	9,403	0.23	1.199	2,200.00
0.20	22,316	0.29	2.845	2,800.00
0.30	30,581	0.21	3.899	2,000.00
0.40	46,451	0.42	5.922	4,100.00
0.50	72,192	-0.24	9.204	-2,500.00
0.60	83,050	-0.20	10.588	-2,100.00
0.70	124,882	-0.01	15.921	-200.00
0.80	180,059	-0.04	22.955	-500.00
0.90	215,455	0.09	27.468	800.00

Table A-91 3 day returns to the Lowest Price Ratio

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	781,368	0.16	100.000	
0.00	0	0.00	0.000	-100.00
0.10	9,392	0.51	1.202	218.75
0.20	22,248	0.80	2.847	400.00
0.30	30,465	0.71	3.899	343.75
0.40	46,246	1.09	5.919	581.25
0.50	71,724	0.07	9.179	-56.25
0.60	82,650	-0.13	10.578	-181.25
0.70	124,329	0.14	15.912	-12.50
0.80	179,431	-0.01	22.964	-106.25
0.90	214,883	0.10	27.501	-37.50

Table A-92 6 day returns to the Lowest Price Ratio

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	778,363	0.33	100.000	
0.00	0	0.00	0.000	-100.00
0.10	9,382	0.66	1.205	100.00
0.20	22,181	1.35	2.850	309.09
0.30	30,345	1.18	3.899	257.58
0.40	46,031	1.90	5.914	475.76
0.50	71,297	0.50	9.160	51.52
0.60	82,222	-0.01	10.563	-103.03
0.70	123,822	0.24	15.908	-27.27
0.80	178,822	0.07	22.974	-78.79
0.90	214,261	0.09	27.527	-72.73

Table A-93 9 day returns to the Lowest Price Ratio

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	775,387	0.51	100.000	
0.00	0	0.00	0.000	-100.00
0.10	9,372	0.69	1.209	35.29
0.20	22,110	1.96	2.851	284.31
0.30	30,229	1.58	3.899	209.80
0.40	45,839	2.65	5.912	419.61
0.50	70,859	1.09	9.139	113.73
0.60	81,796	0.14	10.549	-72.55
0.70	123,350	0.37	15.908	-27.45
0.80	178,180	0.13	22.979	-74.51
0.90	213,652	0.09	27.554	-82.35

Table A-94 12 day returns to the Lowest Price Ratio

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	772,428	0.70	100.000	
0.00	0	0.00	0.000	-100.00
0.10	9,361	0.63	1.212	-10.00
0.20	22,056	2.53	2.855	261.43
0.30	30,110	1.93	3.898	175.71
0.40	45,657	3.47	5.911	395.71
0.50	70,413	1.63	9.116	132.86
0.60	81,380	0.36	10.536	-48.57
0.70	122,864	0.53	15.906	-24.29
0.80	177,549	0.21	22.986	-70.00
0.90	213,038	0.08	27.580	-88.57

Table A-95 15 day returns to the Lowest Price Ratio

All categories contain significant observations, and the same general trend is evident in all timeframes, although the exact cutoffs between underperformance and overperformance vary between timeframes. In general, however, there is a trend of lower values of the Lowest Price Ratio being associated with overperformance, and higher values being associated with underperformance.

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In accordance with the general trend observed above, is expected that lowest price ratio will be useful to the neural network. Thus, lowest price ratio is included as a valid neural network input.

A.20 *Function Profile: Highest Price Ratio*

The full explanation behind the creation of this new technical variable is explained in section A.19 The function profile of the Highest Price Ratio is presented below.
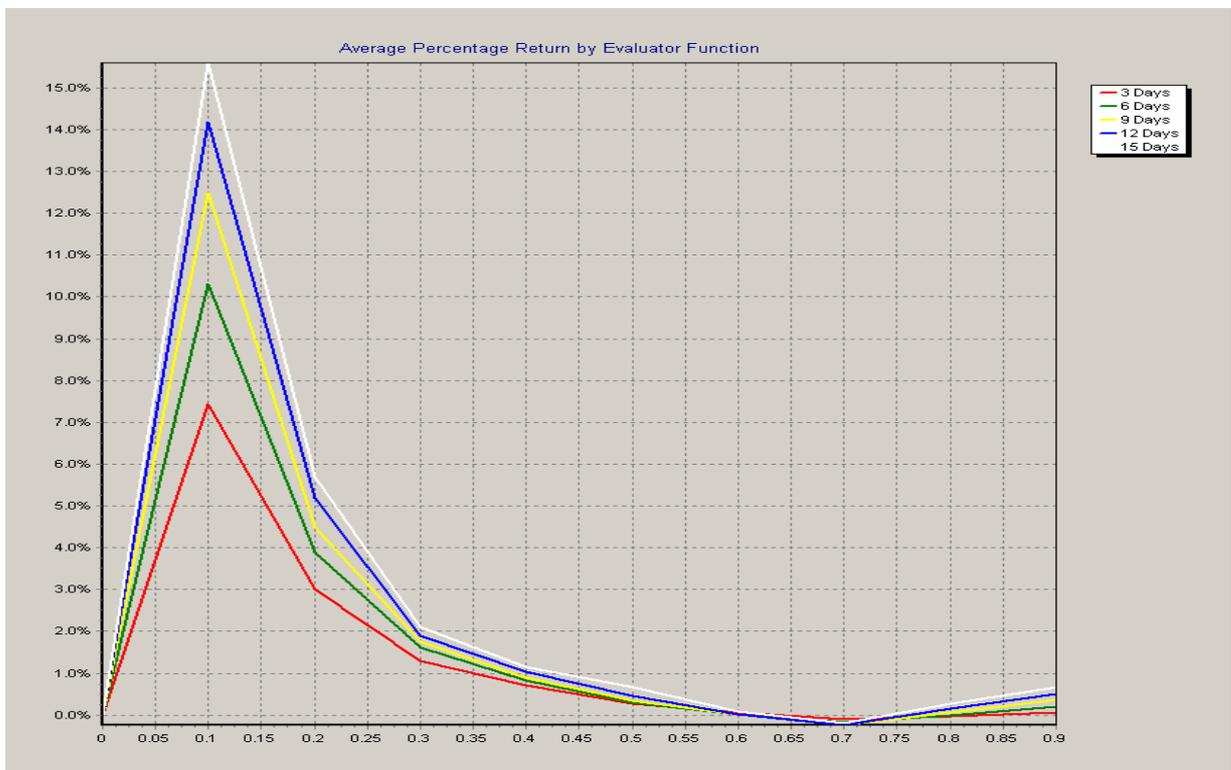

Figure A-20 Function Profile of the Highest Price Ratio

Table A-96 through Table A-100 detail the data that underlies this function profile. In the tables, highlighting has been used to graphically separate outliers from 'normal' data. All categories with less than 1% of total observations are deemed outliers.

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	785,051	0.47	100.000	
0.00	0	0.00	0.000	-100.00
0.10	14,273	7.43	1.818	1,480.85
0.20	40,232	3.01	5.125	540.43
0.30	54,669	1.29	6.964	174.47
0.40	68,991	0.71	8.788	51.06
0.50	86,277	0.26	10.990	-44.68
0.60	91,033	0.07	11.596	-85.11
0.70	111,858	-0.10	14.249	-121.28
0.80	139,153	-0.03	17.725	-106.38
0.90	178,565	0.07	22.746	-85.11

Table A-96 3 day returns to the Highest Price Ratio

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	782,394	0.63	100.000	
0.00	0	0.00	0.000	-100.00
0.10	14,110	10.31	1.803	1,536.51
0.20	39,970	3.89	5.109	517.46
0.30	54,402	1.61	6.953	155.56
0.40	68,666	0.83	8.776	31.75
0.50	85,960	0.29	10.987	-53.97
0.60	90,777	0.01	11.602	-98.41
0.70	111,556	-0.16	14.258	-125.40
0.80	138,834	-0.01	17.745	-101.59
0.90	178,119	0.21	22.766	-66.67

Table A-97 6 day returns to the Highest Price Ratio

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	779,713	0.76	100.000	
0.00	0	0.00	0.000	-100.00
0.10	13,952	12.50	1.789	1,544.74
0.20	39,699	4.50	5.091	492.11
0.30	54,109	1.75	6.940	130.26
0.40	68,365	0.91	8.768	19.74
0.50	85,645	0.34	10.984	-55.26
0.60	90,534	0.02	11.611	-97.37
0.70	111,274	-0.23	14.271	-130.26
0.80	138,481	0.06	17.761	-92.11
0.90	177,654	0.37	22.785	-51.32

Table A-98 9 day returns to the Highest Price Ratio

Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	777,047	0.90	100.000	
0.00	0	0.00	0.000	-100.00
0.10	13,782	14.20	1.774	1,477.78
0.20	39,428	5.19	5.074	476.67
0.30	53,845	1.89	6.929	110.00
0.40	68,042	1.05	8.756	16.67
0.50	85,343	0.46	10.983	-48.89
0.60	90,287	0.02	11.619	-97.78
0.70	110,991	-0.24	14.284	-126.67
0.80	138,130	0.15	17.776	-83.33
0.90	177,199	0.51	22.804	-43.33

Table A-99 12 day returns to the Highest Price Ratio

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Function Value	Observations	% Return	% of Observations	Percentage of Overall % Return
overall	774,417	1.06	100.000	
0.00	0	0.00	0.000	-100.00
0.10	13,609	15.60	1.757	1,371.70
0.20	39,137	5.70	5.054	437.74
0.30	53,572	2.11	6.918	99.06
0.40	67,738	1.14	8.747	7.55
0.50	85,027	0.66	10.979	-37.74
0.60	90,047	0.08	11.628	-92.45
0.70	110,746	-0.20	14.301	-118.87
0.80	137,758	0.27	17.789	-74.53
0.90	176,783	0.66	22.828	-37.74

Table A-100 15 day returns to the Highest Price Ratio

All categories contain significant observations, and the same trend is evident in all timeframes. Lower values of the Highest Price Ratio are related to overperformance, and higher values of the Highest Price Ratio are related to underperformance, with the actual cutoff category separating underperformance and overperformance being the category labeled 0.5 in all timeframes.

It is expected that highest price ratio will be useful to the neural network. Thus, highest price ratio is included as a valid neural network input.