Organization and Analysis of Measurement While Drilling (MWD) Data

Task 2 Report: Correlations Based on Traditional Methods

Prepared by

Curtis Link, PhD

Professor Emeritus Geophysical Engineering

and

David Barrick, P.E.

PhD candidate

Montana Technological University

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Abbreviations

CME: Central Mine Equipment

CPT: Cone Penetration Test

DD: Dry Density

HQ: Drilling core diameter: 2 ½ inch x 3 3/8 inch

HSA: Hollow Stem Auger

MDT: Montana Department of Transportation

MLR: Multiple Linear Regression

MWD: Measurement While Drilling

N1, N2, N3. N: SPT blow counts

NN: Neural Networks

PMT: Pressure Meter Test

Psi: pounds per square inch

REC: Sample Recovery

RQD: Rock Quality Designation

SPT: Standard Penetration Test

Su: Undrained Shear Strength-Total

Su_r: Undrained Shear Strength-Residual

UCS: Unconfined Compressive Strength

UW: Unit Weight

VST: Vane Shear Test

1. Summary

The scope of the MDT funded research project highlighted collection and organization of data onto a portal, data review and quality control and analysis of relationships between MWD drilling parameters and rock properties. Our initial approach was investigation of traditional linear correlations between individual MWD drilling parameters and rock properties such as SPT blow count for hollow stem auger data and UCS or unit weight for rock core data. In addition to individual MWD data types (depth, rotation rate, rotation torque, down pressure and advance rate) we also included the compound parameter specific energy.

We experimented with smoothing of MWD drilling data prior to analysis. Correlation results using smoothed or unsmoothed data were similar so we chose to use unsmoothed MWD data for analysis results presented here.

Based on weak, single parameter, linear correlation results using MWD data from multiple boreholes, we extended our correlation analysis to exponential fitting with no improvement in correlations. To further investigate correlations, we implemented a multiple linear regression (MLR) approach using all possible combinations of the six inputs. Correlation results improved for a number of combinations of inputs but were still resulted in weak predictive models. Finally, because of poor linear correlation model predictive results, we turned to a nonlinear approach by implementing a feedforward neural network. The neural network (NN) model investigated all combinations of MWD drilling parameters as inputs, used one hidden layer with varying numbers of neurons, and a single neuron output layer for predicting either SPT blow count, UCS or unit weight. Using a nonlinear approach greatly improved the predictive power of the MWD inputs for rock properties.

2. Data Used for Analysis

2.1. GIS portal data

The full set of MWD data available on the GIS portal website was presented as Table 1 in the Task 1 report. The data used for analysis are a subset from that list which contains Point Files. Point files contain the actual data files that can be used for analysis. This subset is shown in this report as Table 1 below.

As can be seen in the Table 1 Comment column (below), not all MWD data Point Files contain the same types of data. Most of the borehole data sets contained SPT blow count data with MWD data from 0 to auger refusal depth (i.e., HSA data). Typical auger refusal depth in these eastern Montana IGM's was in the range of approximately 30 feet depth. A smaller set of boreholes contained lab measurements (i.e., UCS or unit weight) from HQ rock coring results below HSA refusal depth.

Our analysis approach took two forms: correlating SPT blow counts from HSA drilling with the various MWD measurements recorded and correlating UCS and unit weight from lab measurements with MWD measurements.

Table 2 lists the boreholes available for SPT blow count correlations and Table 3 lists the boreholes available for UCS and unit weight correlations.

Table 1. Subset of MWD data containing Point Files which can be used for analysis. List is organized by project number e.g., 9727-xx, 9726-xx.

Boring_id	Data_type	Comment	Folder_shortcut	File_url
9727-7	MWD	SPT, MWD, UCS	MWD_Research/9727000/9727-7	Point Files
9727-5	MWD	SPT, MWD, VST, UCS	MWD_Research/9727000/9727-5	Point Files
9727-4	MWD	SPT, MWD, VST	MWD_Research/9727000/9727-4	Point Files
9727-23	MWD	CSPT (1.875" DIA SPOON), MWD, VST, PMT, BST, UCS	MWD_Research/9727000/9727-23	Point Files
9727-22	MWD	CSPT (1.875" DIA SPOON), MWD, VST, PMT, BST, UCS	MWD_Research/9727000/9727-22	Point Files
9727-13	MWD	SPT, MWD, VST	MWD_Research/9727000/9727-13	Point Files
9726-9	MWD	SPT, MWD, UCS	MWD_Research/9726000/9726-9	Point Files
9726-8	MWD	SPT, MWD, VST, UCS	MWD_Research/9726000/9726-8	Point Files
9726-7	MWD	SPT	MWD_Research/9726000/9726-7	Point Files
9726-39	MWD	SPT, MWD, UCS	MWD_Research/9726000/9726-39	Point Files
9726-38	MWD	SPT, MWD, UCS	MWD_Research/9726000/9726-38	Point Files
9726-3	MWD	SPT, MWD	MWD_Research/9726000/9726-3	Point Files
9726-28	MWD	SPT, MWD, VST	MWD_Research/9726000/9726-28	Point Files
9726-25	MWD	SPT, MWD, VST	MWD_Research/9726000/9726-25	Point Files
9726-23	MWD	SPT, MWD, VST	MWD_Research/9726000/9726-23	Point Files
9726-19	MWD	SPT, MWD, VST	MWD_Research/9726000/9726-19	Point Files

9726-13	MWD	SPT, MWD, UCS	MWD_Research/9726000/9726-13	Point Files
9726-12	MWD	SPT, MWD, UCS	MWD_Research/9726000/9726-12	Point Files
9726-1	MWD	SPT, MWD	MWD_Research/9726000/9726-1	Point Files

Table 2. List of boreholes containing SPT blow count data and MWD data.

Boring_id	Data_type	Comment	Folder_shortcut	File_url
9727-7	MWD	SPT, MWD, UCS	MWD_Research/9727000/9727-7	Point Files
9727-5	MWD	SPT, MWD, VST, UCS	MWD_Research/9727000/9727-5	Point Files
9727-4	MWD	SPT, MWD, VST	MWD_Research/9727000/9727-4	Point Files
9727-13	MWD	SPT, MWD, VST	MWD_Research/9727000/9727-13	Point Files
9726-9	MWD	SPT, MWD, UCS	MWD_Research/9726000/9726-9	Point Files
9726-8	MWD	SPT, MWD, VST, UCS	MWD_Research/9726000/9726-8	Point Files
9726-7	MWD	SPT	MWD_Research/9726000/9726-7	Point Files
9726-39	MWD	SPT, MWD, UCS	MWD_Research/9726000/9726-39	Point Files
9726-38	MWD	SPT, MWD, UCS	MWD_Research/9726000/9726-38	Point Files
9726-3	MWD	SPT, MWD	MWD_Research/9726000/9726-3	Point Files
9726-28	MWD	SPT, MWD, VST	MWD_Research/9726000/9726-28	Point Files
9726-25	MWD	SPT, MWD, VST	MWD_Research/9726000/9726-25	Point Files
9726-23	MWD	SPT, MWD, VST	MWD_Research/9726000/9726-23	Point Files
9726-19	MWD	SPT, MWD, VST	MWD_Research/9726000/9726-19	Point Files

9726-13	MWD	SPT, MWD, UCS	MWD_Research/9726000/9726-13	Point Files
9726-12	MWD	SPT, MWD, UCS	MWD_Research/9726000/9726-12	Point Files
9726-1	MWD	SPT, MWD	MWD_Research/9726000/9726-1	Point Files

Table 3. List of boreholes containing UCS lab data and MWD data.

Boring_id	Data_type	Comment	Folder_shortcut	File_url
9727-7	MWD	SPT, MWD, UCS	MWD_Research/9727000/9727-7	Point Files
9727-5	MWD	SPT, MWD, VST, UCS	MWD_Research/9727000/9727-5	Point Files
9727-23	MWD	CSPT (1.875" DIA SPOON), MWD, VST, PMT, BST, UCS	MWD_Research/9727000/9727-23	Point Files
9727-22	MWD	CSPT (1.875" DIA SPOON), MWD, VST, PMT, BST, UCS	MWD_Research/9727000/9727-22	Point Files
9726-9	MWD	SPT, MWD, UCS	MWD_Research/9726000/9726-9	Point Files
9726-8	MWD	SPT, MWD, VST, UCS	MWD_Research/9726000/9726-8	Point Files
9726-39	MWD	SPT, MWD, UCS	MWD_Research/9726000/9726-39	Point Files
9726-38	MWD	SPT, MWD, UCS	MWD_Research/9726000/9726-38	Point Files
9726-13	MWD	SPT, MWD, UCS	MWD_Research/9726000/9726-13	Point Files
9726-12	MWD	SPT, MWD, UCS	MWD_Research/9726000/9726-12	Point Files

2.2. Hollow stem auger data

Our goal for analysing hollow stem auger (HSA) data was to correlate relevant MWD parameters and/or compound parameters with borehole SPT blow count values. As detailed in the Task 1 report, plots of drilling data pulldown pressure exhibit a sharp decrease in pulldown pressure at intervals of 2.5 feet for depths 0 to 15 feet and at intervals of 5 feet for depths 15 to 35 feet. These sharp decreases represent drilling stops for auger section additions. Also, when drilling restarts, there is a delay before pulldown pressures reach full operating values again. These sharp decreases and ramping up of pressure prevent using the raw pulldown pressure values as recorded for analysis. Instead, we manually picked the peak pressure values prior to each auger change to correlate with SPT blow counts. Possible future work will consider an automated approach to identify these drilling discontinuities. After pre-processing, our analysis used data from 12 boreholes for a total of 64 data samples. Table 4 shows the final values used for correlation analysis of SPT blow count data with MWD data and the boreholes used.

2.3. HQ rock core data

Our approach for analyzing MWD and rock coring lab data was exploring correlation of MWD parameters with UCS values as well as unit weight. After pre-processing, our data set for MWD and UCS consisted of data from six boreholes for a total of 117 data samples. The MWD parameters used were depth, pulldown pressure, rotation torque, rotation speed and rate of advance along with compound parameter specific energy. Some rotation torque values from two boreholes were problematic and eliminated. All data were reviewed prior to correlation analysis. Table 5 shows the final values used for correlation analysis of UCS and unit weight with MWD data and their corresponding boreholes.

Table 4. Final spreadsheet containing SPT blow count data and MWD drilling data: Depth (feet), Peak Down Pressure (psi), Rotation Torque (lb-ft), Rotation Speed (rev/min), Moving Speed (ft/h), Specific Energy (ft-lb/ft^3).

Depth (feet)	Peak Down Pressure (psi)	Rotation Torque (lb-ft)	Rotation Speed (rev/min)	Moving Speed (ft/h)	Specific Energy (ftlb/ft^3)	Blows per foot
Borehole 9726-23						
7.5	467.49	247.05	37.43	137.7	67774.25926	4
10	450.74	324.94	36.67	126.06	65547.98104	3
12.5	440.63	370.5	37.42	131.06	64168.56046	4
15	419.98	520.62	36.83	138.64	61415.63133	3
20	415.87	400.05	45.43	127.84	60849.98759	4
25	513.23	632.83	37.96	127.4	75184.64617	9
30	804.32	594.79	49.65	134.24	117314.8978	60
35	794.73	526.88	46.77	121.55	115816.8401	91
40	570.77	640.23	46.98	136.89	83681.89695	75
Borehole 9727-7						
7.5	220.43	202.72	36.04	111.93	32184.85557	6
10	376.07	266.43	35.17	107.2	54747.23321	6
12.5	298.41	244.03	34.29	108.65	43493.66108	5
15	280.25	258.98	34.21	111.52	40895.10369	3
20	497.2	492.46	32.89	120.86	72506.20661	8
25	517.61	581.68	30.92	99.08	75767.64801	28
30	515.5	437.44	39.69	112.05	75283.46153	83
Borehole 9726-28						
7.5	259.84	151.28	40.92	110.46	37797.25311	5
12.5	533.74	640.08	29.08	126.77	77854.92391	28
15	476	647.53	37.72	83.5	70528.95132	38
20	705.45	648.86	44.75	100.65	103542.4518	41
Borehole 9726-13						
5	350.75	139.8	40.97	128.06	50811.50628	0.1
7.5	276.87	141.28	35.44	142.12	40108.3512	0.1
10	298.13	140.5	38.37	144.32	43184.20352	3
12.5	510.63	140.21	33.97	146.78	73750.9213	50
15	634	140.08	43.29	135.29	91600.16512	72
9726-38						
8	561.4	359.53	39.13	104.15	81758.22523	29
13	440.51	447.42	42.02	112.6	64566.462	29
18	470.77	220.77	43.16	109.2	68382.99438	38
23	465.7	536.39	43.83	95.21	68736.4159	39
28	515.35	307.87	42.04	135.12	74860.40573	43
9726-39						
5	194.48	61.5	45.51	105.32	28185.45452	2
10	328.7	125.24	50.14	103.47	47744.63163	3
15	793.36	447.95	47.89	112.87	115533.5794	48
20	540.21	403.28	48.01	113.02	78952.72847	51
9726-1						
7.5	526.88	106.45	62.66	72.56	76494.52049	5
10	580.02	185.79	63.42	66.83	84719.29748	3
12.5	617.27	274.52	52.08	71.99	90234.53378	4
15	566.93	104.47	73.27	76.23	82319.3147	5
20	661.37	59.96	61.87	80.7	95549.22621	18
25	679.6	222.2	40.37	43.64	99257.2378	21
9726-3						
7	560.24	125.27	23.69	160.17	80800.29346	16
9.5	626.96	518.06	29.18	127.28	91088.197	12
12	648.98	375.81	37.1	168.25	94015.45513	43
14.5	693.52	220.58	78.95	38.2	102960.4476	29
9726-19						
6.5	404.43	264.15	40.36	105.22	58925.47823	6
9	588.57	329.05	39.47	158.32	85310.754	26
11.5	863.35	327.16	36.84	152.53	124858.6092	38
9727-4						
5	358.81	244.58	36.05	60.07	52664.67309	4
10	504.75	385.17	36.09	146.29	73328.80947	9
12.5	493.54	455.63	31.77	63.06	72627.44843	16
15	511.83	436.66	32.03	102.16	74632.54059	14
20	378.93	372.13	33.1	63.85	55875.00158	30
9727-5						
5	381.1	150.84	35.38	106.36	55218.88967	5
7.5	262.81	146.09	36.66	114.4	38162.32287	4
10	249.28	119.97	36.36	123.15	36136.68418	5
12.5	203.45	114.52	36.47	124.83	29523.8415	13
15	217.78	180.73	36.86	122.83	31728.35333	11
20	537.37	587.29	39.18	114.2	78748.55616	40
9727-11	* No Point Files					
5	237.41	132.18	34.99	94.66	34518.59048	4
7.5	260.05	149.79	36.48	123.65	37747.0821	2
10	200.78	114.91	36.86	126.96	29138.70796	0.1
12.5	268.16	271.26	33.54	122.27	39119.97411	21
15	508.96	438.04	33.07	92.59	74351.90989	36
20	516.51	569.86	36.65	119.97	75558.78014	54

Table 5. Final spreadsheet containing UCS and unit weight data and MWD drilling data: Depth (feet), Peak Down Pressure (psi), Rotation Torque (lb-ft), Rotation Speed (rev/min), Moving Speed (ft/h), Specific Energy (ft-lb/ft^3).

Depth (feet)	Peak Down Pressure (psi)	Rotation Torque (lb-ft)	Rotation Speed (rev/min)	Moving Speed (ft/h)	Specific Energy (ftlb/ft^3)	UCS (psi)	Unit Weight (pcf)
Borehole 9727-7							
36.75	350.81	41.22	331.86	113.24	54,224	202.3	114.9
39.45	307.77	58.23	333.33	105.69	49,954	62.12	106.4
41.05	281.31	47.08	334.18	118.73	44,575	122.8	111.7
44.55	295.8	67.52	312.19	33.85	61,704	189.4	110.6
46.15	346.5	48.6	313.91	134.07	53,388	196.1	109.9
50.95	494.44	66.37	339.15	164.45	75,400	23.21	106.3
54.25	351.9	66.03	329.4	110.27	56,726	11.03	104
Borehole 9726-12							
31.05	412.4	3	335.57	51.92	59,981	58.84	111.8
31.5	404.39	2.99	337.8	48.78	58,868	136.4	108.4
32.3	495.83	3.12	338.32	6.11	76,701	48.18	109.4
32.9	489.42	2.81	340.15	51.88	71,042	133	109
35.6	223.37	3.04	321.67	146.39	32,370	12.17	98.79
40.65	581.2	3.09	329.09	44.38	84,396	30	90.5
41.25	579.62	3.2	334.17	357.31	83,557	224.9	72.4
41.55	577.5	3.24	332.53	150.53	83,380	320.4	71.9
41.7	282.74	3.17	333.03	19.38	42,386	80.2	83.4
42.1	333.04	3.32	332.5	51.5	48,616	288.2	89.9
42.95	331.48	2.99	332.8	53.1	48,308	86.6	87.3
46.7	399.11	3.22	331.18	55.03	58,067	14.38	105.2
47.7	395.38	3.09	331.64	58.12	57,476	70.81	112.3
51.1	397.69	3.19	316.25	134.72	57,497	51.07	109.8
51.8	426.96	2.98	316.07	146.75	61,679	255	114.4
52.4	426.51	3.28	311.03	50.02	62,043	111.1	113.2
53.05	424.68	2.95	313.91	54.25	61,678	72.62	107.9
53.8	428.17	3.26	314.42	127.01	61,904	70.29	112.2
56	412.15	3.04	333.12	143.54	59,566	28.03	102.1
56.6	349.43	3.04	334.5	76.23	50,727	216	115
60.5	452.71	2.85	320.27	58.56	65,669	218.3	118.7
61.2	450.82	3.12	320.59	60.03	65,429	156.7	119.9
61.9	499.05	3.07	320.48	95.89	72,178	74.58	115.4
62.6	497.16	3.17	320.44	119.88	71,851	115.5	114.1
64.1	480.3	3.16	320.32	234.52	69,296	9.54	104.7
66.15	444.53	3.2	326.14	183.55	64,187	122	112.6
67	506.31	3.25	324.05	171.31	73,097	75.68	109.8
67.7	506.01	2.95	323.41	161.25	73,047	289.8	118.5
69	409.04	3.26	324.41	86.52	59,277	18.33	106
Borehole 9726-13							
30.15	264.22	40.69	331.84	24.85	54,722	49	105
31.8	418.93	40.66	332.26	215.15	62,253	27	107
32.7	521.15	40.56	307.74	59.55	81,478	58	112
38.6	421.69	40.62	331.05	78.41	65,986	233	112
40.6	419.84	40.91	340.43	70.59	66,511	219	117
41.4	414.97	40.64	340.62	46.82	68,828	141	114
42.1	412.4	40.68	340.89	77.53	64,874	101	114
42.7	409.52	40.55	340.55	53.05	66,959	145	117
43.4	565.96	40.64	339.41	87.47	86,337	200	119
44.05	604.44	40.53	339.93	86.49	91,928	102	118
44.8	412.55	40.61	341.42	59.78	66,524	400	119
50.4	404.37	40.47	340.1	76.48	63,752	25	106
51.9	407.56	40.75	340.9	180.42	61,051	26	116
52.8	412.18	40.8	340.96	88.08	64,200	105	115
53.55	184.56	40.64	344.82	15.87	53,673	70	113
9726-38							
33.75	422.96	67.13	252.84	58.7	69,779	83	116.3
34.4	414.67	63.34	253.51	35.83	73,465	445.4	97.1
34.7	410.71	59.36	253.62	24.91	77,688	259	71.8
35.1	407.56	65.27	253.31	34.9	73,226	437.1	75.9
35.3	406.24	63.9	253.17	8.7	115,560	547.1	70.3
35.45	403.23	57.35	254.18	28.3	73,872	351.1	87.3
36.75	392.66	52	255.98	10.82	94,294	119.6	124.5

37.75	330.02	58.74	256.03	30.16	62,825	54.01	122.2
40.25	299.77	39.59	241.95	79.49	46,865	44.01	106.3
41.25	182.48	43.68	248.57	131.81	28,805	206.7	115.4
44.75	282.83	57.53	247.9	29.37	55,628	64.25	114.5
45.25	275.93	39.73	249.87	28.83	50,301	43.85	111.8
46.25	314.54	58.92	247.79	42.76	55,771	78.84	114.8
46.75	313.06	58.28	247.65	43.69	55,218	104.2	112.6
47.25	295.02	56.86	248.37	41.51	52,923	42.26	116.7
48.25	302.84	84.34	263.2	41.01	60,219	41.95	117.8
48.75	305.03	75.37	263.69	49.58	56,225	62.72	119.8
49.75	304.45	70.53	263.71	55.34	54,154	67.43	118.8
50.25	299.34	66.55	264.33	58.99	52,256	161.9	125.4
50.75	295.33	55.84	264.21	82.04	48,046	188.1	121.8
9726-39							
22.25	247.96	95.08	259.51	44.83	52,596	37.14	106.8
24.4	345.15	100.05	259.79	49.95	65,670	462.5	76.6
24.6	343.74	98.94	259.96	50.88	65,011	582	74.3
24.85	343.65	98.68	259.81	52.56	64,454	608.9	71
25.1	328.93	120.32	211.87	70.42	58,474	535.4	77
25.4	336.04	103.54	274.75	47.25	66,865	448.5	72.7
25.65	324.01	105.7	274.73	37.69	70,300	383.7	73.7
26.1	300.01	94.89	246.47	35.04	63,683	8.86	105.2
33.75	313.84	95.54	273.81	104.61	52,867	40.68	112.1
34.25	312.21	92.27	273.71	83.77	54,210	59.2	114.8
36.25	301.52	96.03	247.93	66.38	54,425	228.3	114.7
36.75	287.41	92.08	233.03	53.85	53,615	298.7	116.6
46.75	114.01	83.51	258.49	119.81	21,946	133	120.7
9727-5							
27.5	309.82	23.1	308.49	293.16	45,360	20.69	102
31.05	390.17	28.64	320.65	81.02	59,663	58.84	111.8
31.5	501.63	28.5	321.01	62.44	76,731	136.4	108.4
32.3	497.46	43.73	318.9	108.74	75,570	48.18	109.4
32.9	496.55	47.45	319.17	86.83	76,855	133	109
34.8	416.58	27.37	321.1	88.55	63,033	61.03	105.9
35.6	376.6	17.98	311.46	343.41	54,731	12.17	98.79
40.65	407.35	19.53	331.05	76.56	61,250	30	90.5
41.25	550.38	47.52	329.22	49.37	88,979	224.9	72.4
41.55	549.05	49.69	328.51	64.98	86,772	320.4	71.9
41.7	548.73	49.09	329.22	64.61	86,693	80.2	83.4
42.1	593.61	39.34	328.69	65.55	91,533	288.2	89.9
42.95	593.65	51.83	328.44	63.29	93,739	86.6	87.3
46.7	273.51	33.11	339.74	82.42	43,574	14.38	105.2
47.7	308.07	39.68	338.67	82.78	49,344	70.81	112.3
48.5	323.19	35.73	337.89	140.34	49,179	95.77	108.5
51.1	309.73	43.84	342.17	90.17	49,706	51.01	109.8
51.8	314.32	42.55	342.99	89.46	50,268	255	114.4
52.4	304.12	25.44	343.77	81.47	47,087	111.1	113.2
53.05	171.96	31.79	344.09	114.22	27,701	72.62	107.9
53.8	309.11	34.15	342.67	108.05	47,835	70.29	112.2
56	307.45	52.14	266.73	169.6	46,789	28.03	120.1
56.6	285.88	35.24	267.9	54.24	46,508	216	115
57.4	399.29	53.27	339.43	83.6	64,135	165.4	110.5
60.5	318.01	35.21	318.5	55.79	51,962	218.3	118.7
61.2	481.6	56.24	316.23	69.08	77,251	156.7	119.9
61.9	496.43	57.89	316.48	85.58	78,055	74.58	115.4
62.6	497.85	51.31	318.46	47.43	82,262	155.5	114.1
64.1	419.97	72.15	315.82	83.63	68,837	9.54	104.7
66.15	275.99	25.77	336.15	62.08	44,025	122	112.6
67	397.53	51.49	333.58	75.21	64,252	75.68	109.8
67.7	352.6	35.51	334.8	53.36	57,611	289.8	118.5
69	273.08	25.61	344.21	74.34	42,962	18.33	106

3. Analysis results

3.1. Phase 1: Single parameter linear and exponential regression modeling

Initial analyses consisted of plotting target parameters (SPT blow count, UCS, and unit weight) against the six individual MWD measured parameters: depth, down pressure, rotation torque, rotation speed, moving speed and the compound parameter specific energy. A best fit linear regression line was calculated and the Pearson correlation coefficient (R^2) recorded for each MWD parameter. We also explored correlation results using a best fit exponential curve and tabulated those R^2 values as well.

3.1.1. SPT blow count correlations

Figure 1 shows results for single parameter *linear* regression correlation for SPT blow counts. Figure 2 shows results for single parameter *exponential* fitting for SPT blow counts. R^2 values are tabulated and listed in Table 6.

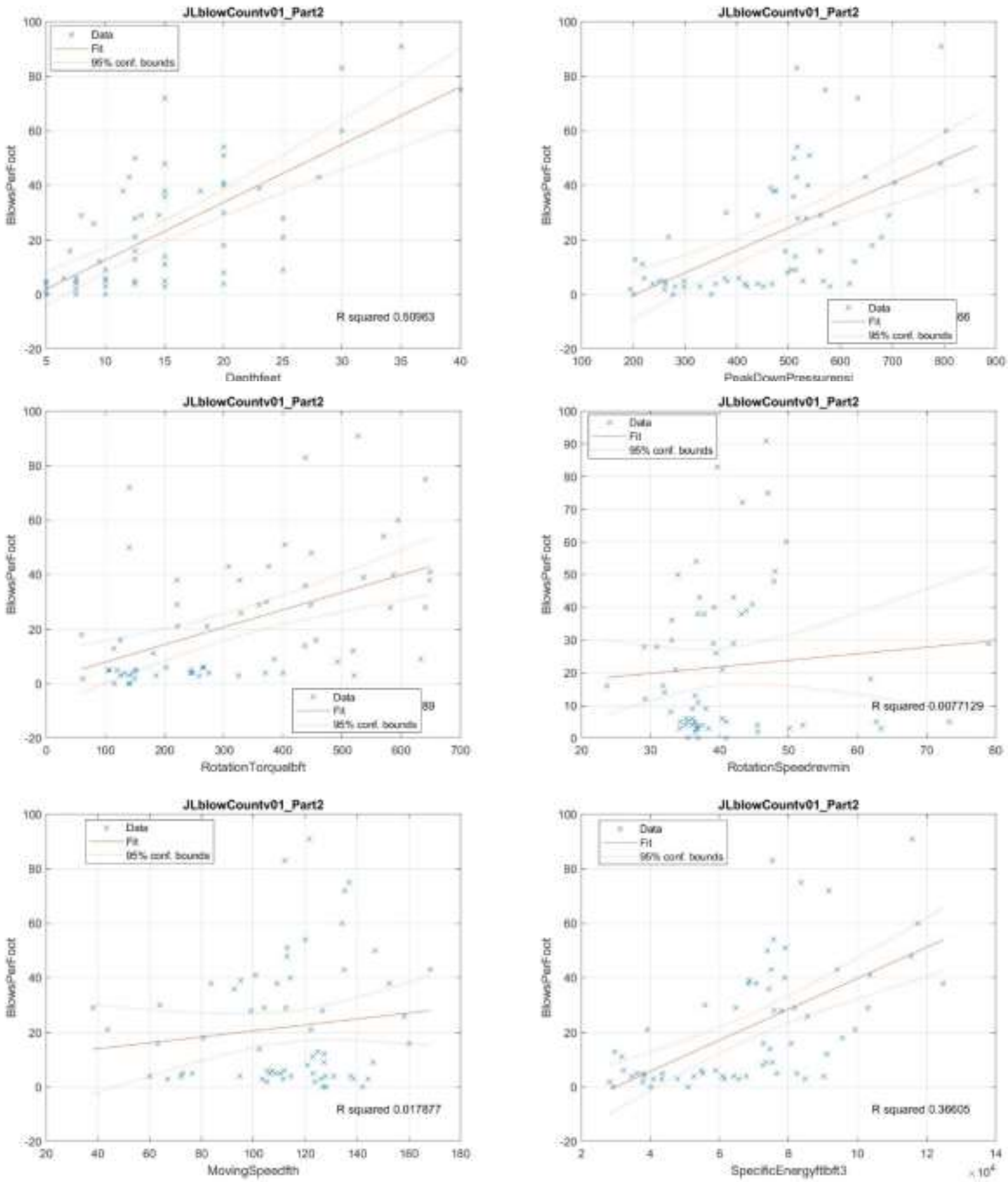


Figure 1. Single parameter linear regression correlation results for SPT blow counts. MWD parameter used is shown on horizontal axis. R^2 values are tabulated in Table 6.

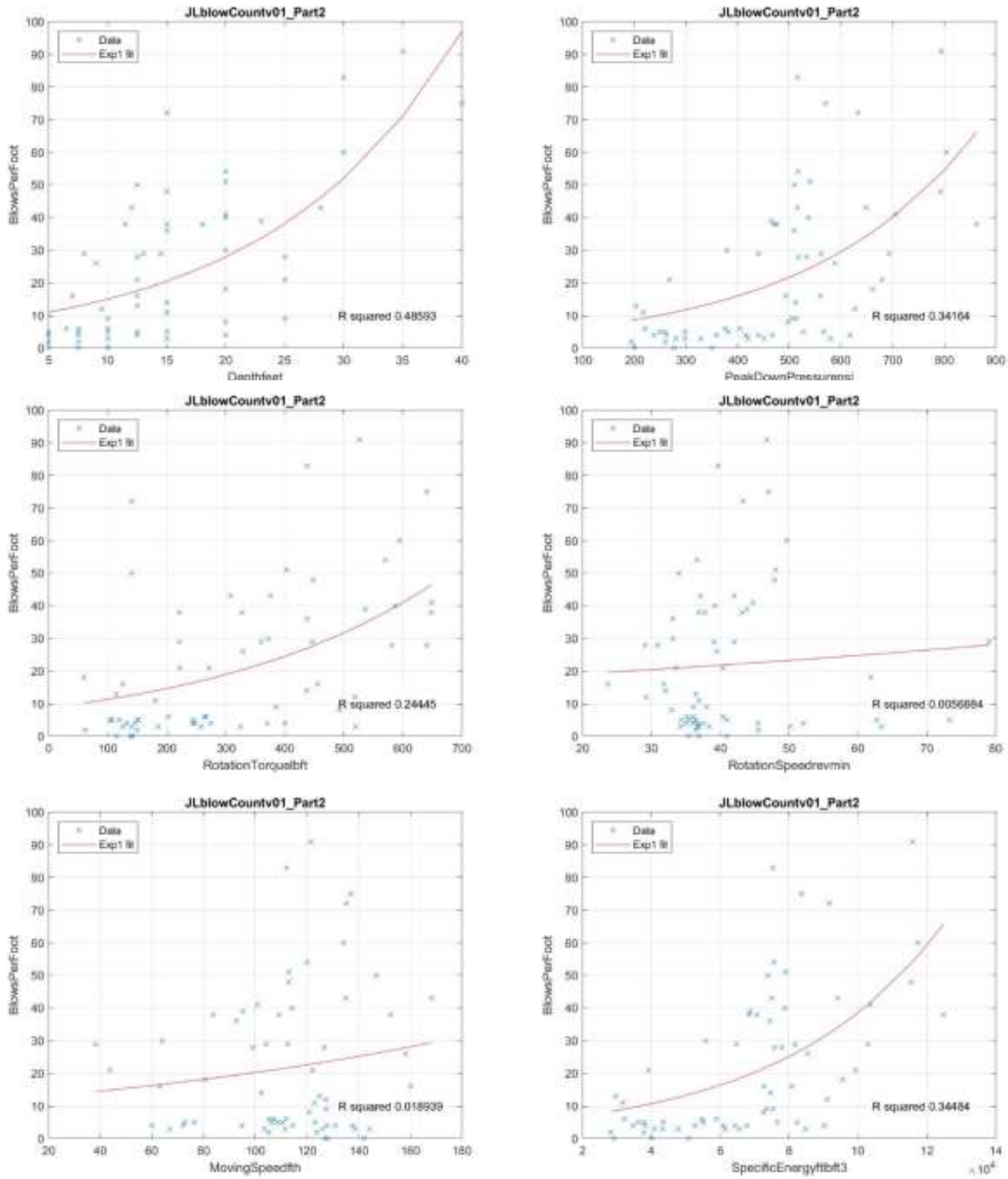


Figure 2. Single parameter exponential regression correlation results for SPT blow counts. MWD parameter used is shown on horizontal axis. R^2 values are tabulated in Table 6.

Table 6. Tabulated R^2 values for single parameter linear and exponential fitting for SPT blow counts.

MWD parameter	Linear R^2	Exponential R^2
Depth	0.51	0.49
Down pressure	0.36	0.34
Rotation torque	0.25	0.24
Rotation speed	0.01	0.01
Moving speed	0.02	0.02
Specific energy	0.37	0.34

3.1.2. UCS correlations

Figure 3 shows results for single parameter *linear* regression correlation for UCS. Figure 4 shows results for single parameter *exponential* fitting for UCS. R^2 values are tabulated and listed in Table 7.

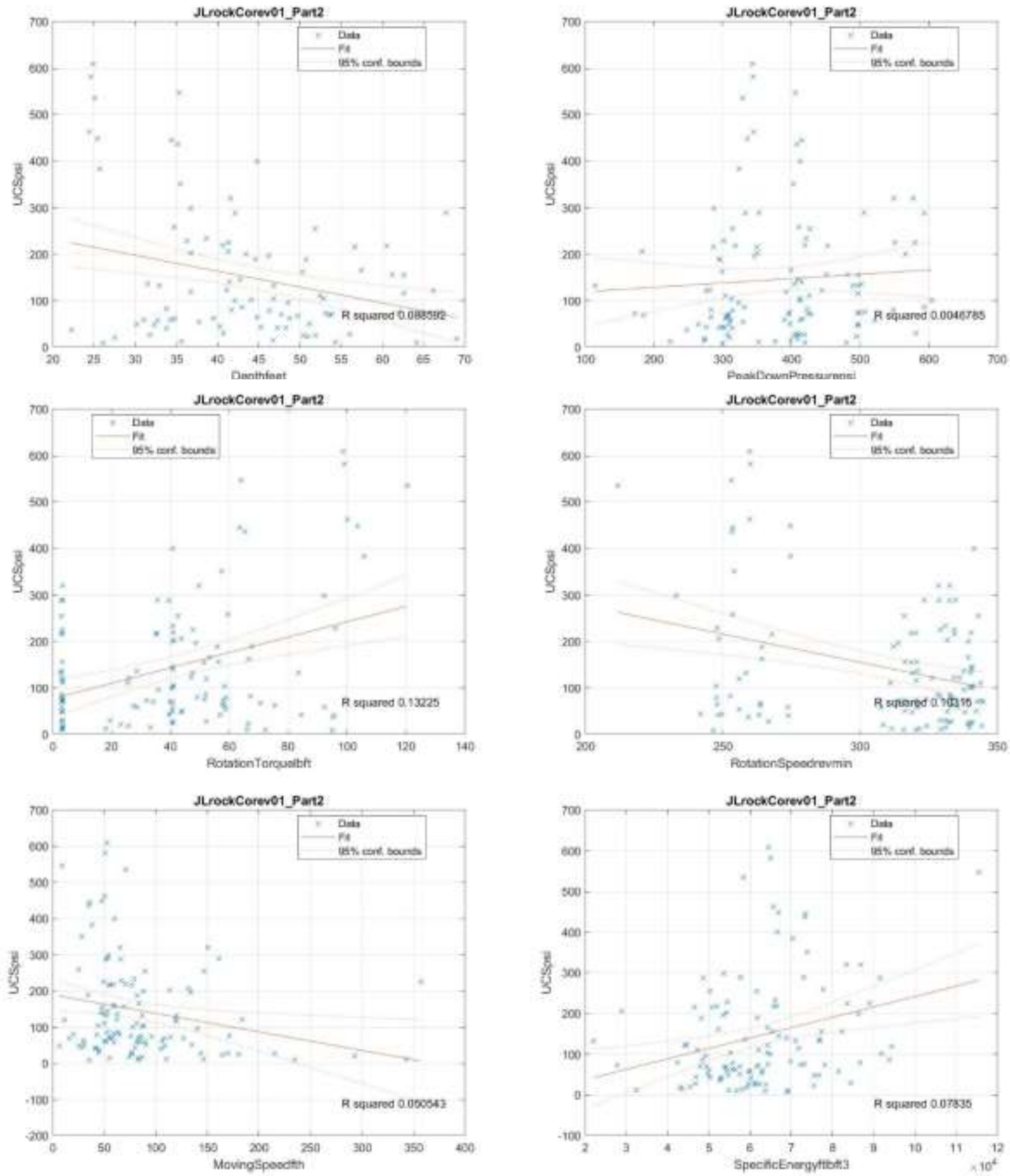


Figure 3. Single parameter linear regression correlation results for UCS. MWD parameter used is shown on horizontal axis. R^2 values are tabulated in Table 7.

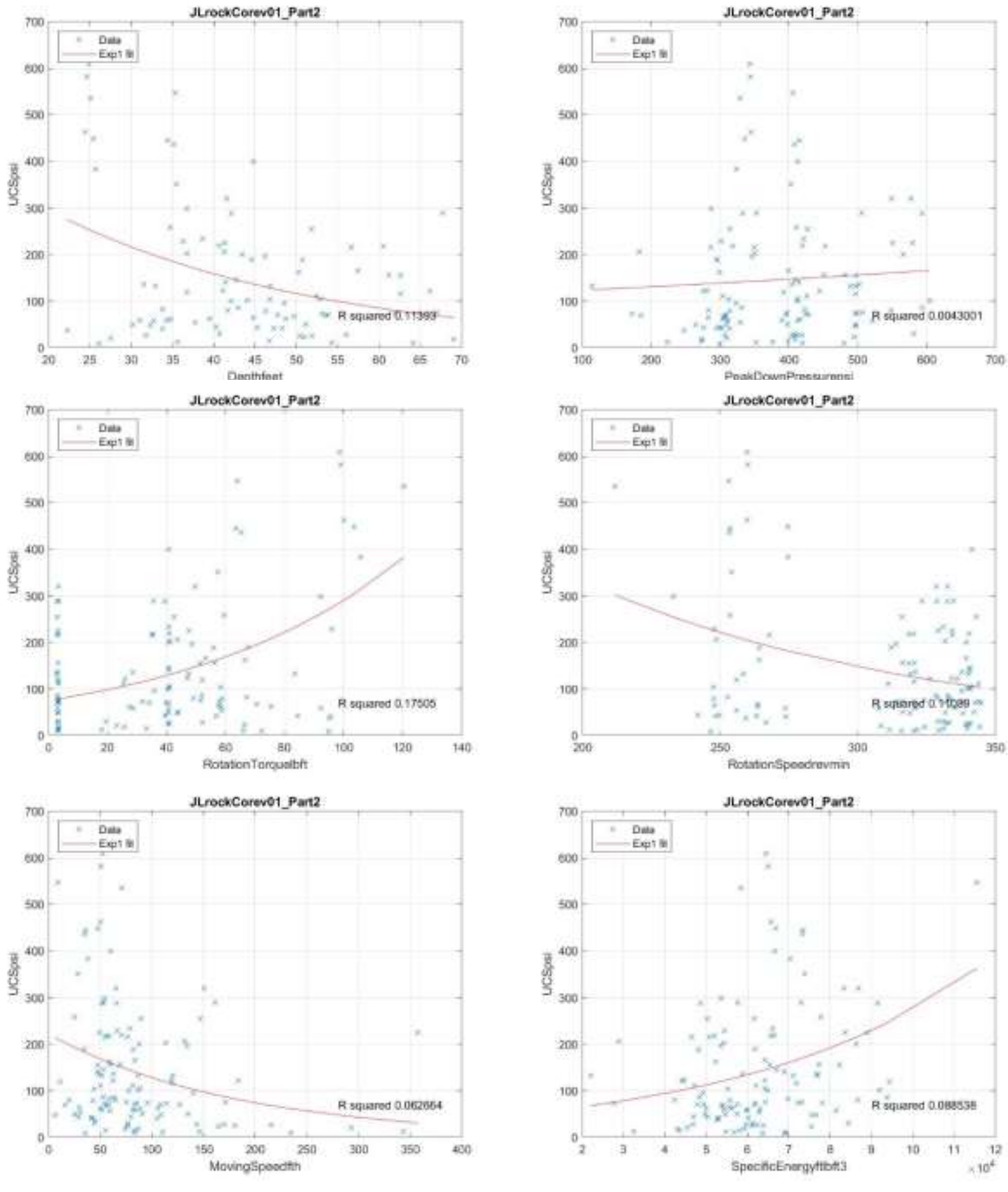


Figure 4. Single parameter exponential regression correlation results for UCS. MWD parameter used is shown on horizontal axis. R^2 values are tabulated in Table 7.

Table 7. Tabulated R^2 values for single parameter linear and exponential fitting for UCS.

MWD parameter	Linear R^2	Exponential R^2
Depth	0.009	0.11
Down pressure	0.005	0.004
Rotation torque	0.13	0.18
Rotation speed	0.10	0.11
Moving speed	0.05	0.06
Specific energy	0.08	0.09

3.1.3. Unit weight correlations

Figure 5 shows results for single parameter *linear* regression correlation for unit weight. Figure 6 shows results for single parameter *exponential* fitting for unit weight. R^2 values are tabulated and listed in Table 8

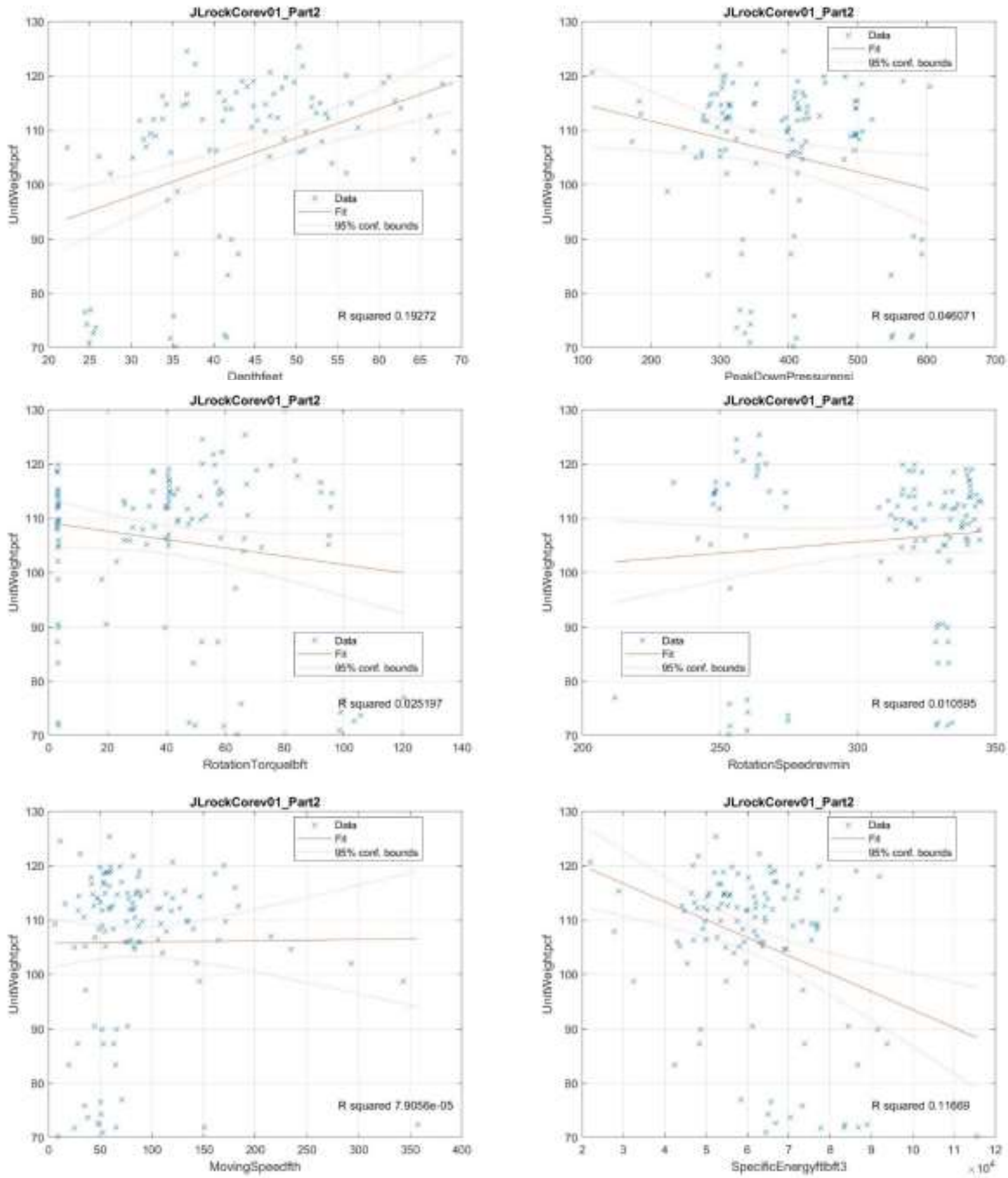


Figure 5. Single parameter linear regression correlation results for unit weight. MWD parameter used is shown on horizontal axis. R^2 values are tabulated in Table 8.

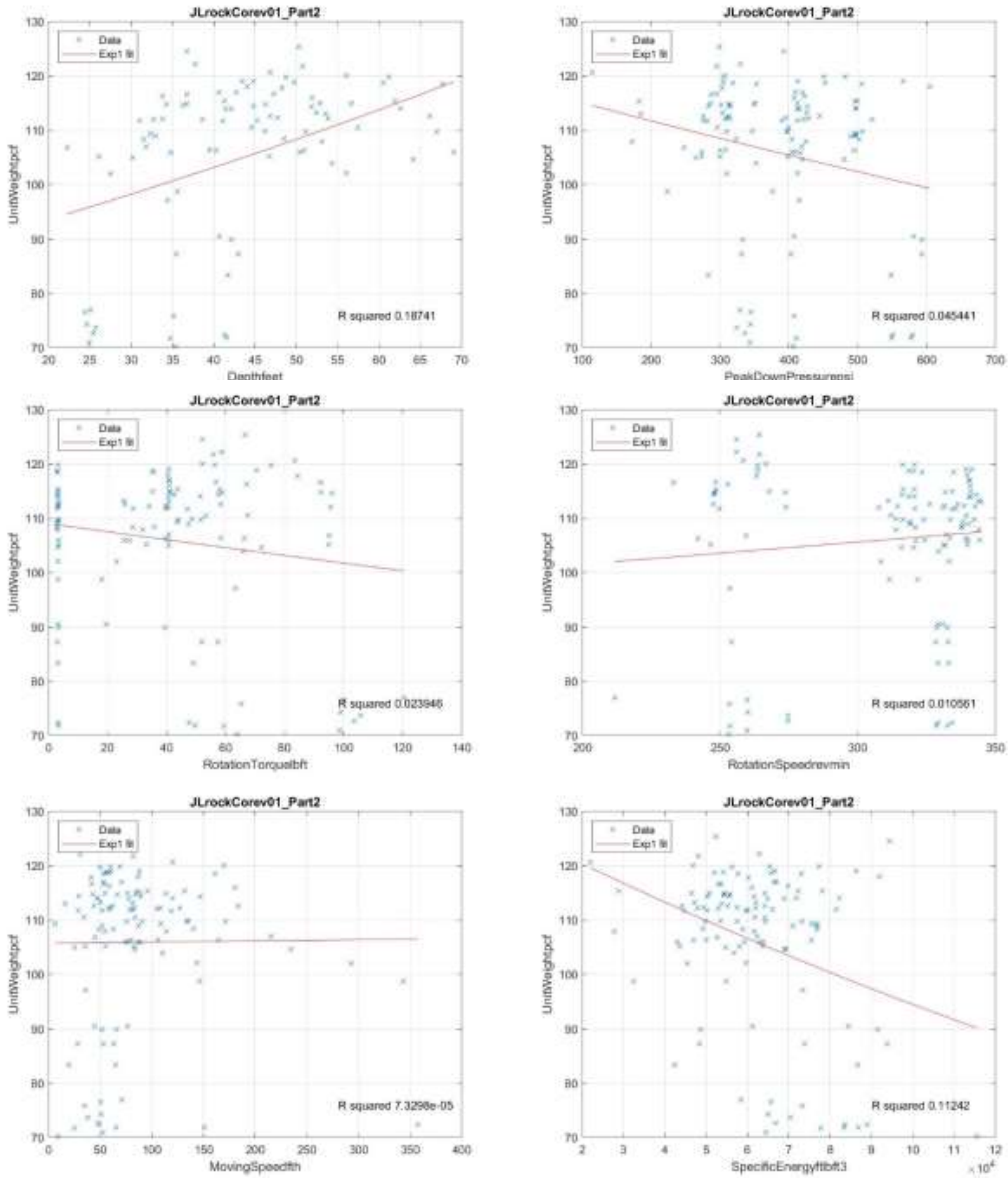


Figure 6. Single parameter exponential regression correlation results for unit weight. MWD parameter used is shown on horizontal axis. R^2 values are tabulated in Table 8.

Table 8. Tabulated R^2 values for single parameter linear and exponential fitting for unit weight.

MWD parameter	Linear R^2	Exponential R^2
Depth	0.19	0.19
Down pressure	0.05	0.05
Rotation torque	0.02	0.02
Rotation speed	0.01	0.01
Moving speed	0.00	0.00
Specific energy	0.17	0.11

3.2. Phase 2: Multiple parameter linear regression modeling

Analysis of correlations using single parameter MWD parameters against SPT blow count, UCS and unit weight yielded correlations with poor predictive power as can be seen by the low Pearson correlation coefficient (R^2) values. Trying to understand the poor results, we speculated that working in IGM's categorized as extremely weak rock (35 to 150 psi) and very weak rock (150 to 725 psi) could be a major contributing factor. Another possibility was the fact that MWD data were collected in the same borehole that sampling was done which could have a possible impact on modifying the materials in situ.

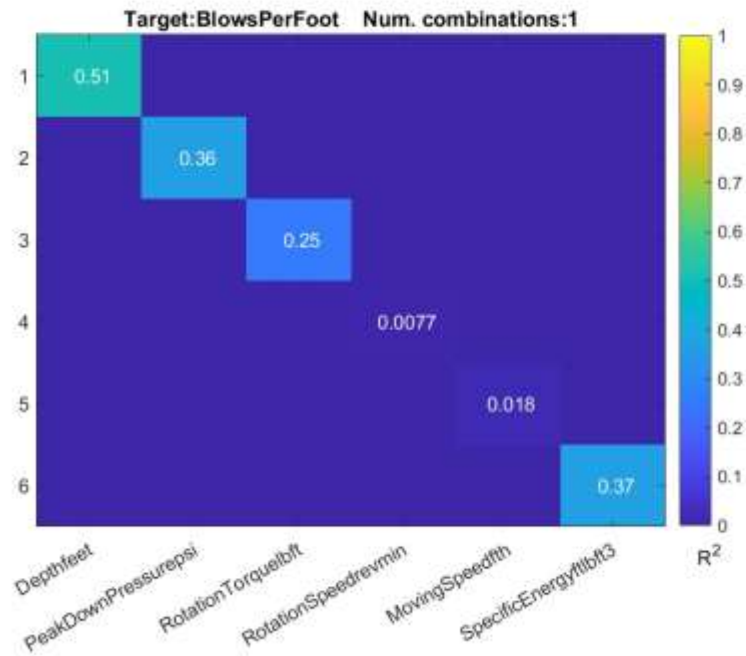
To further investigate *linear* correlation of MWD data and rock strength data, we implemented a multiple linear regression (MLR) approach. We used the same set of six MWD parameters as inputs and investigated correlations of these inputs to SPT blow counts, UCS and unit weight – an approach similar to single parameter linear regression analysis. However, we explored all of the possible input combinations in the analysis. That is, all possible combinations of six inputs using one input, all possible combinations of six inputs using two inputs, etc., up to the combination using all six inputs which resulted in 63 different combinations to test: 6 combinations using 1 input, 15 combinations using 2 inputs, 20 combinations using 3 inputs, 15 combinations using 4 inputs, 6 combinations using 5 inputs and 1 combination using all 6 inputs).

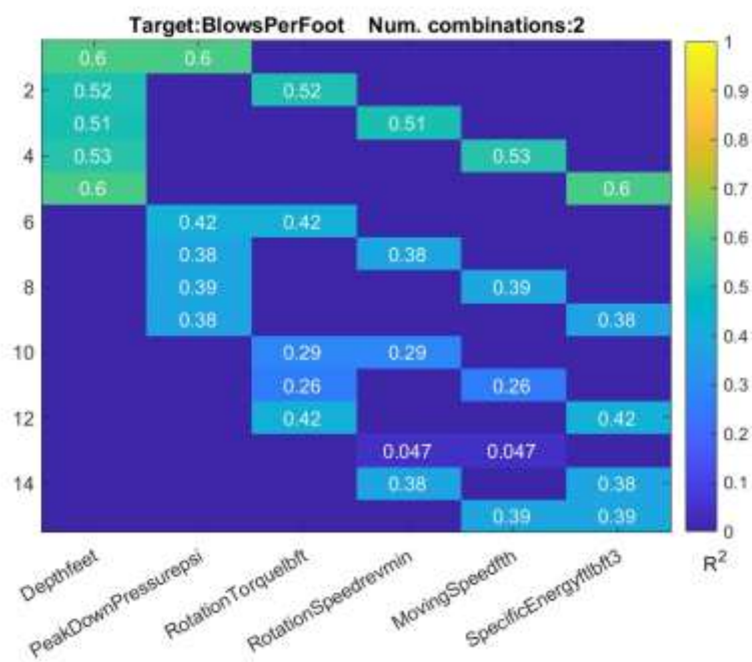
To display our results, we developed a graphical matrix approach. The matrix columns represent each of the possible six MWD inputs. The rows represent the number of possible combinations. The R^2 correlation coefficient for each correlation is displayed in each cell of the horizontal row for a particular combination. In addition to displaying the numerical R^2 value, the cells are color-coded on a scale of 0 to 1 with blue representing low R^2 values and yellow representing high R^2 values. Color-coding makes quick comparisons of various combinations easy for either a specific number of combinations or across various numbers of correlations.

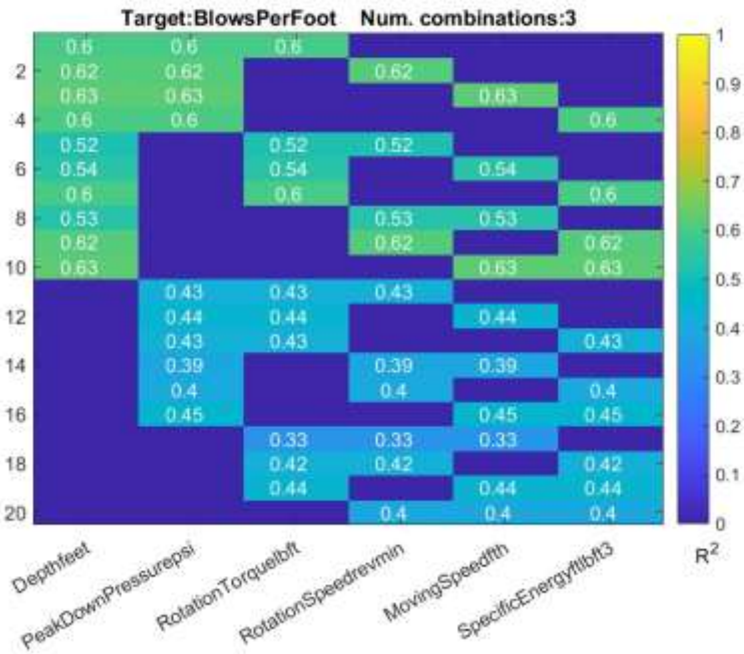
3.2.1. SPT blow count MLR correlations

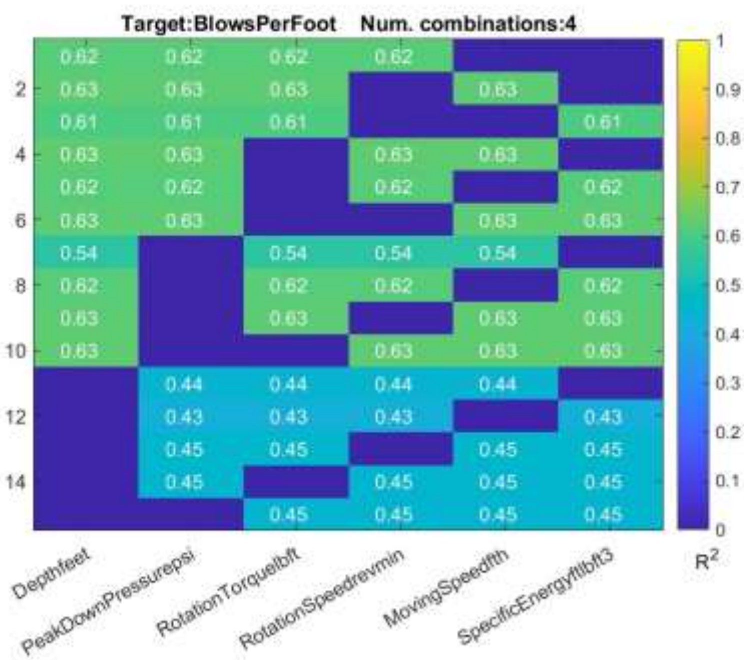
Figure 7 shows six matrix plots representing MLR correlation results for SPT blow counts. The first plot shows R^2 values for one combination of MWD inputs, the second plot shows R^2 results for all possible combinations of two inputs, and so on to the sixth plot which shows only one possible combination of the six MWD inputs.

A text summary of MLR results for SPT blow count prediction is also shown in Appendix A.






Target:BlowsPerFoot Num. combinations:3
0.6 0.6 0.6
0.62 0.62 0.62
0.63 0.63 0.63
0.6 0.6 0.6
0.52 0.52 0.52
0.54 0.54 0.54
0.6 0.6 0.6
0.53 0.53 0.53
0.62 0.62 0.62
0.63 0.63 0.63
0.43 0.43 0.43
0.44 0.44 0.44
0.43 0.43 0.43
0.39 0.39 0.39
0.4 0.4 0.4
0.45 0.45 0.45
0.33 0.33 0.33
0.42 0.42 0.42
0.44 0.44 0.44
0.4 0.4 0.4
2
4
6
8
10
12
14
16
18
20
Depthfeet
PeakDownPressurepsi
RotationTorquelbft
RotationSpeedrevmin
MovingSpeedfth
SpecificEnergyftlbft3
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
R2


Target:BlowsPerFoot Num. combinations:4
0.62 0.62 0.62 0.62
0.63 0.63 0.63 0.63
0.61 0.61 0.61 0.61
0.63 0.63 0.63 0.63
0.62 0.62 0.62 0.62
0.63 0.63 0.63 0.63
0.54 0.54 0.54 0.54
0.62 0.62 0.62 0.62
0.63 0.63 0.63 0.63
0.63 0.63 0.63 0.63
0.44 0.44 0.44 0.44
0.43 0.43 0.43 0.43
0.45 0.45 0.45 0.45
0.45 0.45 0.45 0.45
0.45 0.45 0.45 0.45
2
4
6
8
10
12
14
Depthfeet
PeakDownPressurepsi
RotationTorquelbft
RotationSpeedrevmin
MovingSpeedfth
SpecificEnergyftlbft3
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
R2

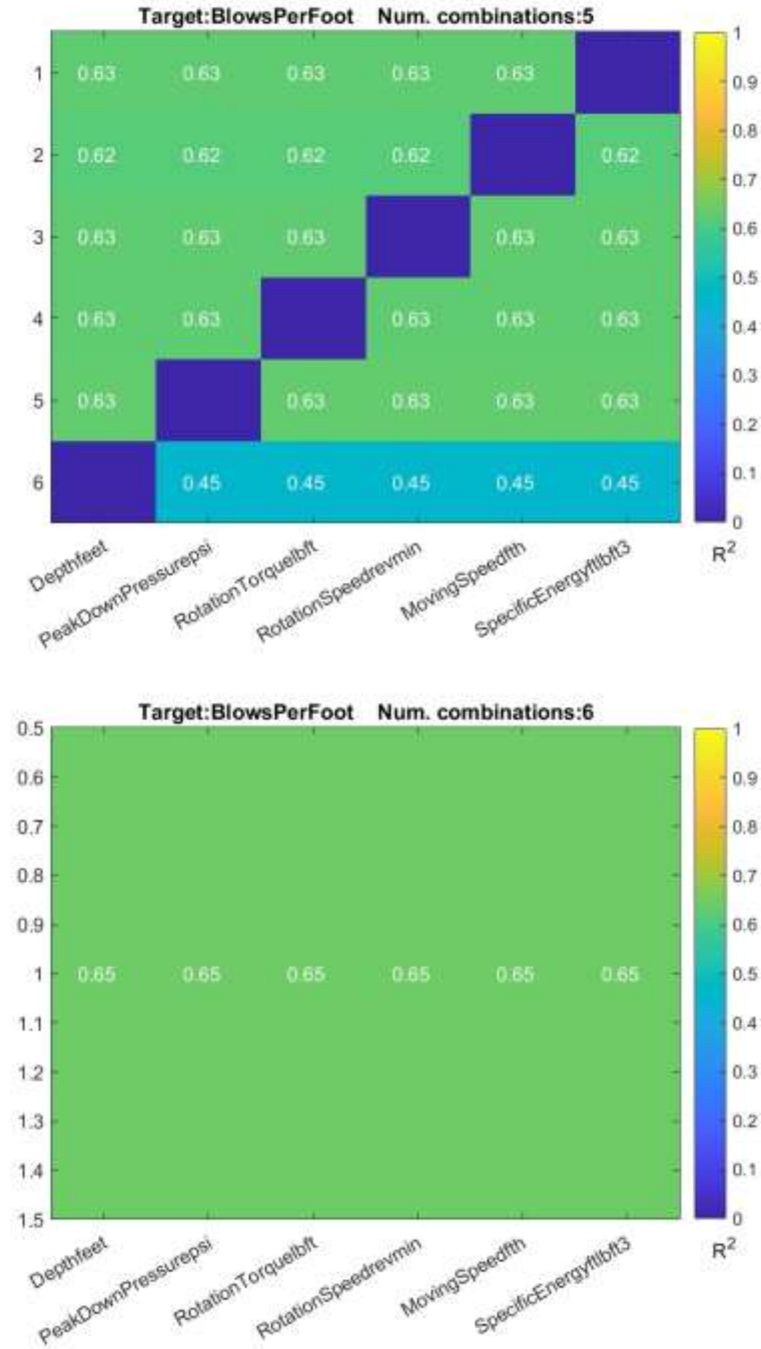
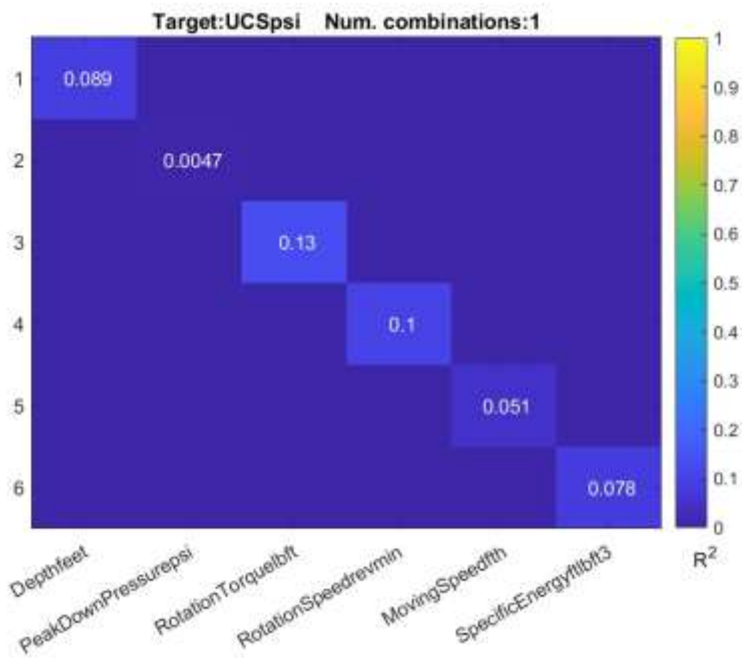


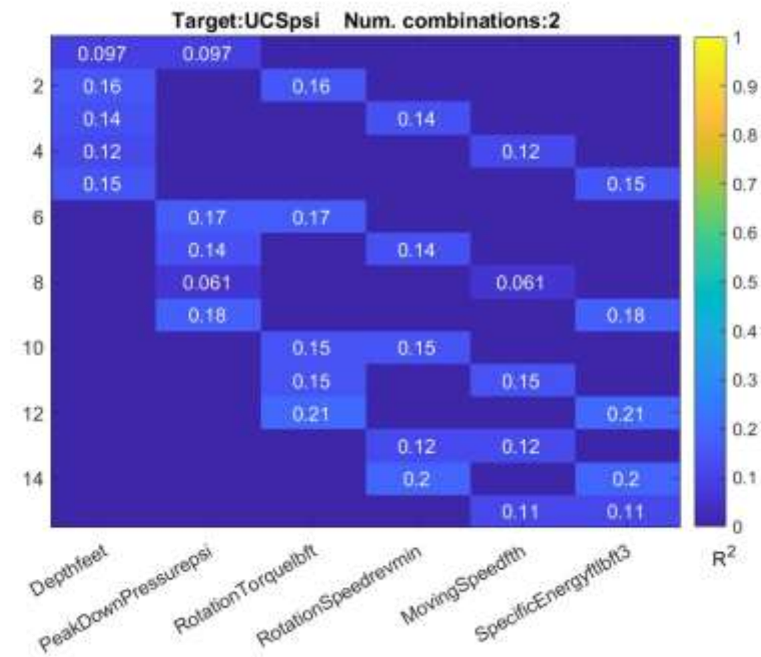
Figure 7. Six matrix plots showing MLR results for the target SPT blow counts. Matrix columns represent the six MWD inputs. Rows show MLR R^2 values in cells representing which of the six MWD inputs were used for the correlation. R^2 values are color-coded from blue to yellow for easy comparison in a single plot or across plots.

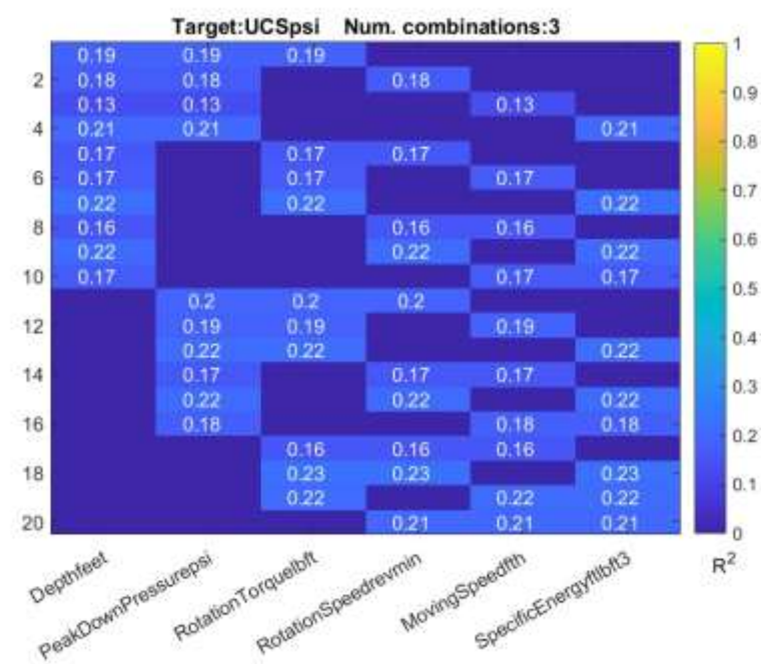
3.2.2. UCS MLR correlations

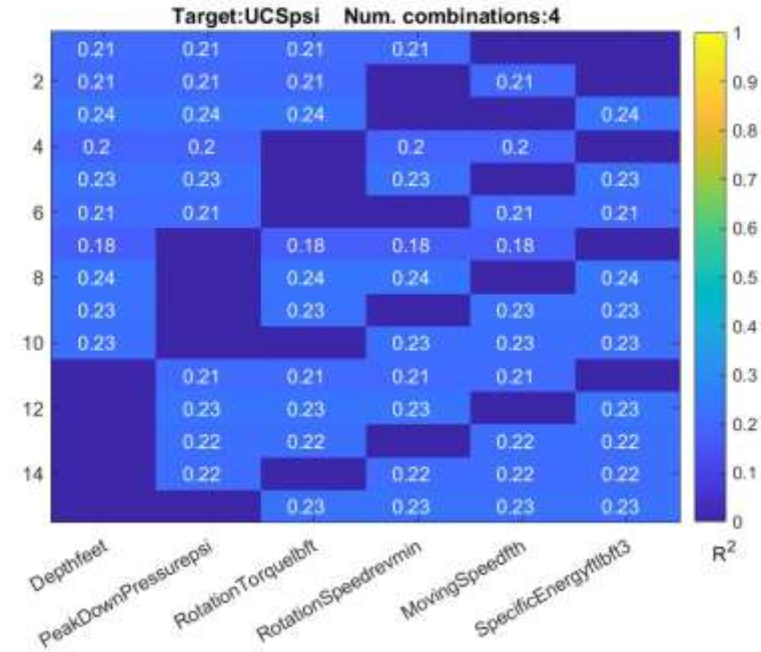
Figure 8 shows the six matrix plots representing MLR correlation results for predicting UCS. Similar to SPT blow count results, the first plot shows R^2 values for one combination of MWD inputs, the second plot shows R^2 results for all possible combinations of two inputs, and so on to the sixth plot which shows only one possible combination of the six MWD inputs.

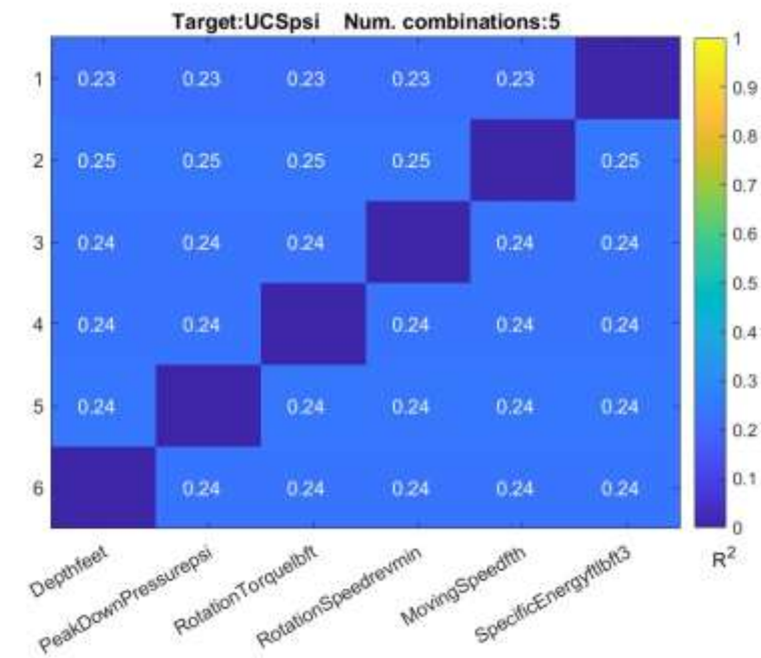
A text summary of MLR results for UCS prediction is shown in Appendix B.




Target:UCSpsi Num. combinations:2
Depthfeet
PeakDownPressurepsi
RotationTorquelbft
RotationSpeedrevmin
MovingSpeedfth
SpecificEnergyftlbft3
R^2


Target:UCSpsi Num. combinations:3
Depthfeet
PeakDownPressurepsi
RotationTorquelbft
RotationSpeedrevmin
MovingSpeedfth
SpecificEnergyftlbft3
R^2


Target:UCSpsi Num. combinations:4
Depthfeet
PeakDownPressurepsi
RotationTorquelbft
RotationSpeedrevmin
MovingSpeedfth
SpecificEnergyftlbft3
R2


Target:UCSpsi Num. combinations:5
Depthfeet
PeakDownPressurepsi
RotationTorquelbft
RotationSpeedrevmin
MovingSpeedfth
SpecificEnergyftlbft3
R2

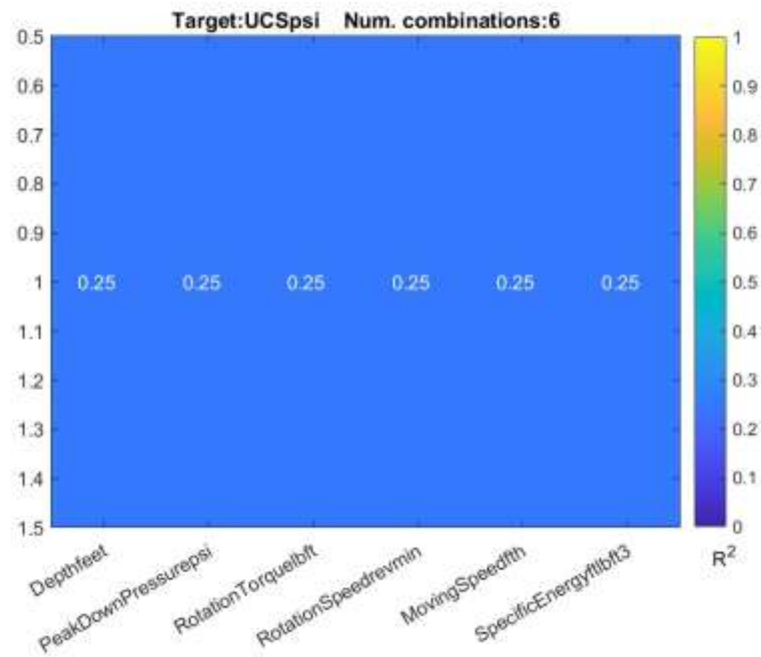
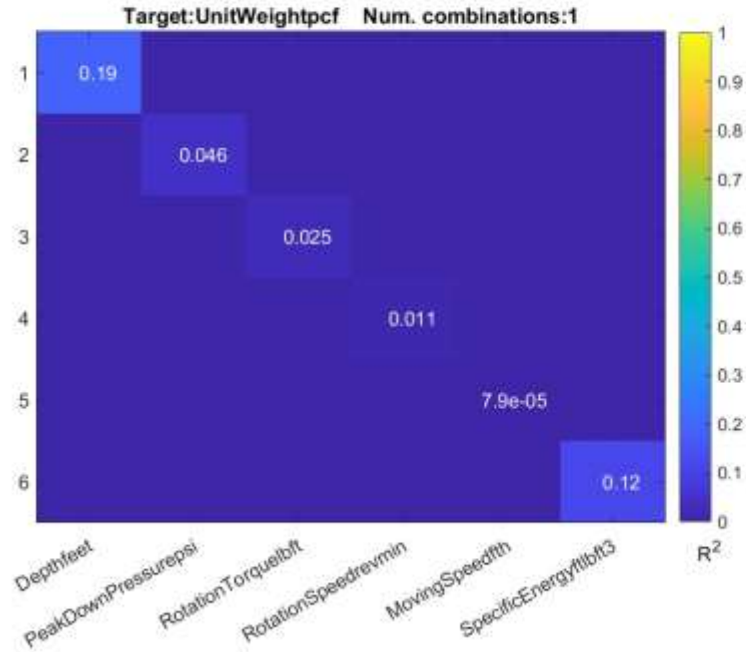


Figure 8. Six matrix plots showing MLR results for the target UCS. Matrix columns represent the six MWD inputs. Rows show MLR R^2 values in cells representing which of the six MWD inputs were used for the correlation. R^2 values are color-coded from blue to yellow for easy comparison in a single plot or across plots.

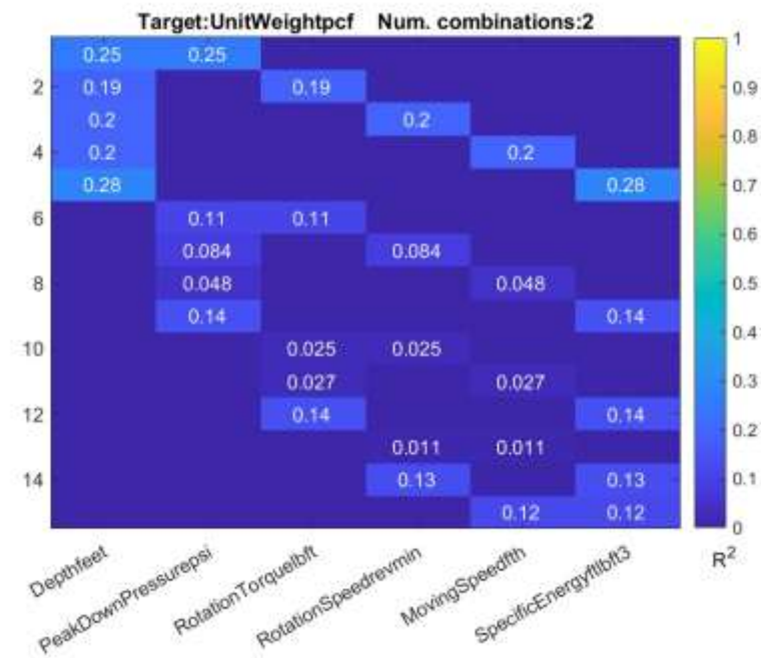
3.2.3. Unit weight MLR correlations

Figure 9 shows the six matrix plots representing MLR correlation results for predicting unit weight. The first plot shows R^2 values for one combination of MWD inputs, the second plot shows R^2 results for all possible combinations of two inputs, and so on to the sixth plot which shows only one possible combination of the six MWD inputs.

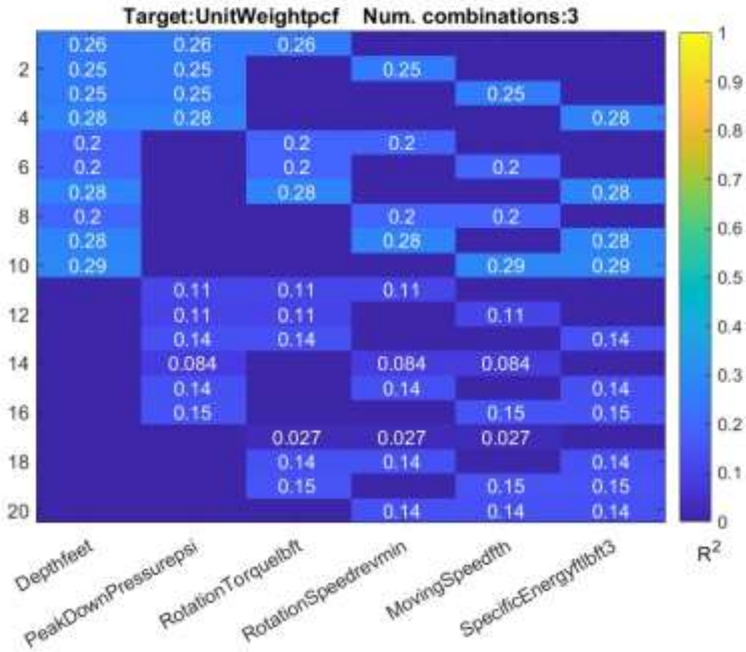
A text summary of MLR results for unit weight prediction is shown in Appendix C.

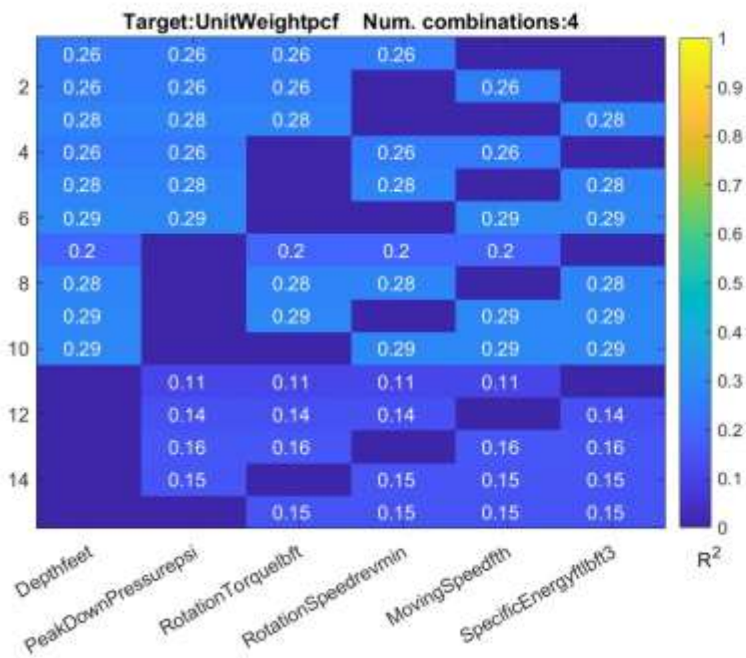


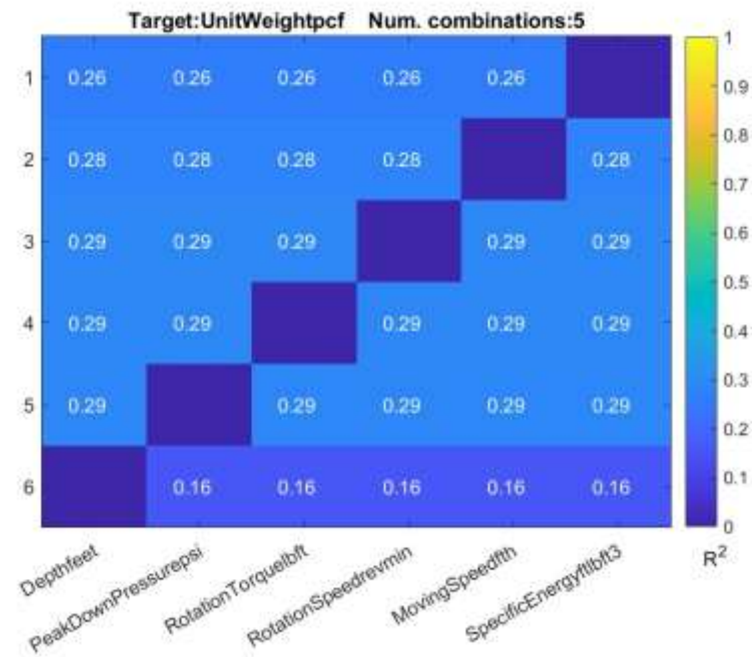
Target:UnitWeightpcf Num. combinations:1
0.19
0.046
0.025
0.011
7.9e-05
0.12
Depthfeet
PeakDownPressurepsi
RotationTorquelbft
RotationSpeedrevmin
MovingSpeedfth
SpecificEnergyftlbft3
R2



Target:UnitWeightpcf Num. combinations:2
Depthfeet
PeakDownPressurepsi
RotationTorquelbft
RotationSpeedrevmin
MovingSpeedfth
SpecificEnergyftlbft3
R2


Target:UnitWeightpcf Num. combinations:3
Depthfeet
PeakDownPressurepsi
RotationTorquelbft
RotationSpeedrevmin
MovingSpeedfth
SpecificEnergyftlbft3
R^2


Target:UnitWeightpcf Num. combinations:4
Depthfeet
PeakDownPressurepsi
RotationTorquelbft
RotationSpeedrevmin
MovingSpeedfth
SpecificEnergyftlbft3
R^2



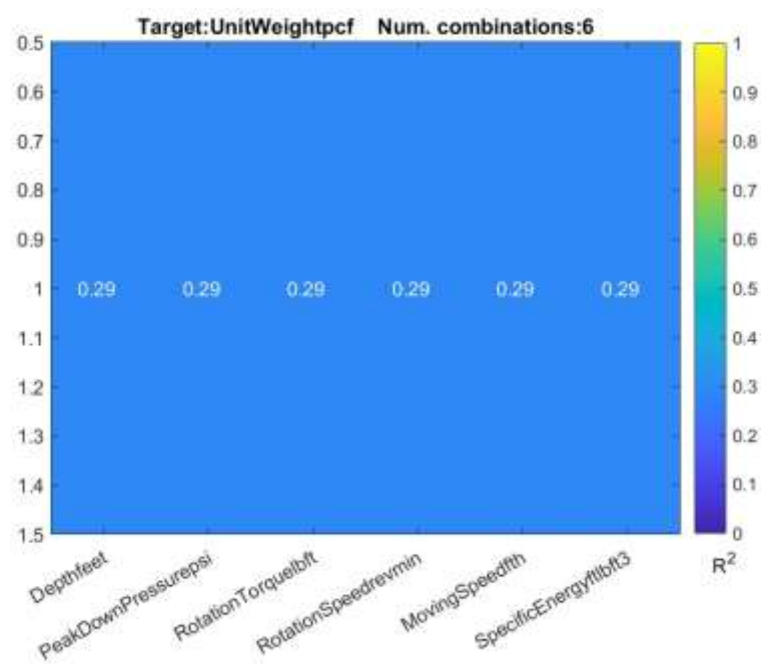


Figure 9. Six matrix plots showing MLR results for the target unit weight. Matrix columns represent the six MWD inputs. Rows show MLR R^2 values in cells representing which of the six MWD inputs were used for the correlation. R^2 values are color-coded from blue to yellow for easy comparison in a single plot or across plots.

3.3. Phase 3: Multiple parameter non-linear regression modeling

Considering the overall weak predictive power of regression modeling as evidenced in the preceding sections, we next implemented a non-linear, neural network (NN) modeling approach. Literature is rich with many references for details of NN modeling. An especially useful reference is Hagan et al. (2014). Neural network modeling was implemented using Matlab® software and toolboxes (https://www.mathworks.com/). The Matlab® scripting environment allowed easy implementation of loops over the number of neurons used in the hidden layer and the number of trials to use for each hidden layer architecture. For our work, we modeled the hidden layer with [2 3 5 7 9 10 11 15 20 25 30] neurons and 100 trials for each hidden layer neuron number. In addition to varying the number of neurons in the hidden layer we used the same set of 63 possible combinations of inputs for each hidden layer setting. This resulted in 693 different NN model architectures to test with 100 iterations for each architecture.

Neural network modeling is a stochastic method. Each individual model is initiated with random initial weights and biases comprising the network (these are adjusted in training to decrease error in an iterative process). In addition, the input data set is divided into training (70%), validation (15%) and testing subsets (15%) which are randomly chosen for each trial. The network is trained using data from the training subset. The validation subset is used to dynamically monitor if error increases instead of decreasing and the independent testing subset is applied after training to test the generalization capability of the trained network. Figure 10 is a schematic illustrating the fitting network architecture we used showing inputs, hidden layer and output layer. Our modeling varied the number of inputs and the number of hidden layer neurons.

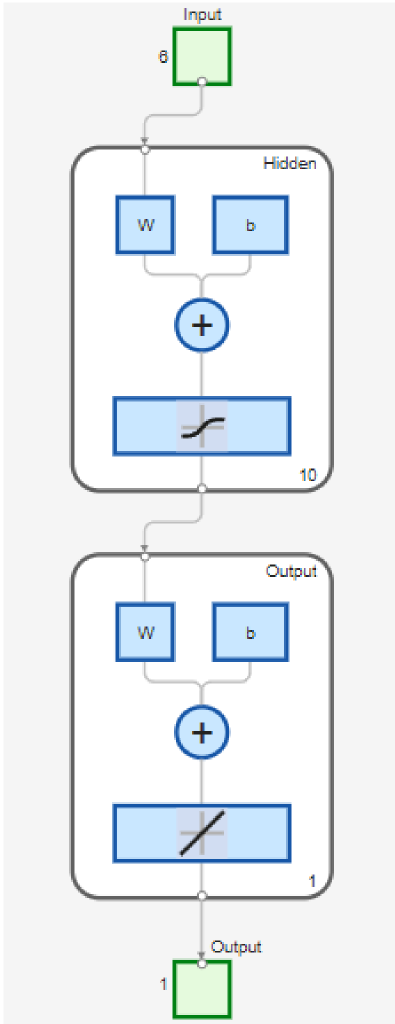


Figure 10. Feedforward fitting neural network schematic used for our analysis. Schematic shows 6 inputs (our inputs vary from 1 to 6), one hidden layer using a tansig transfer function with 10 neurons (our number of neurons varies from 2 to 30) with weights w and biases b and 1 output neuron with a linear transfer function and one weight and bias. The output neuron produced a value for either SPT blow count, UCS or unit weight.

NN modeling used the same set of input data used for correlation analysis: SPT blow count data (n = 64) and UCS and unit weight data (n = 117). To show NN modeling results, we generated plots showing Pearson correlation coefficient R^2 values for the individual training, validation and testing subsets as well as for the entire data set (all). The correlation coefficients were calculated by comparing predicted values from the trained network with the true training, validation and testing targets. Two sets of plots were produced: a plot showing the mean R^2values for 100 trials for each hidden layer number of neurons and a plot showing the best R^2 value out of the 100 trials for each hidden layer number of neurons.

NN modelling results are presented in Appendices D, E and F. Each appendix contains two sets of results (D-1, D-2, E-1, E-2, F-1, F-2). The first appendix subset shows the plots displaying mean R^2 values and best R^2 values for the 100 trials of each NN architecture. Each set (mean, best) comprises 63 scenarios. The number of scenarios results from the total possible number of input combinations: 6 combinations using 1 input, 15 combinations using 2 inputs, 20 combinations using 3 inputs, 15 combinations using 4 inputs, 6 combinations using 5 inputs and 1 combination using all 6 inputs. On each plot, the horizontal axis shows the number of neurons used in the hidden layer for each scenario. Mean R^2 and best R^2 are displayed using four colors: blue for training, green for validation, red for testing and black for all. These plots are useful for quick comparisons of performance of the various NN scenarios.

In addition to the plots, a second appendix subset contains a text listing of the mean R^2 and best R^2 values for each scenario. The full text list is quite large because each of the 63 scenarios models over the number of neurons in the hidden layer (2 3 5 7 9 10 11 15 20 25 30) resulting in 693 sets of mean and best results (63*11). We choose to only show a subset of the 693 results to save space in this report. The full list is used to select the best overall NN model which is then used in the application phase for new data input.

The complete text list along with all of the plots are saved in a folder. Furthermore, each of the NN model architectures for the best R^2 results is also saved to the same folder. This allows the user, after NN training, to review the performance results and choose the saved NN that has the best R^2 performance for a specified number of neurons in the hidden layer from the best combination of the six inputs. This represents the application phase of NN modelling. At this point, the user chooses the desired trained NN model and presents new MWD data resulting in a prediction of either SPT blow counts, UCS or unit weight. The application phase is analogous to having a regression equation and providing a new independent variable to produce the new dependent variable (i.e. present a new ‘x’ to the regression equation to get a new ‘y’).

3.3.1. NN SPT blow count prediction

Prior to beginning NN modelling, we used an F-test to compare the importance of the contribution of each of the six input variables to predicting the desired target. We implemented the F-test using the built-in F-test function in Matlab®.

Figure 11 is a bar plot showing the relative importance of each of the six inputs to predicting SPT blow counts. The F-test calculations are based on comparison of variances of two parameters.

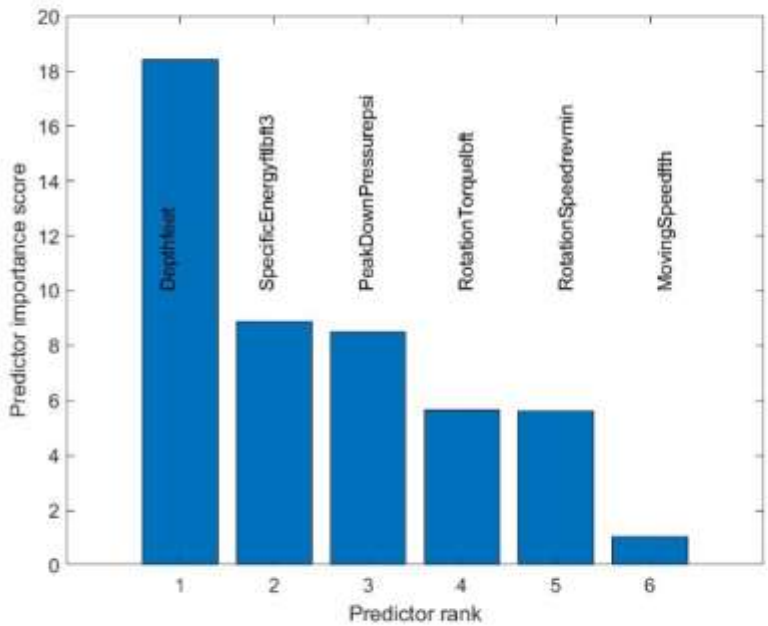


Figure 11. Bar plot showing the relative importance of the six input parameters in predicting SPT blow counts. Each column is labeled with the name of the corresponding input parameter. As can be seen, depth has the greatest relative importance in predicting SPT blow counts; moving speed the least.

Results for NN modelling of SPT blow counts are presented in Appendices D-1 and D-2 as described in section 3.3. Appendix D-1 contains the two sets of 63 network scenario plots (mean R^2 and best R^2 for 100 trials). Appendix D-2 contains a subset of the full text list of the 693 NN scenarios.

3.3.2. NN UCS prediction

Prior to beginning NN modelling for UCS, we used an F-test to compare the importance of the contribution of each of the six input variables to predicting UCS. We implemented the F-test using the built-in F-test function in Matlab®.

Figure 12 is a bar plot showing the relative importance of each of the six inputs to predicting UCS. The F-test calculations are based on comparison of variances of two parameters.

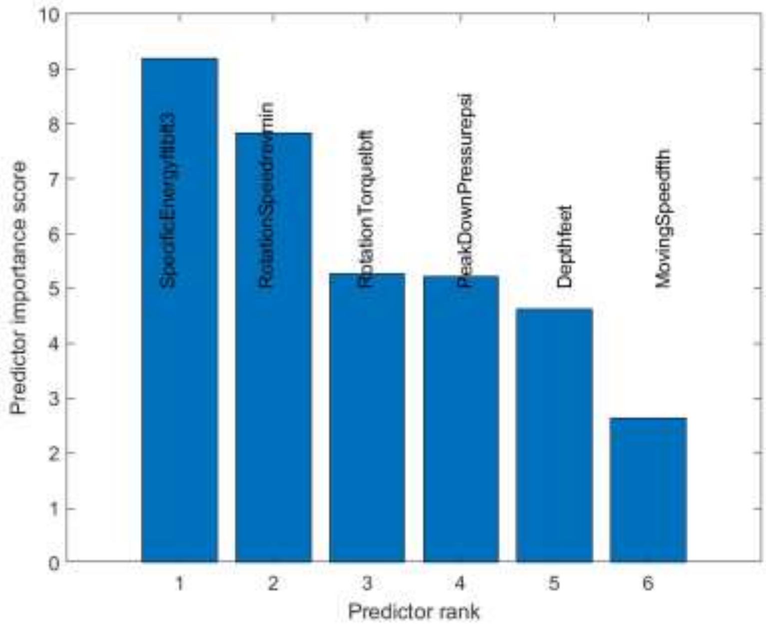


Figure 12. Bar plot showing the relative importance of the six input parameters in predicting UCS. Each column is labeled with the name of the corresponding input parameter. For UCS modelling, specific energy has the greatest relative importance in predicting UCS; moving speed the least.

Results for NN modelling of UCS are presented in Appendices E-1 and E-2 as described in section 3.3. Appendix E-1 contains the two sets of 63 network scenario plots (mean R^2 and best R^2 for 100 trials). Appendix E-2 contains a subset of the full text list of the 693 NN scenarios.

3.3.3. NN unit weight prediction

Prior to beginning NN modelling for unit weight, we used an F-test to compare the importance of the contribution of each of the six input variables to predicting unit weight. We implemented the F-test using the built-in F-test function in Matlab®.

Figure 13 is a bar plot showing the relative importance of each of the six inputs to predicting unit weight. The F-test calculations are based on comparison of variances of two parameters.

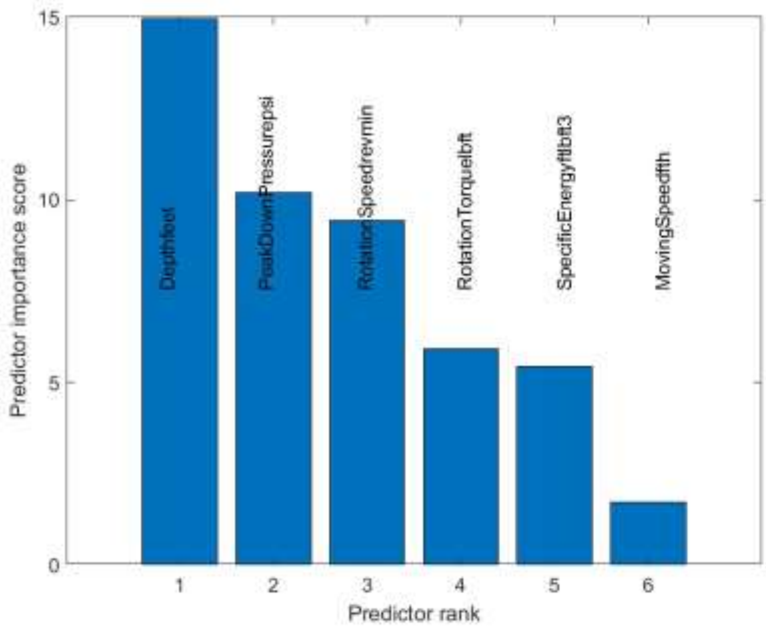


Figure 13. Bar plot showing the relative importance of the six input parameters in predicting unit weight. Each column is labeled with the name of the corresponding input parameter. For unit weight modelling, depth has the greatest relative importance in predicting unit weight; moving speed the least.

4. Discussion

4.1. Data subsets

As stated in the proposal and contract, the focus of Task 2 was investigation of correlations between MWD measurements and geotechnical parameters of interest. After assembling and organizing MWD data and geotechnical data, initial investigation explored linear correlations of the two data types. It quickly became apparent that the streams of recorded MWD data required significant user input for data quality control. Specifically, for exploring correlations of MWD and SPT blow counts, it was necessary to extract a small subset of values from the recorded data stream. As detailed in the Task 1 report, the down pressure data stream recorded sharp drops in measured pressure when auger changes happened. Our approach was to identify the pressure values before the sharp drops and use those pressures and corresponding MWD measurements for SPT blow count correlations.

Similarly, for UCS and unit weight correlations, we identified the MWD values associated with the UCS and unit weight lab values at those depths and used that data set for correlation analysis. In addition, we evaluated the lab measurement values for unrealistic values.

After inspection of MWD data, we ended up with a data set for SPT blow count correlations of 64 examples. For UCS and unit weight correlations, we used 117 data examples. These data sets are described in section 2 of this report.

For correlation analysis we used six inputs from MWD measurements: depth, down pressure, rotation torque, rotation speed, moving speed and the compound parameter specific energy.

4.2. Single parameter linear correlations – phase 1

Correlation results for single parameter linear correlation are detailed in section 3.1 in this report. We used the Pearson correlation coefficient (R^2) to quantify goodness of fit. The single best R^2 value was 0.49 for depth and SPT blow counts. Tables in section 3.1 summarize the results. Figures in section 3.1 show plots with the linear regression fit lines overlain on the data used. Correlation results for UCS and unit weight were very low. Obviously this approach was not going to be of use for any prediction analysis.

4.3. Evaluating the relative importance of inputs

An F-test was used to evaluate the relative importance of the six individual inputs to predict each of the three targets: SPT blow counts, UCS and unit weight. The results of the F-tests are presented at the beginning of sections 3.3.1, 3.3.2 and 3.3.3. Interestingly, depth is an important predictive variable for both SPT blow count and unit weight predictions.

Although the F-test provides a useful tool for evaluating the relative importance of inputs in modelling, a more comprehensive insight is obtained by reviewing results from both MLR and NN modelling. For MLR, results are shown as matrix values in graphical form and as a text listing in Appendices A, B and C. Each row in the plots or text listing represents a single combination of inputs. The highlighted cells on the plots are populated with the MLR correlation coefficient for those particular inputs. These values can be viewed as giving the importance of that combination of inputs.

For NN modelling, we can look at either the plots of modelling results, or the text listings. These are shown in Appendices D, E and F. The text listing shows the four correlation coefficients (training, validation, testing and all) for each of the 63 combinations as well as varying that over the number of neurons in the hidden layer resulting in 693separate sets of results.

4.4. Multiple parameter linear correlations – phase 2

Considering the poor correlation results for single parameter linear correlation, we implemented a multiple parameter linear approach. Details are discussed in section 3.2 of this report. Continuing with the six MWD inputs, we calculated all of the possible combinations of those inputs resulting in 63 possible sets of inputs. We calculated the multiple linear regressions (MLR) for those inputs for the same geotechnical parameters: SPT blow counts, UCS and unit weight. MLR results are detailed in section 3.2 and shown in Appendices A, B and C.

The appendices show the results in text form; figures in section 3.2 show the result in graphic form. As the number of inputs increased, MLR R^2 values also increased. The highest R^2 value of 0.65 occurred for correlating SPT blow counts with all six possible inputs. Best correlation values for UCS and unit weight also occurred with all six inputs but were low at 0.25 for UCS and 0.29 for unit weight.

MLR results showed a significant improvement over single parameter linear results likely indicating that we are dealing with a multiparameter process; not surprizing considering complicated geologic conditions.

4.5. Multiple parameter nonlinear correlations – phase 3

In light of the correlation improvements with MLR, we next implemented a nonlinear, multiple parameter approach in the context of machine learning (ML). There are a variety of ML techniques to explore including classification and clustering. Methods can be broadly grouped as supervised or unsupervised. Unsupervised approaches explore data sets to identify groupings without user intervention. Supervised approaches require known *targets* to train to. Both techniques are iterative methods and begin with a starting model guess or estimation.

We chose to use a supervised neural network (NN) approach because we are correlating inputs with known geotechnical parameters (targets). Also, in the framework of exploring models, we can implement multiple models in a programming framework that does not require user intervention for individual models. We used Matlab®'s Statistics and Machine Learning Toolbox to implement the modelling.

We used the same sets of 63 possible combinations of inputs we used for MLR for NN modelling. Additional variables in NN modelling are the number of hidden layers and the number of neurons in each hidden layer. We used a single hidden layer with number of neurons varying from 2 3 5 7 9 10 11 15 20 25 30 (11 possibilities). This results in 693 modeling scenarios. For each of these scenarios, we used 100 trials. For each trial, we recorded the best trial based on regression results as well as the mean regression results. Section 3.3 details results for predictions of SPT blow counts, UCS and unit weight. Results are presented in Appendices D, E and F as plots and in Appendices G, H and I in text format.

Results for nonlinear NN modeling showed large improvements in predictive ability. Compared to best case R^2 values of 0.65. 0.25 and 0.29 for MLR, we see correlation results in the 0.9 or higher range for SPT blow counts and 0.8 to 0.9 range for UCS and unit weight.

4.6. Final models

4.6.1. Phase 1 final models – single parameter linear/exponential regression

The best result for traditional, linear correlation for SPT blow counts is 0.51 R^2 for using the input of measured depth.

The best result for traditional correlation for UCS is 0.18 R^2 using an exponential fit and input of rotational torque.

The best result for traditional correlation for unit weight is 0.19 R^2 using either a linear or exponential fit and the input of measured depth.

4.6.2. Phase 2 final models – multiple parameter linear regression

The best result for multiple linear regression for SPT blow counts is 0.65 R^2 using all six MWD inputs.

The best result for multiple linear regression for UCS is 0.25 R^2 using all six MWD inputs or the combination of depth, down pressure, rotation torque, rotation speed and specific energy.

The best result for multiple linear regression for unit weight is 0.29 R^2 using all six MWD inputs, or depth, moving speed, specific energy, or depth, down pressure, moving speed, specific energy, or depth, rotation torque, moving speed, specific energy, or depth, rotation speed, moving speed, specific energy, or almost any of the combinations of five inputs which use depth.

4.6.3. Phase 3 final models – nonlinear fitting using neural networks

The best result for neural network fitting for SPT blow counts was a model using inputs depth, rotation speed, moving speed and specific energy. The sum of R^2 values for training, validation, testing and all was 3.79/4.0 using 15 neurons in the hidden layer.

The best result for neural network fitting for UCS was a model using inputs down pressure, rotation torque and specific energy. The sum of R^2 values for training, validation, testing and all was 3.52/4.0 using 10 neurons in the hidden layer.

The best result for neural network fitting for unit weight was a model using inputs depth, rotation torque, rotation speed and specific energy. The sum of R^2 values for training, validation, testing and all was 3.71/4.0 using 10 neurons in the hidden layer.

4.7. Looking ahead

MWD is a relatively new approach for answering relevant questions about subsurface parameters. MWD technology and standards are evolving as we speak. Developing robust recording technology on the drill rig is not a trivial challenge. Revisiting drilling methodology and training MWD drillers will be critical to achieving high data quality. As the technology is applied in new geologic settings, new analysis techniques will need to be evaluated.

The takeaways from the current MDT project highlight drilling methodology for consistent, usable data and analysis techniques to explore nonlinear relationships among MWD parameters and geotechnical parameters.

Suggestions for future MWD projects are to consider a separate borehole for the sole purpose of collecting MWD data alongside of a borehole used for HSA sampling and rock coring and focused training for MWD drillers with input from other MWD practitioners. Such training would include how drilling methodology affects final MWD data quality and how these data are used for analysis, basically having the drillers get *'some skin in the game'*.

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Appendices

Appendix A – MLR SPT blows per foot

------- MLR ---------

---> Target = BlowsPerFoot

---- Number of combinations = 1

Depthfeet R squared = 0.50963
PeakDownPressurepsi R squared = 0.36366
RotationTorquelbft R squared = 0.25189
RotationSpeedrevmin R squared = 0.0077129
MovingSpeedfth R squared = 0.017877
SpecificEnergyftlbft3 R squared = 0.36605

---- Number of combinations = 2

Depthfeet PeakDownPressurepsi R squared = 0.60025
Depthfeet RotationTorquelbft R squared = 0.51796
Depthfeet RotationSpeedrevmin R squared = 0.51058
Depthfeet MovingSpeedfth R squared = 0.53243
Depthfeet SpecificEnergyftlbft3 R squared = 0.59937
PeakDownPressurepsi RotationTorquelbft R squared = 0.42455
PeakDownPressurepsi RotationSpeedrevmin R squared = 0.37985
PeakDownPressurepsi MovingSpeedfth R squared = 0.38953
PeakDownPressurepsi SpecificEnergyftlbft3 R squared = 0.37529
RotationTorquelbft RotationSpeedrevmin R squared = 0.28888
RotationTorquelbft MovingSpeedfth R squared = 0.26066
RotationTorquelbft SpecificEnergyftlbft3 R squared = 0.42397
RotationSpeedrevmin MovingSpeedfth R squared = 0.046513
RotationSpeedrevmin SpecificEnergyftlbft3 R squared = 0.38316
MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.39421

---- Number of combinations = 3

Depthfeet PeakDownPressurepsi RotationTorquelbft R squared = 0.60039
Depthfeet PeakDownPressurepsi RotationSpeedrevmin R squared = 0.6169
Depthfeet PeakDownPressurepsi MovingSpeedfth R squared = 0.62666
Depthfeet PeakDownPressurepsi SpecificEnergyftlbft3 R squared = 0.60485
Depthfeet RotationTorquelbft RotationSpeedrevmin R squared = 0.51798
Depthfeet RotationTorquelbft MovingSpeedfth R squared = 0.53789
Depthfeet RotationTorquelbft SpecificEnergyftlbft3 R squared = 0.59945
Depthfeet RotationSpeedrevmin MovingSpeedfth R squared = 0.53443
Depthfeet RotationSpeedrevmin SpecificEnergyftlbft3 R squared = 0.61634
Depthfeet MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.62705
PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin R squared = 0.42501

PeakDownPressurepsi RotationTorquelbft MovingSpeedfth R squared = 0.44232
PeakDownPressurepsi RotationTorquelbft SpecificEnergyftlbft3 R squared = 0.42569
PeakDownPressurepsi RotationSpeedrevmin MovingSpeedfth R squared = 0.39281
PeakDownPressurepsi RotationSpeedrevmin SpecificEnergyftlbft3 R squared = 0.39965
PeakDownPressurepsi MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.45037
RotationTorquelbft RotationSpeedrevmin MovingSpeedfth R squared = 0.33081
RotationTorquelbft RotationSpeedrevmin SpecificEnergyftlbft3 R squared = 0.42464
RotationTorquelbft MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.4434
RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.39758

---- Number of combinations = 4
Depthfeet PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin R squared = 0.62068
Depthfeet PeakDownPressurepsi RotationTorquelbft MovingSpeedfth R squared = 0.62676
Depthfeet PeakDownPressurepsi RotationTorquelbft SpecificEnergyftlbft3 R squared = 0.60725
Depthfeet PeakDownPressurepsi RotationSpeedrevmin MovingSpeedfth R squared = 0.63007
Depthfeet PeakDownPressurepsi RotationSpeedrevmin SpecificEnergyftlbft3 R squared = 0.61831
Depthfeet PeakDownPressurepsi MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.62837
Depthfeet RotationTorquelbft RotationSpeedrevmin MovingSpeedfth R squared = 0.54391
Depthfeet RotationTorquelbft RotationSpeedrevmin SpecificEnergyftlbft3 R squared = 0.62073
Depthfeet RotationTorquelbft MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.62724
Depthfeet RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.63044
PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin MovingSpeedfth R squared = 0.44467
PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin SpecificEnergyftlbft3 R squared = 0.42569
PeakDownPressurepsi RotationTorquelbft MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.45449
PeakDownPressurepsi RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.45203
RotationTorquelbft RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.44547

---- Number of combinations = 5
Depthfeet PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin MovingSpeedfth R squared = 0.63216
Depthfeet PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin SpecificEnergyftlbft3 R squared = 0.62074
Depthfeet PeakDownPressurepsi RotationTorquelbft MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.63139
Depthfeet PeakDownPressurepsi RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.63144
Depthfeet RotationTorquelbft RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.63298
PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.45449

---- Number of combinations = 6
Depthfeet PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.64512

Appendix B – MLR UCS

------- MLR ---------

---> Target = UCSpsi

---- Number of combinations = 1
Depthfeet R squared = 0.088592
PeakDownPressurepsi R squared = 0.0046785
RotationTorquelbft R squared = 0.13225
RotationSpeedrevmin R squared = 0.10315
MovingSpeedfth R squared = 0.050543
SpecificEnergyftlbft3 R squared = 0.07835

---- Number of combinations = 2
Depthfeet PeakDownPressurepsi R squared = 0.096613
Depthfeet RotationTorquelbft R squared = 0.15775
Depthfeet RotationSpeedrevmin R squared = 0.14069
Depthfeet MovingSpeedfth R squared = 0.12097
Depthfeet SpecificEnergyftlbft3 R squared = 0.14908
PeakDownPressurepsi RotationTorquelbft R squared = 0.17245
PeakDownPressurepsi RotationSpeedrevmin R squared = 0.14307
PeakDownPressurepsi MovingSpeedfth R squared = 0.060659
PeakDownPressurepsi SpecificEnergyftlbft3 R squared = 0.1816
RotationTorquelbft RotationSpeedrevmin R squared = 0.14531
RotationTorquelbft MovingSpeedfth R squared = 0.14708
RotationTorquelbft SpecificEnergyftlbft3 R squared = 0.20815
RotationSpeedrevmin MovingSpeedfth R squared = 0.12432
RotationSpeedrevmin SpecificEnergyftlbft3 R squared = 0.19532
MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.1146

---- Number of combinations = 3
Depthfeet PeakDownPressurepsi RotationTorquelbft R squared = 0.19317
Depthfeet PeakDownPressurepsi RotationSpeedrevmin R squared = 0.17533
Depthfeet PeakDownPressurepsi MovingSpeedfth R squared = 0.13392
Depthfeet PeakDownPressurepsi SpecificEnergyftlbft3 R squared = 0.21037
Depthfeet RotationTorquelbft RotationSpeedrevmin R squared = 0.16644
Depthfeet RotationTorquelbft MovingSpeedfth R squared = 0.17115
Depthfeet RotationTorquelbft SpecificEnergyftlbft3 R squared = 0.22397
Depthfeet RotationSpeedrevmin MovingSpeedfth R squared = 0.1582
Depthfeet RotationSpeedrevmin SpecificEnergyftlbft3 R squared = 0.21717
Depthfeet MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.17261
PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin R squared = 0.19811
PeakDownPressurepsi RotationTorquelbft MovingSpeedfth R squared = 0.18953
PeakDownPressurepsi RotationTorquelbft SpecificEnergyftlbft3 R squared = 0.22136

PeakDownPressurepsi RotationSpeedrevmin MovingSpeedfth   R squared = 0.16713
PeakDownPressurepsi RotationSpeedrevmin SpecificEnergyftlbft3   R squared = 0.21806
PeakDownPressurepsi MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.18346
RotationTorquelbft RotationSpeedrevmin MovingSpeedfth   R squared = 0.15767
RotationTorquelbft RotationSpeedrevmin SpecificEnergyftlbft3   R squared = 0.22874
RotationTorquelbft MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.21562
RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.20536

---- Number of combinations = 4
Depthfeet PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin   R squared = 0.21255
Depthfeet PeakDownPressurepsi RotationTorquelbft MovingSpeedfth   R squared = 0.20875
Depthfeet PeakDownPressurepsi RotationTorquelbft SpecificEnergyftlbft3   R squared = 0.23503
Depthfeet PeakDownPressurepsi RotationSpeedrevmin MovingSpeedfth   R squared = 0.1956
Depthfeet PeakDownPressurepsi RotationSpeedrevmin SpecificEnergyftlbft3   R squared = 0.23422
Depthfeet PeakDownPressurepsi MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.21242
Depthfeet RotationTorquelbft RotationSpeedrevmin MovingSpeedfth   R squared = 0.17801
Depthfeet RotationTorquelbft RotationSpeedrevmin SpecificEnergyftlbft3   R squared = 0.2398
Depthfeet RotationTorquelbft MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.23098
Depthfeet RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.22589
PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin MovingSpeedfth   R squared = 0.21175
PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin SpecificEnergyftlbft3   R squared = 0.23483
PeakDownPressurepsi RotationTorquelbft MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.22344
PeakDownPressurepsi RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.21992
RotationTorquelbft RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.23374

---- Number of combinations = 5
Depthfeet PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin MovingSpeedfth   R squared = 0.22542
Depthfeet PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin SpecificEnergyftlbft3   R squared = 0.24526
Depthfeet PeakDownPressurepsi RotationTorquelbft MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.23722
Depthfeet PeakDownPressurepsi RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.23624
Depthfeet RotationTorquelbft RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.24473
PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.23686

---- Number of combinations = 6
Depthfeet PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.24738

Appendix C – MLR – unit weight

------- MLR ---------

---> Target = UnitWeightpcf

---- Number of combinations = 1
Depthfeet R squared = 0.19272
PeakDownPressurepsi R squared = 0.046071
RotationTorquelbft R squared = 0.025197
RotationSpeedrevmin R squared = 0.010595
MovingSpeedfth R squared = 7.9056e-05
SpecificEnergyftlbft3 R squared = 0.11669

---- Number of combinations = 2
Depthfeet PeakDownPressurepsi R squared = 0.2533
Depthfeet RotationTorquelbft R squared = 0.19352
Depthfeet RotationSpeedrevmin R squared = 0.19652
Depthfeet MovingSpeedfth R squared = 0.1965
Depthfeet SpecificEnergyftlbft3 R squared = 0.27739
PeakDownPressurepsi RotationTorquelbft R squared = 0.10551
PeakDownPressurepsi RotationSpeedrevmin R squared = 0.084097
PeakDownPressurepsi MovingSpeedfth R squared = 0.047597
PeakDownPressurepsi SpecificEnergyftlbft3 R squared = 0.13725
RotationTorquelbft RotationSpeedrevmin R squared = 0.025198
RotationTorquelbft MovingSpeedfth R squared = 0.026826
RotationTorquelbft SpecificEnergyftlbft3 R squared = 0.14058
RotationSpeedrevmin MovingSpeedfth R squared = 0.01095
RotationSpeedrevmin SpecificEnergyftlbft3 R squared = 0.13298
MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.11794

---- Number of combinations = 3
Depthfeet PeakDownPressurepsi RotationTorquelbft R squared = 0.25658
Depthfeet PeakDownPressurepsi RotationSpeedrevmin R squared = 0.25424
Depthfeet PeakDownPressurepsi MovingSpeedfth R squared = 0.25419
Depthfeet PeakDownPressurepsi SpecificEnergyftlbft3 R squared = 0.27754
Depthfeet RotationTorquelbft RotationSpeedrevmin R squared = 0.1966
Depthfeet RotationTorquelbft MovingSpeedfth R squared = 0.19666
Depthfeet RotationTorquelbft SpecificEnergyftlbft3 R squared = 0.27765
Depthfeet RotationSpeedrevmin MovingSpeedfth R squared = 0.19891
Depthfeet RotationSpeedrevmin SpecificEnergyftlbft3 R squared = 0.27805
Depthfeet MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.28634
PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin R squared = 0.10942

PeakDownPressurepsi RotationTorquelbft MovingSpeedfth   R squared = 0.10629
PeakDownPressurepsi RotationTorquelbft SpecificEnergyftlbft3   R squared = 0.14379
PeakDownPressurepsi RotationSpeedrevmin MovingSpeedfth   R squared = 0.084133
PeakDownPressurepsi RotationSpeedrevmin SpecificEnergyftlbft3   R squared = 0.14022
PeakDownPressurepsi MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.15104
RotationTorquelbft RotationSpeedrevmin MovingSpeedfth   R squared = 0.026853
RotationTorquelbft RotationSpeedrevmin SpecificEnergyftlbft3   R squared = 0.14192
RotationTorquelbft MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.14791
RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.13835

---- Number of combinations = 4
Depthfeet PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin   R squared = 0.25658
Depthfeet PeakDownPressurepsi RotationTorquelbft MovingSpeedfth   R squared = 0.25853
Depthfeet PeakDownPressurepsi RotationTorquelbft SpecificEnergyftlbft3   R squared = 0.27837
Depthfeet PeakDownPressurepsi RotationSpeedrevmin MovingSpeedfth   R squared = 0.25556
Depthfeet PeakDownPressurepsi RotationSpeedrevmin SpecificEnergyftlbft3   R squared = 0.27893
Depthfeet PeakDownPressurepsi MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.2902
Depthfeet RotationTorquelbft RotationSpeedrevmin MovingSpeedfth   R squared = 0.19921
Depthfeet RotationTorquelbft RotationSpeedrevmin SpecificEnergyftlbft3   R squared = 0.27805
Depthfeet RotationTorquelbft MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.28643
Depthfeet RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.28635
PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin MovingSpeedfth   R squared = 0.11055
PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin SpecificEnergyftlbft3   R squared = 0.14425
PeakDownPressurepsi RotationTorquelbft MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.15734
PeakDownPressurepsi RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.154
RotationTorquelbft RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.15007

---- Number of combinations = 5
Depthfeet PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin MovingSpeedfth   R squared = 0.25855
Depthfeet PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin SpecificEnergyftlbft3   R squared = 0.27917
Depthfeet PeakDownPressurepsi RotationTorquelbft MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.29108
Depthfeet PeakDownPressurepsi RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.29157
Depthfeet RotationTorquelbft RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.28653
PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3   R squared = 0.15784

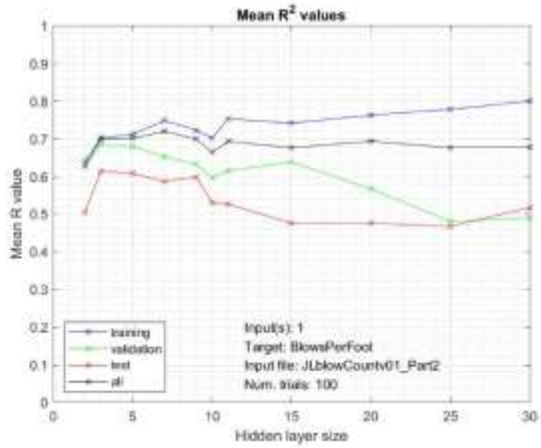
---- Number of combinations = 6
Depthfeet PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3 R squared = 0.29184

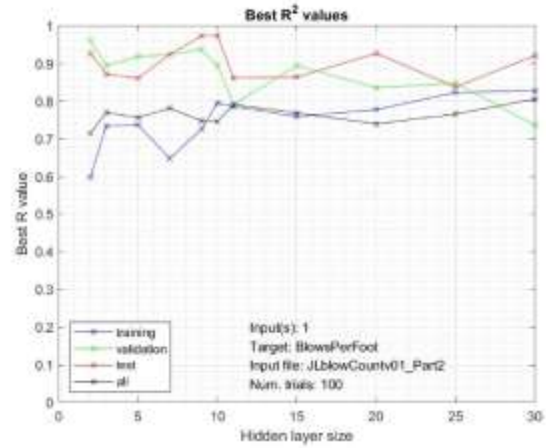
Appendix D – NN modeling for SPT blow count: mean R^2 and best R^2 from 100 iterations, hidden layer size 2 to 30, 63 combinations of 6 inputs

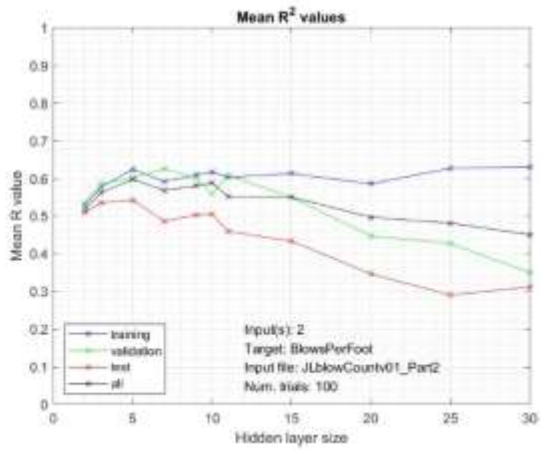
The inset text on each plot shows the training input number code, the training target, input file name (for reference) and the number of modeling iterations (trials). The legend on the plots is color coded for the data sets: blue for training, green for validation, red for testing and black for all.

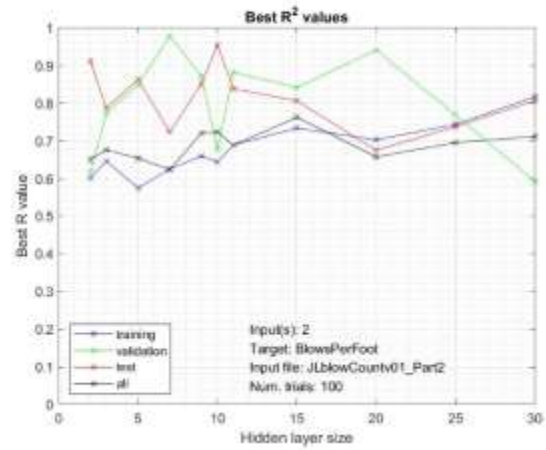
Appendix D-1 – Plots of mean and best R^2 values for SPT blow counts

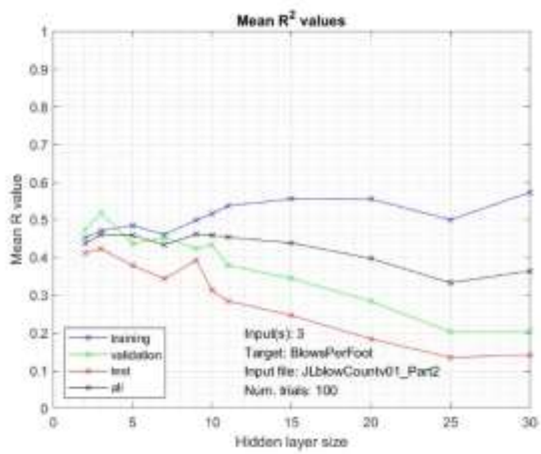
Results for NN modeling of SPT blow counts. Appendix D-1 contains the two sets of 63 network scenario plots (mean R^2 and best R^2 for 100 trials).

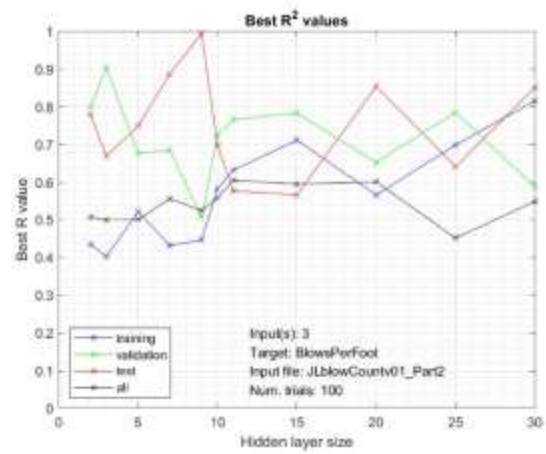


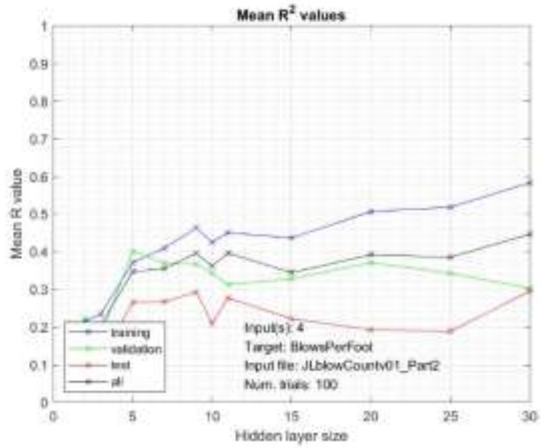


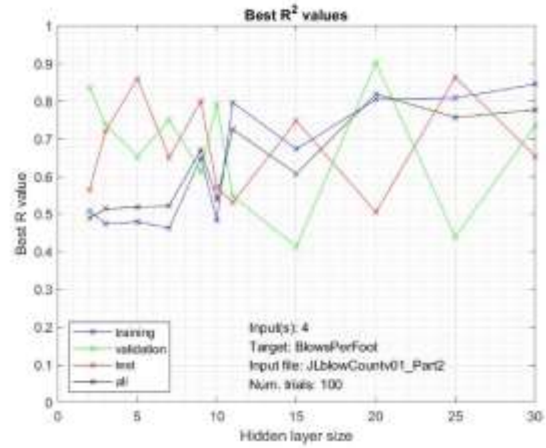


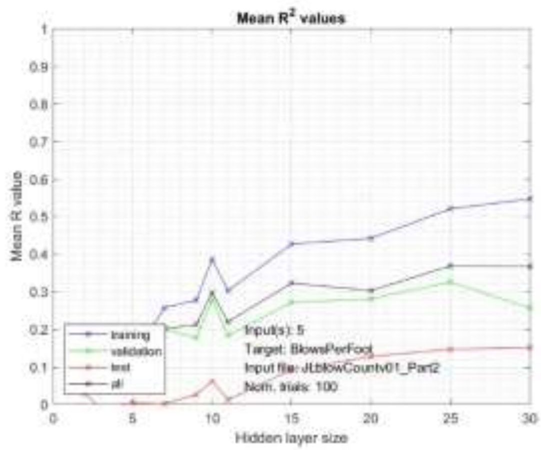


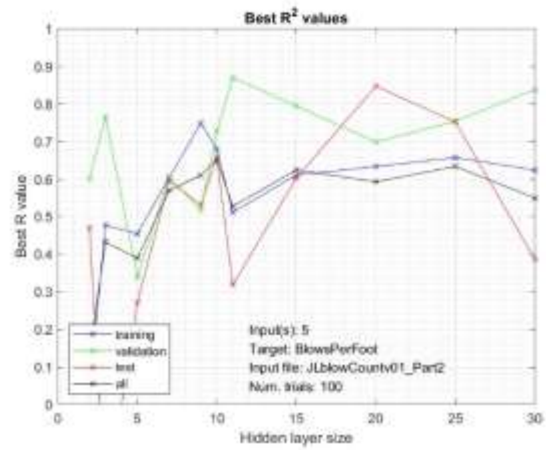


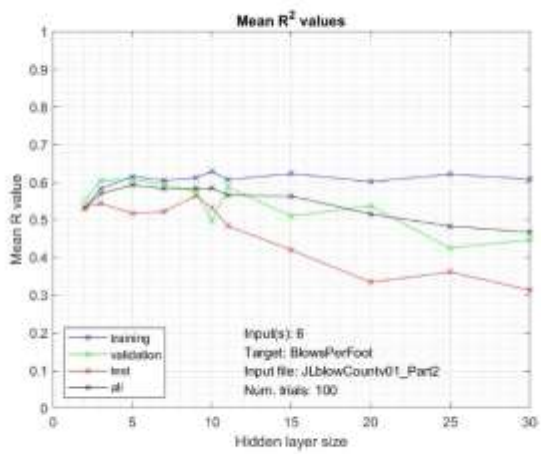


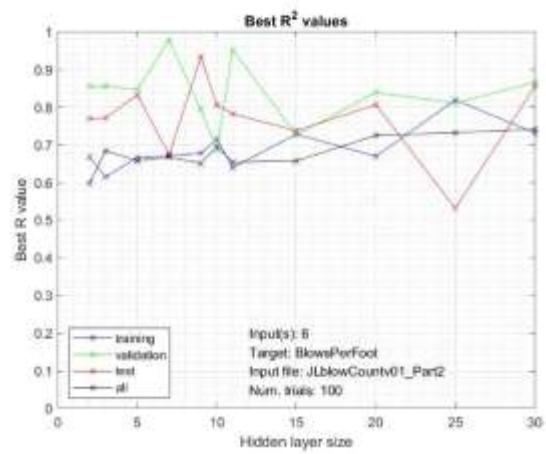

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 4
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

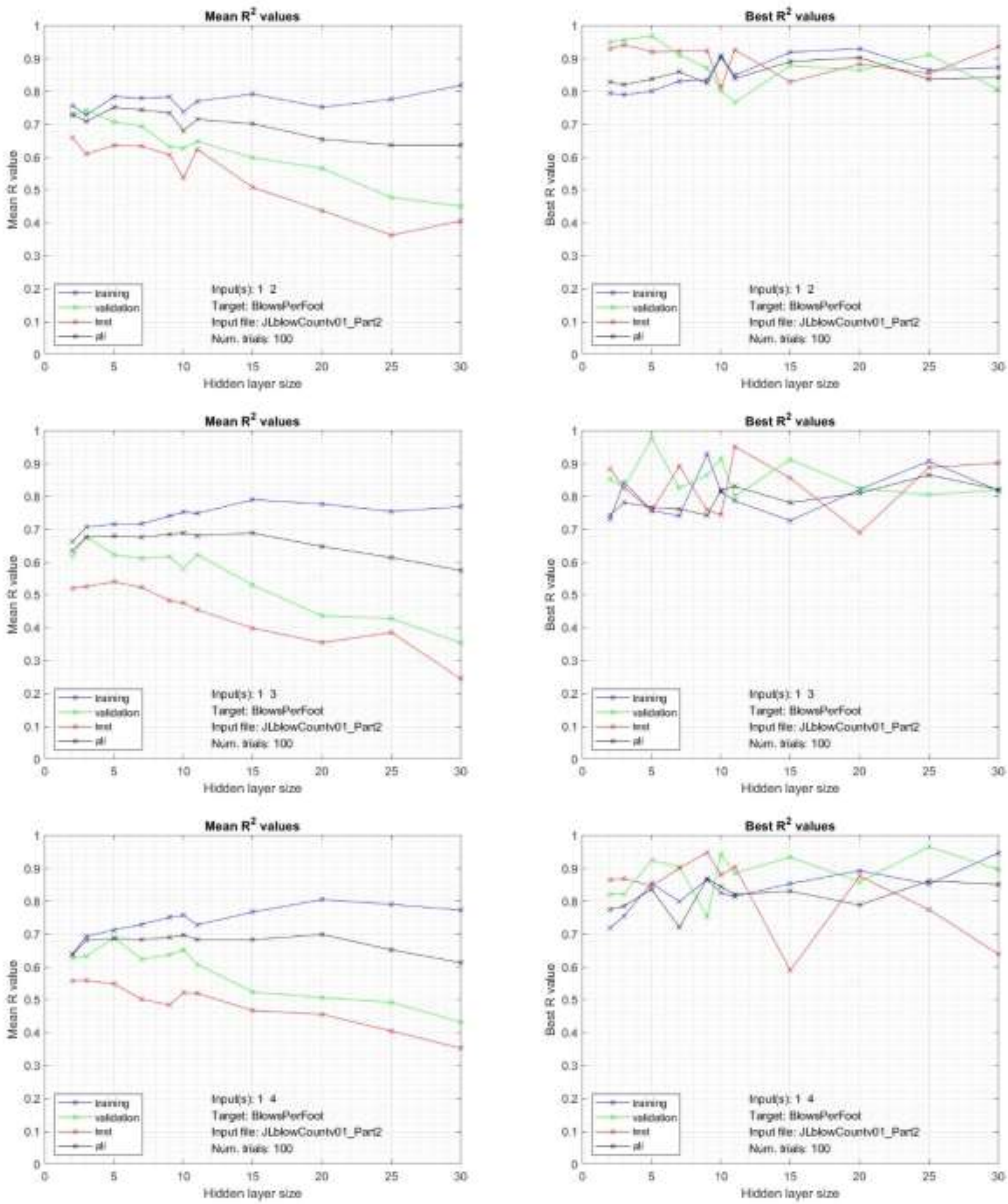

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 4
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

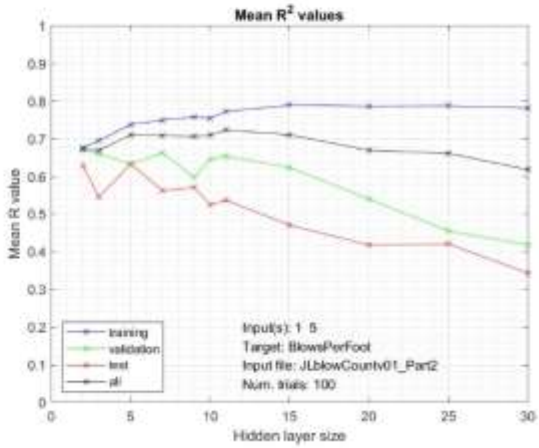

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

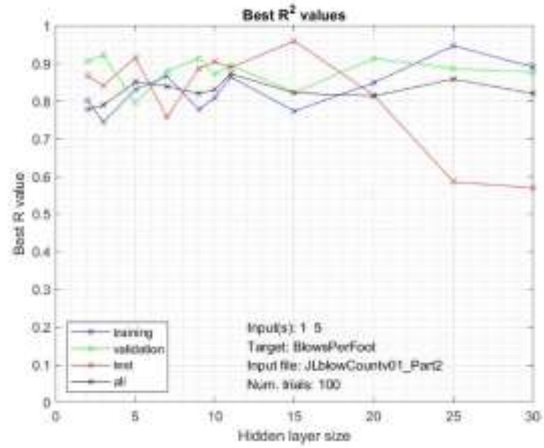

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

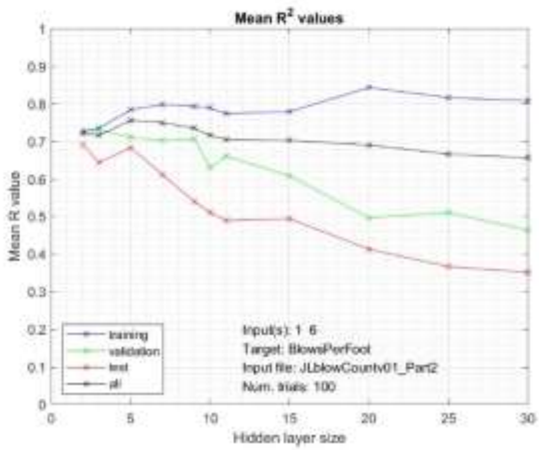

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

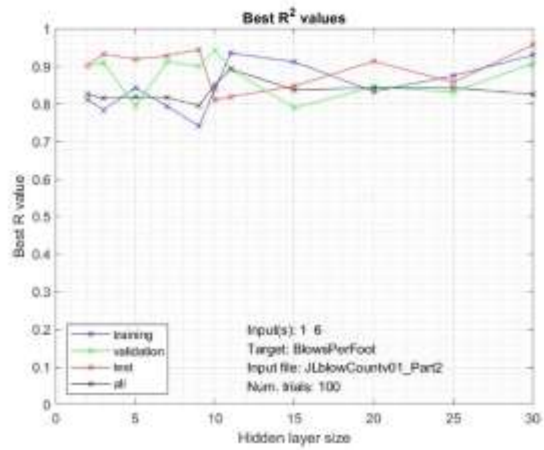

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

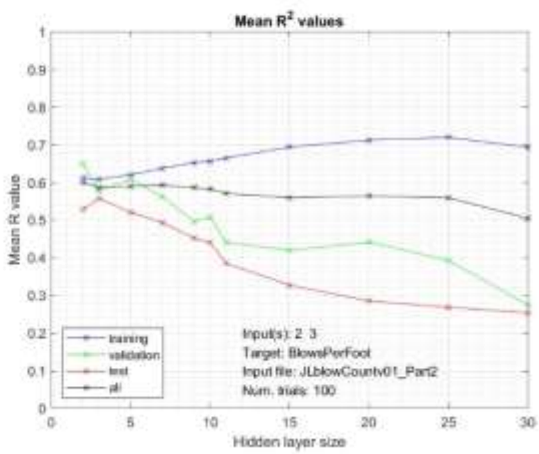

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100
Best R^2 values
Best R value
Hidden layer size
Input(s): 1 2
Input(s): 1 3
Input(s): 1 4

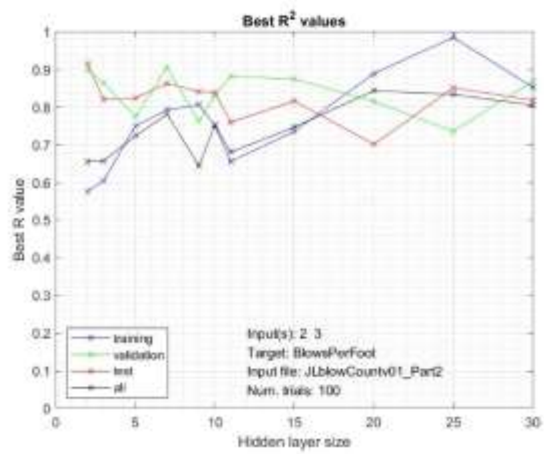

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

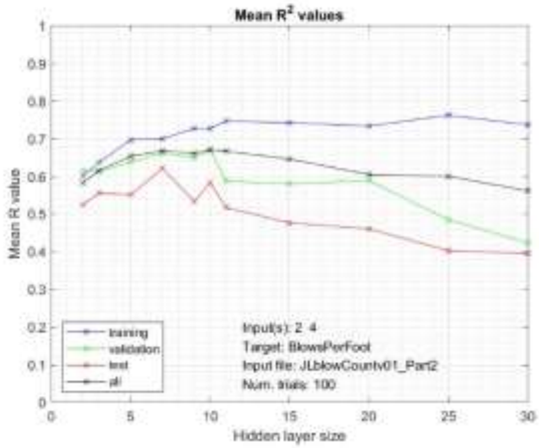

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

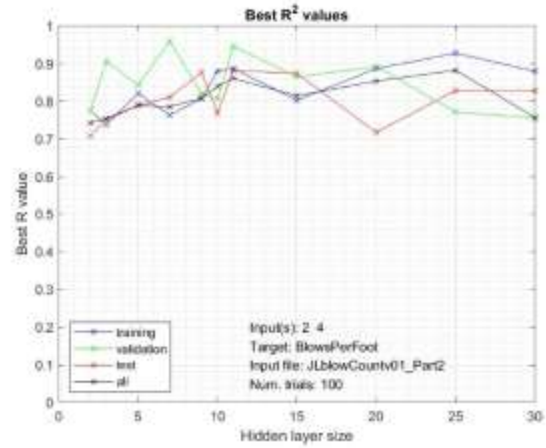

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

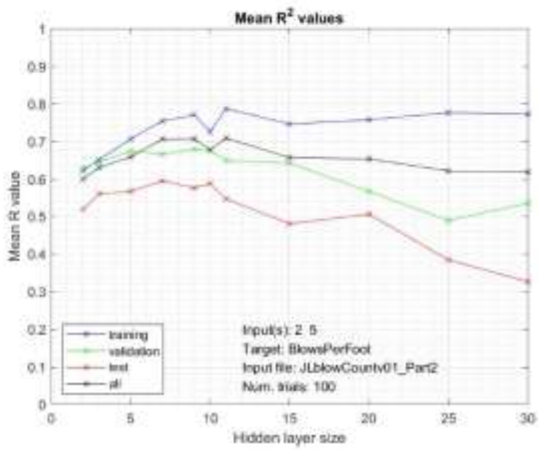

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

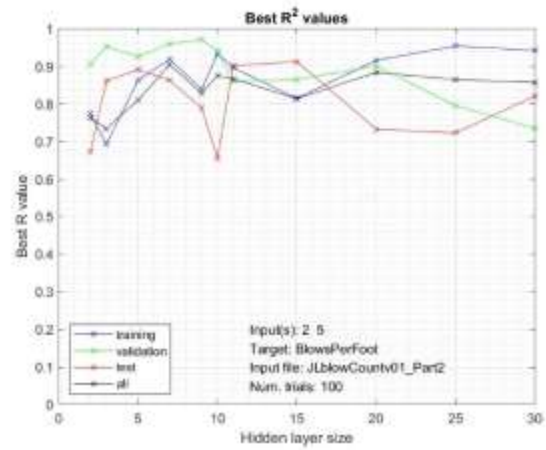

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

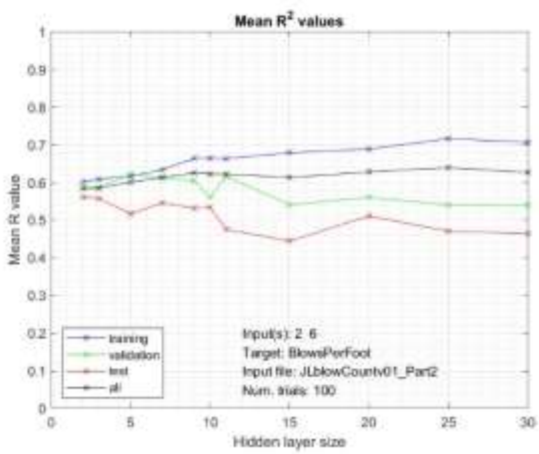

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 3
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

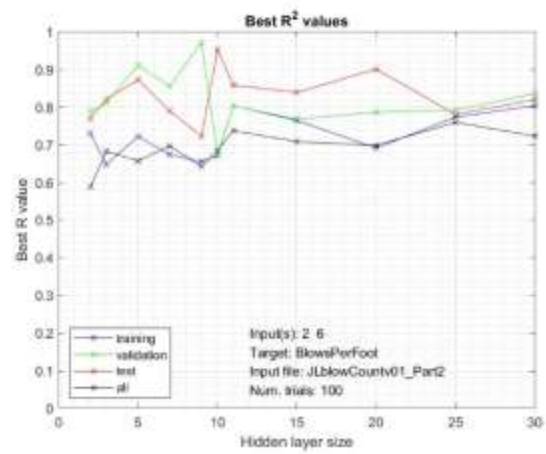

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 4
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

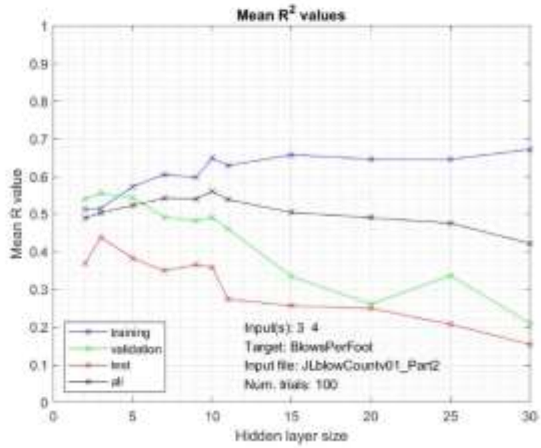

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 4
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

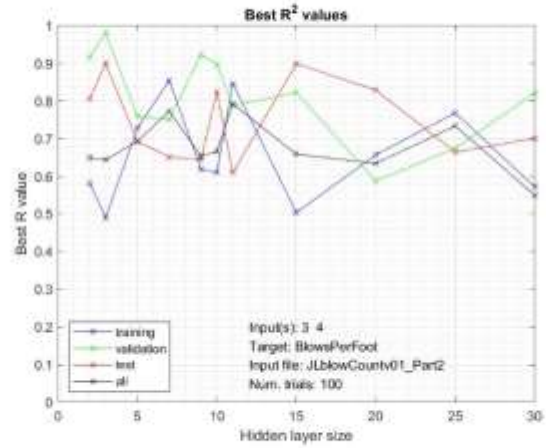

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

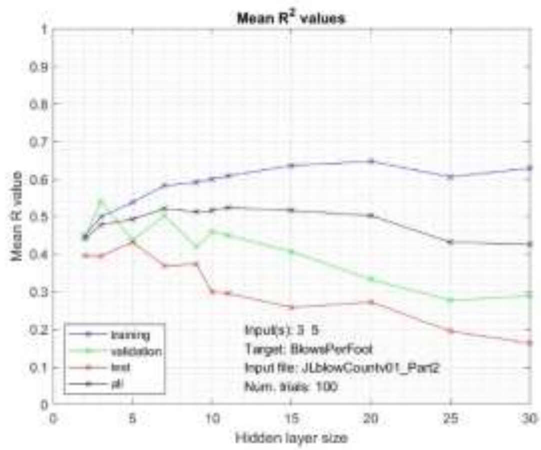

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

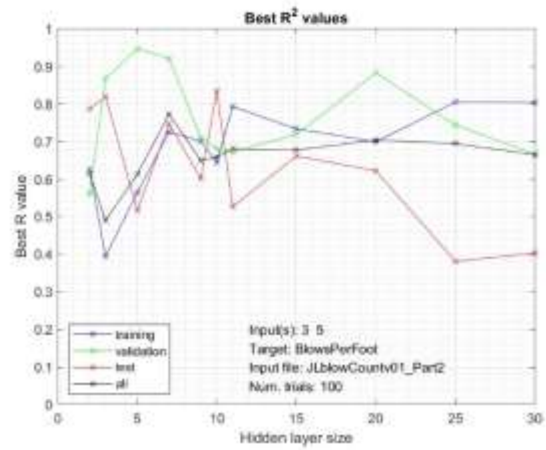

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

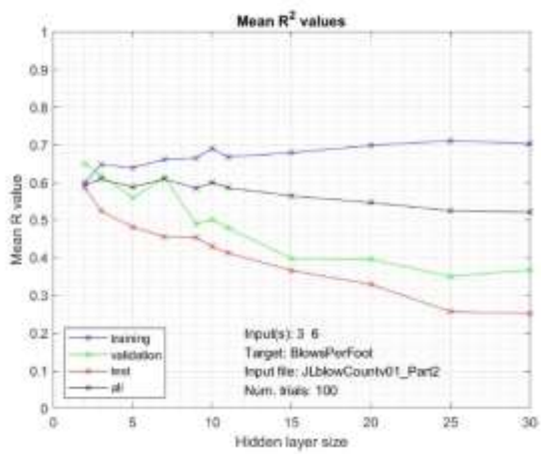

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

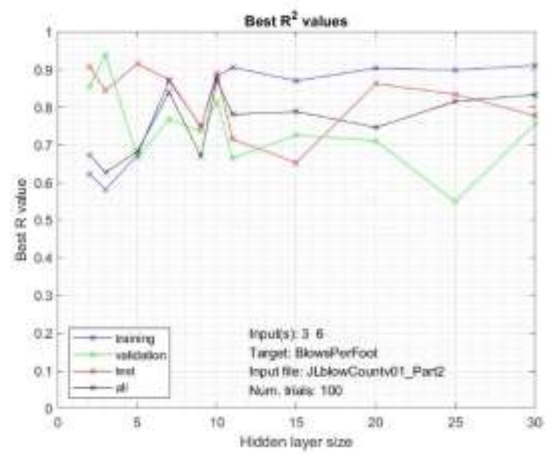

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 4
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

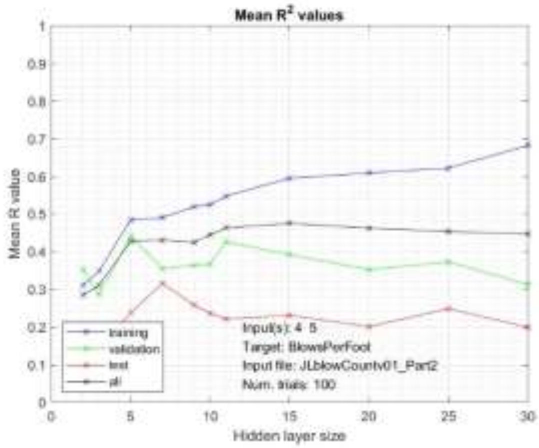

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 4
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

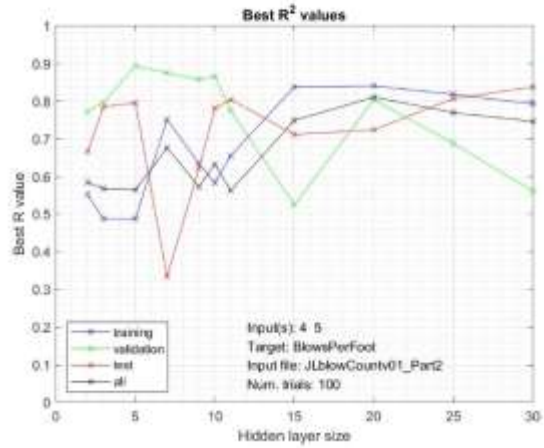

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

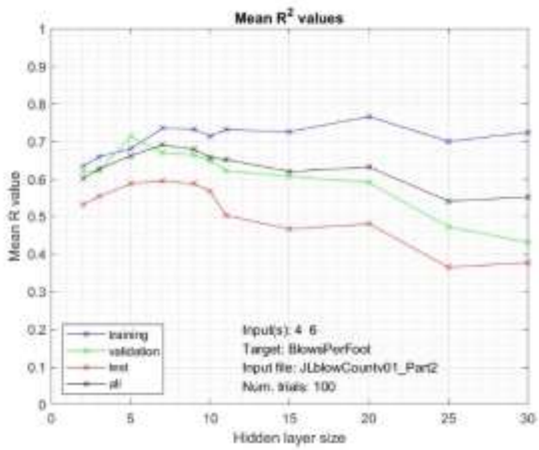

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

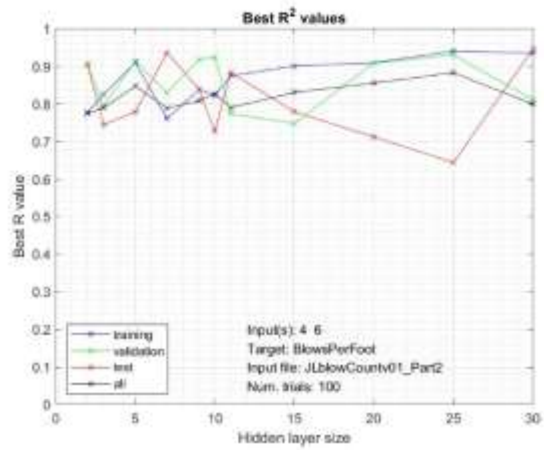

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

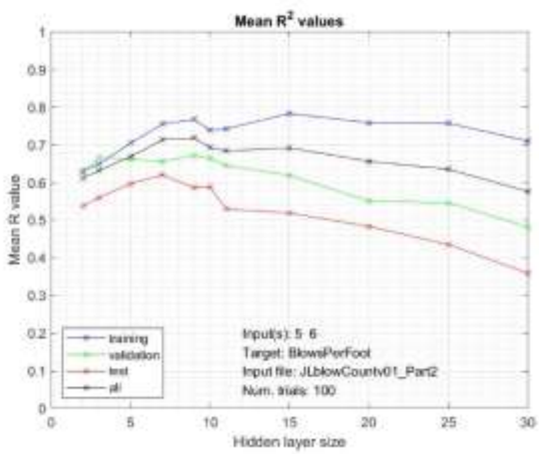

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

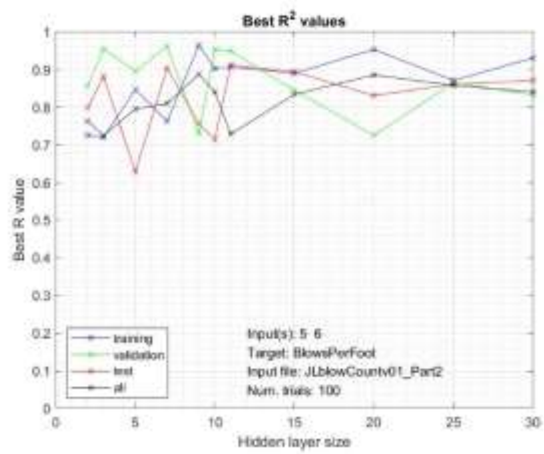

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

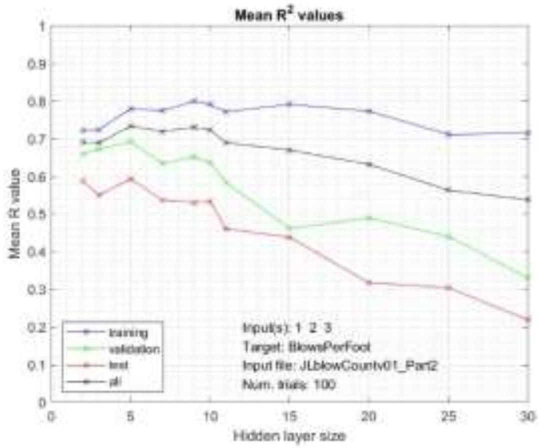

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

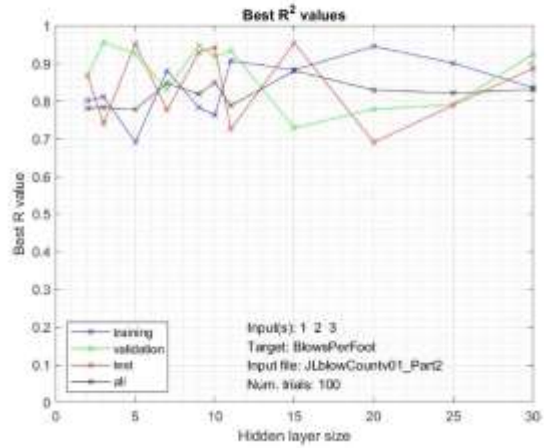

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 4 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

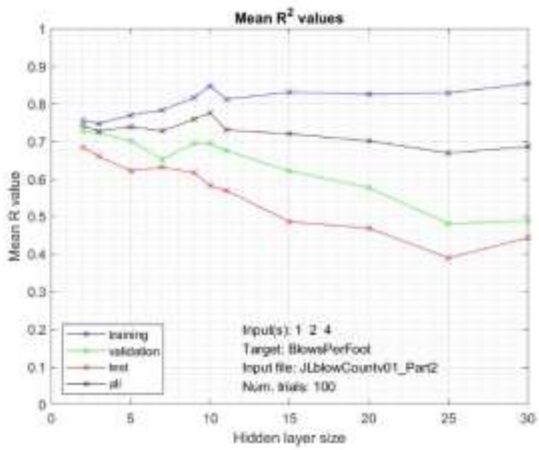

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 4 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

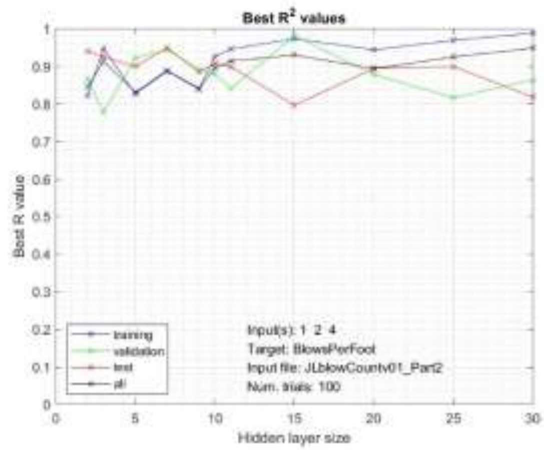

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

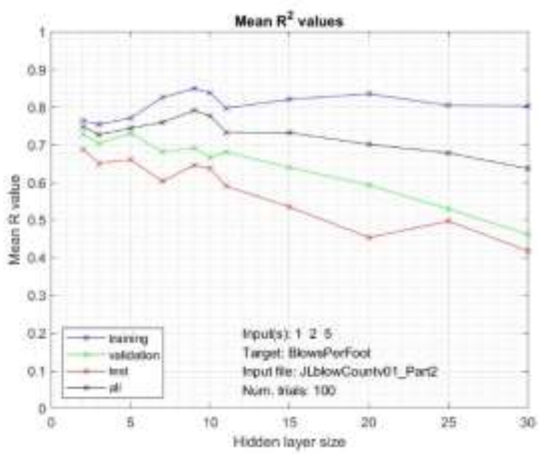

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

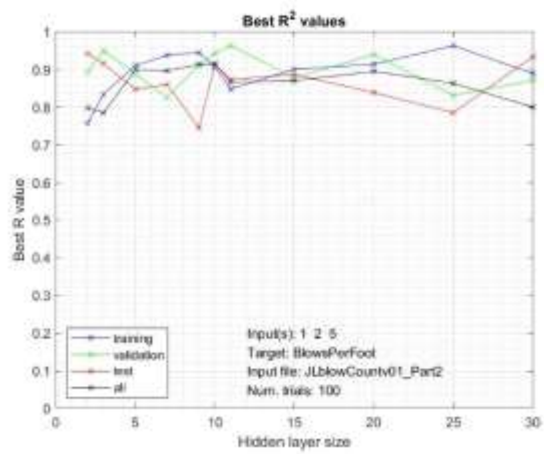

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

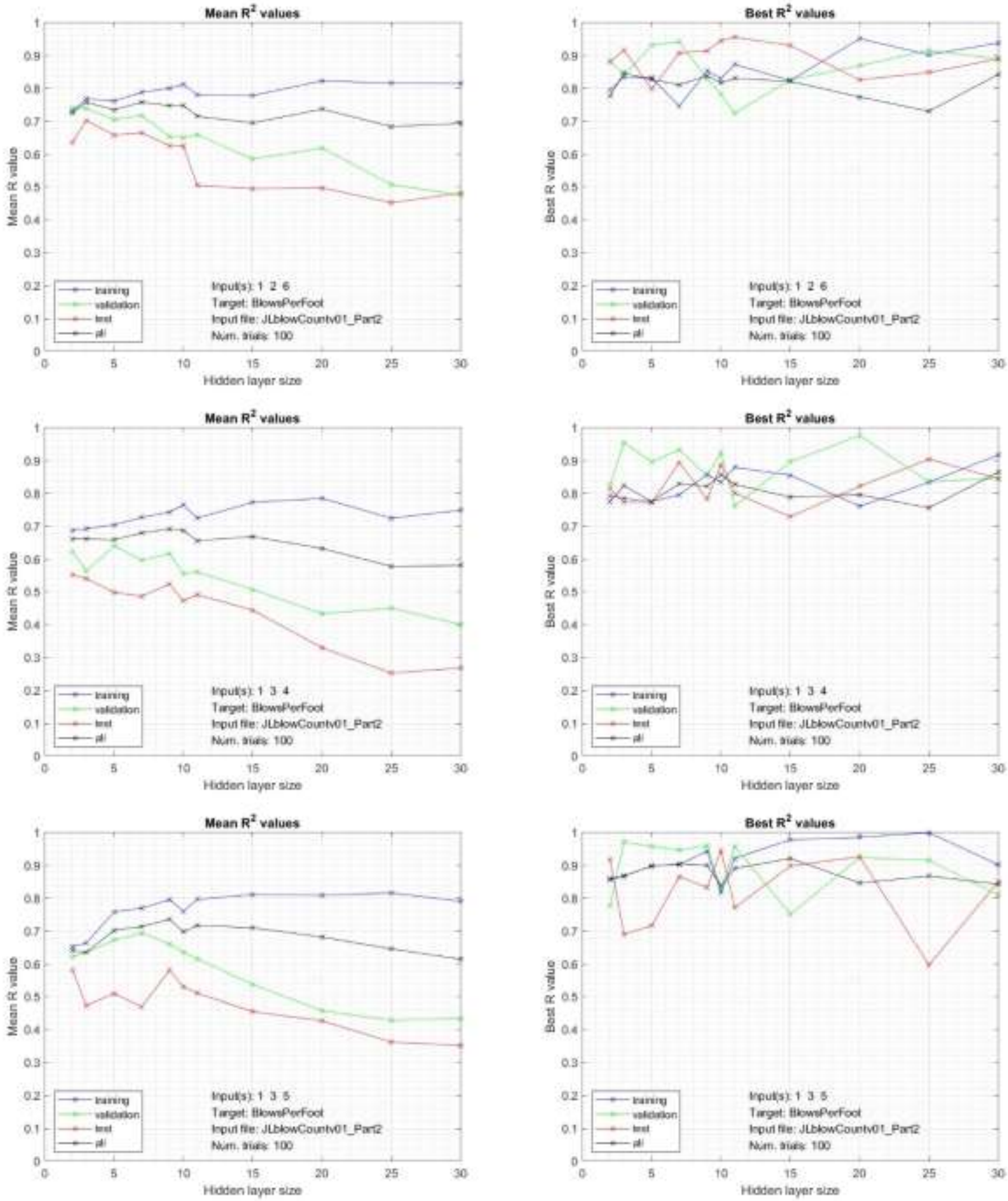

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 4
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 4
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100
Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100
Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100
Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100
Mean R^2 values
Mean R value
Hidden layer size
training
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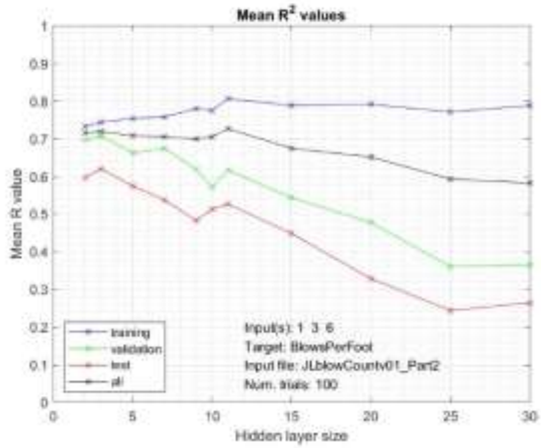
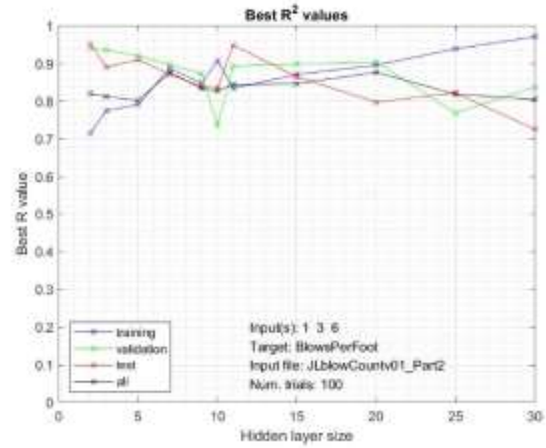
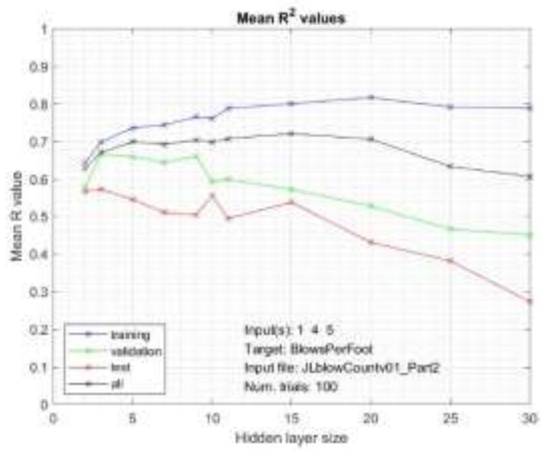
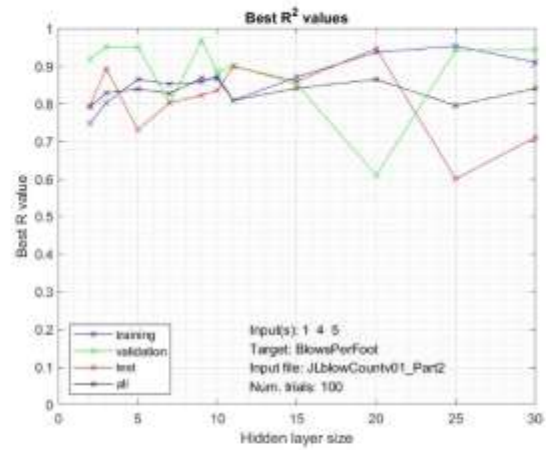
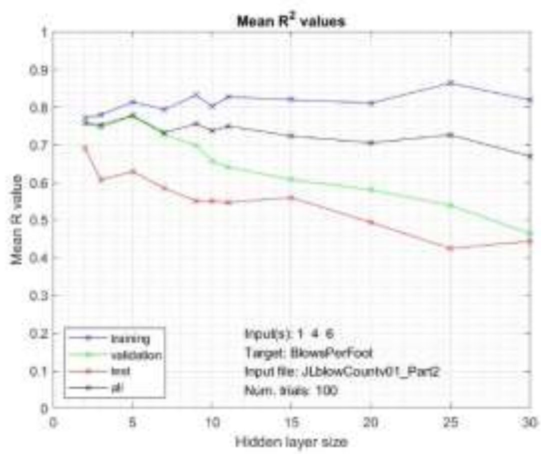
test
all
Input(s): 1 3 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100
Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

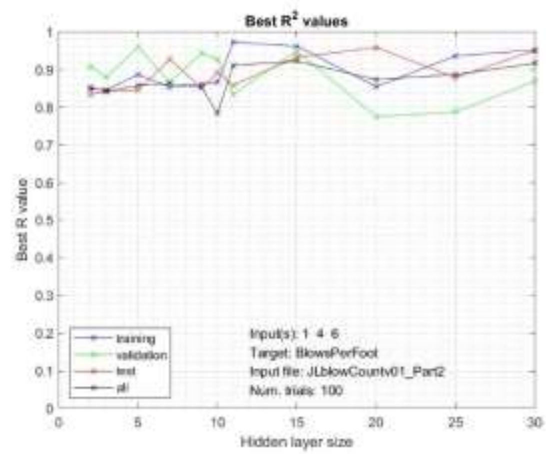

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
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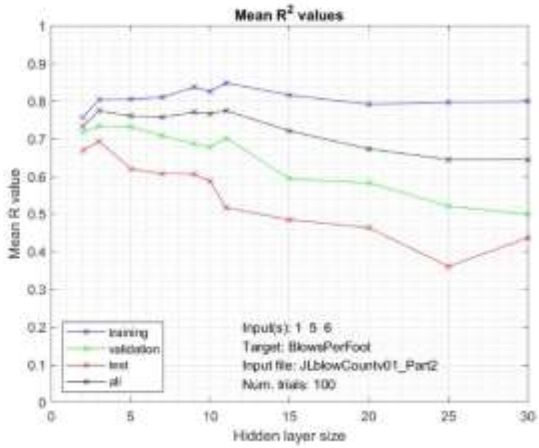
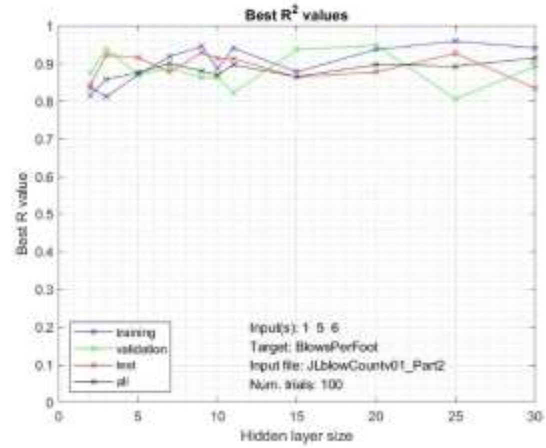
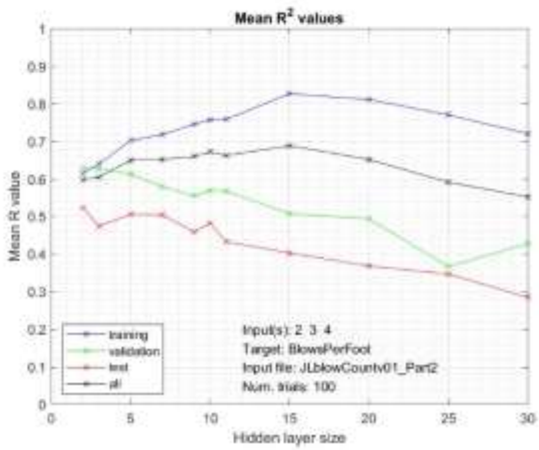
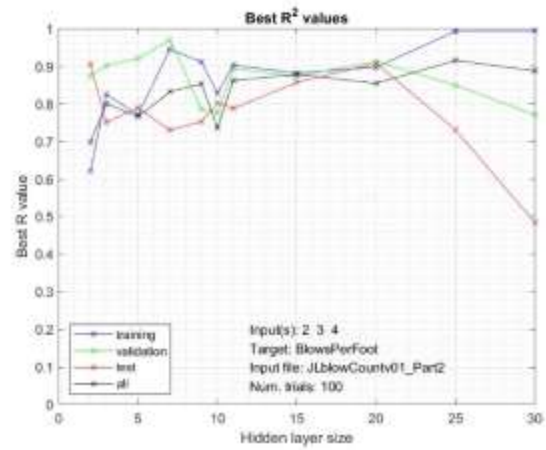
validation
test
all
Input(s): 1 4 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
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validation
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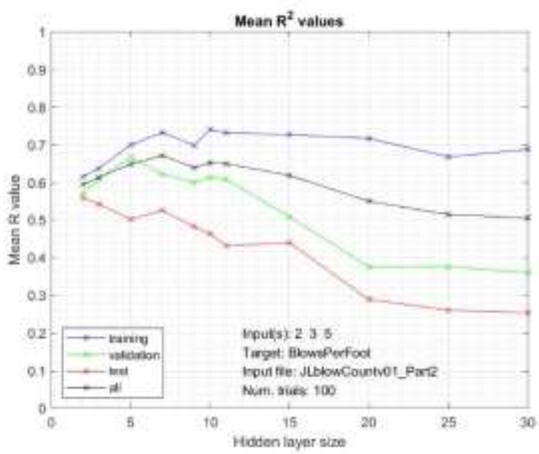
Input(s): 2 3 4
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R² values
Mean R value
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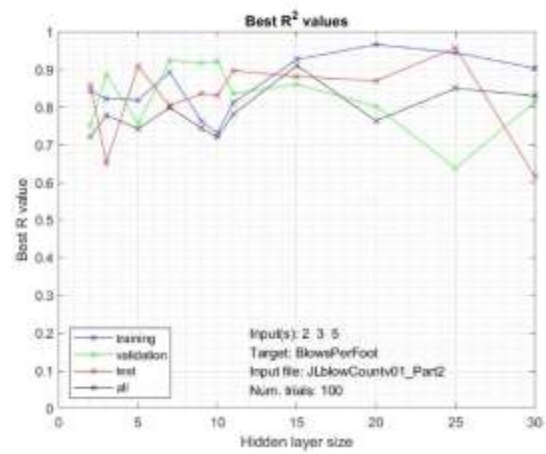
test
all
Input(s): 2 3 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
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validation
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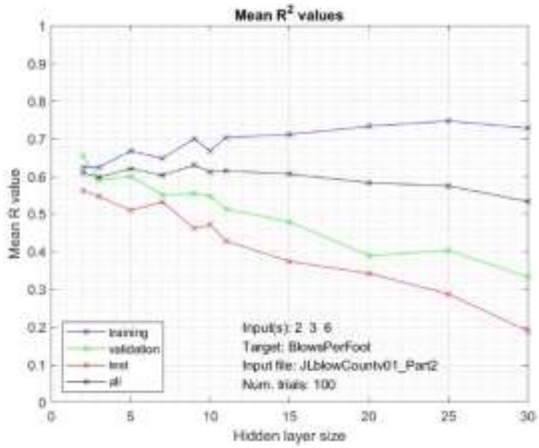
Input(s): 2 3 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
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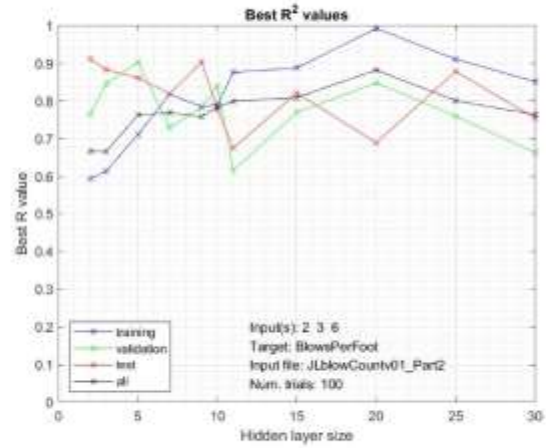
validation
test
all
Input(s): 2 3 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
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validation
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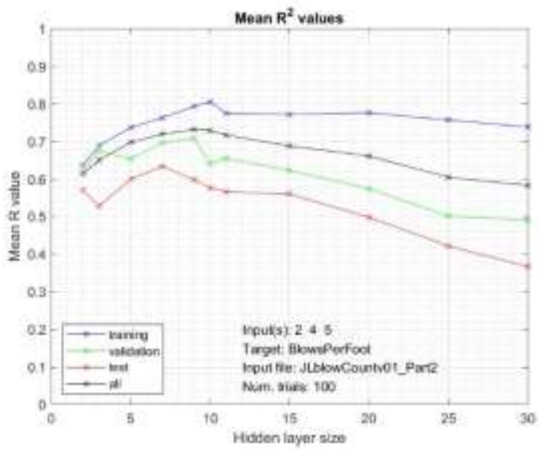
all
Input(s): 2 3 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
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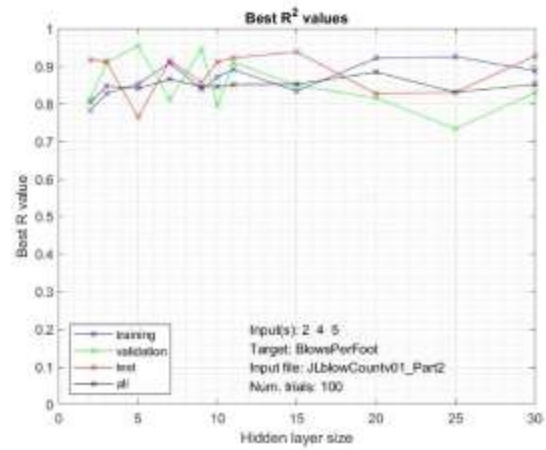
validation
test
all
Input(s): 2 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
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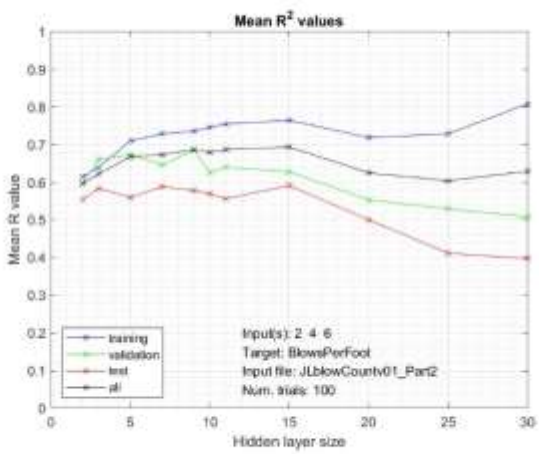
validation
test
all
Input(s): 2 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
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validation
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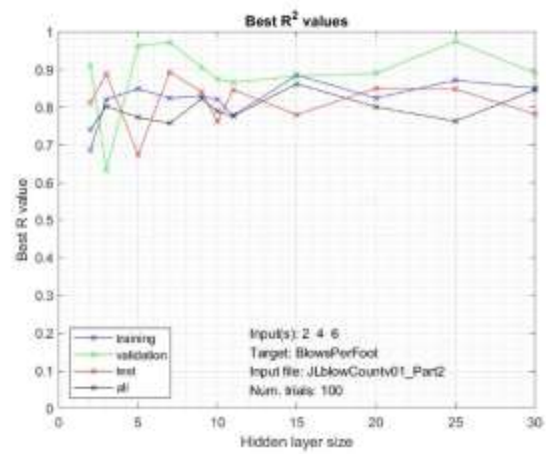
all
Input(s): 2 4 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
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validation
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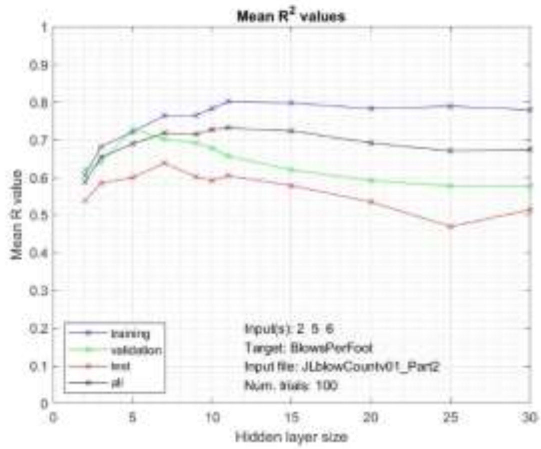
all
Input(s): 2 4 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
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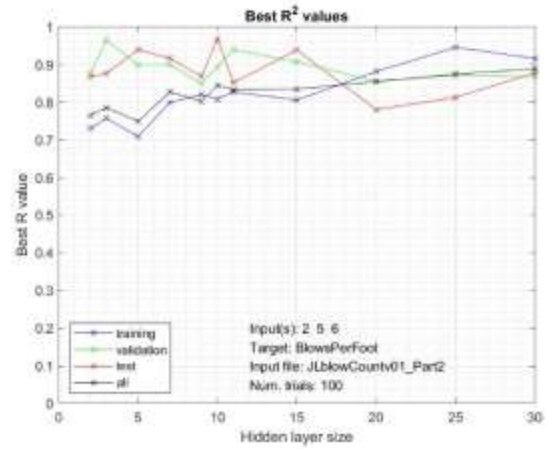
validation
test
all
Input(s): 2 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
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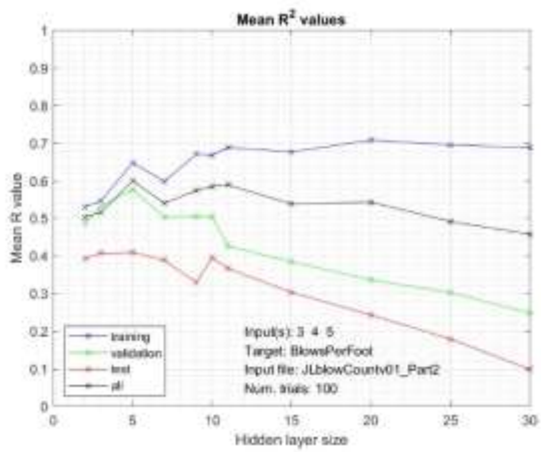
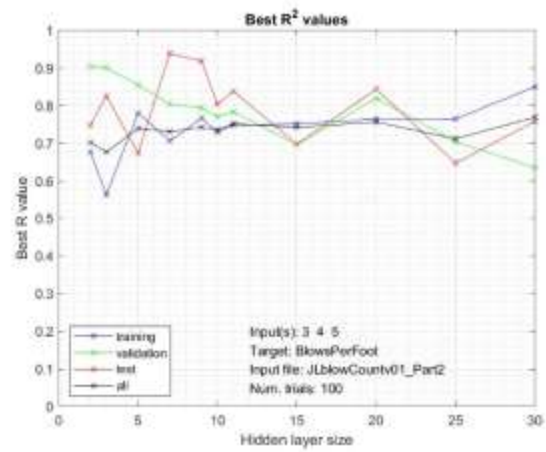
validation
test
all
Input(s): 2 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
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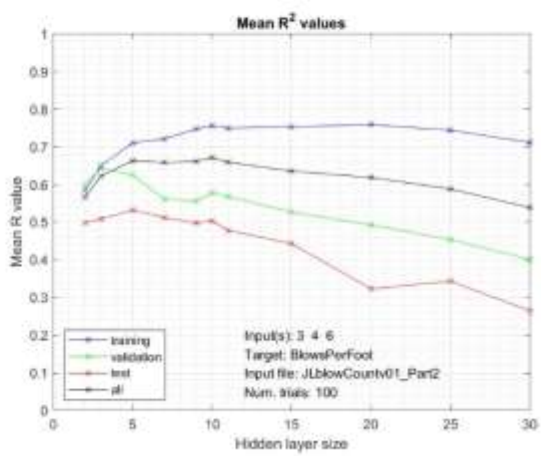
validation
test
all
Input(s): 3 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
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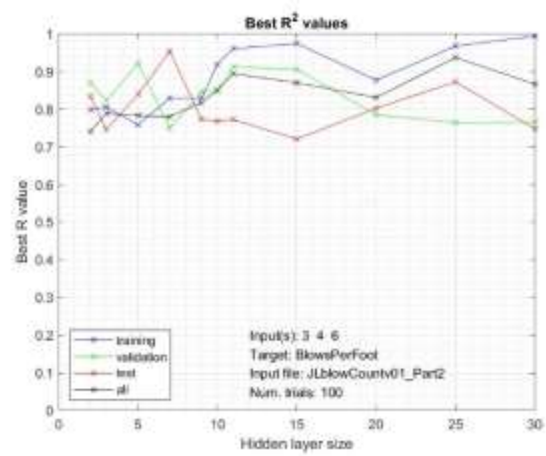
validation
test
all
Input(s): 3 4 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
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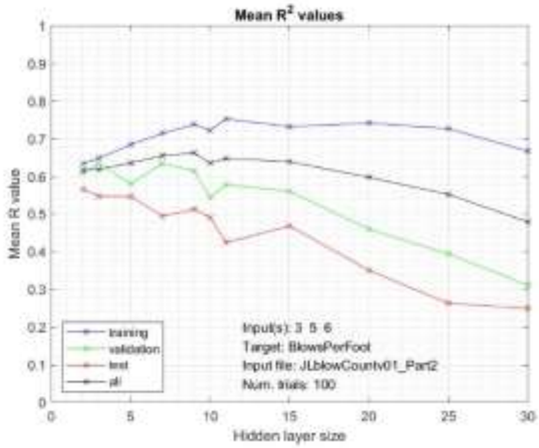
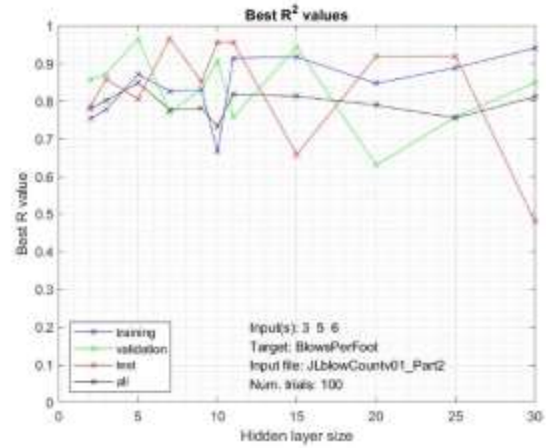
validation
test
all
Input(s): 3 4 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R^2 values
Best R value
Hidden layer size
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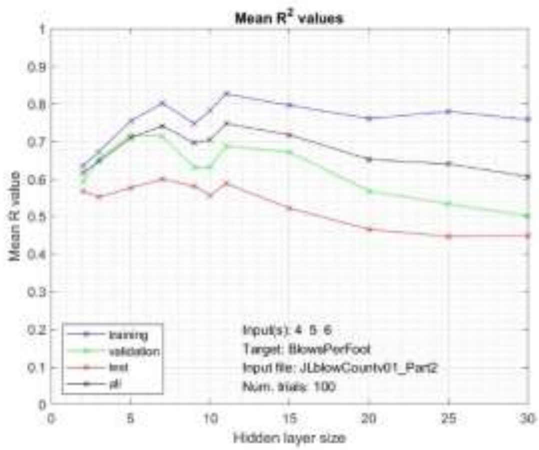
Input(s): 3 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
Hidden layer size
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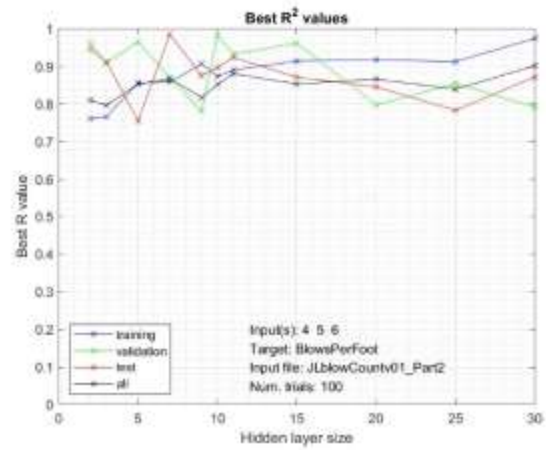
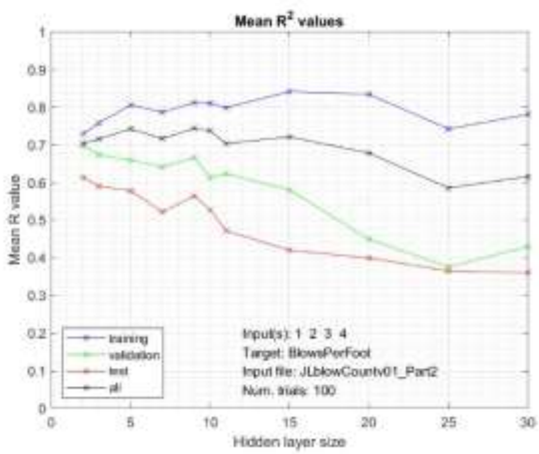
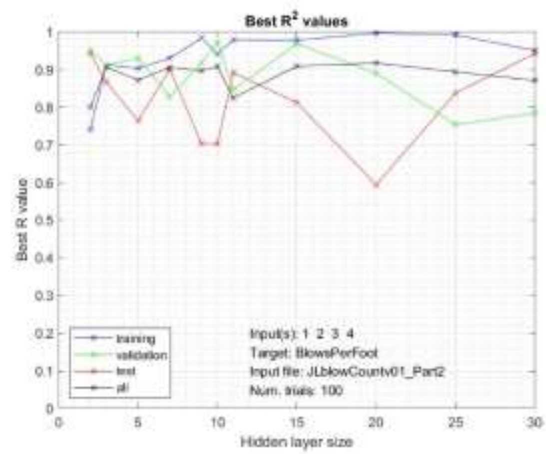
validation
test
all
Input(s): 4 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 4 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R^2 values
Best R value
Hidden layer size
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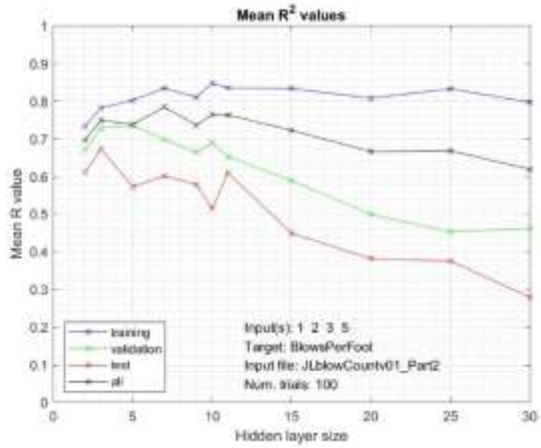
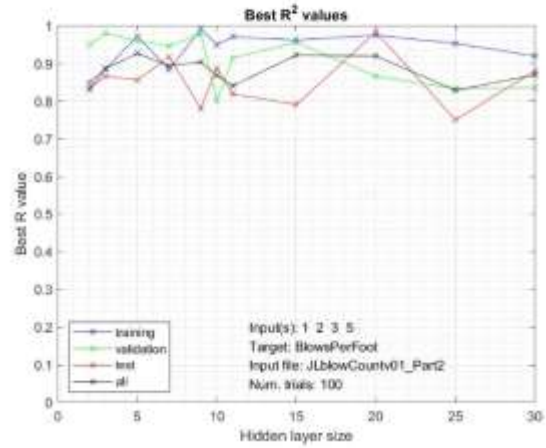
Input(s): 1 2 3 4
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R^2 values
Best R value
Hidden layer size
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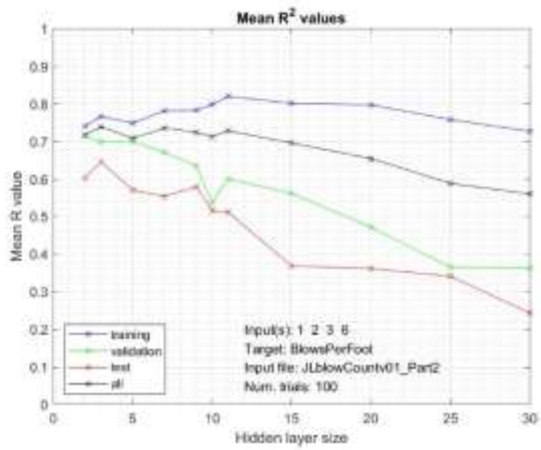
validation
test
all
Input(s): 1 2 3 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
Hidden layer size
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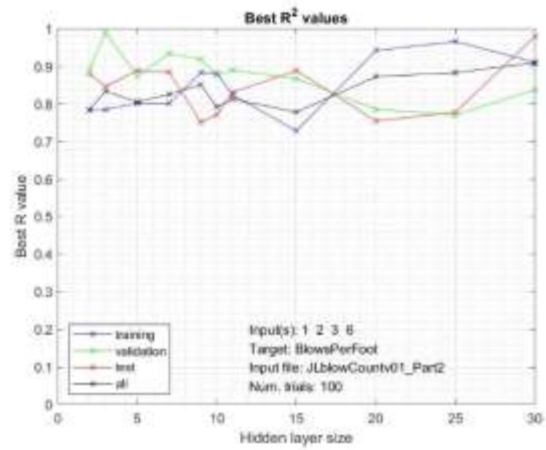
validation
test
all
Input(s): 1 2 3 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R^2 values
Best R value
Hidden layer size
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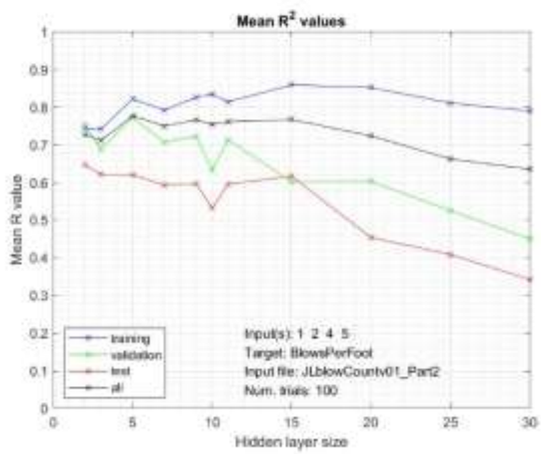
validation
test
all
Input(s): 1 2 3 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
Hidden layer size
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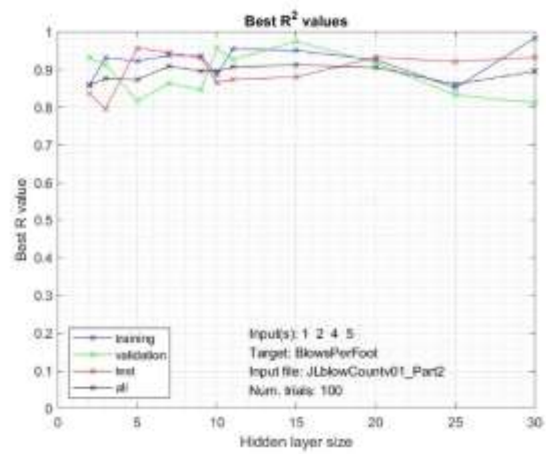
validation
test
all
Input(s): 1 2 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R^2 values
Best R value
Hidden layer size
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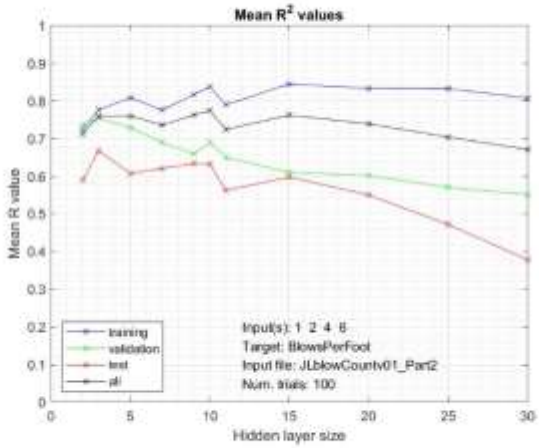
validation
test
all
Input(s): 1 2 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
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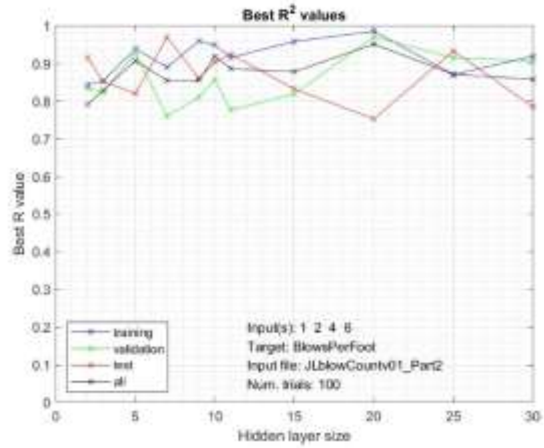
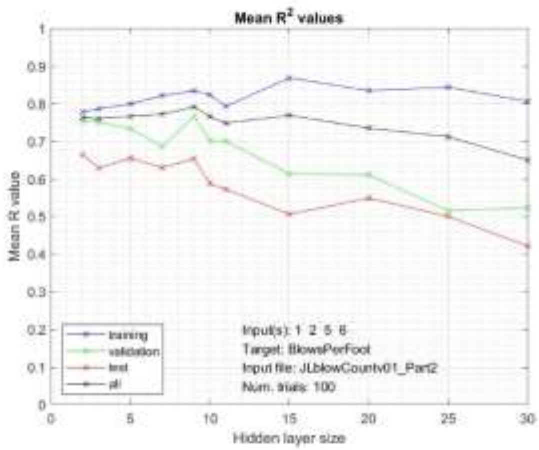
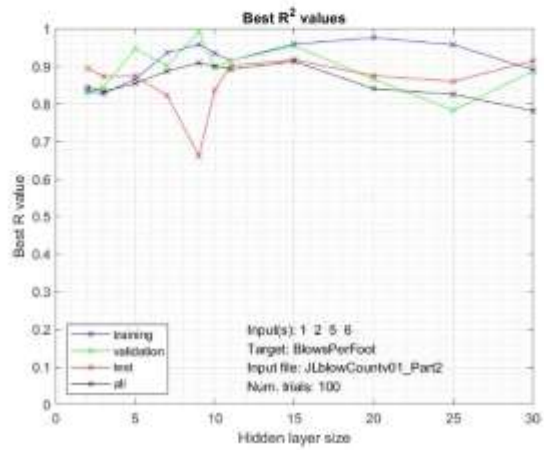
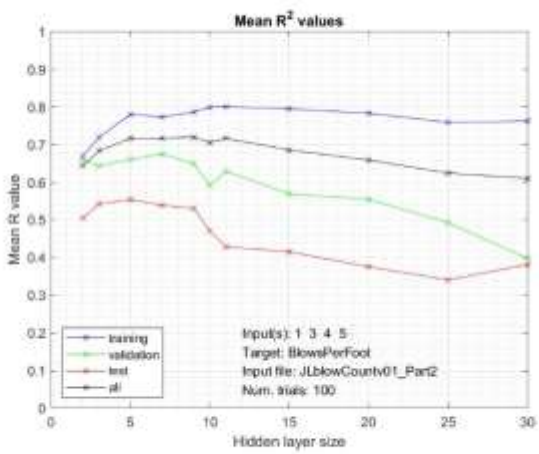
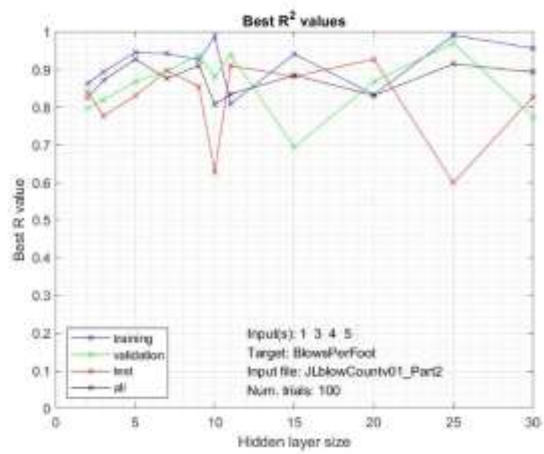
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

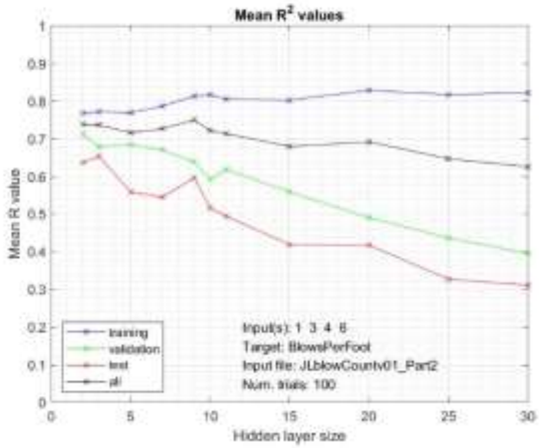

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 4 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

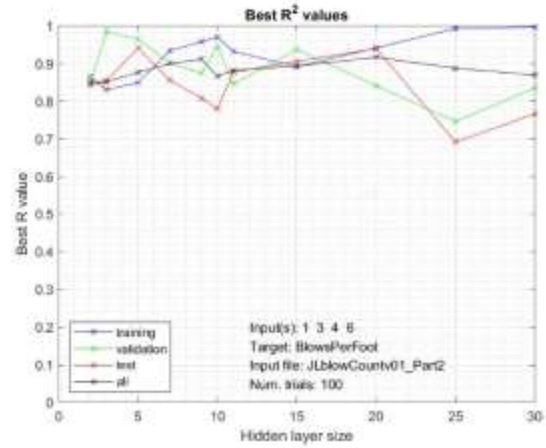

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

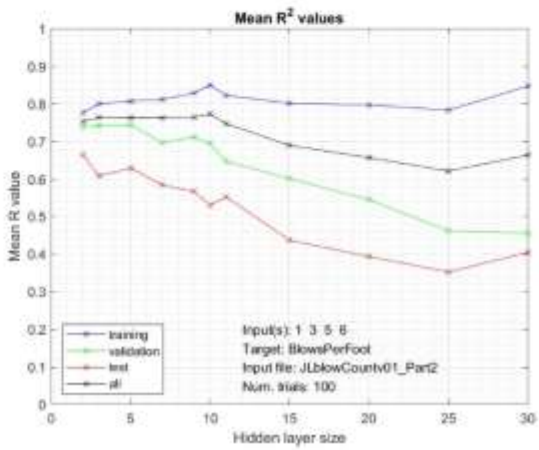

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

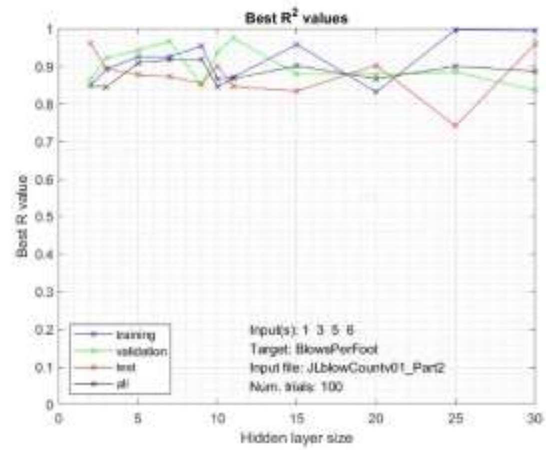

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

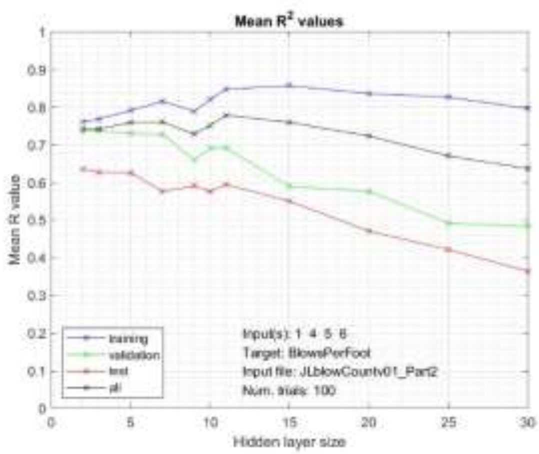

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

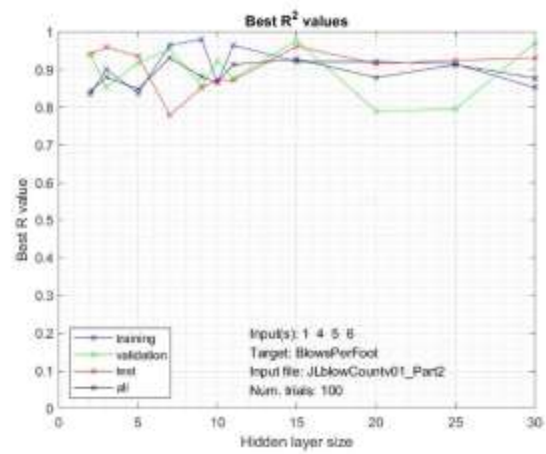

Mean R2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

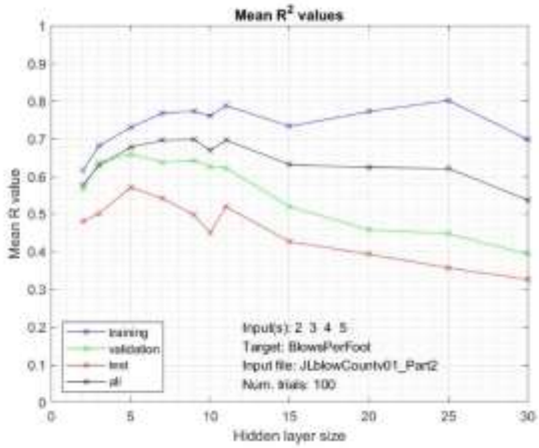

Best R2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

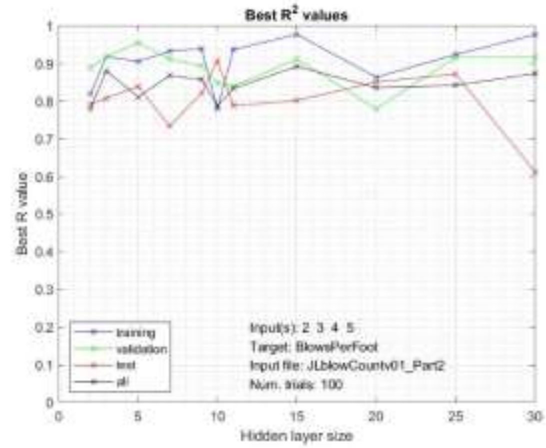

Mean R2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

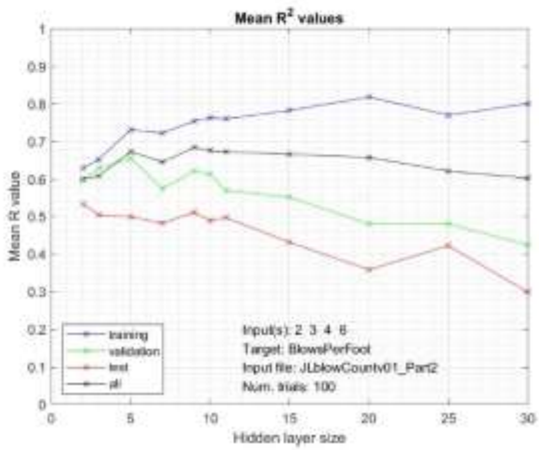

Best R2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

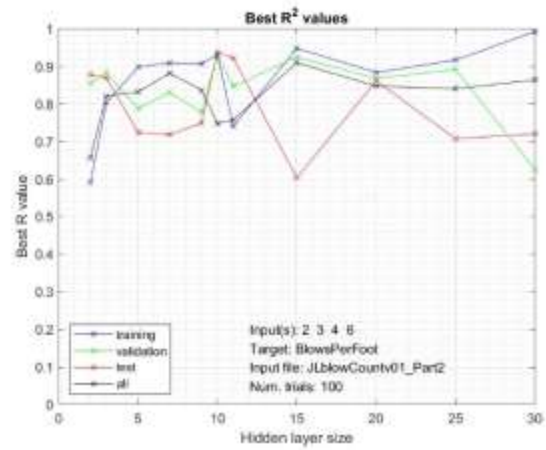

Mean R2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

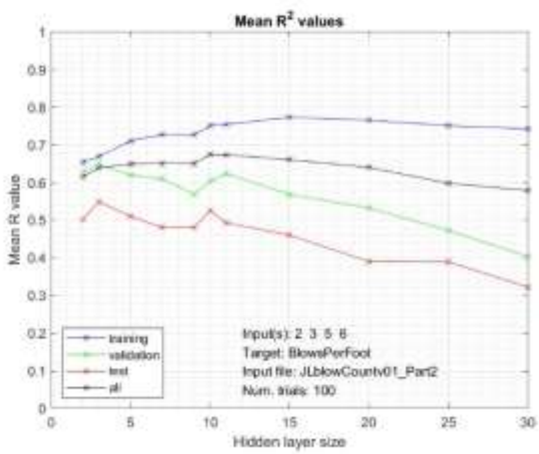

Best R2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

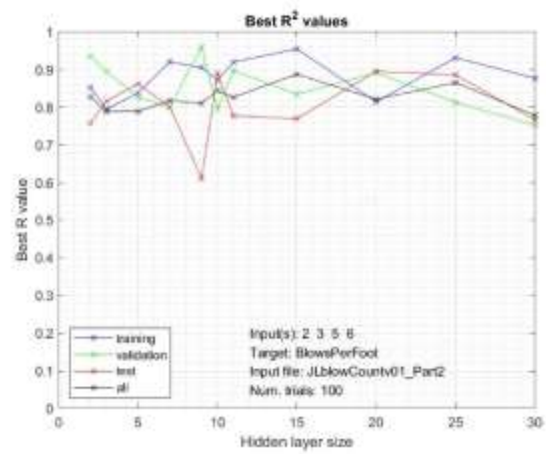

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

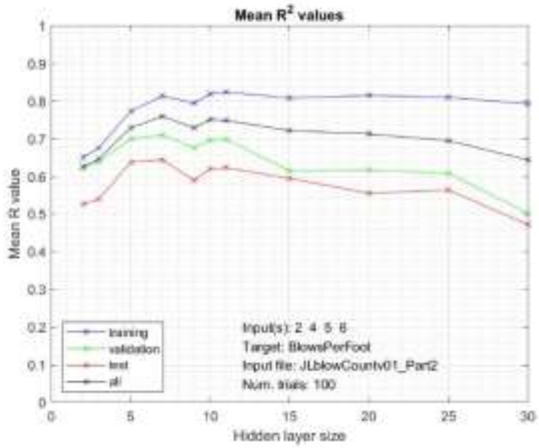

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

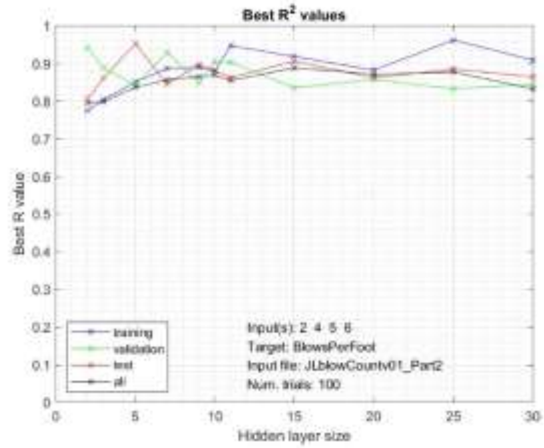

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

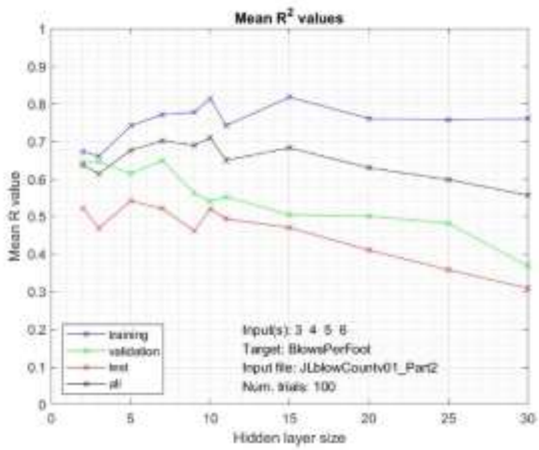

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

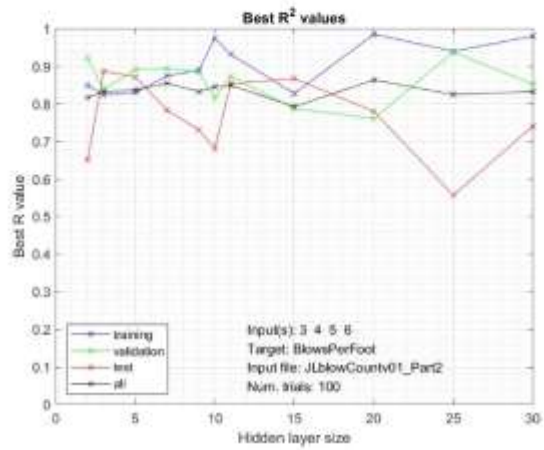

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

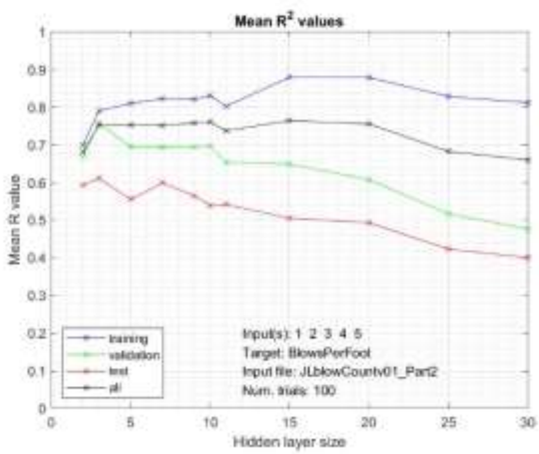

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

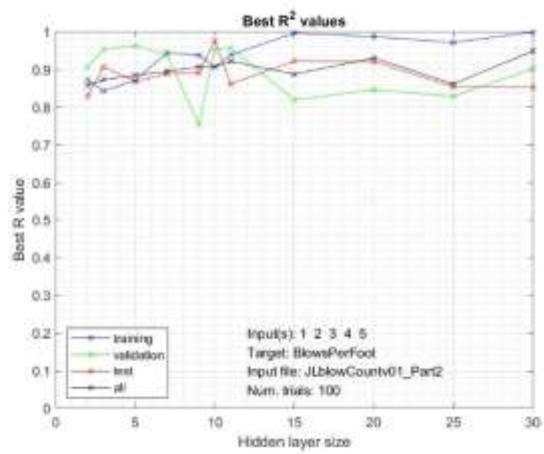

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 4 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

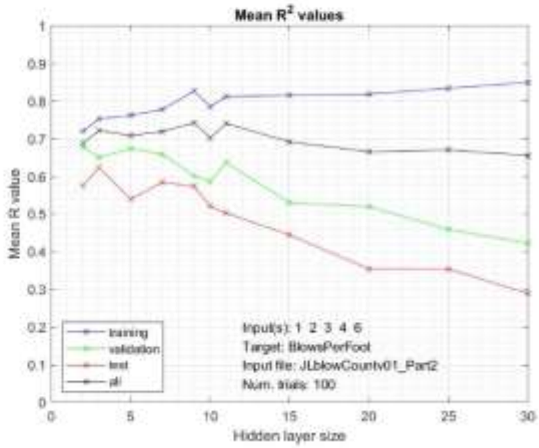

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 4 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

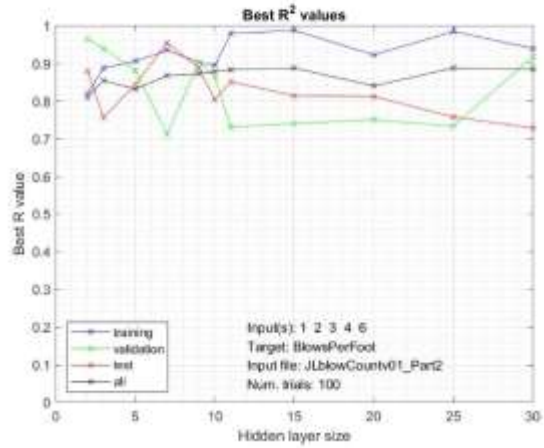

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 4 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

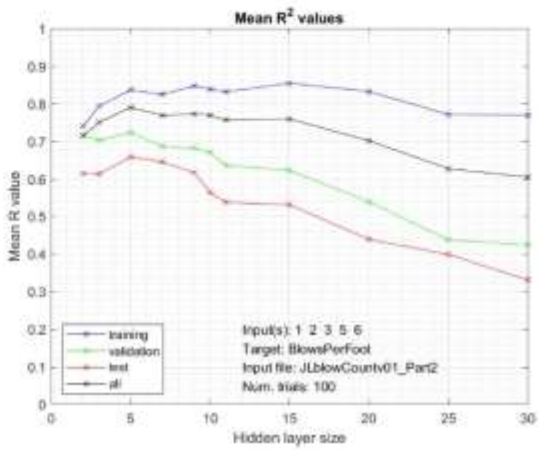

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 4 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

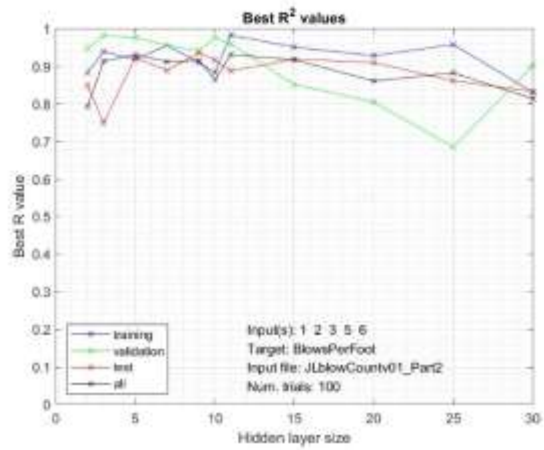

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

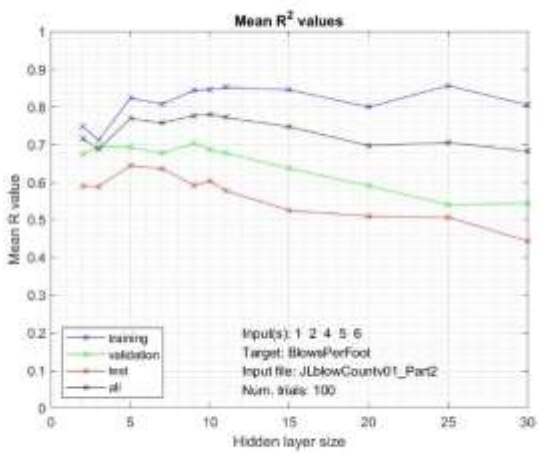

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4 5
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

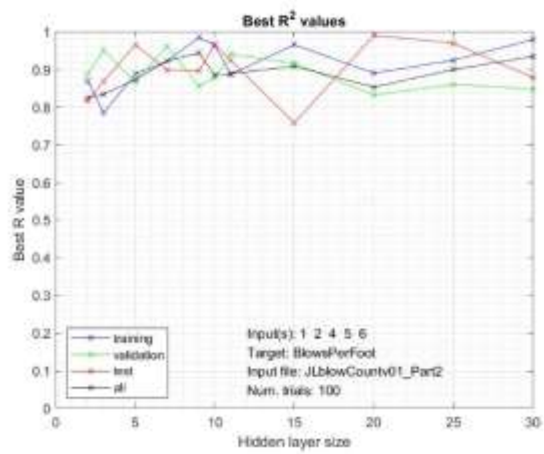

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

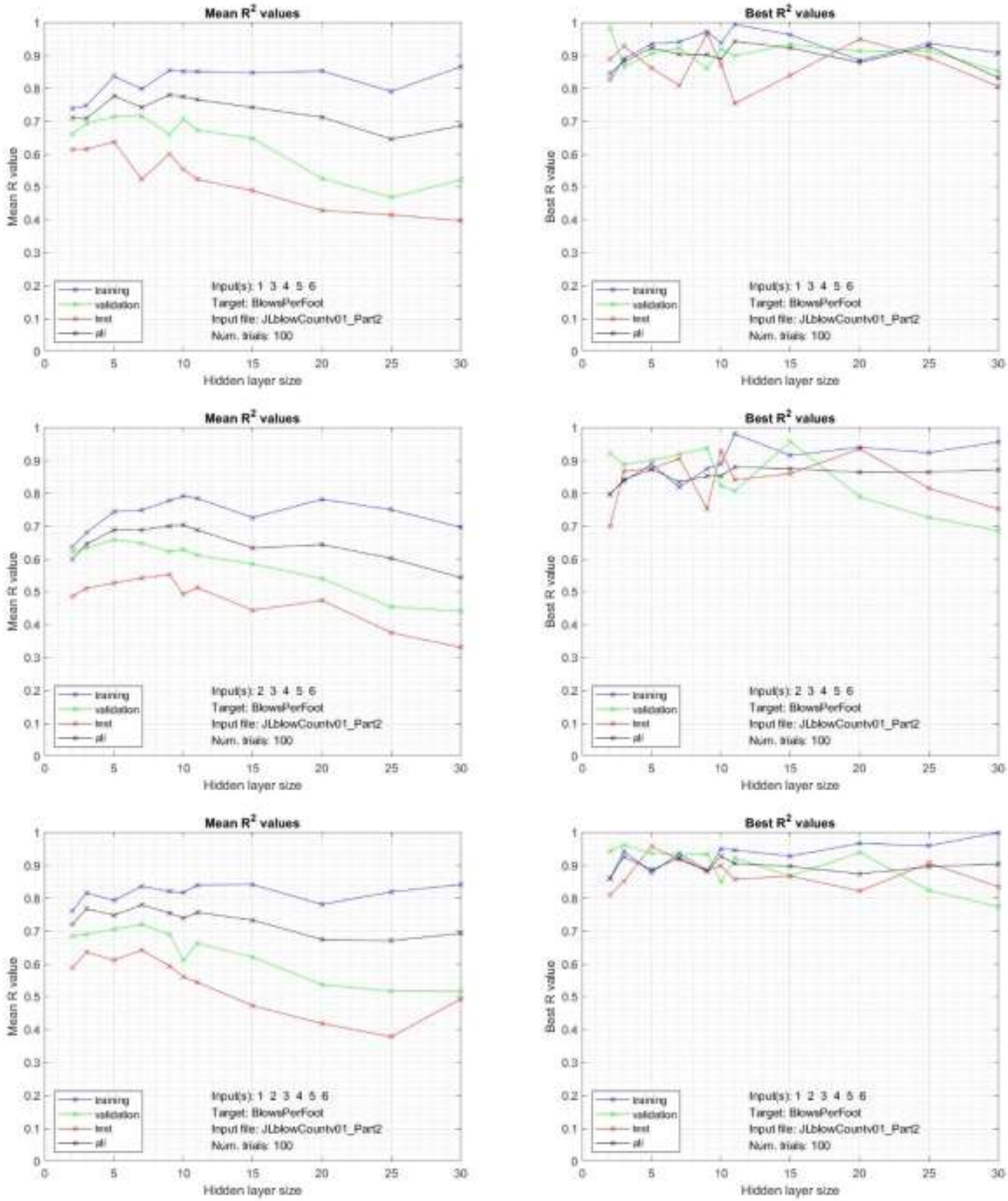

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 4 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 4 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100


Mean R^2 values
Best R^2 values
Mean R value
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4 5 6
Input(s): 2 3 4 5 6
Input(s): 1 2 3 4 5 6
Target: BlowsPerFoot
Input file: JLblowCountv01_Part2
Num. trials: 100

Appendix D-2 – Mean and best R^2 results in text form for SPT blow counts

Results for NN modelling of SPT blow counts. Appendix D-2 contains a subset of the full text list of the 693 NN scenarios. This subset represents the six combinations of a single input (i.e. 1 to 6). These results are equivalent to single parameter linear regression.

```
Training INPUTS: 1  2  3  4  5  6
 Columns 1 through 4
   {'Depthfeet '}    {'PeakDownPressur…'}    {'RotationTorquel…'}    {'RotationSpeedre…'}
 Columns 5 through 6
   {'MovingSpeedfth '}    {'SpecificEnergyf…'}
--------------------
Training TARGETS: 7
   {'BlowsPerFoot '}
--------------------
---> Target = BlowsPerFoot
--------------------
************ NUMBER OF COMBINATIONS = 1 ************
numIts =
  100
inp =
    1
---> Input(s) = Depthfeet
        HL no.    all       train       val        test    Sum Bst R
        -----     ---       -----       ---        ----    ---------
MeanR =
         2    0.62919    0.64132    0.62689    0.50544
         3    0.69944    0.70308    0.68566    0.61421
         5    0.70161    0.71185    0.68007    0.60867
         7    0.72014    0.74886    0.65301    0.58706
         9    0.69962    0.72319    0.63272    0.59897
        10     0.66493    0.70233     0.5971    0.53113
        11     0.69378    0.75351    0.61558    0.52687
        15     0.67615    0.74204    0.63862    0.47561
        20     0.69425    0.76332    0.56731    0.47587
        25     0.67643    0.77853    0.48095    0.46803
        30     0.67904    0.80046    0.49038    0.51752
BestR =
         2    0.71512    0.59868    0.96249    0.92731     3.2036
         3    0.77015    0.73441    0.89429    0.87183     3.2707
         5    0.75691    0.73734    0.91872    0.86166     3.2746
         7    0.78155    0.64827    0.92409    0.92472     3.2786
         9    0.74812    0.72637    0.93732    0.97377     3.3856
        10     0.7459    0.79578    0.89538    0.97501     3.4121
        11     0.79153    0.78595    0.79133    0.86234     3.2312
        15     0.76893    0.75993     0.8949    0.86422      3.288
        20     0.74021    0.77777    0.83594    0.92738     3.2813
        25     0.76601    0.82361    0.84884    0.83783     3.2763
        30     0.80622    0.82845    0.73628    0.92184     3.2928
inp =
```

```
     2
--->  Input(s) = PeakDownPressurepsi
        HL no.    all      train      val       test    Sum Bst R
        -----     ---      -----      ---       ----    ---------
MeanR =
         2    0.51778    0.5299    0.53429    0.51093
         3    0.56213    0.57669    0.5861    0.53543
         5     0.5981    0.62462    0.60132    0.54307
         7    0.56852    0.59234    0.62577    0.48658
         9    0.58081    0.60976    0.60156    0.50384
        10    0.58857    0.61781    0.55942    0.5058
        11    0.55233    0.60364    0.60839    0.46003
        15    0.55064    0.61352    0.55048    0.4336
        20    0.49733    0.58605    0.4474    0.3466
        25    0.48183    0.62755    0.42771    0.29057
        30    0.45098    0.63104    0.35009    0.31232
BestR =
         2    0.65167    0.60122    0.61646    0.91233    2.7817
         3    0.67619    0.6462    0.77293    0.78626    2.8816
         5    0.65419    0.57509    0.84981    0.86355    2.9426
         7    0.62331    0.62482    0.97894    0.72371    2.9508
         9    0.72147    0.66039    0.87173    0.85125    3.1048
        10    0.7242    0.64424    0.67808    0.9548    3.0013
        11    0.68848    0.68882    0.88245    0.83868    3.0984
        15    0.76291    0.73398    0.84198    0.8066    3.1455
        20    0.65754    0.70299    0.94121    0.67532    2.9771
        25    0.6955    0.74397    0.76918    0.73791    2.9466
        30    0.71218    0.81701    0.59157    0.80663    2.9274
inp =
     3
--->  Input(s) = RotationTorquelbft
        HL no.    all      train      val       test    Sum Bst R
        -----     ---      -----      ---       ----    ---------
MeanR =
         2    0.43705    0.45221    0.47248    0.41206
         3    0.46179    0.47116    0.51937    0.42342
         5    0.4591    0.48551    0.43649    0.37942
         7    0.43427    0.46124    0.45268    0.34353
         9    0.46215    0.49959    0.42354    0.3937
        10    0.45931    0.51699    0.43443    0.31352
        11    0.45447    0.53766    0.37949    0.28489
        15    0.43894    0.55591    0.34509    0.24668
        20    0.39766    0.55556    0.28422    0.18437
        25    0.33329    0.50065    0.20293    0.1353
        30    0.36471    0.57312    0.2043    0.142
BestR =
         2    0.50756    0.43607    0.79943    0.7795    2.5226
         3    0.49993    0.40252    0.90405    0.66955    2.4761
         5    0.50097    0.5215    0.67614    0.74891    2.4475
         7    0.55626    0.43276    0.68583    0.88745    2.5623
         9    0.52481    0.44687    0.50652    0.99529    2.4735
```

```
        10    0.5577    0.58306    0.72496    0.69859    2.5643
        11    0.60581   0.63215    0.76608    0.57695    2.581
        15    0.59556   0.7119     0.78382    0.56641    2.6577
        20    0.60103   0.56653    0.65285    0.85445    2.6749
        25    0.45207   0.69914    0.78553    0.64152    2.5783
        30    0.54933   0.81641    0.58798    0.85225    2.806
inp =
    4
--->  Input(s) = RotationSpeedrevmin
        HL no.    all     train     val      test    Sum Bst R
        -----     ---     -----     ---      ----    ---------
MeanR =
         2    0.18874    0.21618    0.2219    0.064022
         3    0.2065     0.23453    0.17691   0.11757
         5    0.34791    0.37109    0.40186   0.26522
         7    0.35573    0.41026    0.36962   0.26728
         9    0.39567    0.46375    0.36794   0.29366
        10    0.36286    0.42527    0.34325   0.20991
        11    0.39681    0.45103    0.31338   0.27769
        15    0.34507    0.43712    0.32806   0.22229
        20    0.39246    0.50725    0.37181   0.19305
        25    0.38555    0.51865    0.343     0.18902
        30    0.44726    0.58381    0.30364   0.29581
BestR =
         2    0.49004    0.50821    0.83692    0.56498    2.4001
         3    0.51445    0.47446    0.73886    0.72102    2.4488
         5    0.51841    0.48004    0.6531     0.86039    2.5119
         7    0.52236    0.4635     0.751      0.65096    2.3878
         9    0.67117    0.64938    0.61238    0.8        2.7329
        10    0.53967    0.48337    0.79286    0.57129    2.3872
        11    0.7253     0.79665    0.54789    0.53125    2.6011
        15    0.60752    0.67265    0.41378    0.74745    2.4414
        20    0.81899    0.80521    0.90215    0.50519    3.0315
        25    0.75711    0.80873    0.43948    0.86412    2.8694
        30    0.77732    0.84556    0.73359    0.65522    3.0117
inp =
    5
--->  Input(s) = MovingSpeedfth
        HL no.    all     train     val      test    Sum Bst R
        -----     ---     -----     ---      ----    ---------
MeanR =
         2    0.10586    0.13028    0.092724    0.030175
         3    0.1195     0.1687     0.055869   -0.011732
         5    0.10221    0.12315    0.15625     0.0050608
         7    0.20263    0.25791    0.20089     0.0024654
         9    0.21231    0.27812    0.17801     0.026866
        10    0.29775    0.38664    0.27893     0.062657
        11    0.21996    0.303      0.18395     0.013358
        15    0.32335    0.42713    0.27219     0.092479
        20    0.30358    0.44285    0.28162     0.12801
        25    0.36928    0.52123    0.32655     0.14762
```

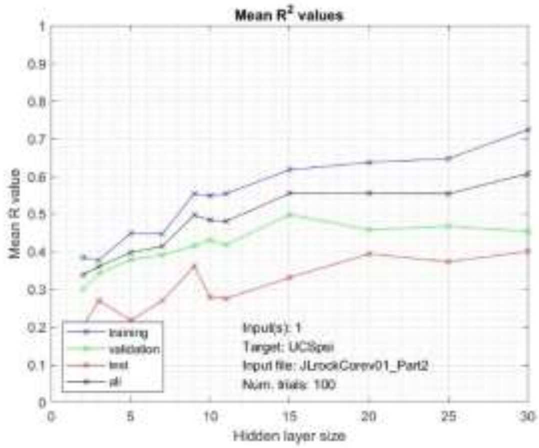
```
        30    0.36771    0.54727    0.25685     0.1517
BestR =
         2    0.13866   0.042928    0.60244    0.47061     1.2546
         3    0.43304    0.47721    0.76685   -0.28246     1.3946
         5    0.38939    0.45498    0.33927    0.27183     1.4555
         7    0.56925     0.6038    0.60676    0.59546     2.3753
         9    0.61084    0.74931    0.51754     0.5314     2.4091
        10    0.65188    0.68029    0.72679    0.66011     2.7191
        11    0.52773    0.51215    0.87071    0.31855     2.2291
        15    0.62463    0.61089    0.79489    0.60277     2.6332
        20    0.59308    0.63368    0.69908    0.84774     2.7736
        25    0.63401    0.65763    0.75426    0.75229     2.7982
        30    0.54985    0.62439    0.83859    0.38598     2.3988
inp =
    6
--->  Input(s) = SpecificEnergyftlbft3
        HL no.     all      train       val        test    Sum Bst R
        -----      ---      -----       ---        ----    ---------
MeanR =
         2    0.53032    0.53366    0.55108    0.53383
         3    0.57025    0.58297     0.6048    0.54422
         5    0.59321    0.61595    0.60861    0.51758
         7    0.58308    0.60476    0.59403    0.52218
         9    0.58469    0.61225    0.57605    0.56518
        10    0.58482    0.62889    0.49689     0.5323
        11    0.56614    0.60658    0.58767    0.48495
        15    0.56335    0.62323    0.51044    0.41995
        20    0.51572    0.60187    0.53715     0.3349
        25    0.48366    0.62145    0.42534    0.36163
        30    0.46711    0.60854    0.44761    0.31391
BestR =
         2    0.59926    0.66762    0.85687     0.7696     2.8933
         3    0.68432    0.61486    0.85636    0.77165     2.9272
         5    0.65817     0.6664    0.84747    0.83284     3.0049
         7    0.66758     0.6713     0.9785    0.67408     2.9915
         9    0.65183    0.67764    0.79459    0.93393      3.058
        10    0.69587    0.71497    0.68637    0.80645     2.9037
        11    0.65435    0.63989    0.95243    0.78223     3.0289
        15    0.65778    0.72856    0.72693    0.73795     2.8512
        20    0.72519    0.66985    0.83901    0.80674     3.0408
        25    0.73259     0.8197    0.81116    0.53158      2.895
        30    0.74172    0.73166    0.86593     0.8558     3.1951
--------------------
Elapsed time is 5261.830468 seconds.
Elapsed time is 87.6972 minutes.
```

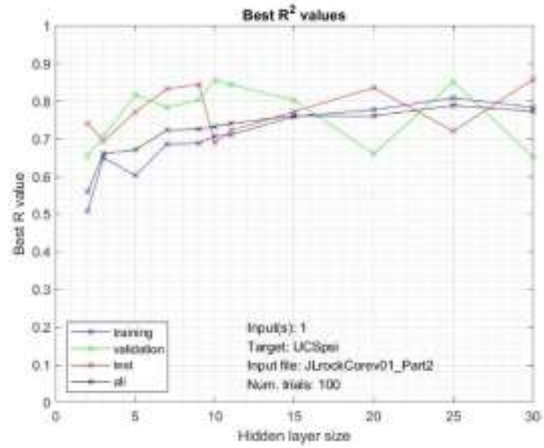
Appendix E – NN modeling for UCS: mean R^2 and best R^2 from 100 iterations, hidden layer size 2 to 30, 63 combinations of 6 inputs

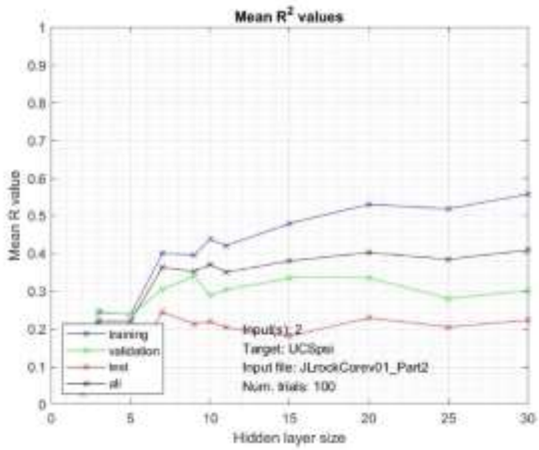
The inset text on each plot shows the training input number code, the training target, input file name (for reference) and the number of modeling iterations (trials). The legend on the plots is color coded for the data sets: blue for training, green for validation, red for testing and black for all.

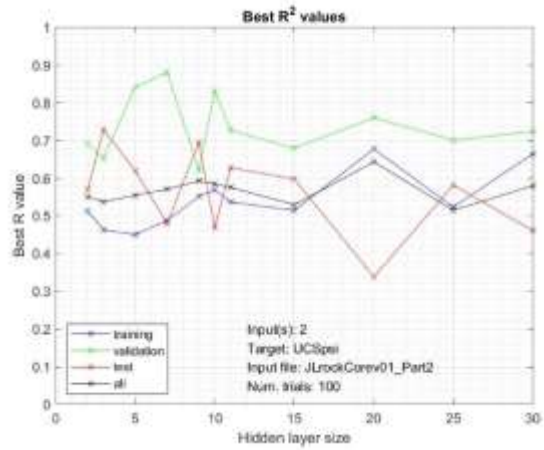
Appendix E-1 – Plots of mean and best R^2 values for UCS

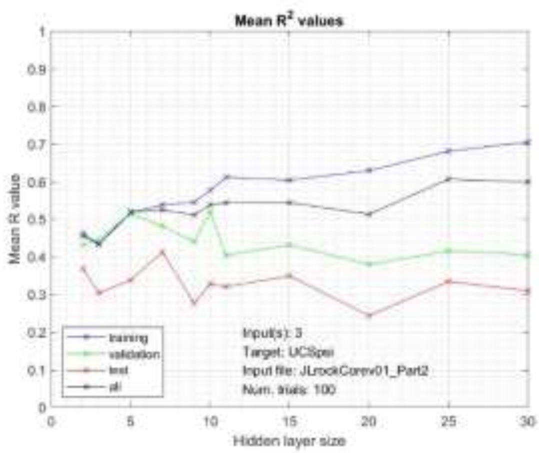
Results for NN modeling of UCS. Appendix E-1 contains the two sets of 63 network scenario plots (mean R^2 and best R^2 for 100 trials).

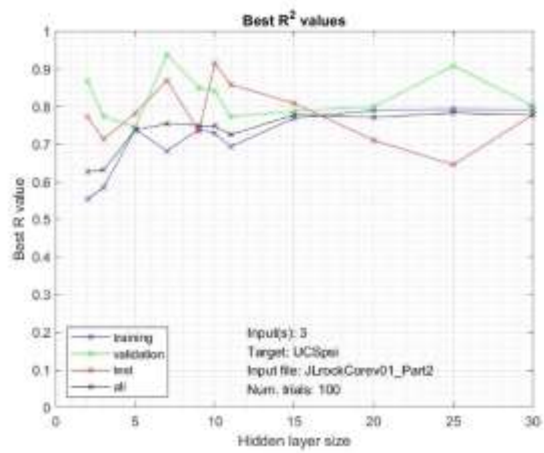


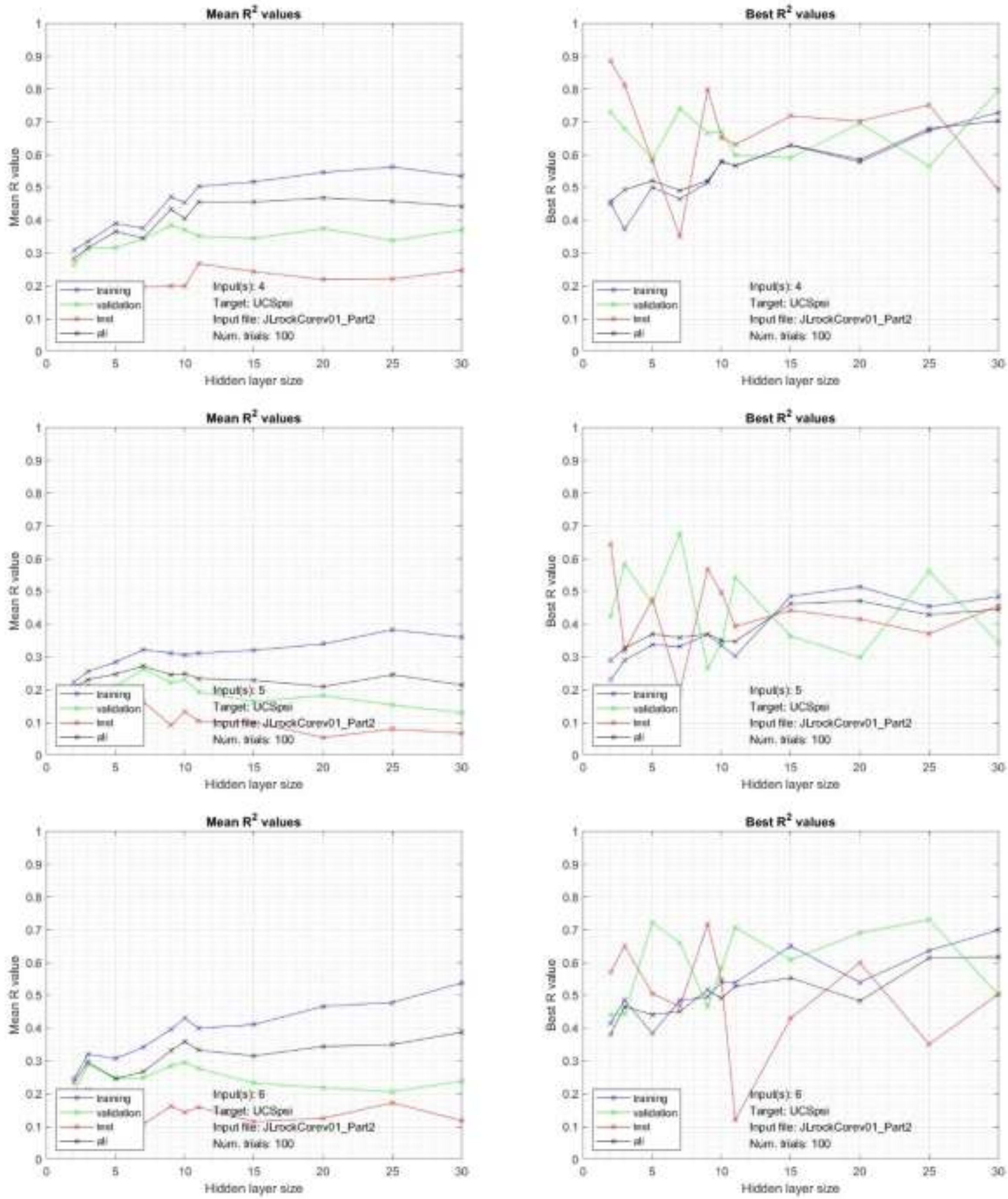


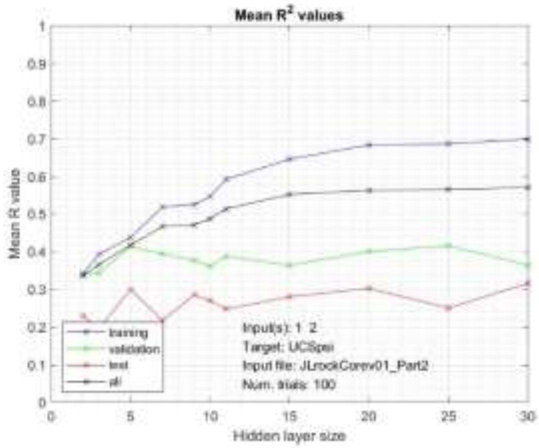


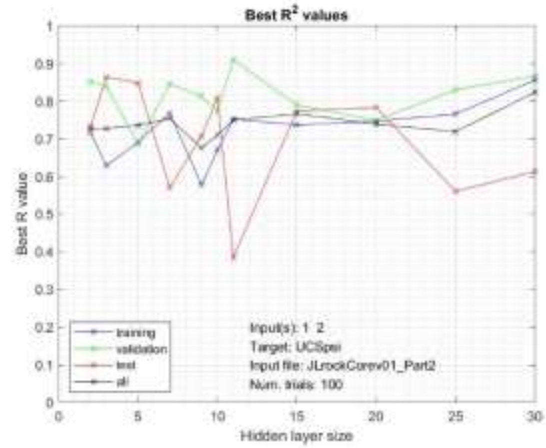


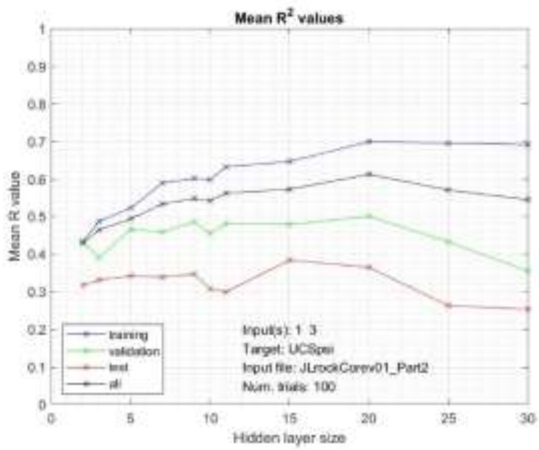


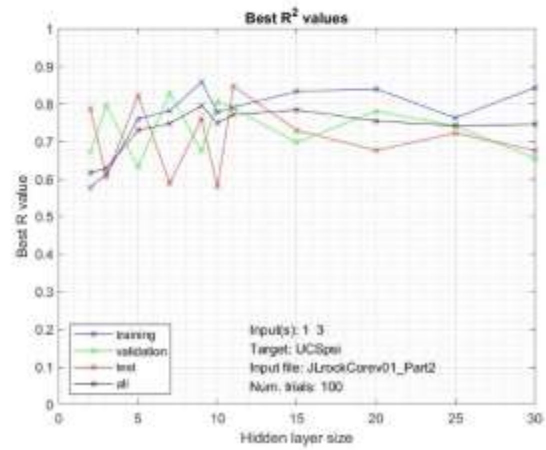


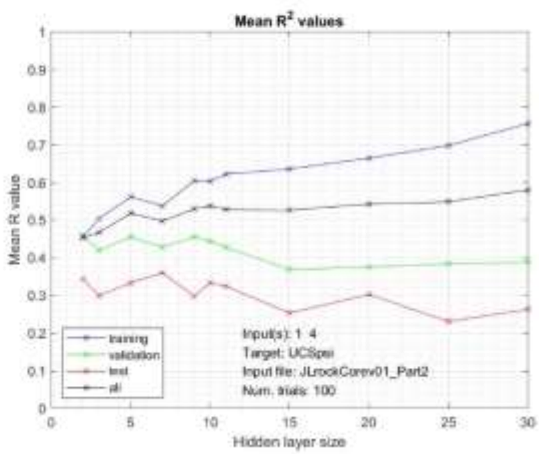

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 4
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100
Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 4
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100
Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100
Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100
Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100
Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

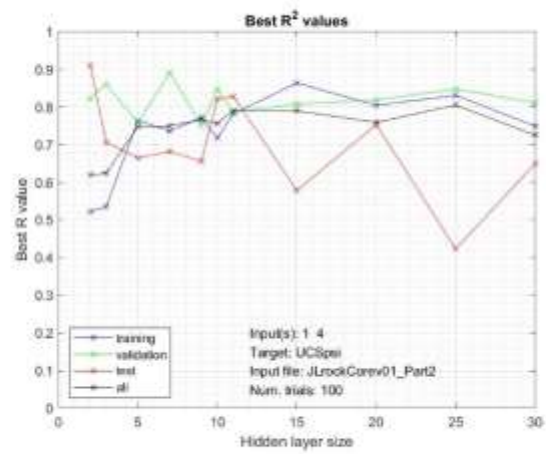

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

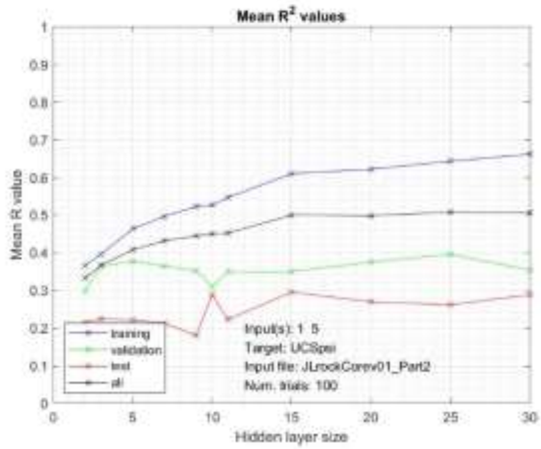

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

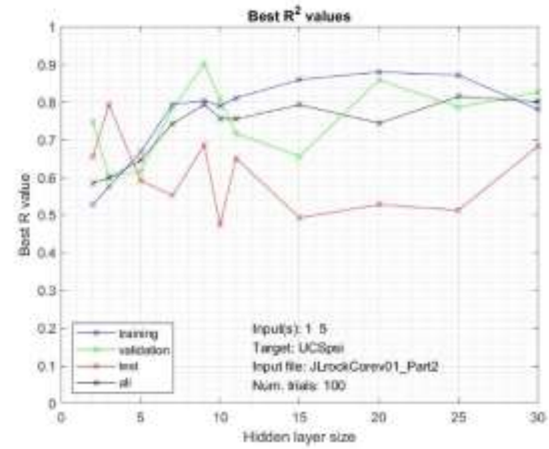

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

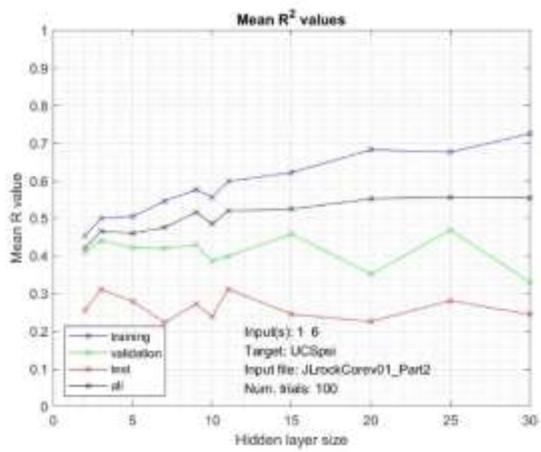

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

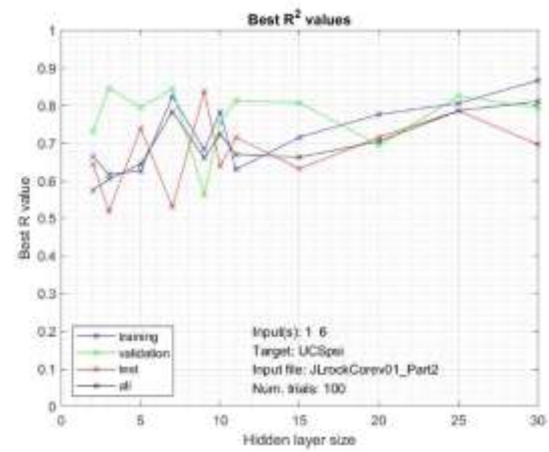

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 4
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

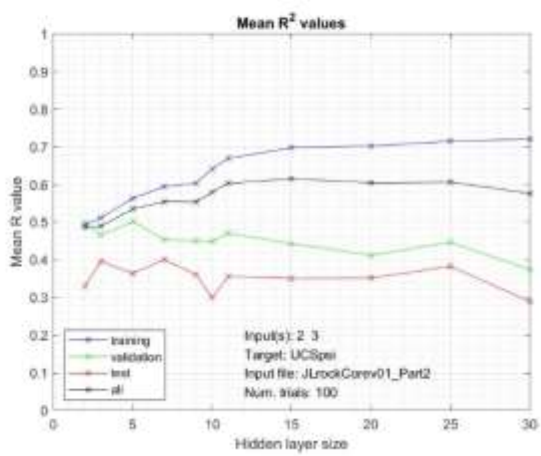

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 4
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

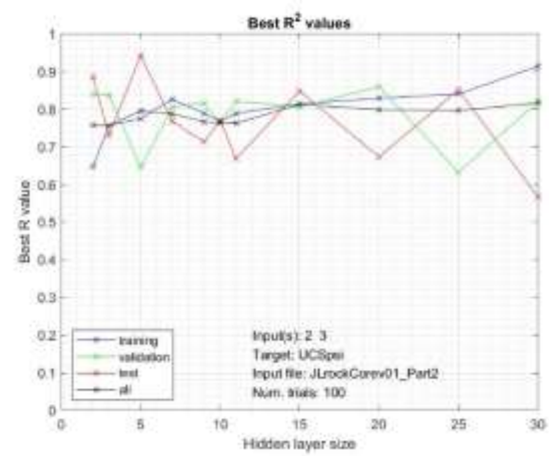

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

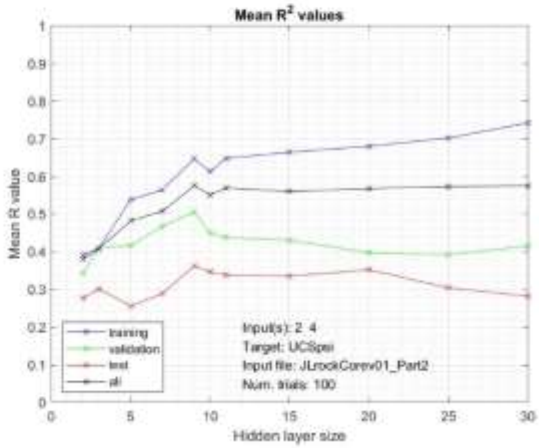

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

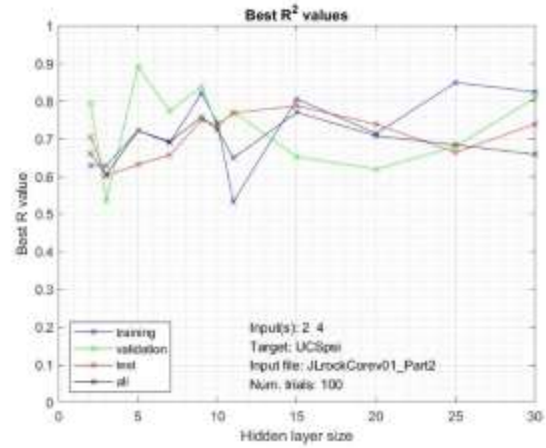

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

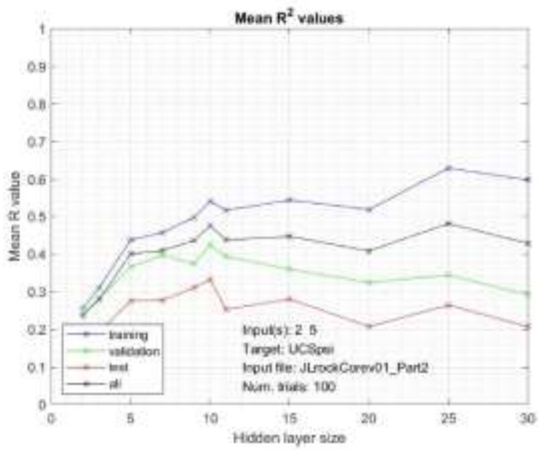

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

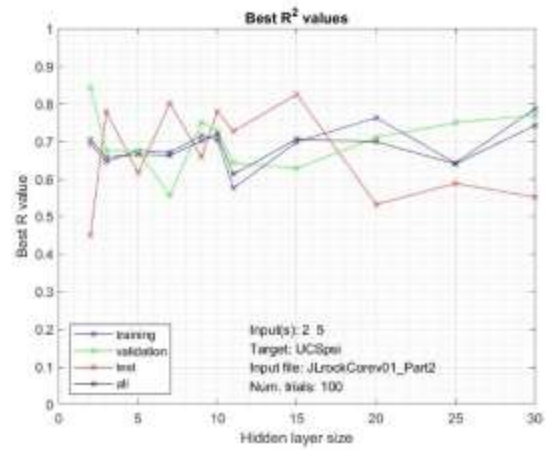

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

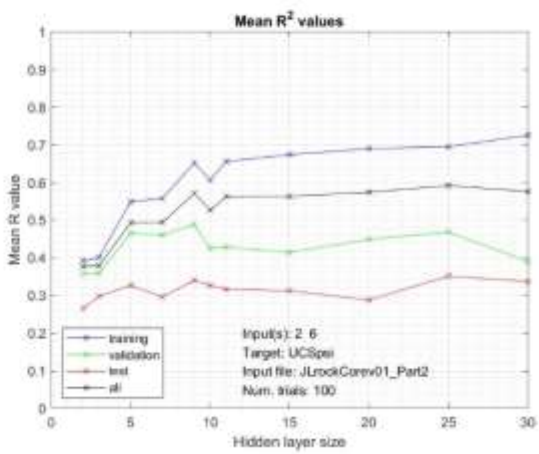

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 3
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

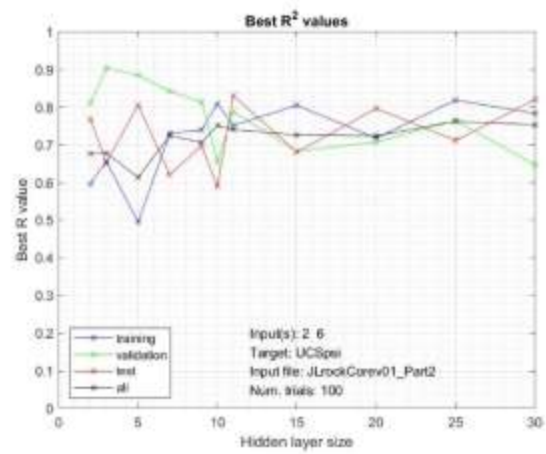

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 4
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

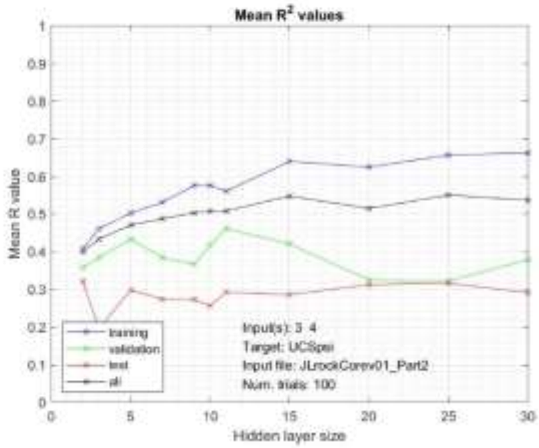

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 4
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

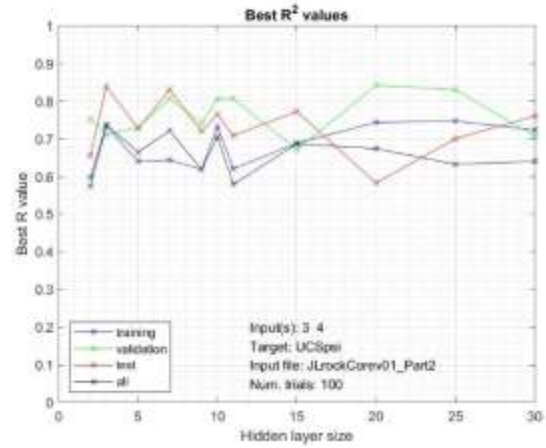

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

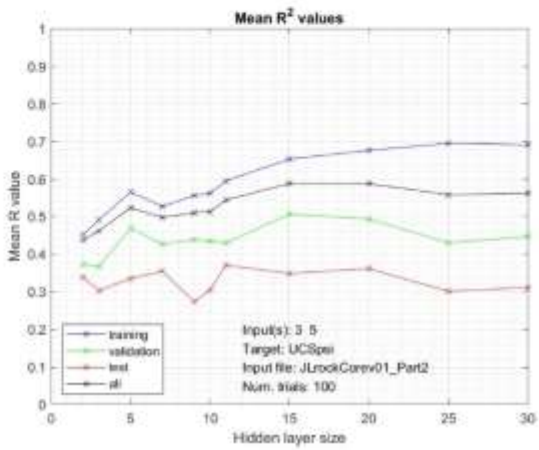

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

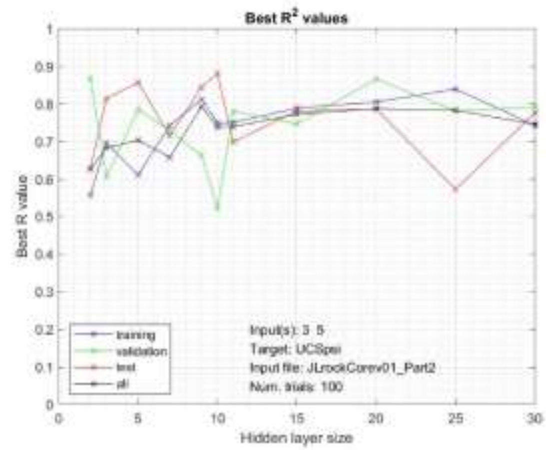

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

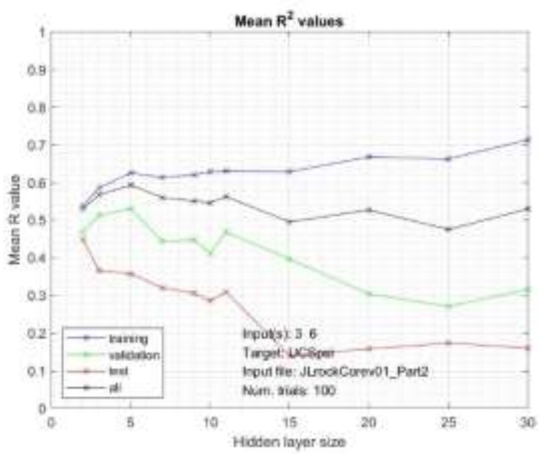

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

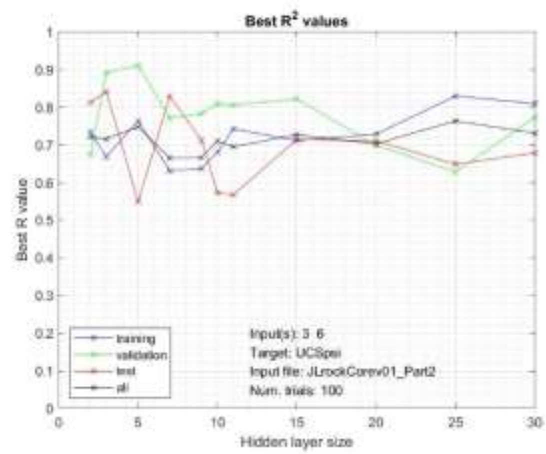

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 4
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

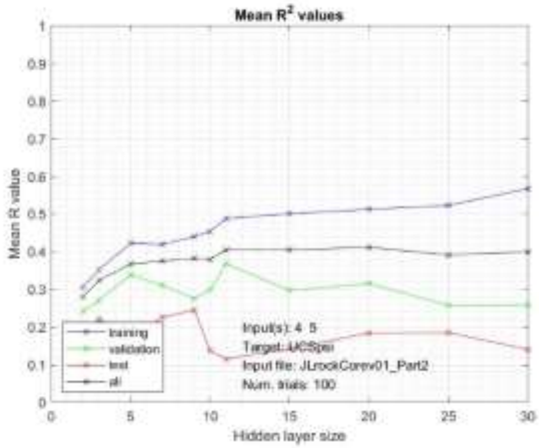

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 4
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

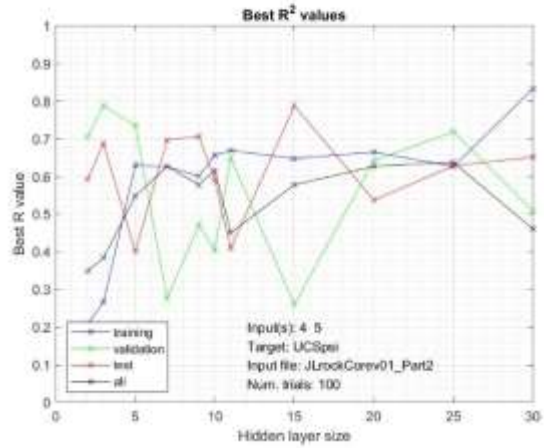

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

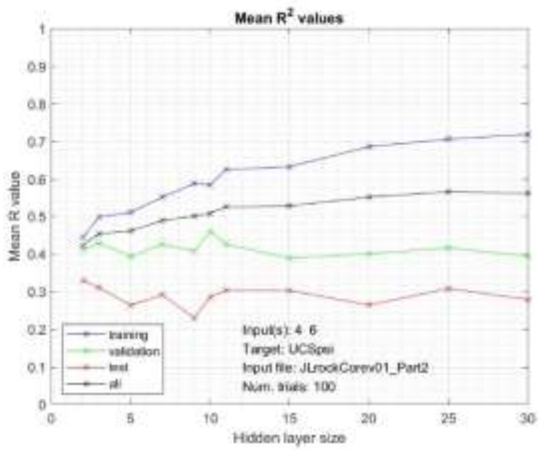

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

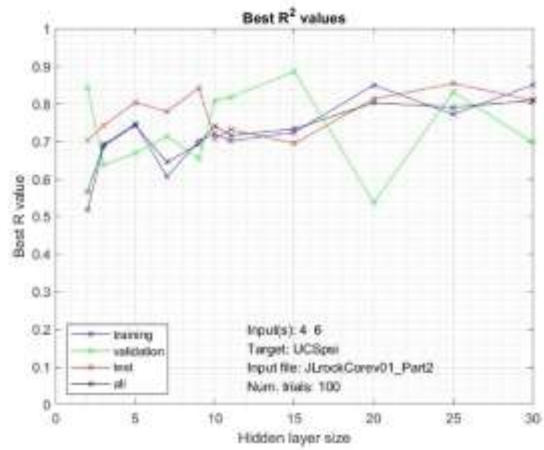

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

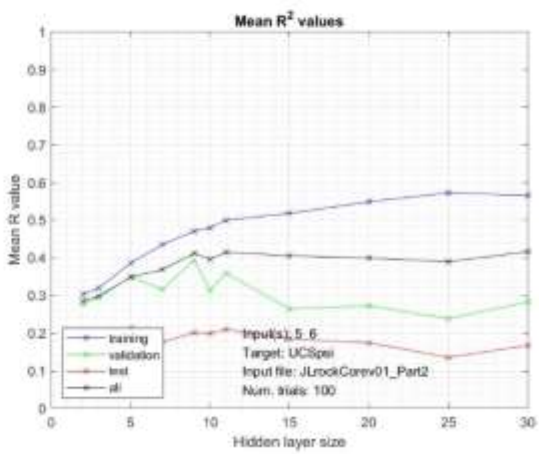

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

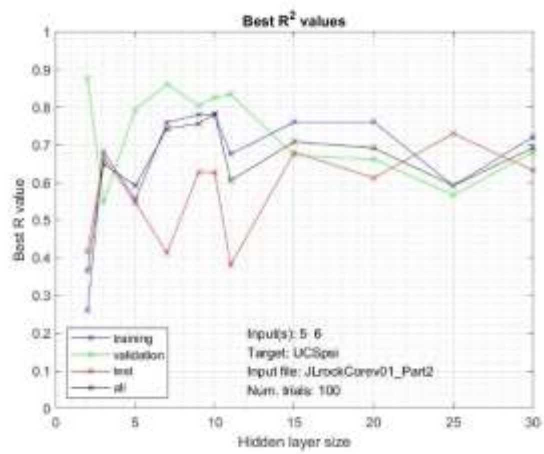

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 4 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

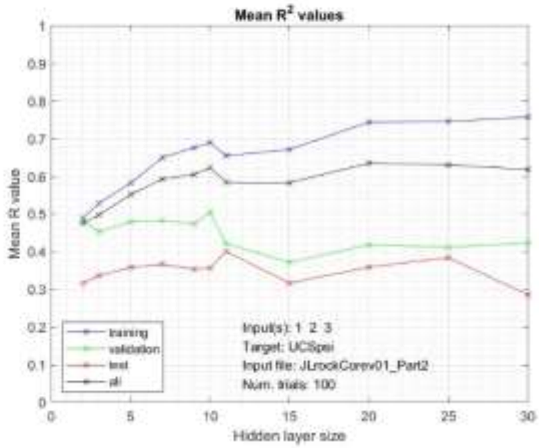

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 4 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

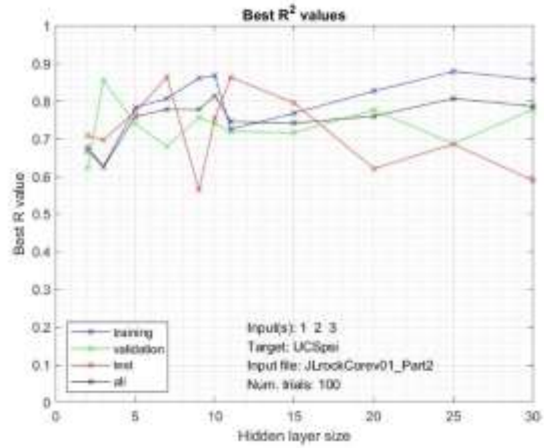

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

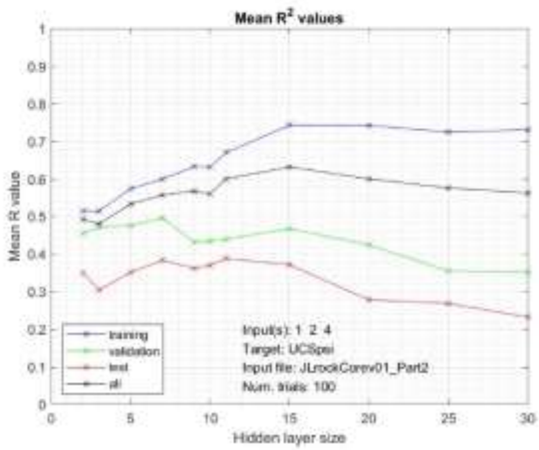

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

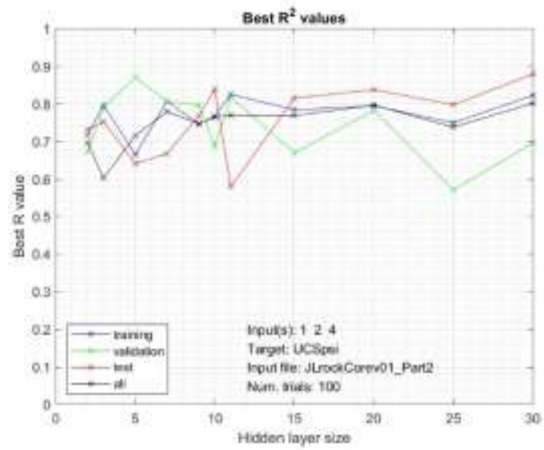

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

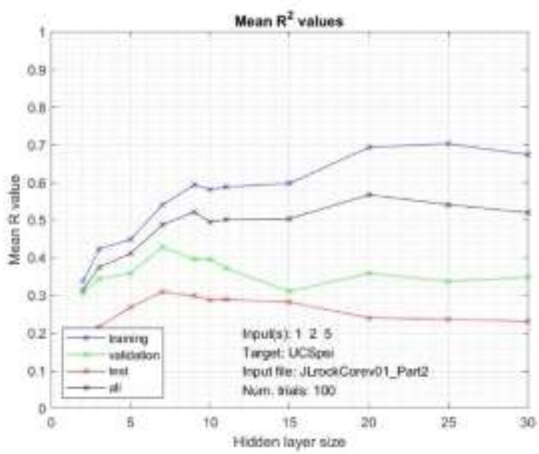

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

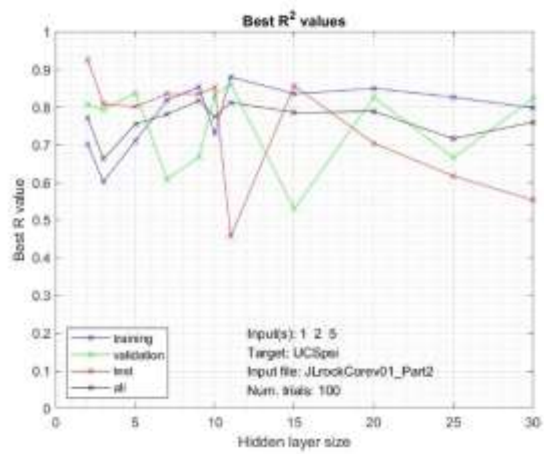

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3
Target: UCSpei
Input file: JLrockCorev01_Part2
Num. trials: 100

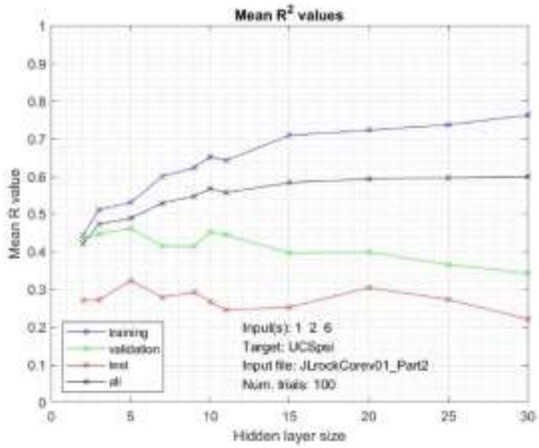

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3
Target: UCSpei
Input file: JLrockCorev01_Part2
Num. trials: 100

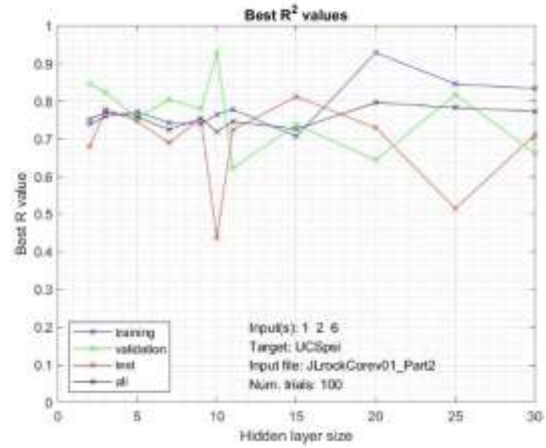

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 4
Target: UCSpei
Input file: JLrockCorev01_Part2
Num. trials: 100

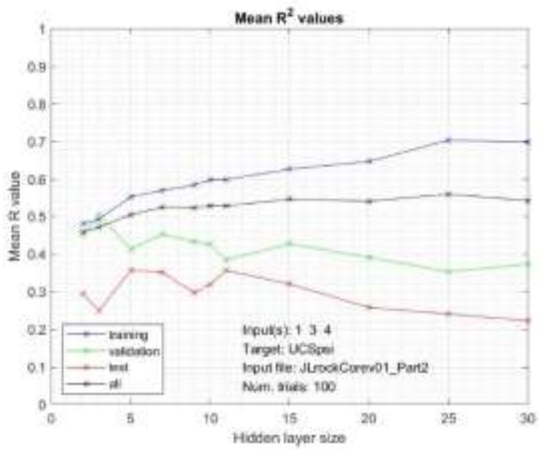

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 4
Target: UCSpei
Input file: JLrockCorev01_Part2
Num. trials: 100

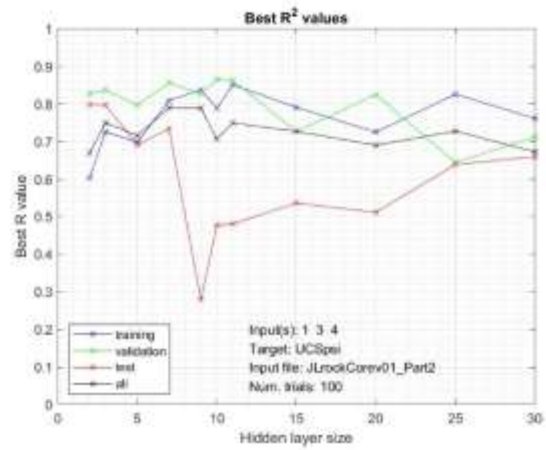

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 5
Target: UCSpei
Input file: JLrockCorev01_Part2
Num. trials: 100

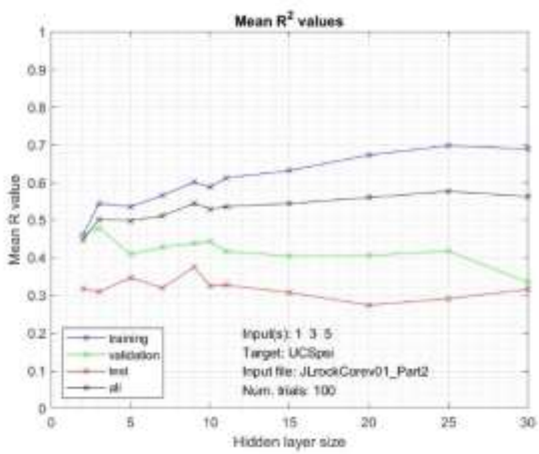

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 5
Target: UCSpei
Input file: JLrockCorev01_Part2
Num. trials: 100

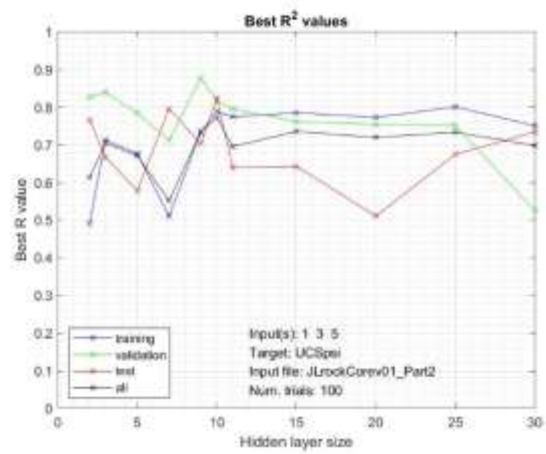

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

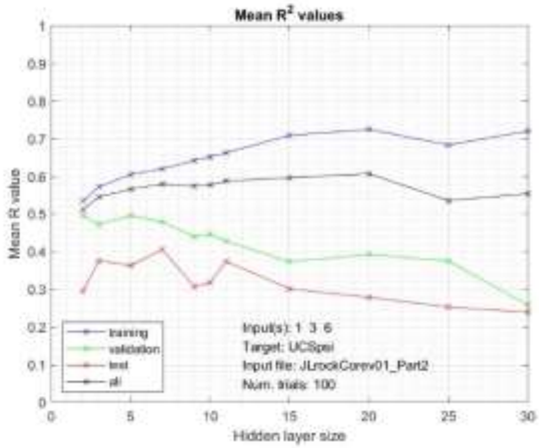

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

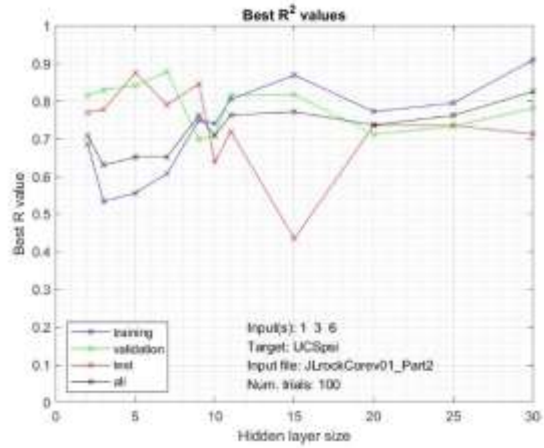

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

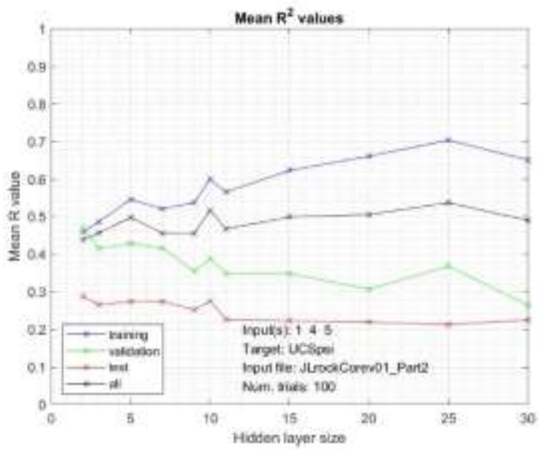

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

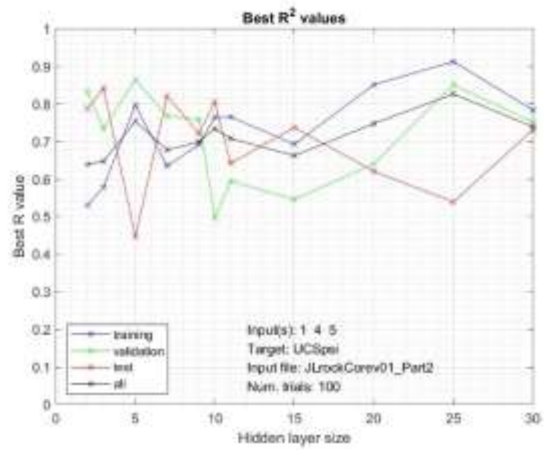

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

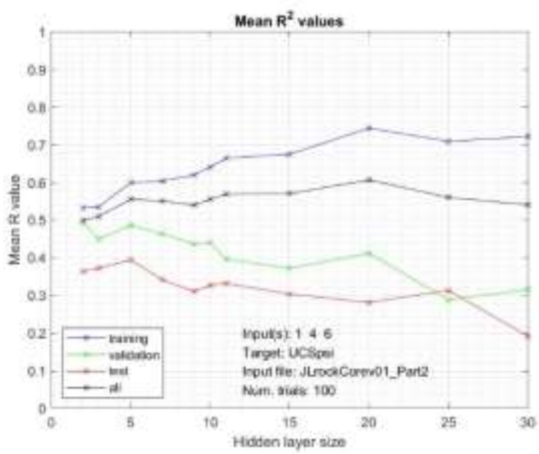

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

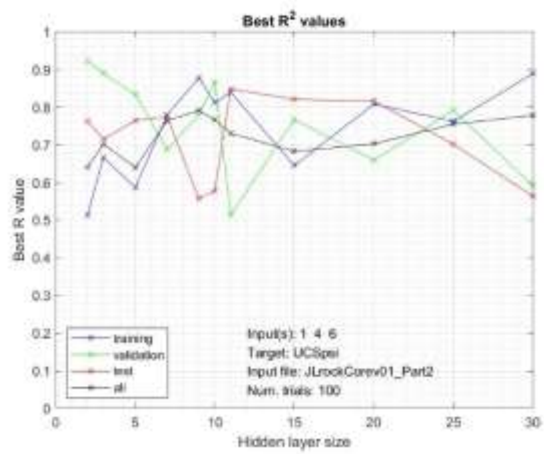

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

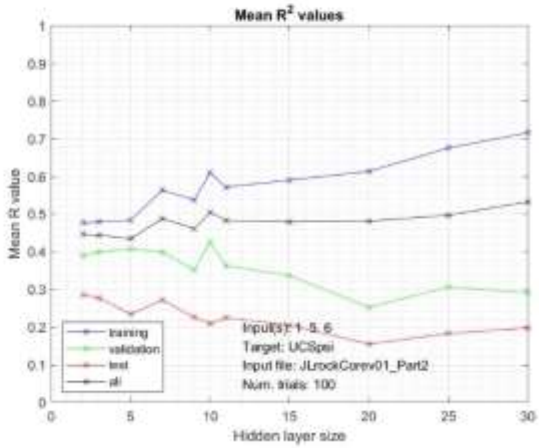

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

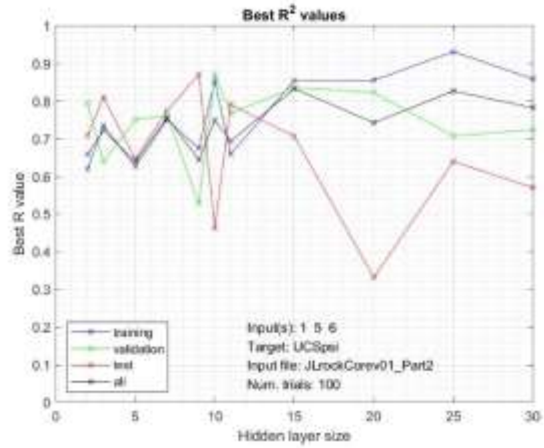

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

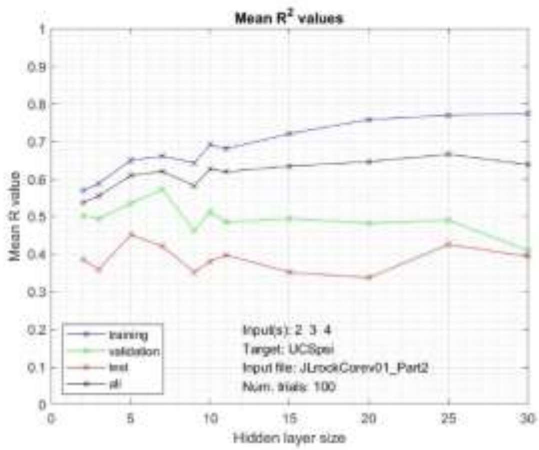

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

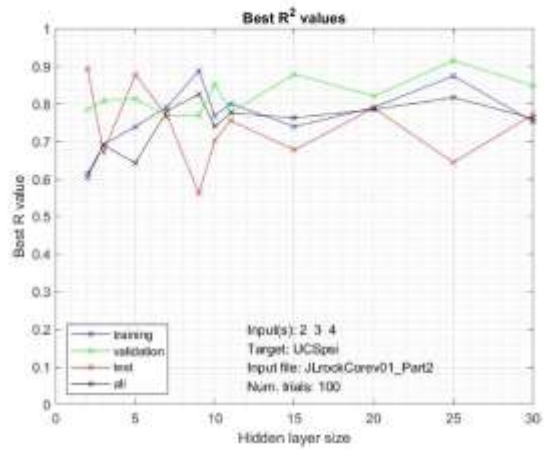

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

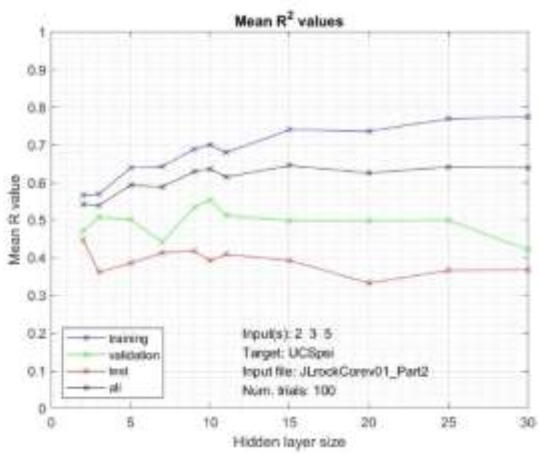

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
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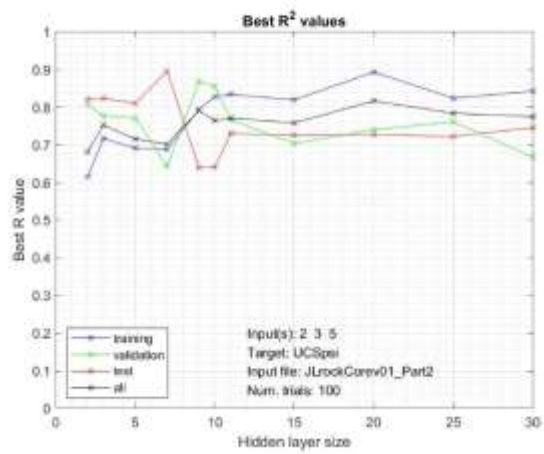
test
all
Input(s): 2 3 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
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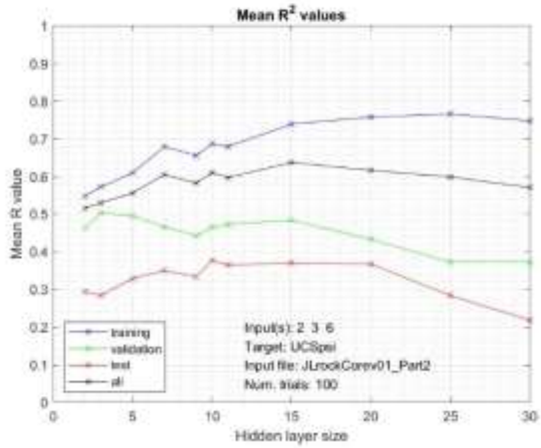
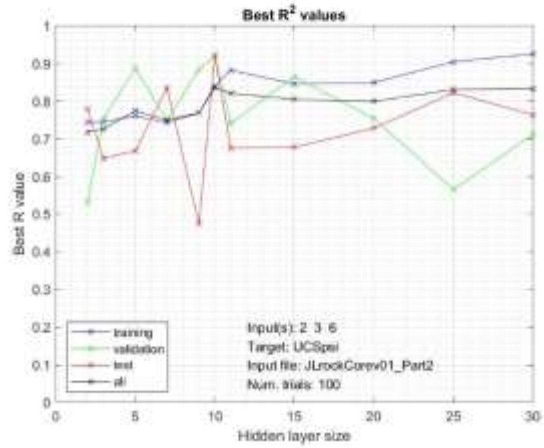
Input(s): 2 3 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R^2 values
Best R value
Hidden layer size
training
validation
test
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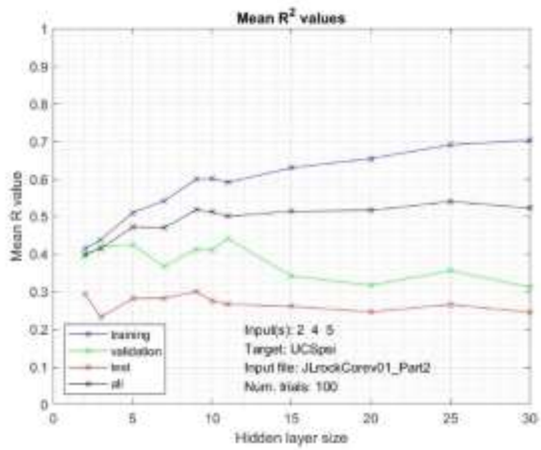
Input(s): 2 3 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
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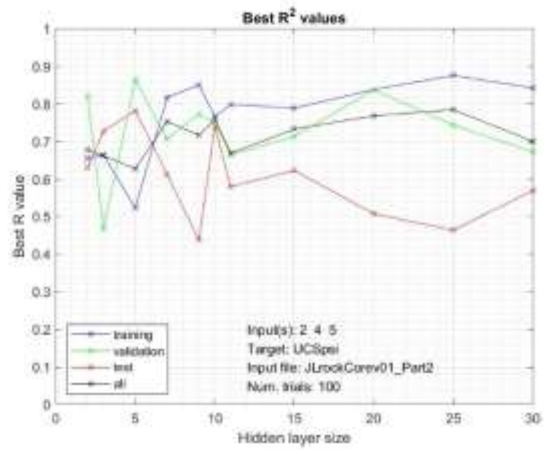
Input(s): 2 4 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R^2 values
Best R value
Hidden layer size
training
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test
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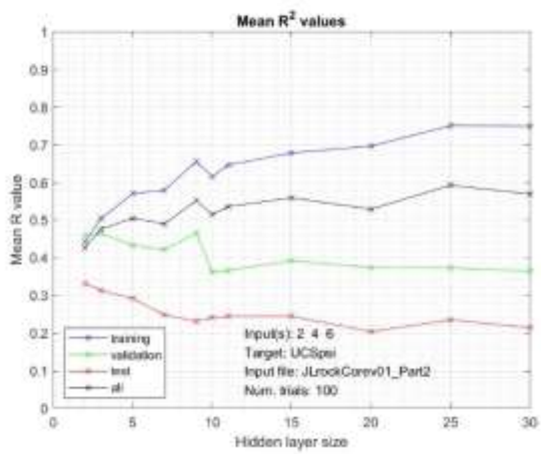
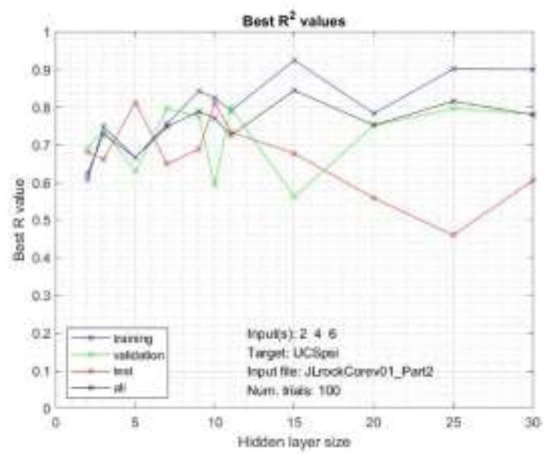
Input(s): 2 4 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R^2 values
Best R value
Hidden layer size
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validation
test
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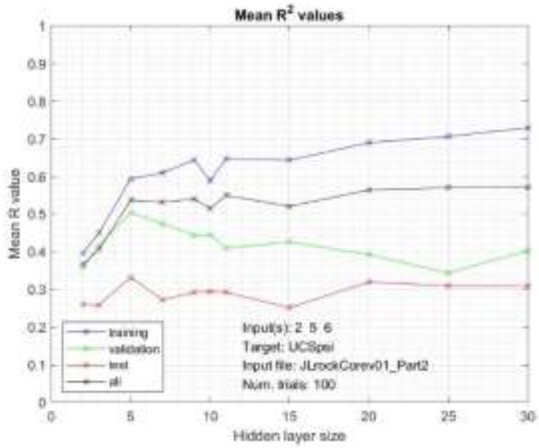
Input(s): 2 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
Hidden layer size
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validation
test
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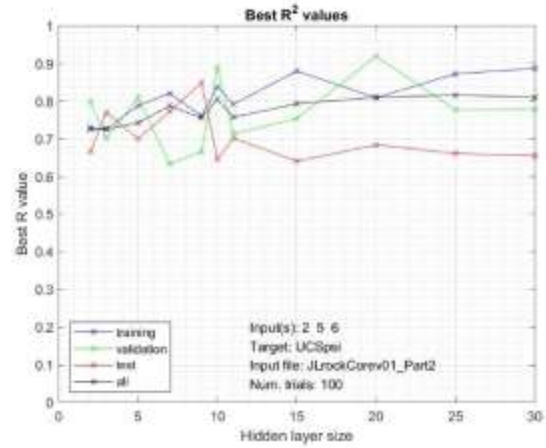
Input(s): 2 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R^2 values
Best R value
Hidden layer size
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validation
test
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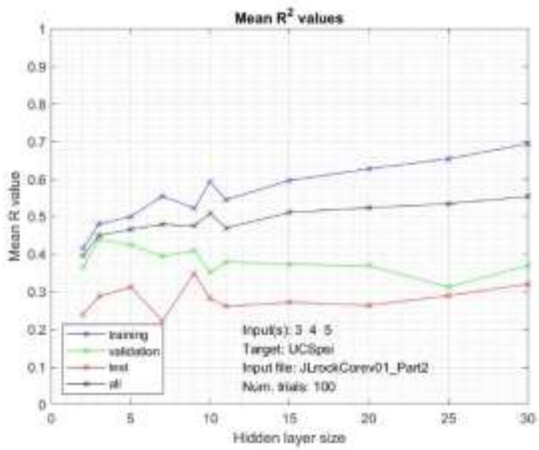
Input(s): 2 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
Hidden layer size
training
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test
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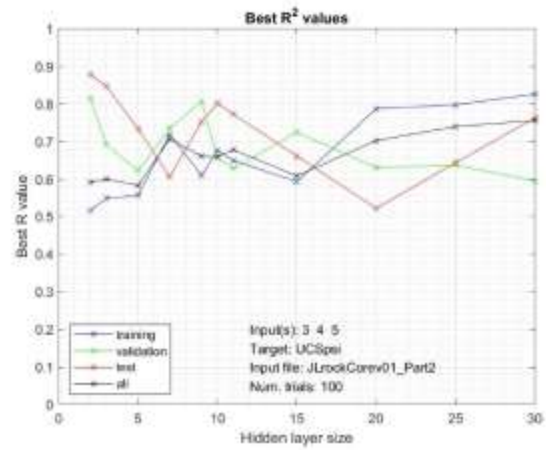
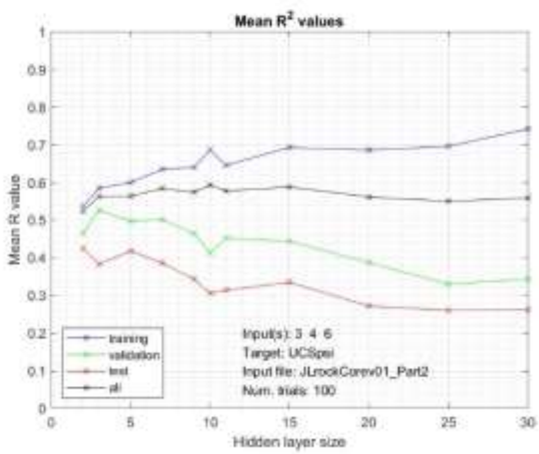
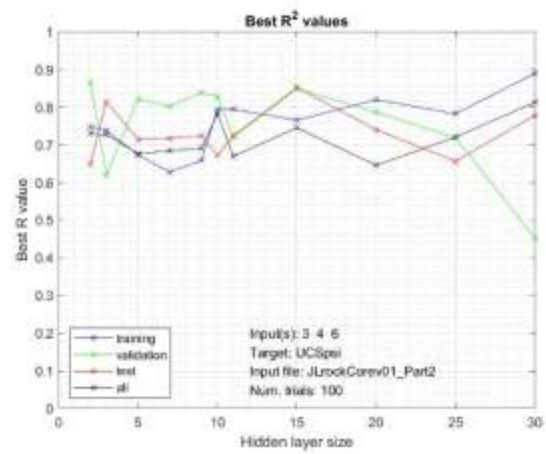
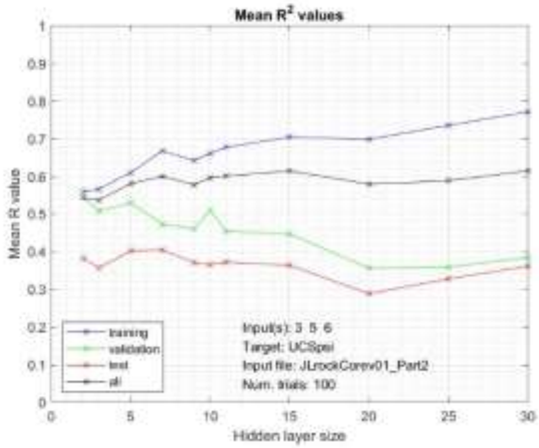
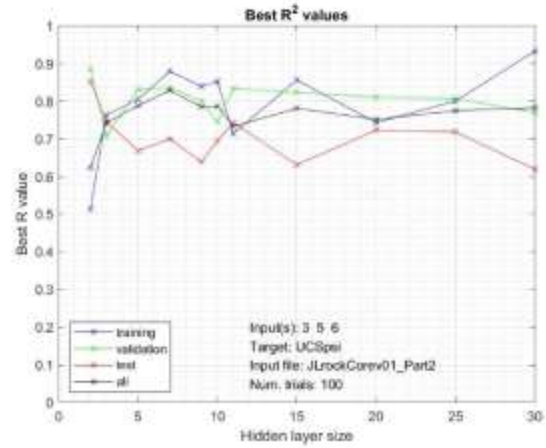
Input(s): 3 4 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

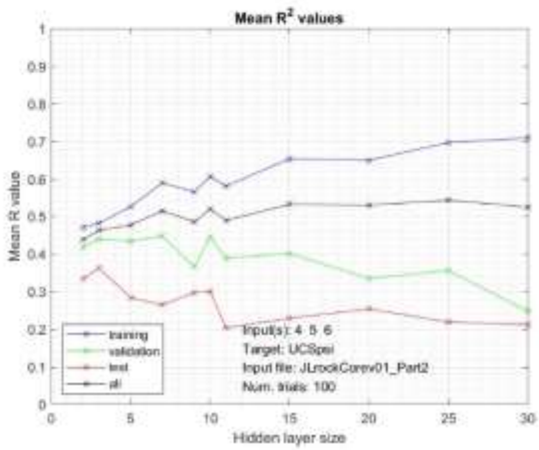

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 4 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

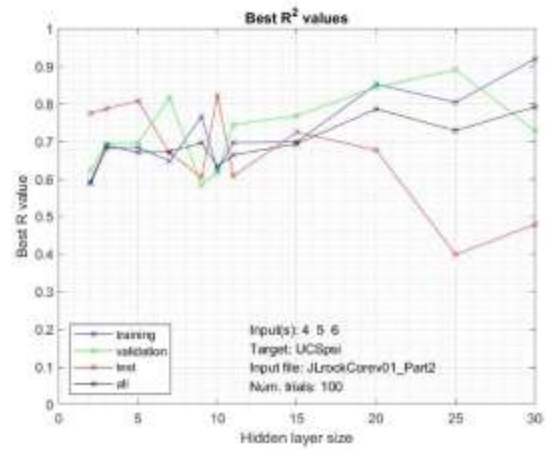

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

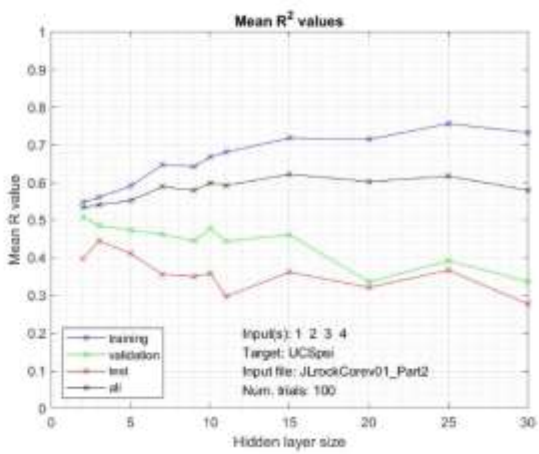

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

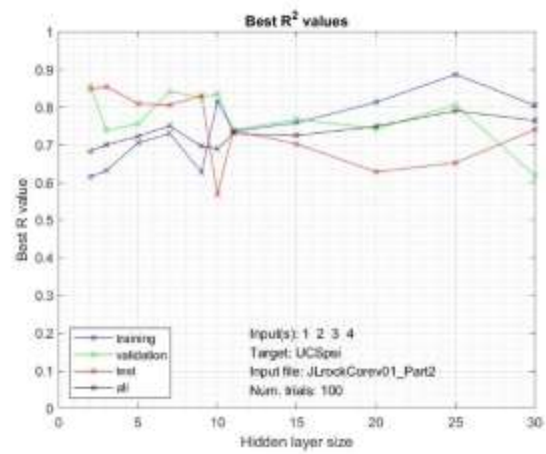

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

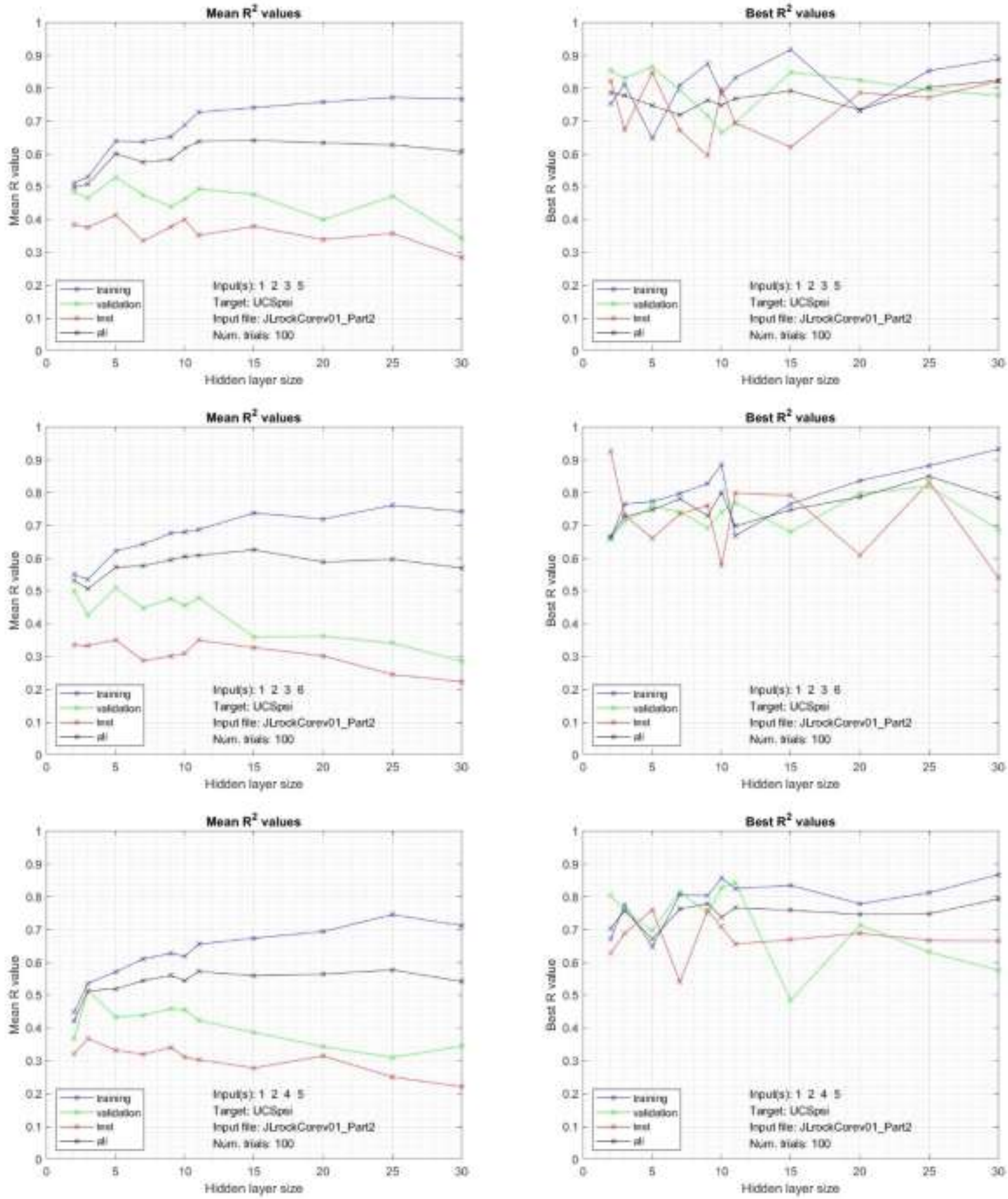

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

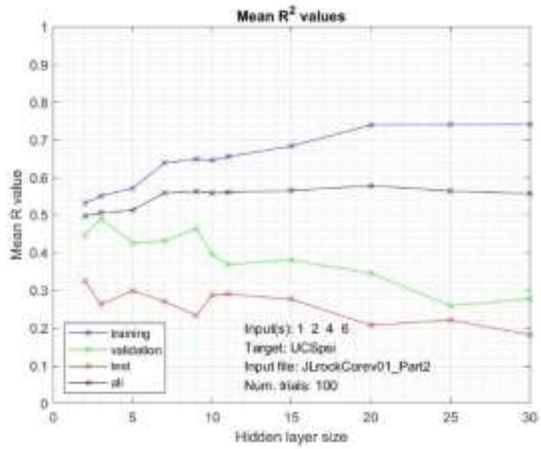

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

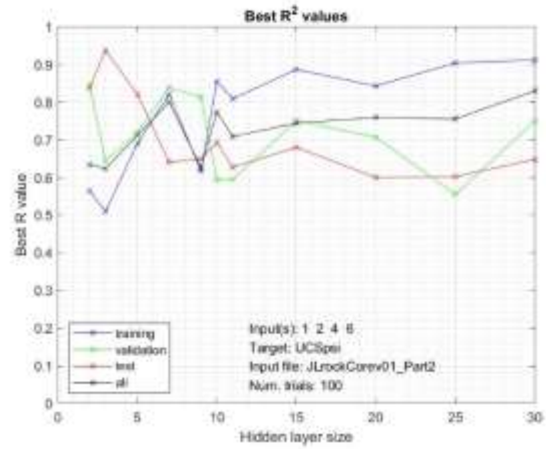

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 5
Target: UCSpei
Input file: JLrockCorev01_Part2
Num. trials: 100
Best R² values
Best R value
Hidden layer size
Input(s): 1 2 3 5
Target: UCSpei
Input file: JLrockCorev01_Part2
Num. trials: 100
Mean R² values
Input(s): 1 2 3 6
Target: UCSpei
Input file: JLrockCorev01_Part2
Num. trials: 100
Best R² values
Input(s): 1 2 3 6
Target: UCSpei
Input file: JLrockCorev01_Part2
Num. trials: 100
Mean R² values
Input(s): 1 2 4 5
Target: UCSpei
Input file: JLrockCorev01_Part2
Num. trials: 100
Best R² values
Input(s): 1 2 4 5
Target: UCSpei
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
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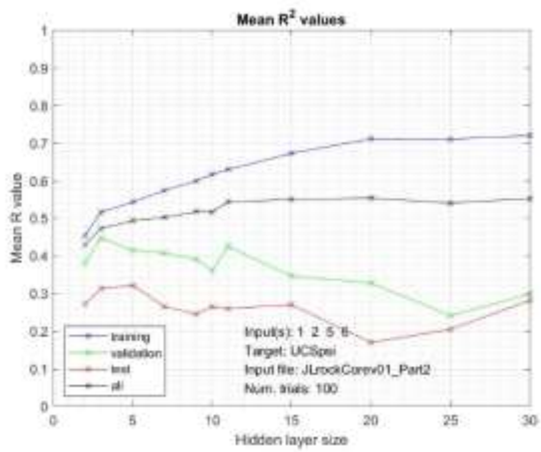
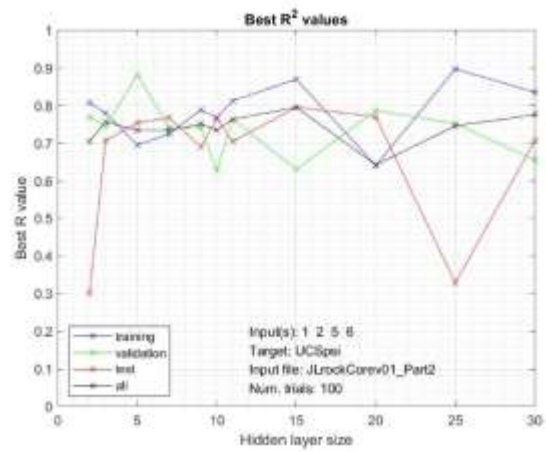
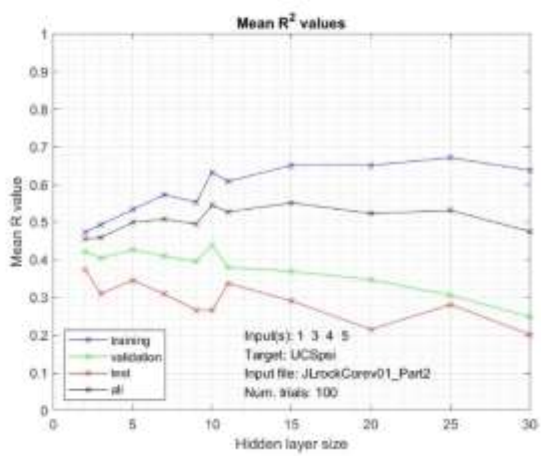
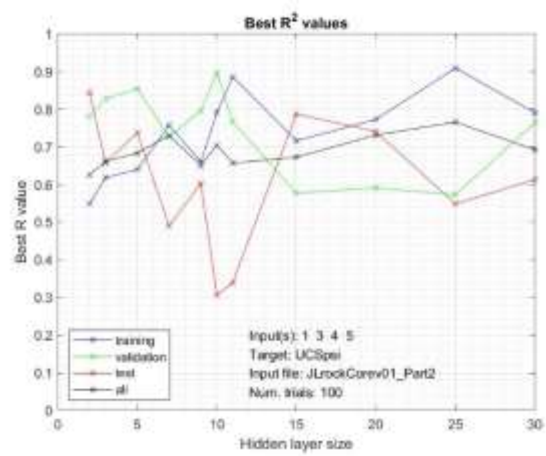
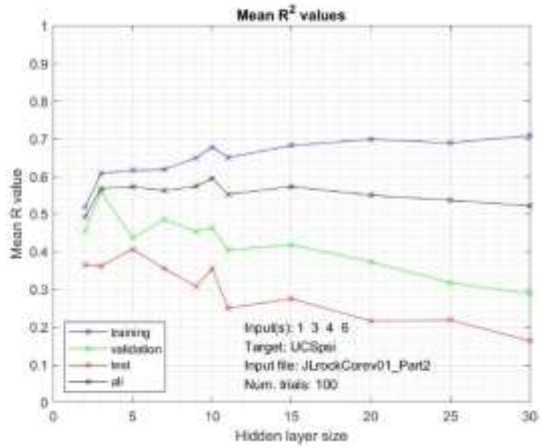
validation
test
all
Input(s): 1 2 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
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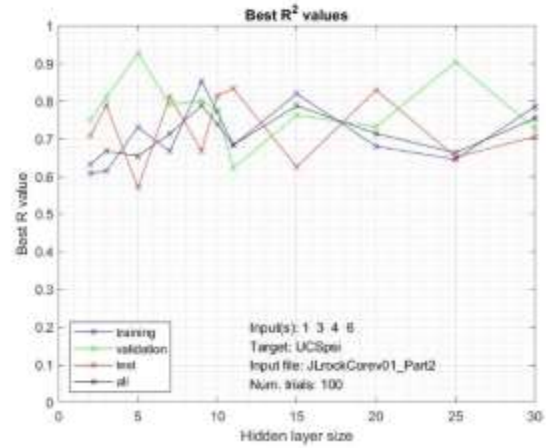
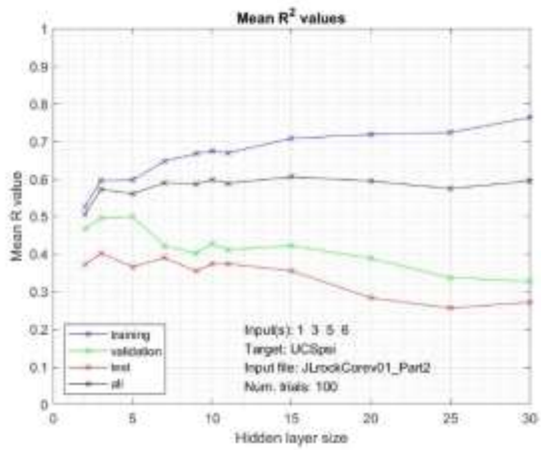
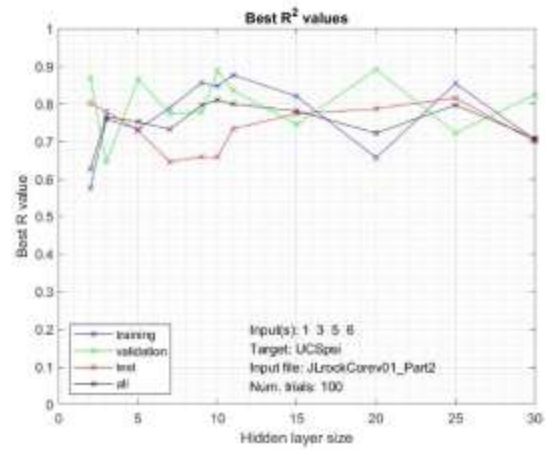
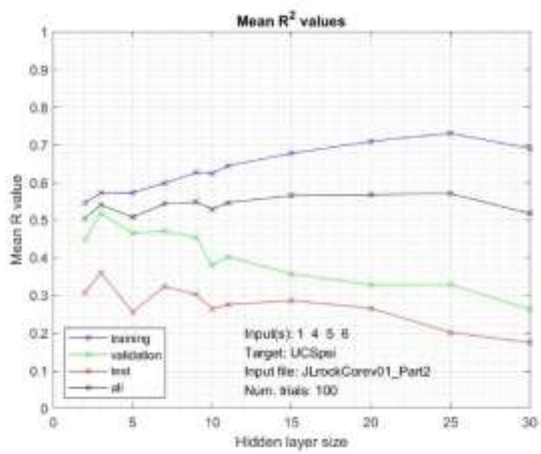
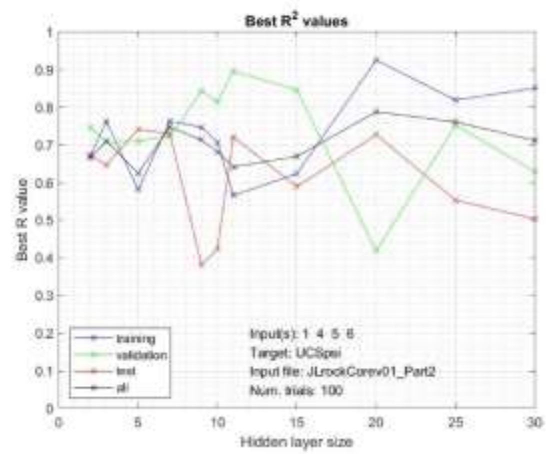
validation
test
all
Input(s): 1 3 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

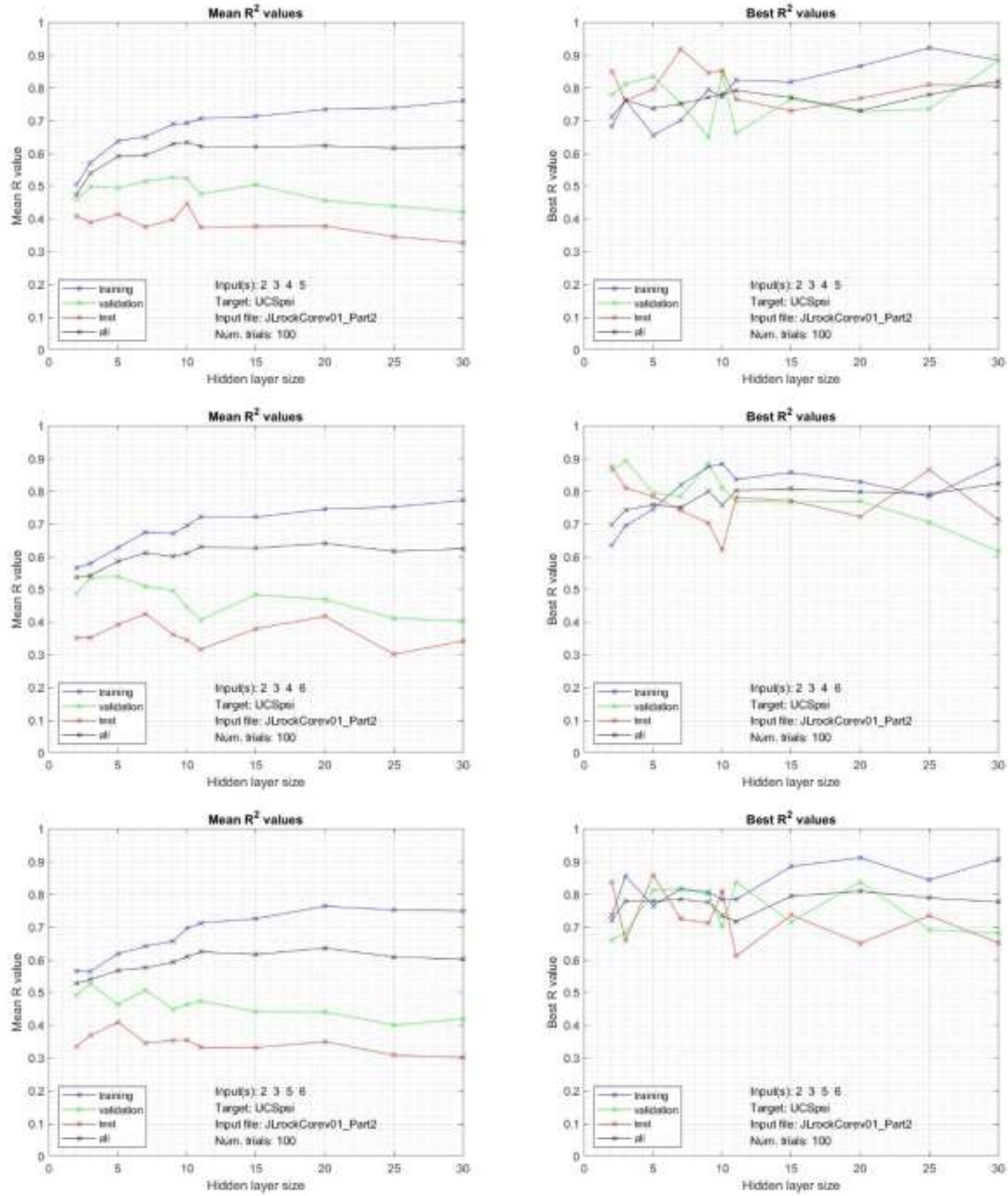

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

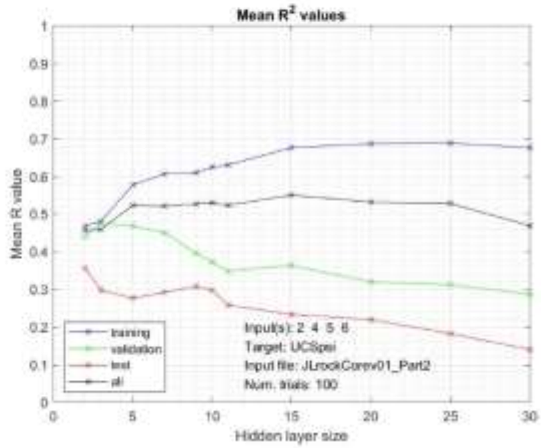

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

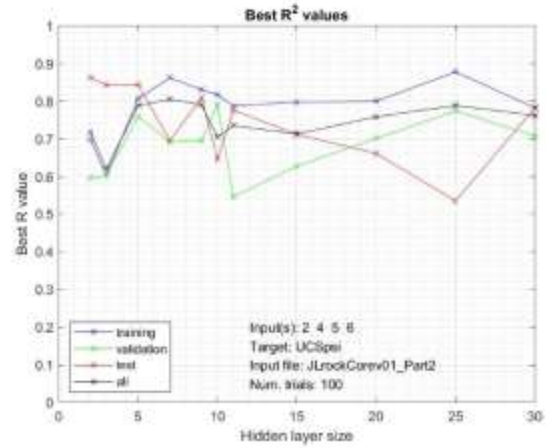

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

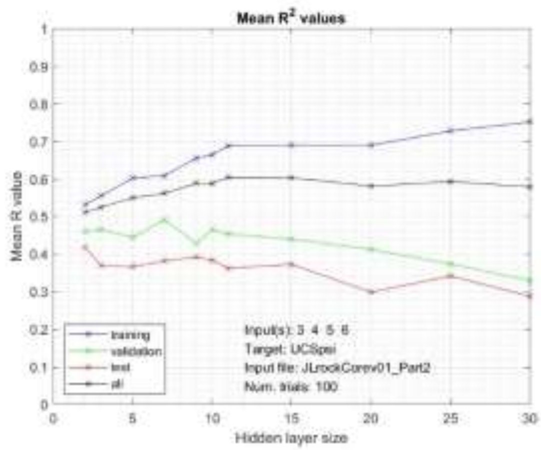

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

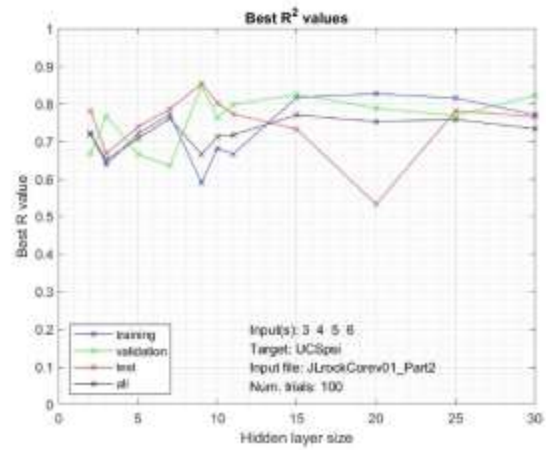

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

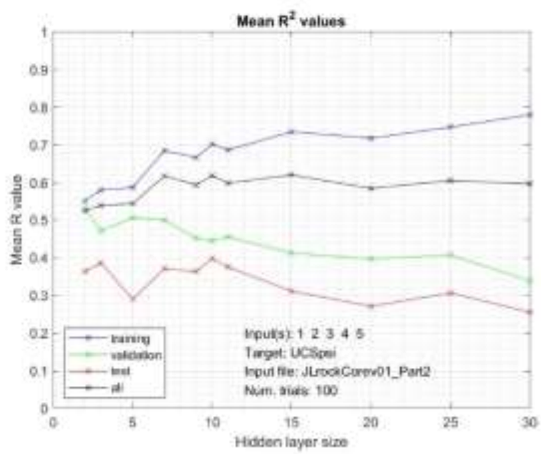

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100
Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100
Mean R² values
Mean R value
Hidden layer size
Input(s): 2 3 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100
Best R² values
Best R value
Hidden layer size
Input(s): 2 3 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100
Mean R² values
Mean R value
Hidden layer size
Input(s): 2 3 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100
Best R² values
Best R value
Hidden layer size
Input(s): 2 3 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

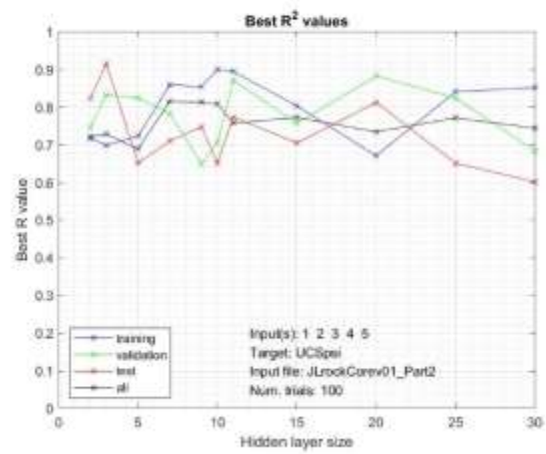

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

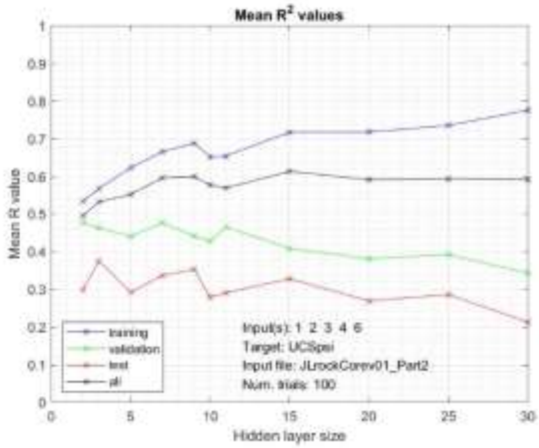

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

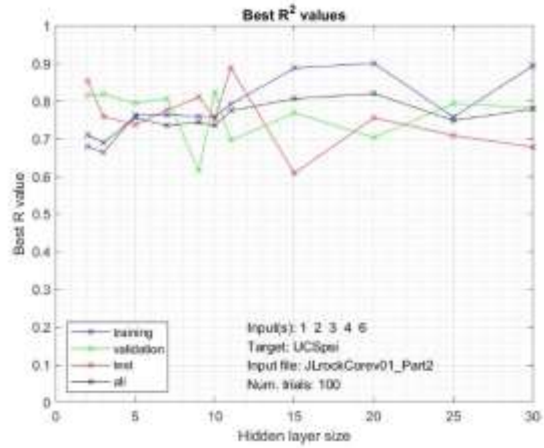

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

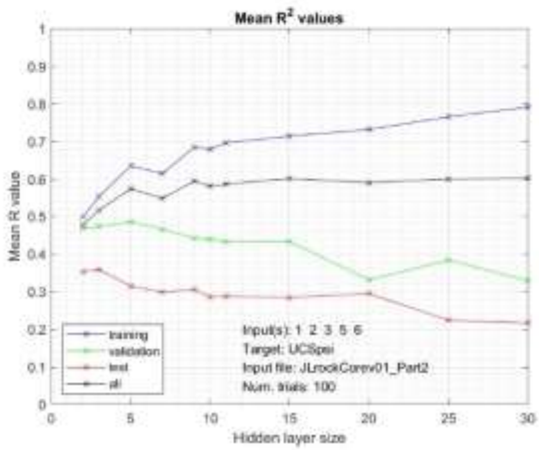

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

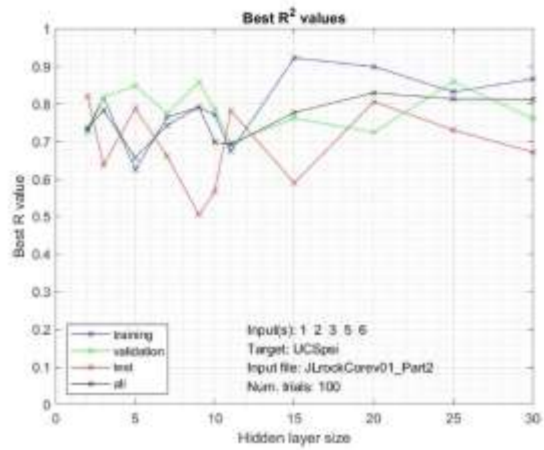

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

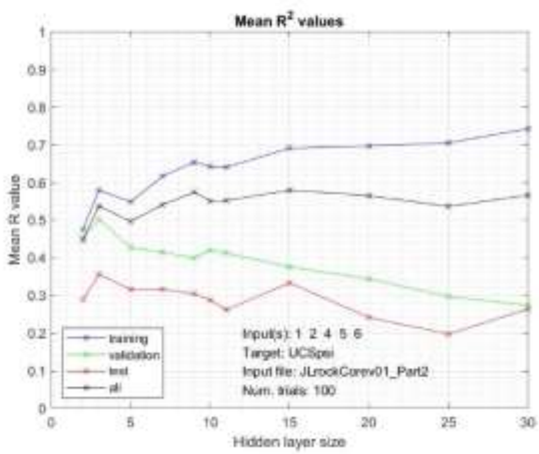

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4 5
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

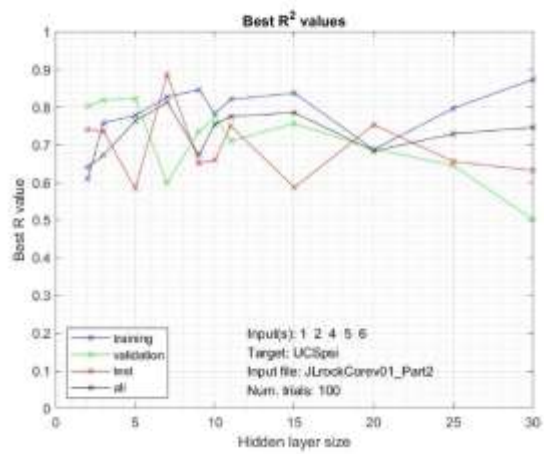

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

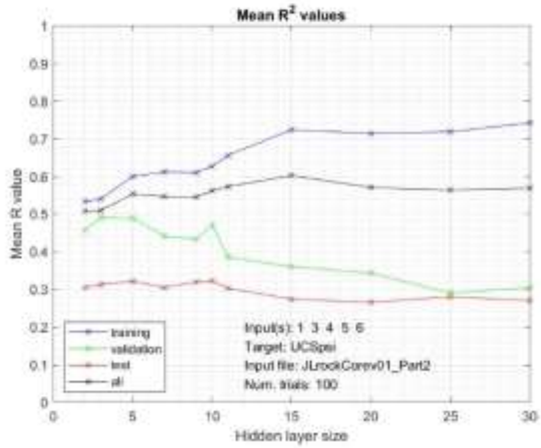

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

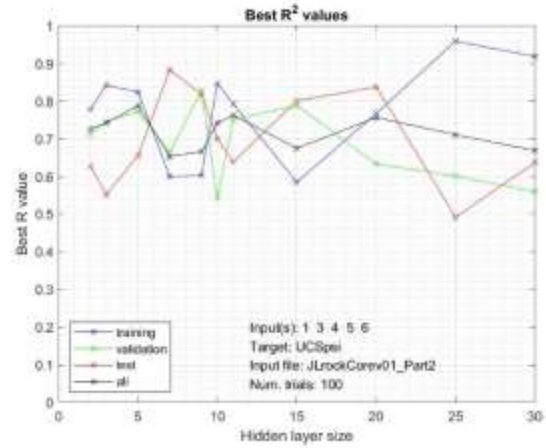

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

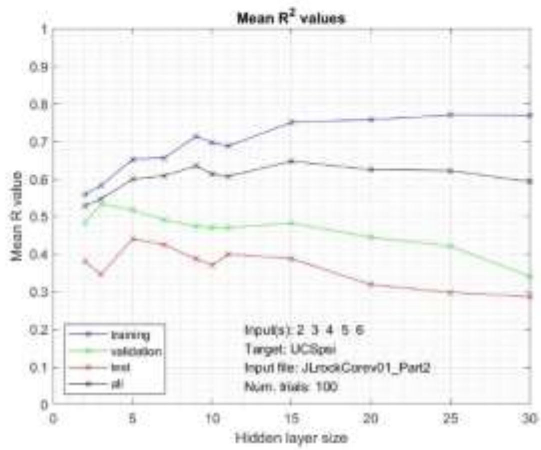

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

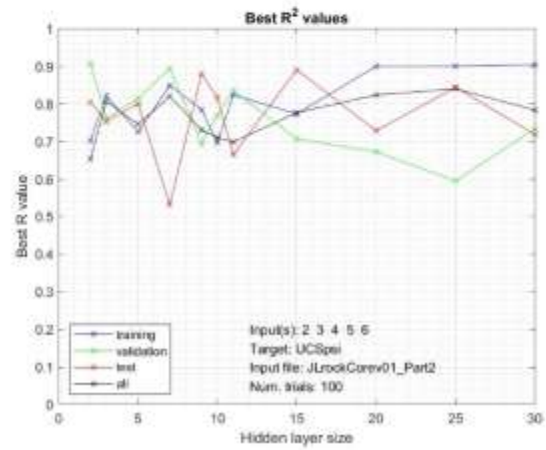

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

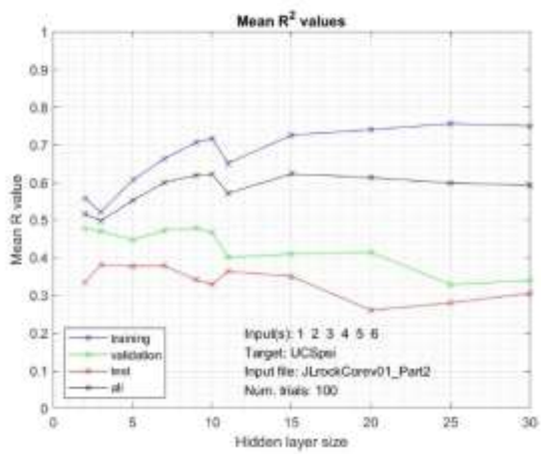

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

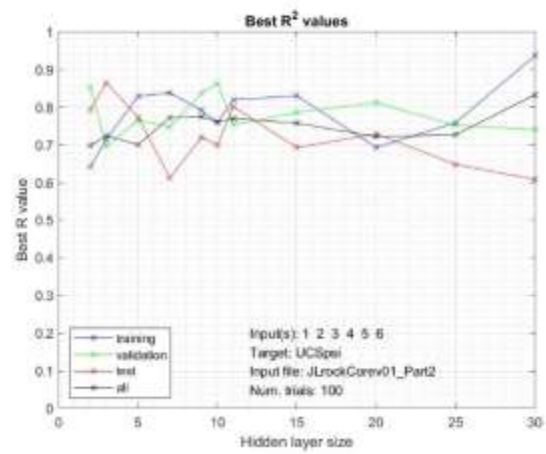

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4 5 6
Target: UCSpsi
Input file: JLrockCorev01_Part2
Num. trials: 100

Appendix E-2 – Mean and best R^2 results in text form for UCS

Results for NN modelling of SPT blow counts. Appendix E-2 contains a subset of the full text list of the 693 NN scenarios. This subset represents the six combinations of a single input (i.e. 1 to 6). These results are equivalent to single parameter linear regression.

```
Training INPUTS: 1  2  3  4  5  6
 Columns 1 through 4
   {'Depthfeet '}    {'PeakDownPressur…'}    {'RotationTorquel…'}    {'RotationSpeedre…'}
 Columns 5 through 6
   {'MovingSpeedfth '}    {'SpecificEnergyf…'}
--------------------
Training TARGETS: 8
   {'UCS '}
--------------------
--->  Target = BlowsPerFoot
--------------------
************ NUMBER OF COMBINATIONS = 1 ************
numIts = 100
inp = 1
--->  Input(s) = Depthfeet
        HL no.    all       train       val        test    Sum Bst R
        -----     ---       -----       ---        ----    ---------
MeanR =
          2    0.33824    0.38535    0.30147    0.20107
          3    0.36113    0.37836    0.34166    0.27158
          5    0.39833    0.44941     0.3795    0.21808
          7    0.41498    0.44779    0.39173    0.27051
          9    0.49754    0.55472    0.41608     0.3617
         10    0.484644    0.548523    0.431324    0.279997
         11    0.481282    0.554749    0.419258    0.276147
         15    0.555506    0.618048    0.498636    0.331666
         20    0.555332     0.63754    0.458719    0.394654
         25    0.554232    0.648006    0.468418    0.373932
         30    0.608294    0.724466    0.454184    0.400955
BestR =
          2    0.55994    0.50826    0.65545    0.74123     2.4649
          3    0.66082    0.65053    0.70699    0.69379     2.7121
          5    0.67074    0.60294    0.81759    0.77241     2.8637
          7     0.7233    0.68599    0.78335    0.83264     3.0253
          9    0.72619    0.68875    0.80378    0.84498     3.0637
         10    0.732861    0.707475     0.85554    0.690227     2.9861
         11    0.741045    0.710957    0.844842      0.7216    3.01844
         15    0.761601    0.759724    0.801986    0.772461     3.09577
         20    0.761485    0.777638    0.660445    0.835951     3.03552
         25    0.789174    0.808933    0.852054    0.720771     3.17093
         30    0.773582    0.784076    0.652137    0.857928     3.06772
inp = 2
--->  Input(s) = PeakDownPressurepsi
        HL no.    all       train       val        test    Sum Bst R
```

```
      -----     ---      -----      ---       ----    ---------
MeanR =
        2    0.10638    0.11854    0.11727     0.0303
        3    0.22179      0.245    0.24619    0.11885
        5    0.22201     0.2383    0.23832    0.11288
        7    0.36391    0.40086    0.30523    0.24498
        9    0.35263    0.39625    0.34048    0.21334
        10    0.371788    0.439011     0.28946     0.21974
        11     0.35066    0.420808     0.30407    0.203763
        15    0.380693    0.480236    0.335322    0.181477
        20    0.403029    0.531015    0.336158    0.229479
        25    0.384777    0.519224    0.280888     0.20518
        30    0.409872    0.557809    0.302058    0.223308
BestR =
        2    0.55136    0.51298    0.69138    0.56907     2.3248
        3    0.53753    0.46344    0.65452    0.72854      2.384
        5      0.555    0.45061    0.84193    0.61992     2.4675
        7    0.57128     0.4885    0.88169    0.48042     2.4219
        9    0.59332    0.55189    0.62111    0.69482     2.4611
        10       0.585     0.56902    0.830403    0.469453     2.45388
        11    0.575937    0.537036    0.727013    0.627834     2.46782
        15    0.529693    0.514953    0.679547    0.598052     2.32225
        20    0.643653    0.677569    0.760678    0.338218     2.42012
        25    0.515262    0.523482    0.701142    0.581818      2.3217
        30    0.580387    0.665004    0.723539     0.46122     2.43015
inp = 3
--->  Input(s) = RotationTorquelbft
      HL no.    all      train       val        test    Sum Bst R
      -----     ---      -----      ---       ----    ---------
MeanR =
        2    0.46231    0.45648    0.43213    0.36846
        3    0.43503    0.43316     0.4474    0.30425
        5    0.51966    0.51868    0.51527    0.33953
        7    0.52547    0.53896    0.48234    0.41259
        9    0.51201    0.54586    0.44076    0.27779
        10     0.53881    0.577333     0.52189     0.32824
        11    0.544966    0.612414    0.404981    0.321683
        15    0.544852    0.604767    0.432425    0.349868
        20    0.514158    0.630034    0.380853    0.244413
        25    0.607246    0.681723    0.416135    0.335392
        30    0.599984    0.706065    0.407013    0.310676
BestR =
        2     0.6275    0.55364     0.8677    0.77388     2.8227
        3    0.63178    0.58532     0.7742    0.71314     2.7044
        5    0.73838    0.73966    0.74587    0.78258     3.0065
        7    0.75475    0.68219    0.93839    0.86931     3.2446
        9    0.74976    0.74014    0.85059    0.73466     3.0752
        10    0.748878    0.728829    0.841637      0.9155     3.23484
        11    0.725033     0.69372    0.773573    0.859075      3.0514
        15    0.778914    0.770181    0.788257    0.808841     3.14619
        20    0.771286    0.790133    0.799994    0.710342     3.07175
```

```
        25    0.783795    0.793448    0.908446    0.645309      3.131
        30    0.778463    0.791161    0.802708    0.778657     3.15099
inp = 4
--->  Input(s) = RotationSpeedrevmin
      HL no.    all      train       val        test    Sum Bst R
      -----     ---      -----       ---        ----    ---------
MeanR =
         2    0.28341    0.30872    0.26464    0.16084
         3    0.31575    0.33538    0.31622    0.18746
         5    0.36581    0.39047    0.31634    0.19843
         7    0.34567    0.37608    0.34374    0.19653
         9    0.43343    0.47146     0.3839    0.20008
        10    0.405519    0.453583    0.370461    0.199729
        11    0.455291     0.50325    0.351658    0.267844
        15    0.455829    0.517281    0.344953    0.243287
        20    0.468261    0.546089    0.374837    0.219693
        25    0.458077    0.562645    0.338285    0.220992
        30    0.442781    0.534831    0.371132    0.247201
BestR =
         2    0.45699    0.45058    0.72867    0.88459     2.5208
         3     0.4925    0.37231    0.67906    0.81227     2.3561
         5    0.52092    0.50081    0.58799     0.5819     2.1916
         7    0.49046    0.46497     0.7407    0.35071     2.0468
         9    0.52092    0.51514    0.66574    0.79832     2.5001
        10    0.578413      0.5799     0.67097    0.653602     2.48288
        11    0.566612    0.565799     0.59872    0.630511     2.36164
        15    0.629224    0.628406    0.590631    0.718181     2.56644
        20    0.585436    0.577969     0.69614    0.702703     2.56225
        25    0.679471    0.673057    0.564866    0.751625     2.66902
        30    0.703572    0.728012     0.79567     0.49388     2.72113
inp = 5
--->  Input(s) = MovingSpeedfth
      HL no.    all      train       val        test    Sum Bst R
      -----     ---      -----       ---        ----    ---------
MeanR =
         2     0.2073    0.22405    0.17385    0.16912
         3    0.23082    0.25564    0.21244     0.1374
         5    0.24777     0.2843    0.20891    0.18892
         7    0.27221     0.3223    0.26393    0.16299
         9     0.2449    0.31203    0.22141   0.091723
        10    0.248907    0.306401     0.23127    0.132692
        11    0.233712    0.311114    0.193141    0.103624
        15    0.229122    0.320764     0.16374   0.0998928
        20    0.209318    0.339743    0.182341   0.0542047
        25    0.245931    0.382869    0.153716   0.0799338
        30    0.214409    0.360158    0.129161   0.0671115
BestR =
         2     0.2903    0.23117    0.42505    0.64494     1.5915
         3    0.32639    0.28948    0.58312     0.3182     1.5172
         5    0.36957    0.33718    0.46529    0.47646     1.6485
         7     0.3599    0.33211    0.67622    0.19485     1.5631
```

9 0.36985 0.36874 0.26505 0.56844 1.5721
10 0.35016 0.334721 0.341347 0.49581 1.52204
11 0.347945 0.302916 0.541976 0.393387 1.58622
15 0.461935 0.485488 0.363301 0.442389 1.75311
20 0.471541 0.514172 0.298665 0.415678 1.70006
25 0.428811 0.453495 0.56118 0.370374 1.81386
30 0.445465 0.483917 0.344456 0.456067 1.72991

inp = 6

---> Input(s) = SpecificEnergyftlbft3

HL no. all train val test Sum Bst R
----- --- ----- --- ---- ---------

MeanR =

2 0.2348 0.24635 0.20085 0.15893
3 0.29719 0.3206 0.28994 0.2108
5 0.24623 0.30746 0.24532 0.091078
7 0.26712 0.34143 0.24815 0.10711
9 0.33112 0.39623 0.28494 0.16151
10 0.35961 0.429719 0.295668 0.143826
11 0.332938 0.399839 0.276925 0.159141
15 0.315669 0.41119 0.232751 0.115221
20 0.344575 0.466465 0.218834 0.125212
25 0.350108 0.47829 0.206196 0.172341
30 0.387371 0.538175 0.239019 0.117708

BestR =

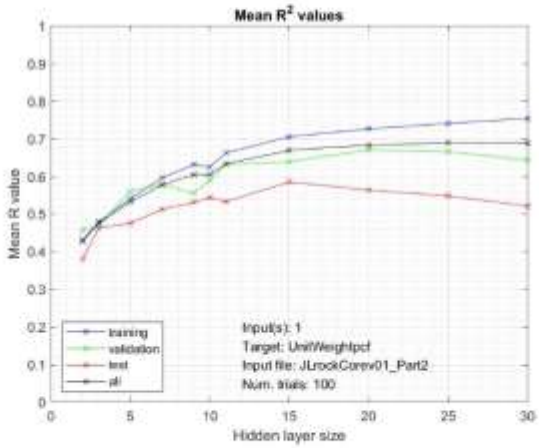
2 0.38127 0.41594 0.44068 0.57087 1.8088
3 0.46604 0.48583 0.44357 0.6511 2.0465
5 0.44104 0.38437 0.72234 0.50585 2.0536
7 0.45137 0.48405 0.66004 0.46641 2.0619
9 0.51633 0.49599 0.46622 0.71726 2.1958
10 0.490946 0.540703 0.583732 0.546707 2.16209
11 0.527689 0.538848 0.707471 0.12008 1.89409
15 0.553191 0.650362 0.608235 0.429763 2.24155
20 0.483021 0.539891 0.690083 0.599688 2.31268
25 0.613973 0.63617 0.731088 0.350775 2.33201
30 0.617393 0.699651 0.50159 0.503966 2.3226

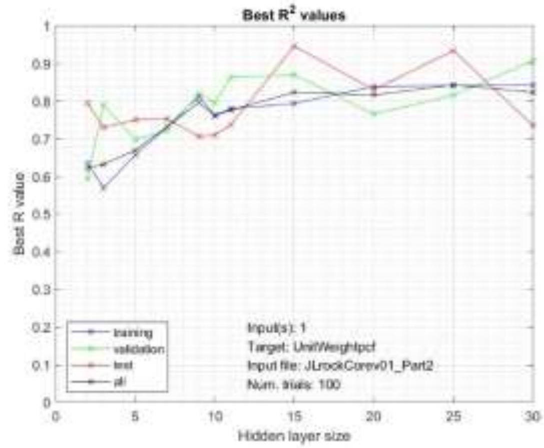
Appendix F – NN modeling for unit weight: mean R^2 and best R^2 from 100 iterations, hidden layer size 2 to 30, 63 combinations of 6 inputs

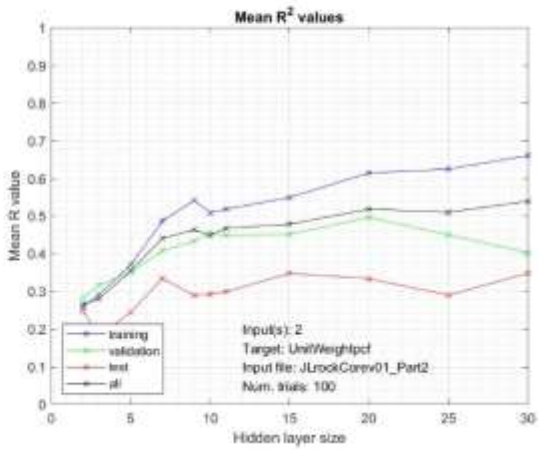
The inset text on each plot shows the training input number code, the training target, input file name (for reference) and the number of modeling iterations (trials). The legend on the plots is color coded for the data sets: blue for training, green for validation, red for testing and black for all.

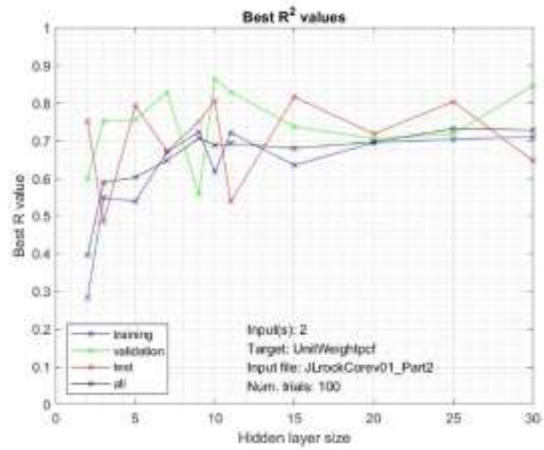
Appendix F-1 – Plots of mean and best R^2 values for unit weight

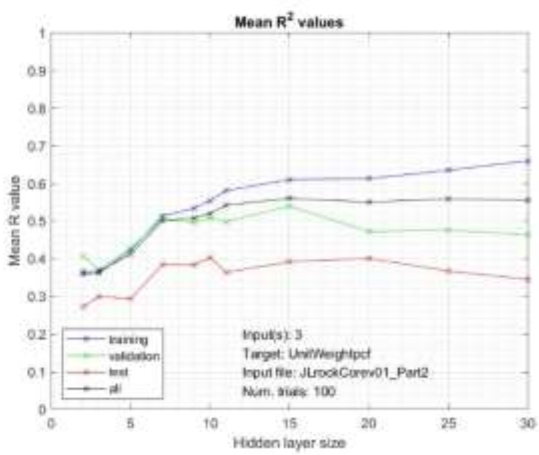
Results for NN modeling of unit weight. Appendix F-1 contains the two sets of 63 network scenario plots (mean R^2 and best R^2 for 100 trials).

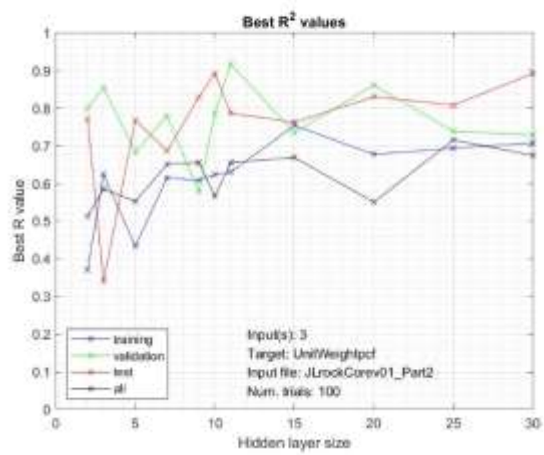


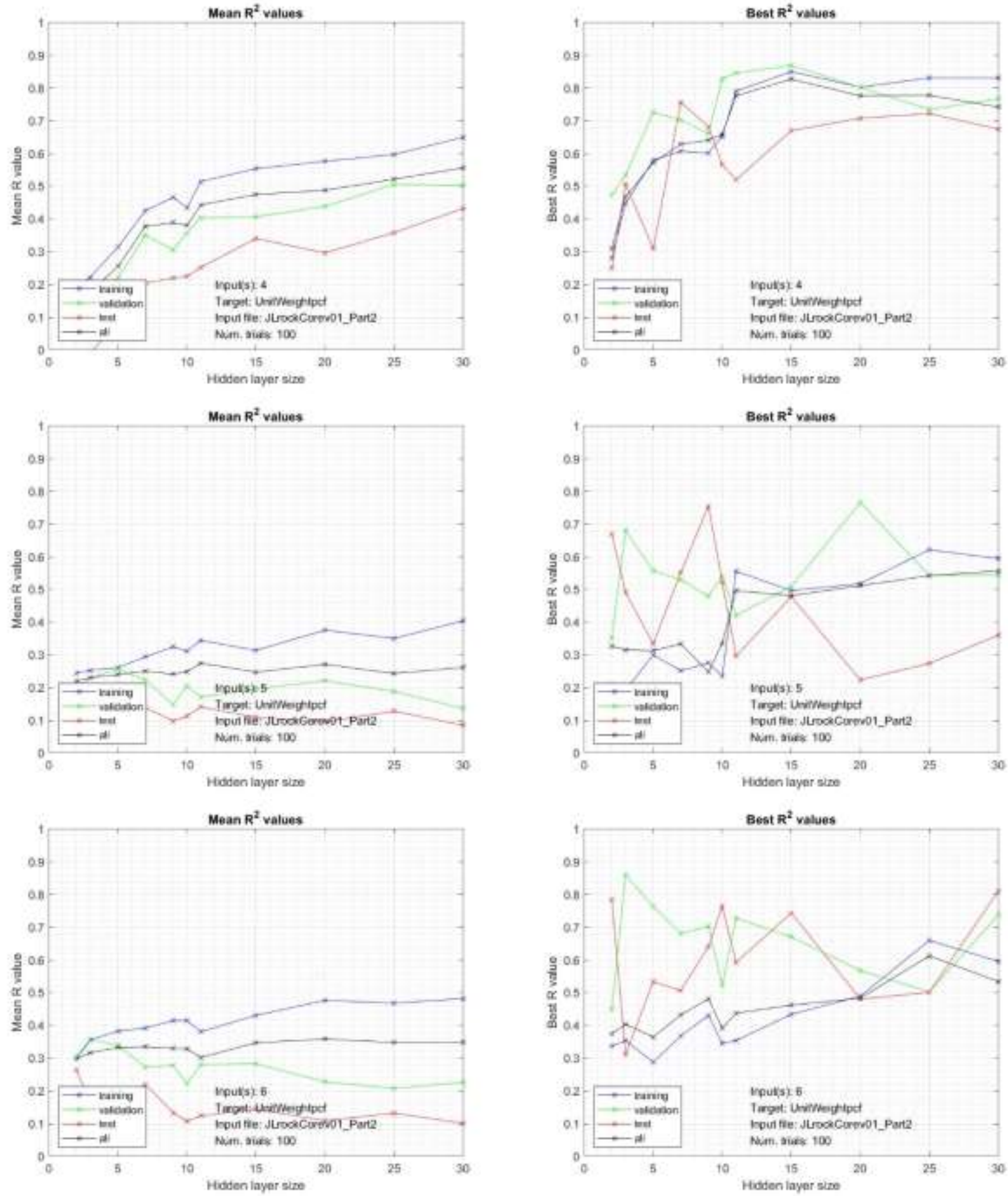


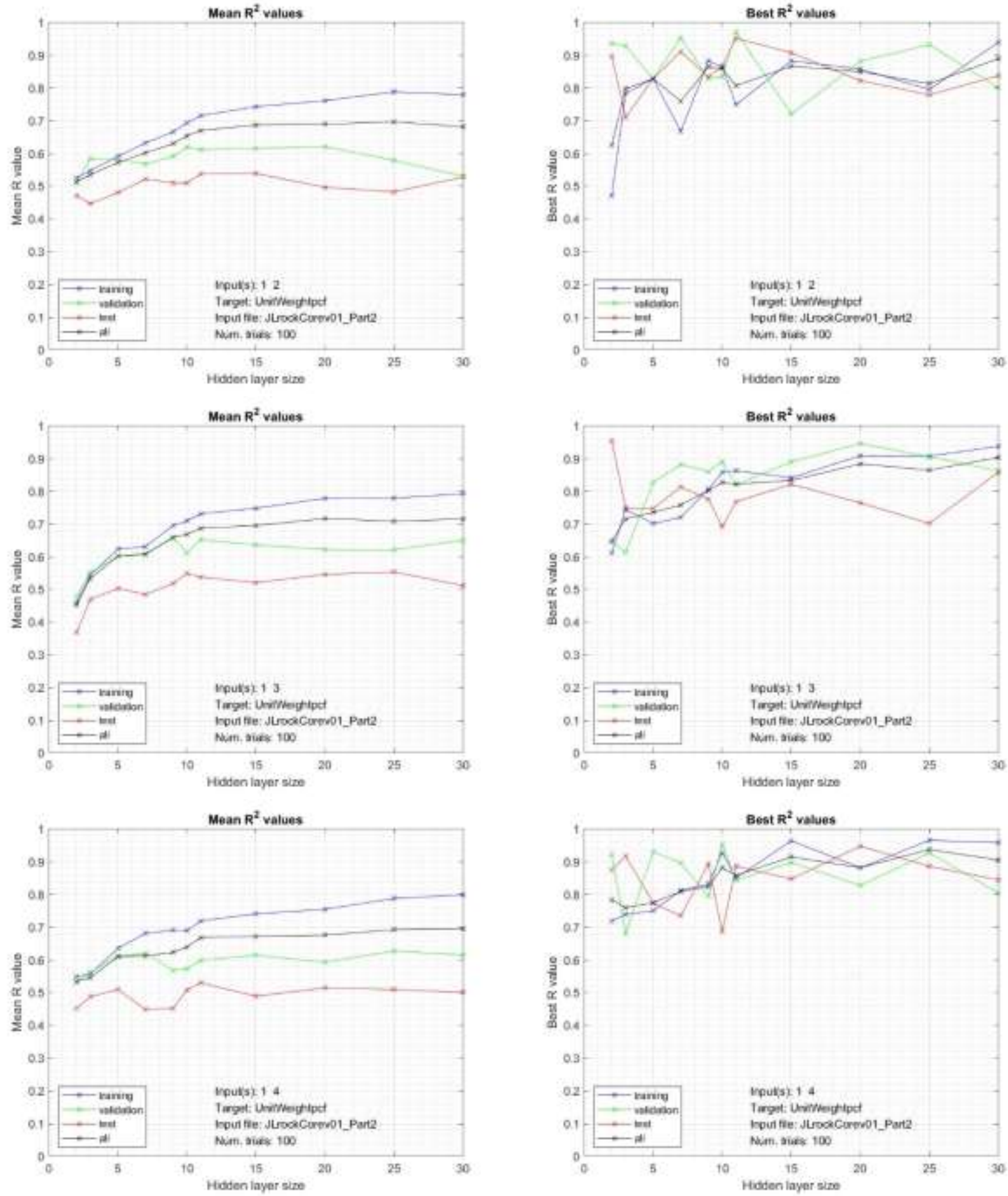


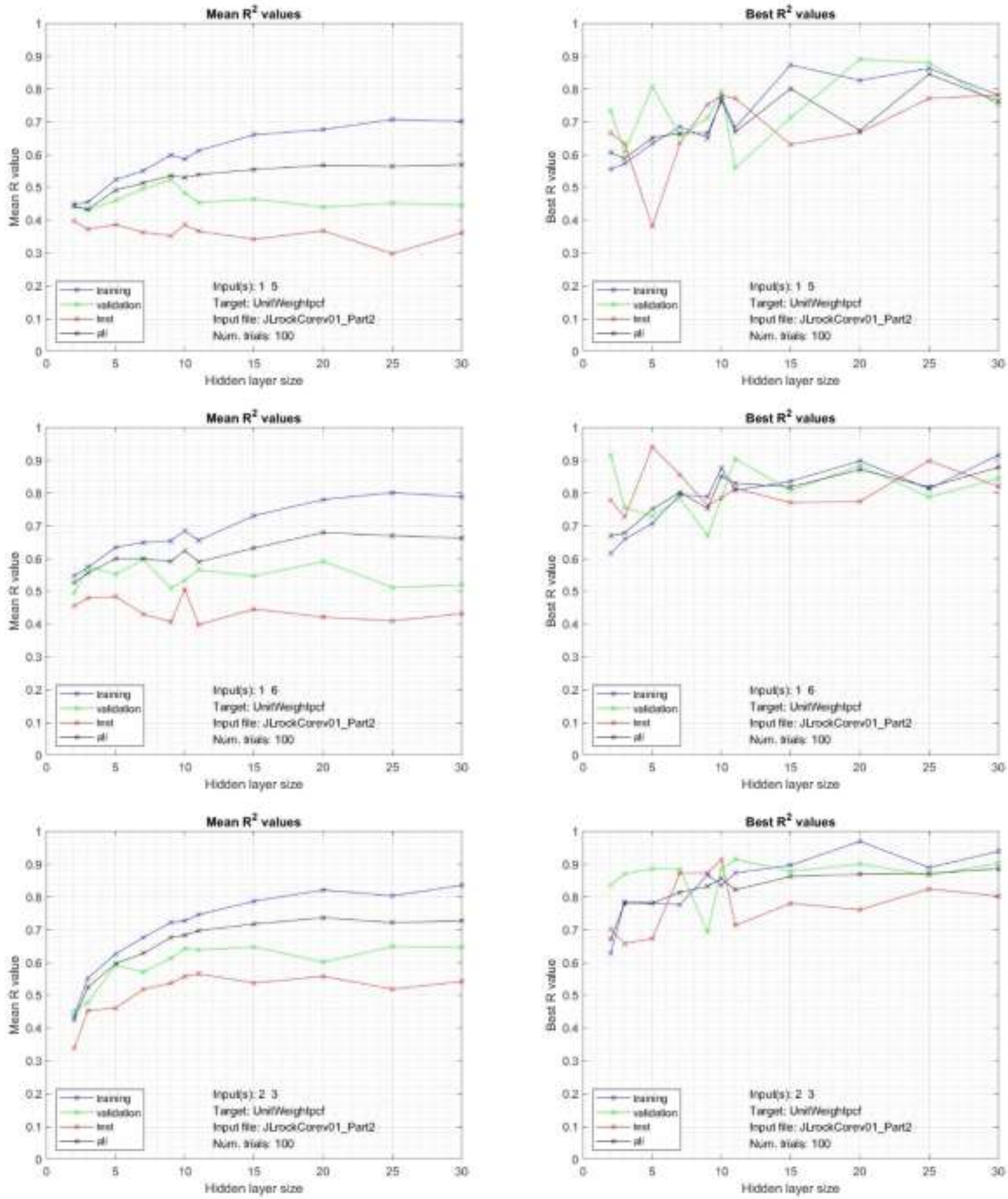


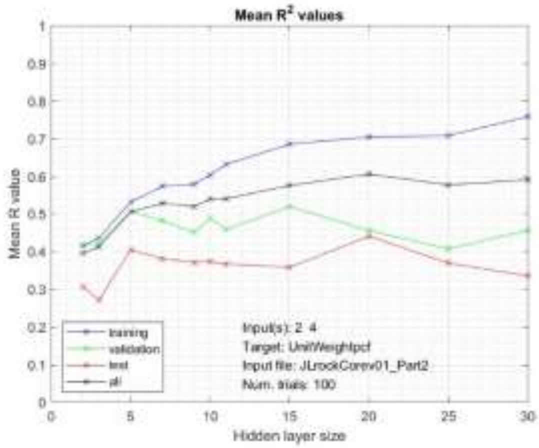


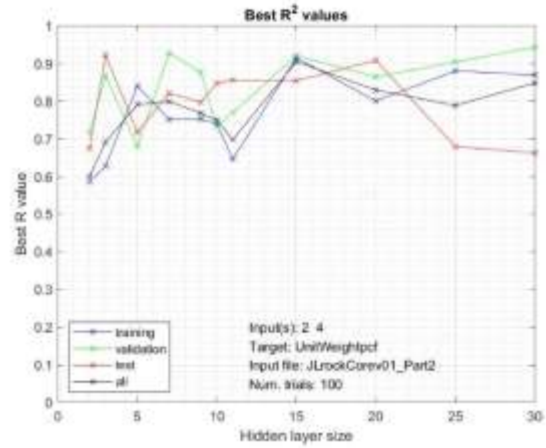


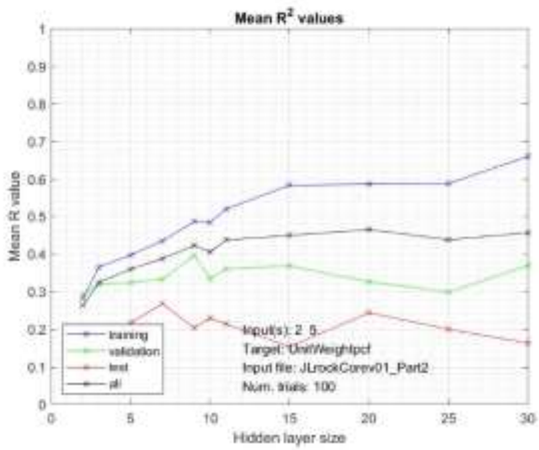

Mean R² values
Best R² values
Mean R value
Best R value
Hidden layer size
training
validation
test
all
Input(s): 4
Input(s): 5
Input(s): 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

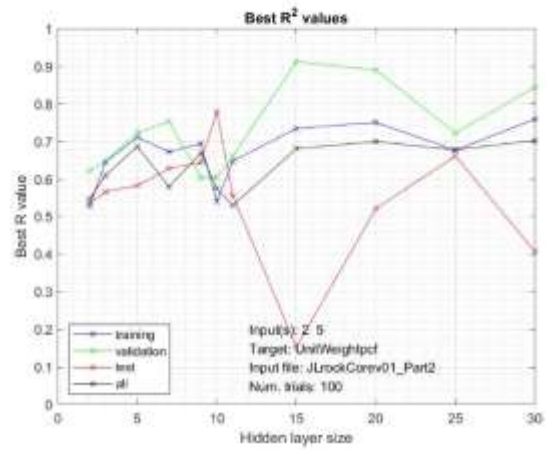

Mean R² values
Best R² values
Mean R value
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2
Input(s): 1 3
Input(s): 1 4
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

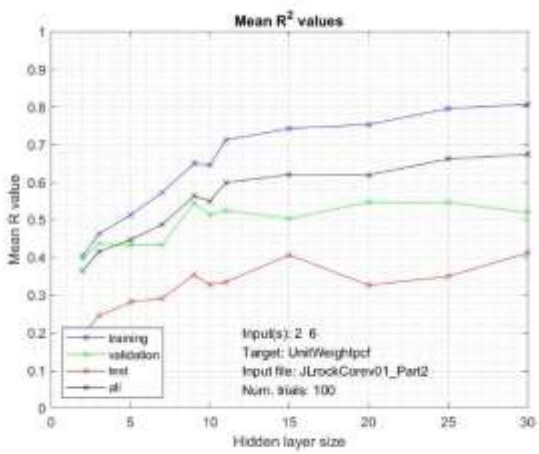

Mean R² values
Best R² values
Mean R value
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 5
Input(s): 1 6
Input(s): 2 3
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

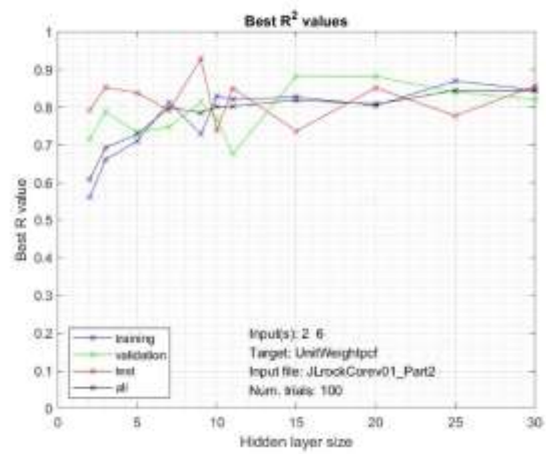

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 4
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

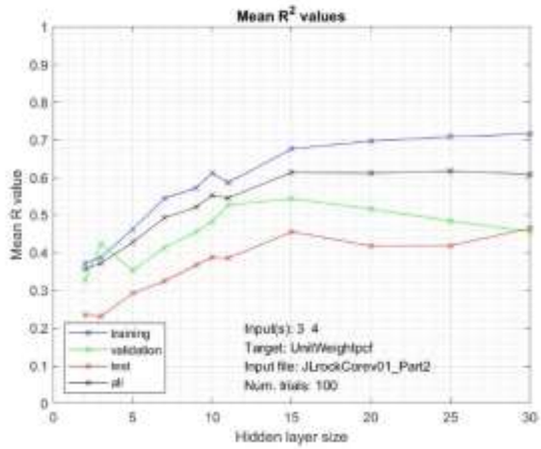

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 4
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

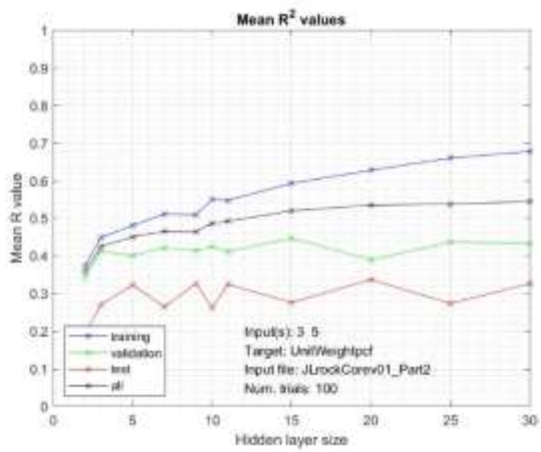

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

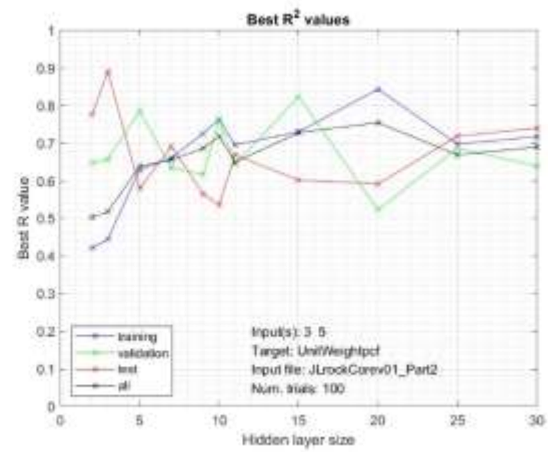

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

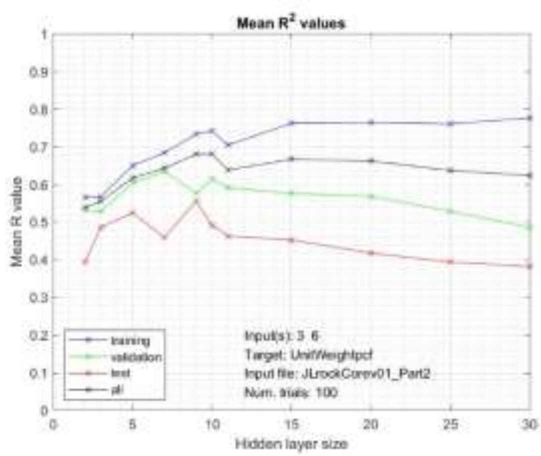

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

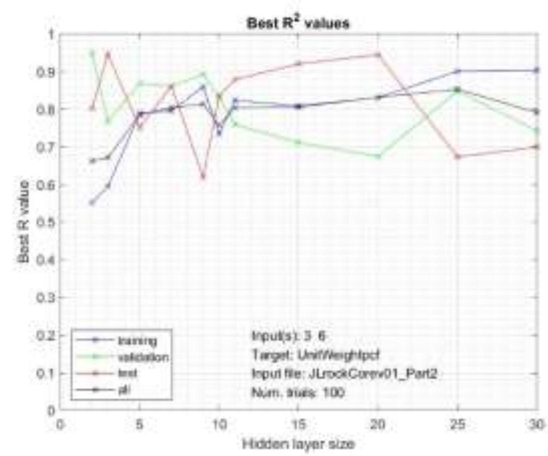

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 4
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

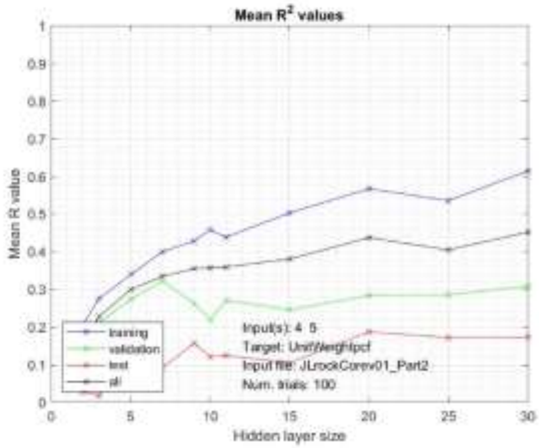

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 4
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
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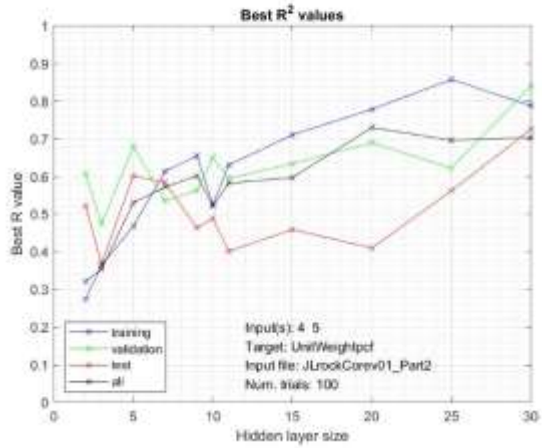
validation
test
all
Input(s): 4 5
Target: UnifWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
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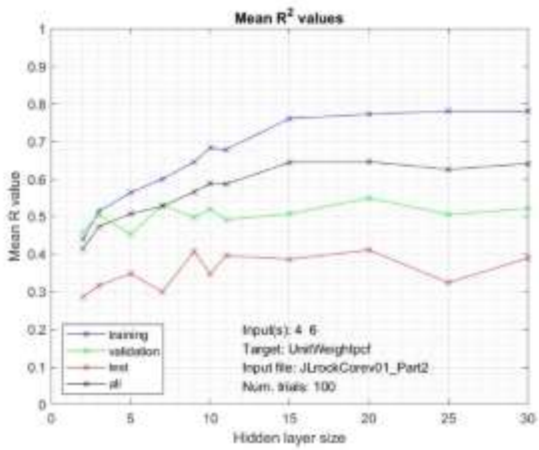
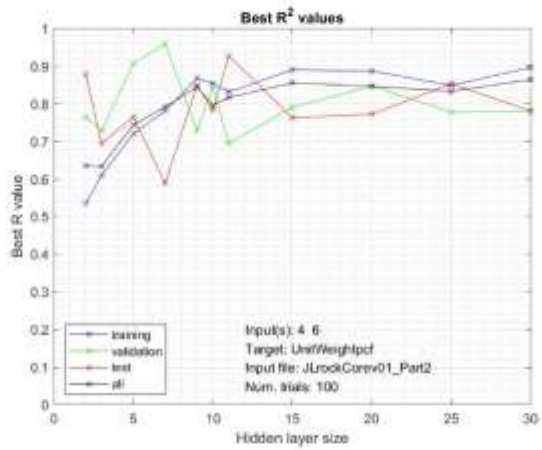
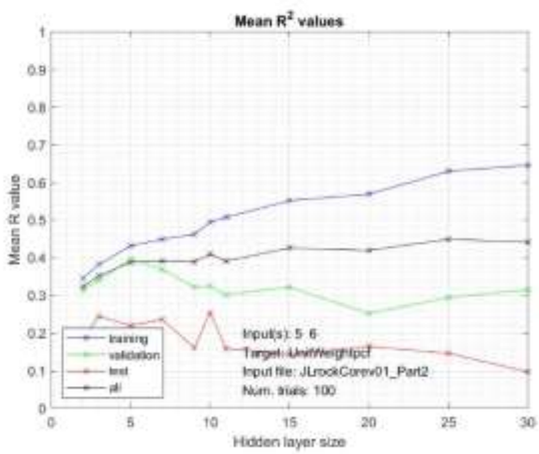
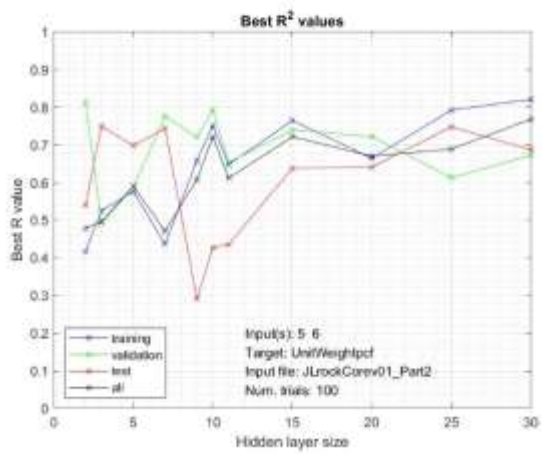
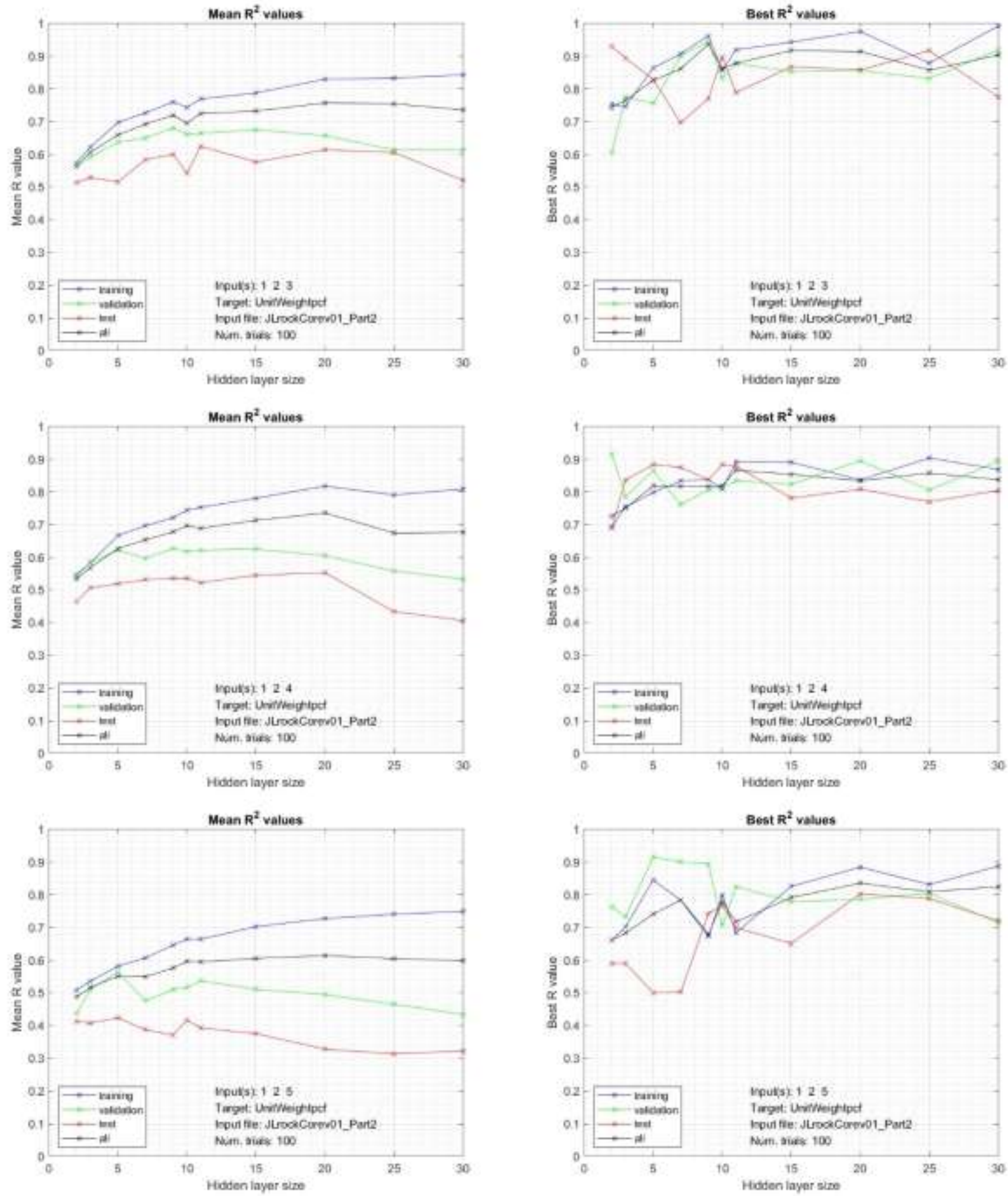
validation
test
all
Input(s): 4 5
Target: UnifWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

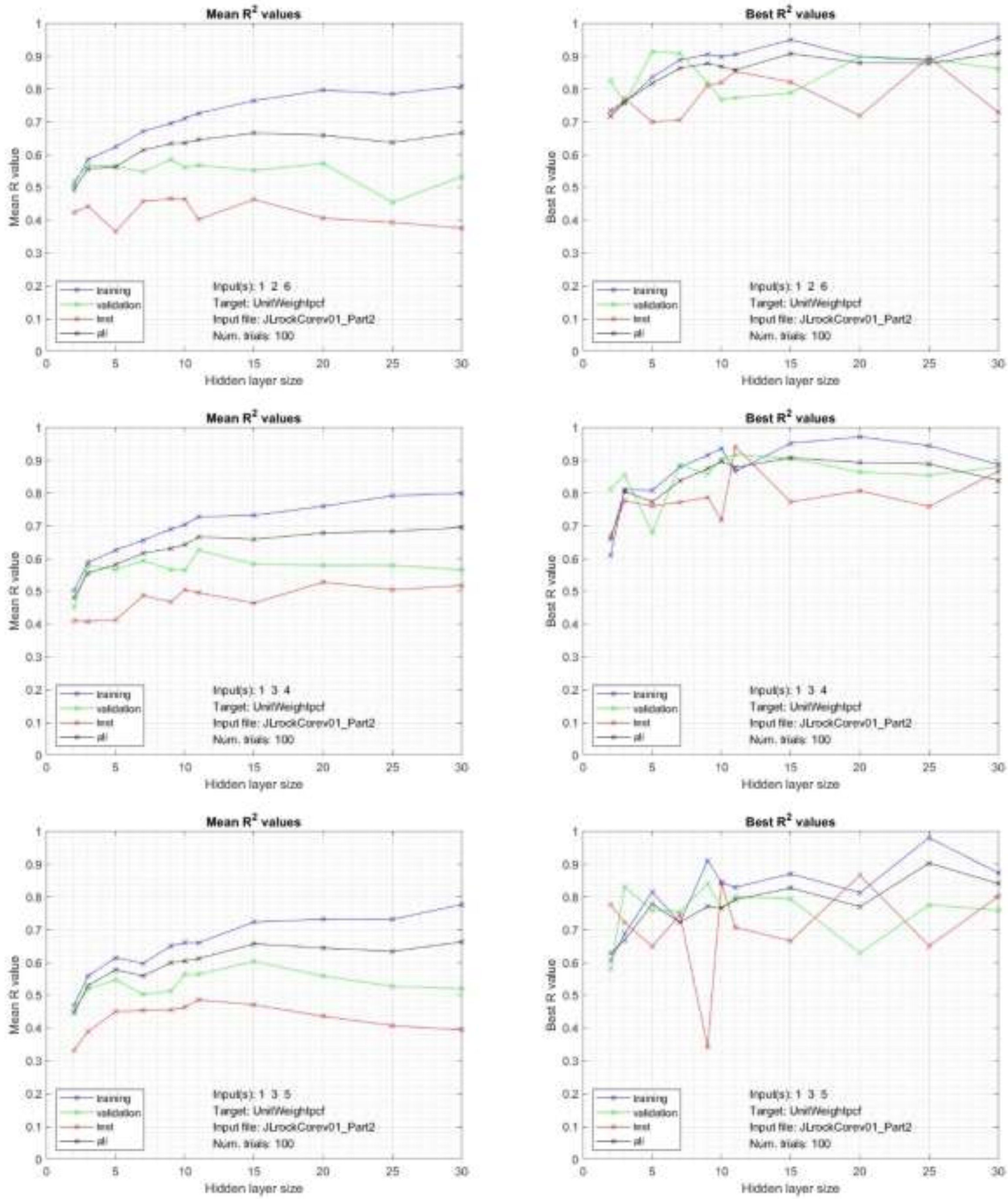

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 4 6
Target: UnifWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

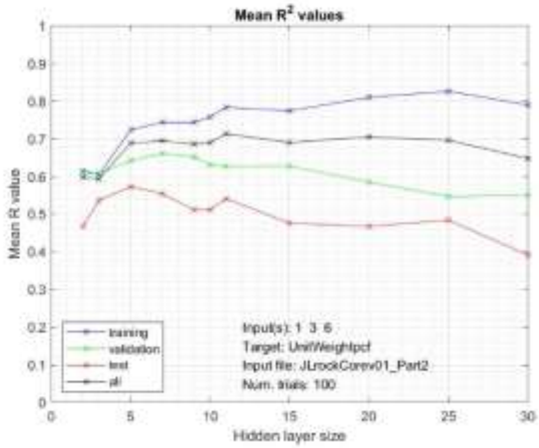

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 4 6
Target: UnifWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

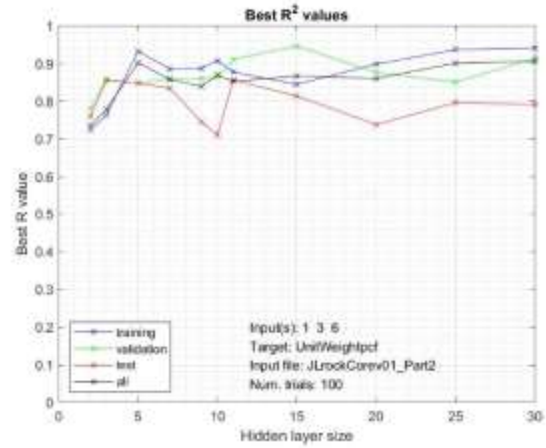

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 5 6
Target: UnifWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 5 6
Target: UnifWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Best R² values
Mean R value
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3
Input(s): 1 2 4
Input(s): 1 2 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Best R² values
Mean R value
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100
Input(s): 1 3 4
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100
Input(s): 1 3 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
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validation
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all
Input(s): 1 3 6
Target: UnitWeightpcf
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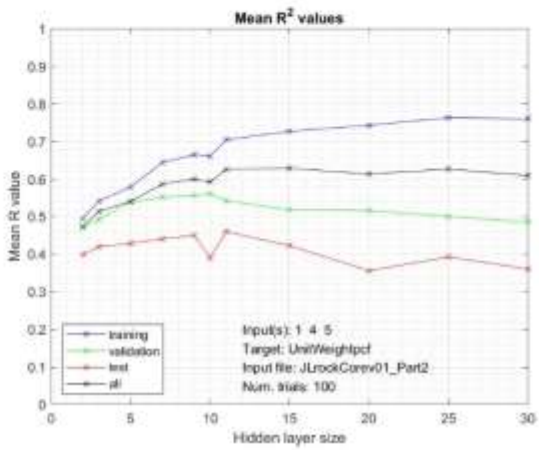
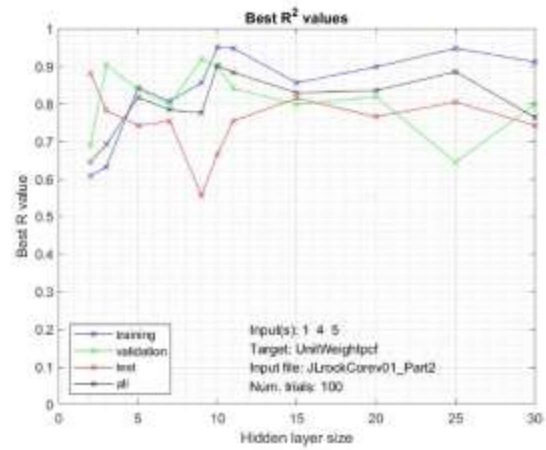
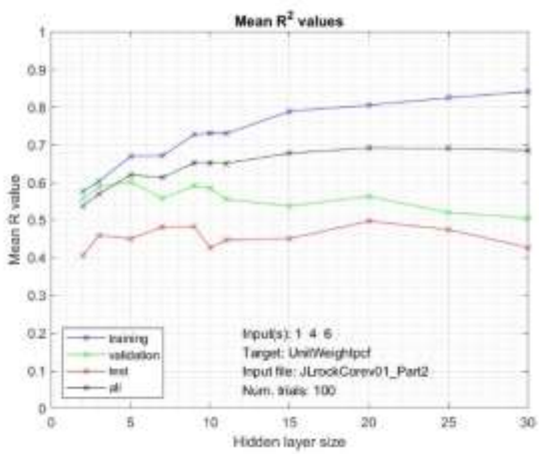
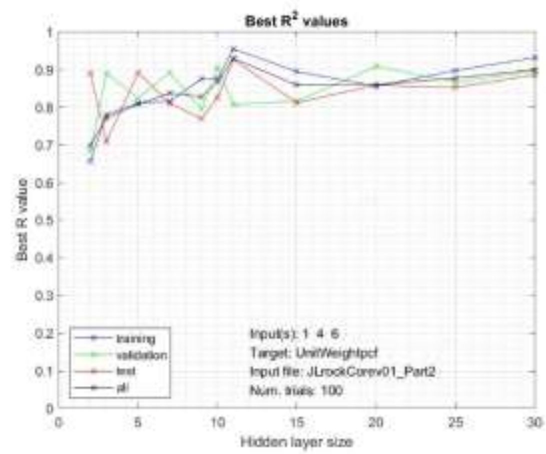
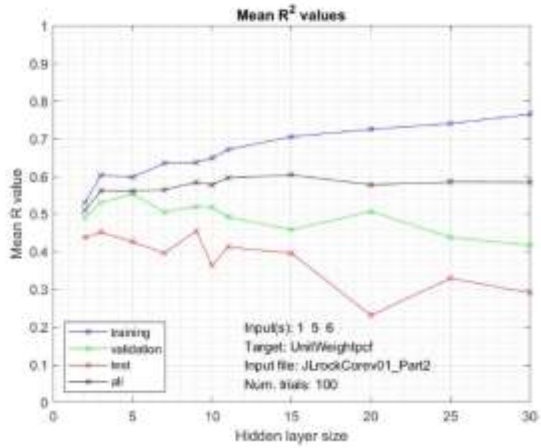
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

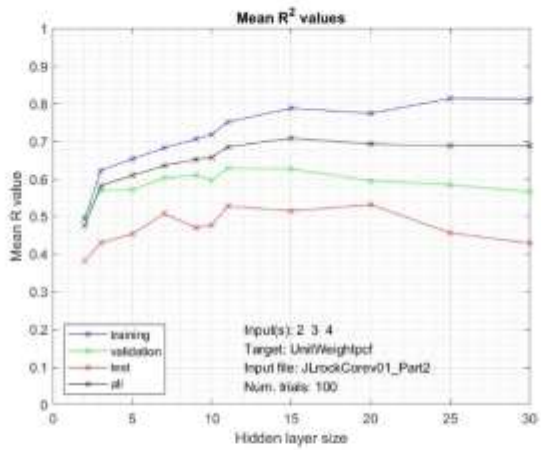

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

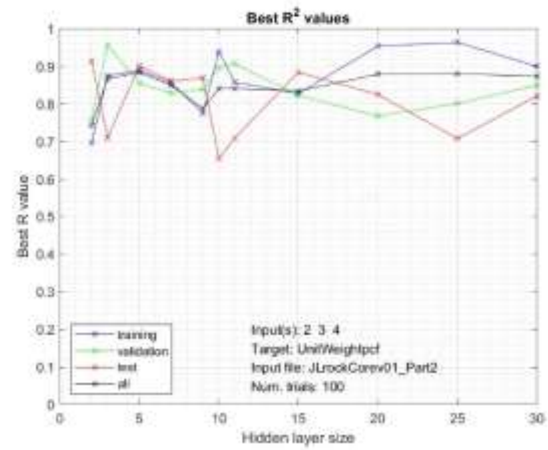

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

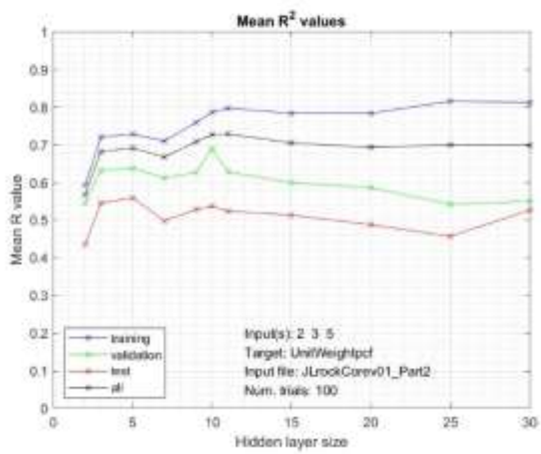

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

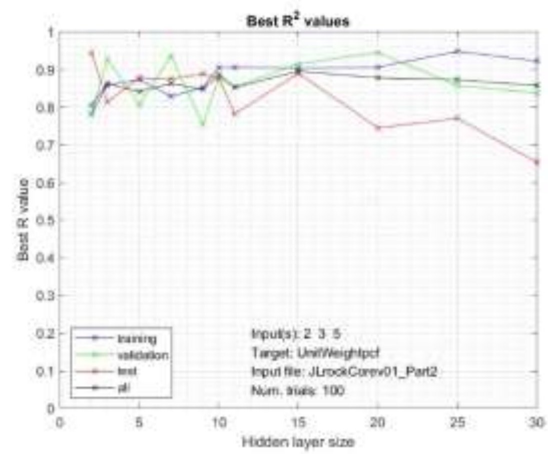

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

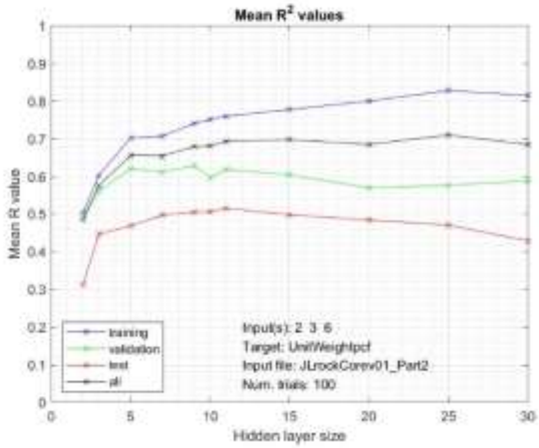

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

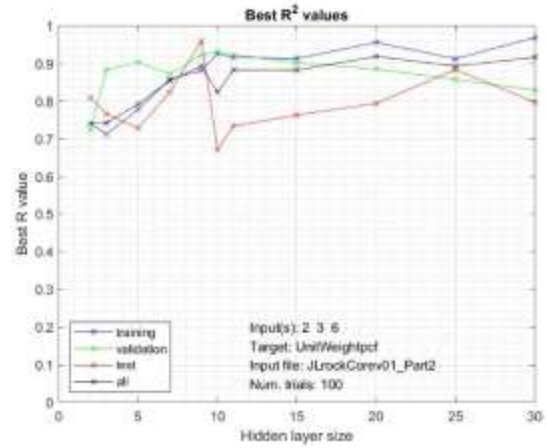

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

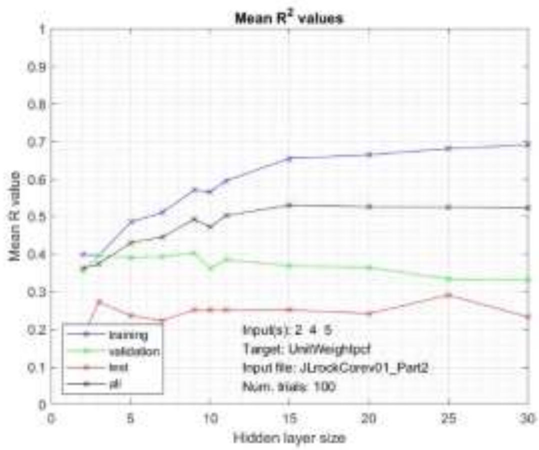

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

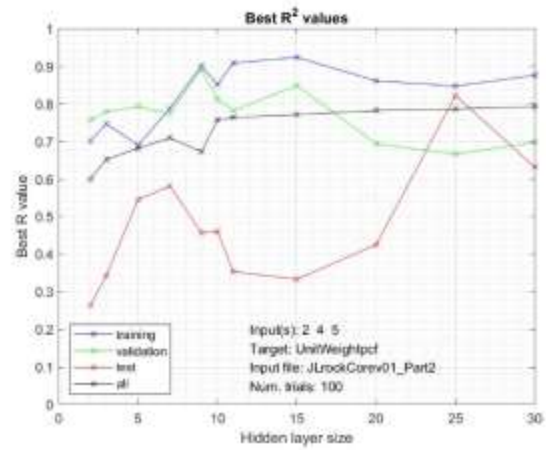

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

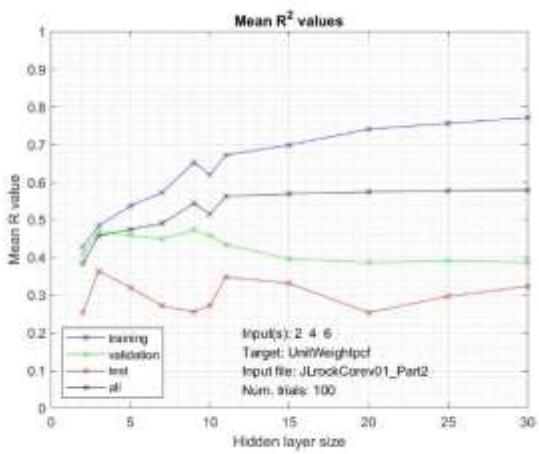

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

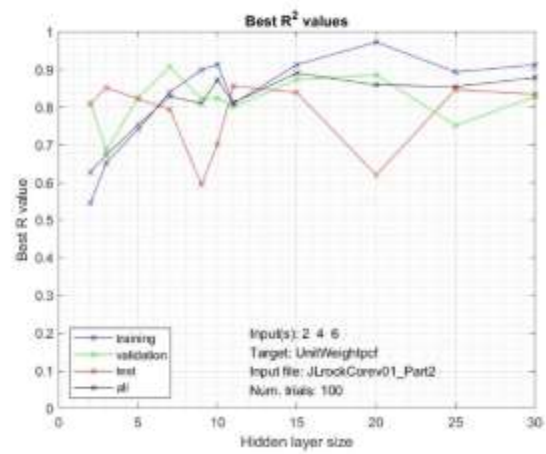

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

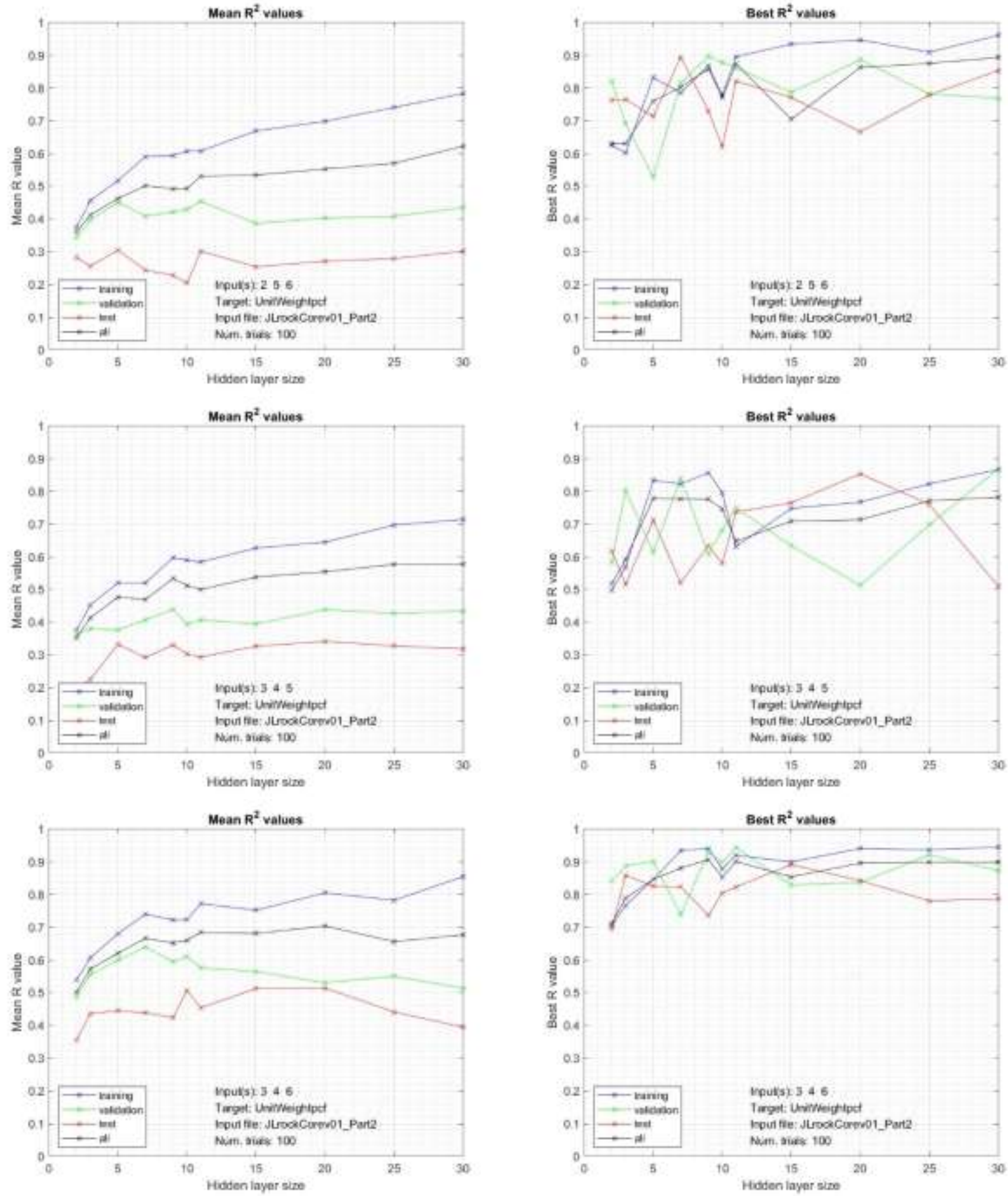

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

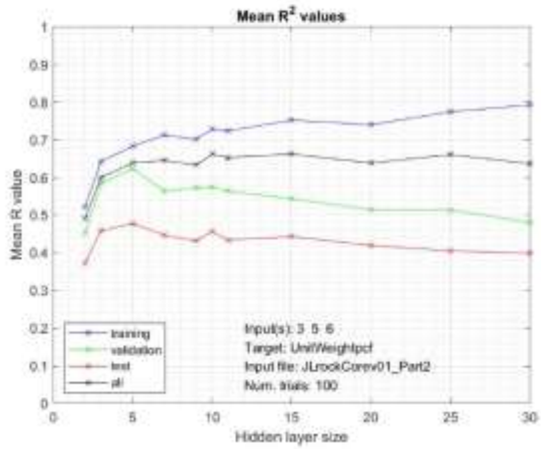

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 4 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 4 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

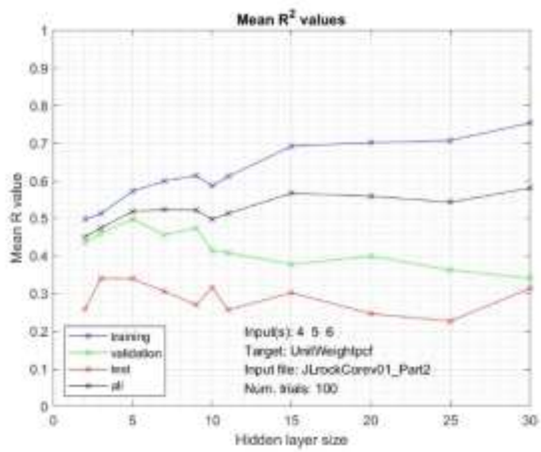

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 4 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

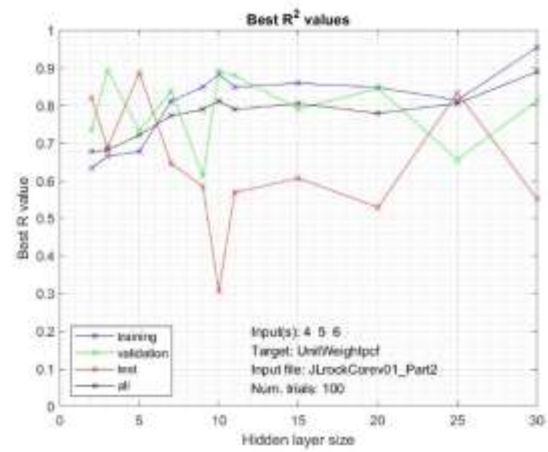

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 4 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

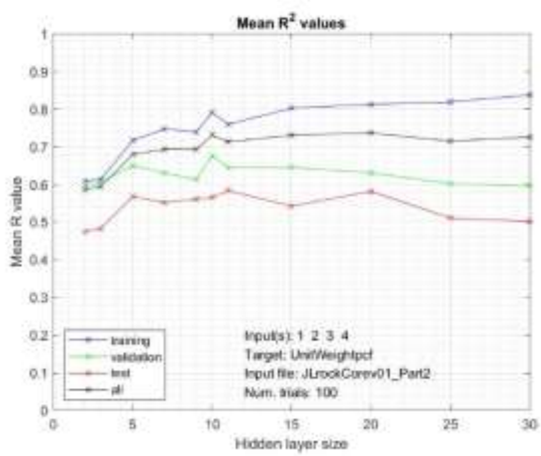

Mean R² values
Best R² values
Mean R value
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 5 6
Input(s): 3 4 5
Input(s): 3 4 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

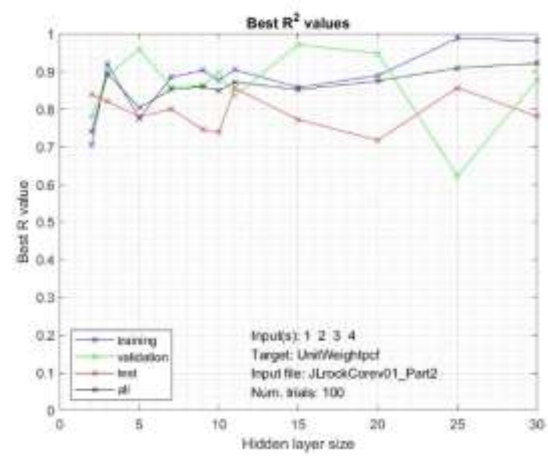

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

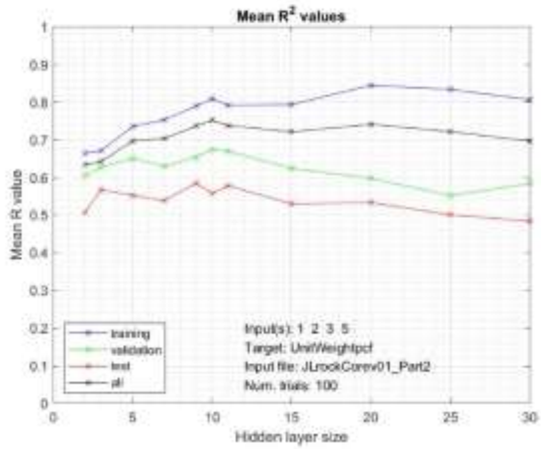

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 4 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

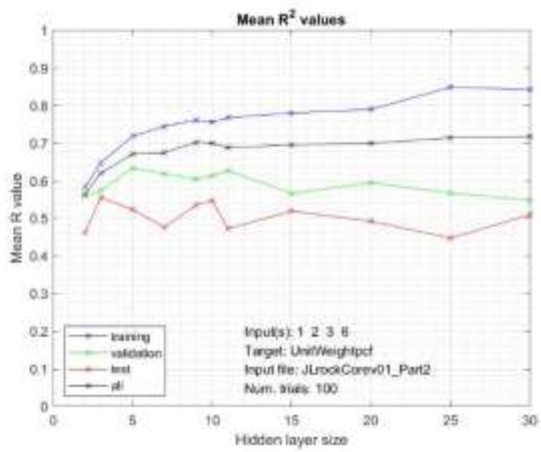

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 4 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

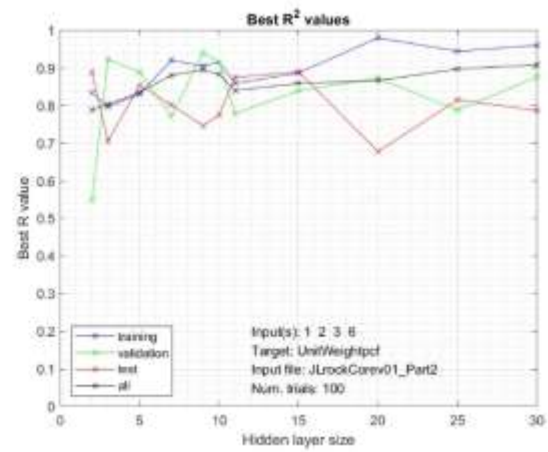

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

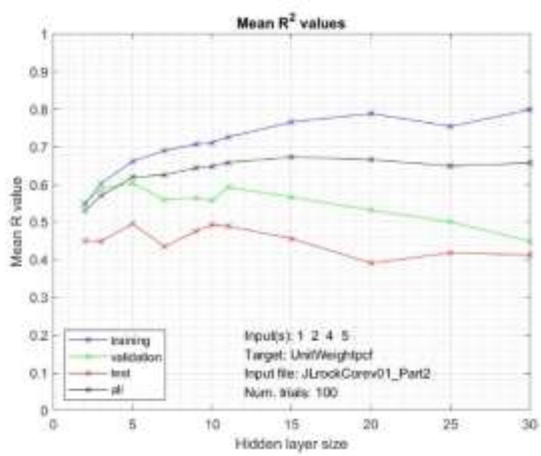

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

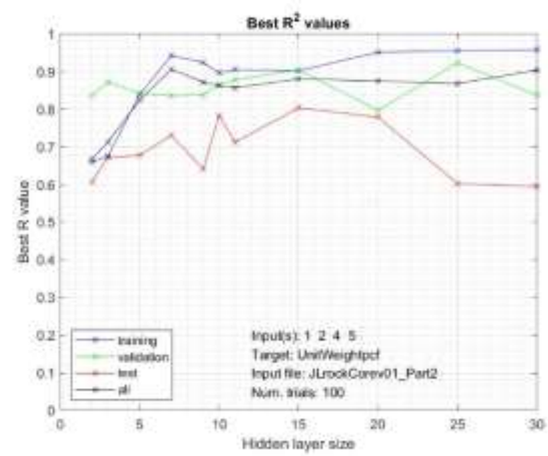

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

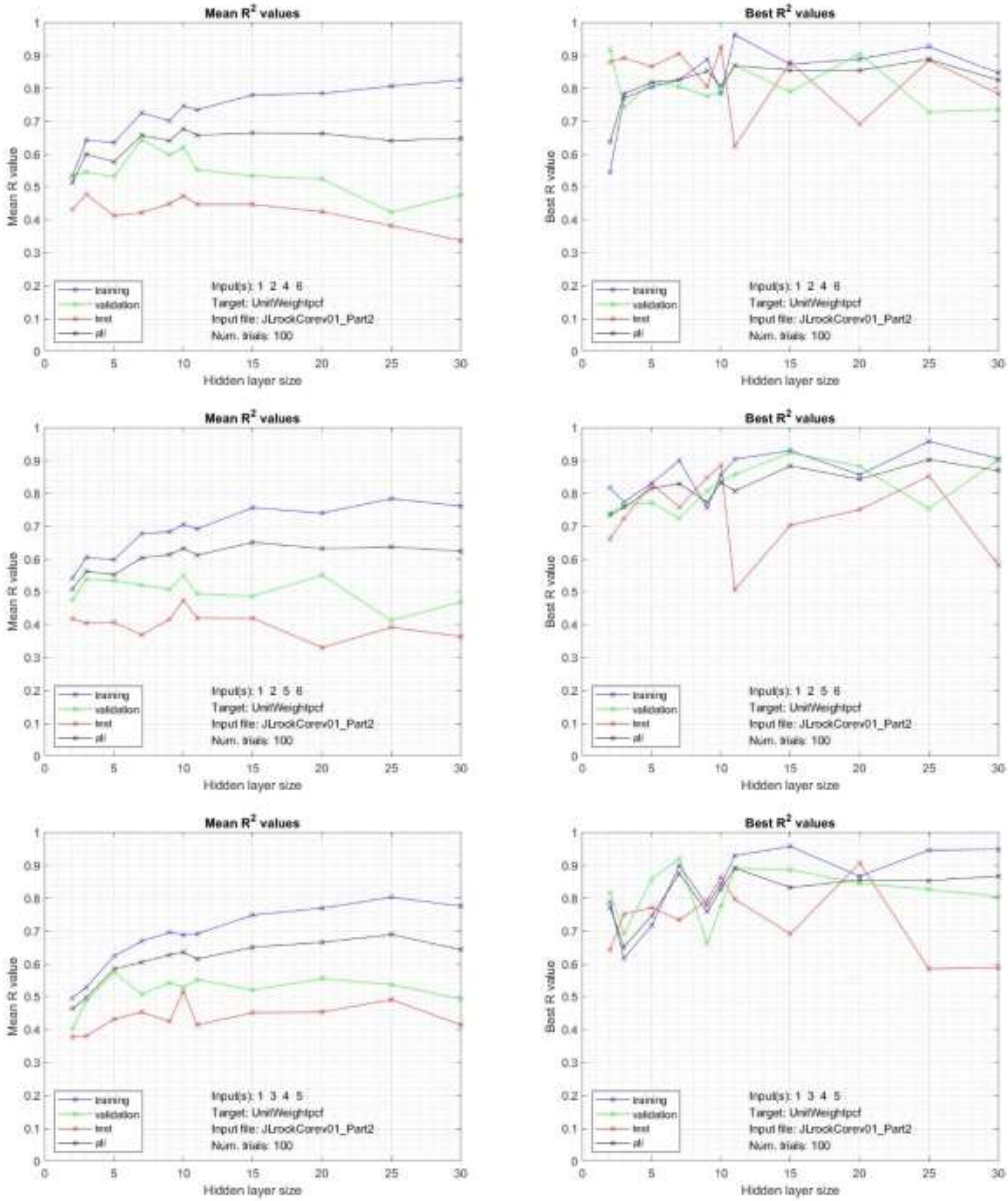

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

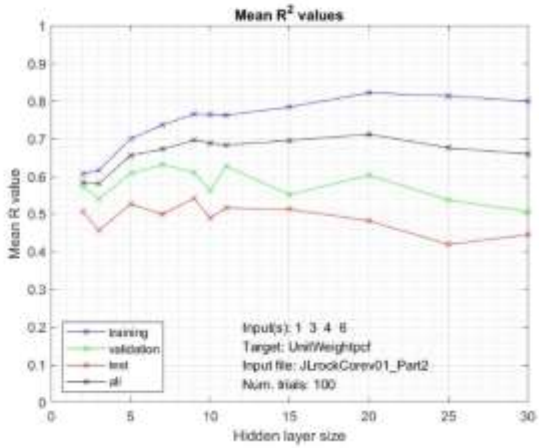

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

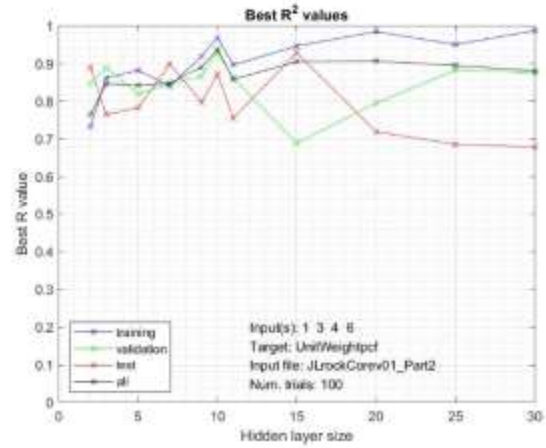

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

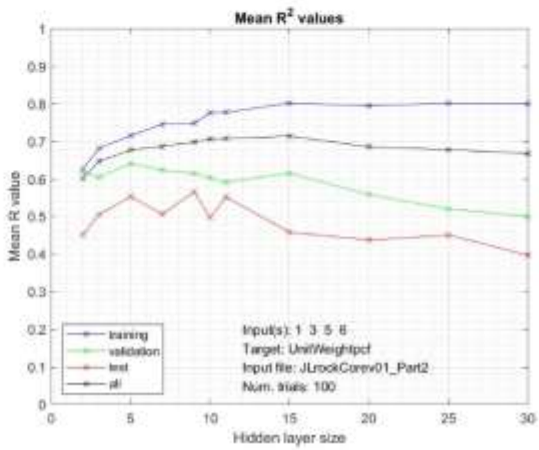

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 4 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

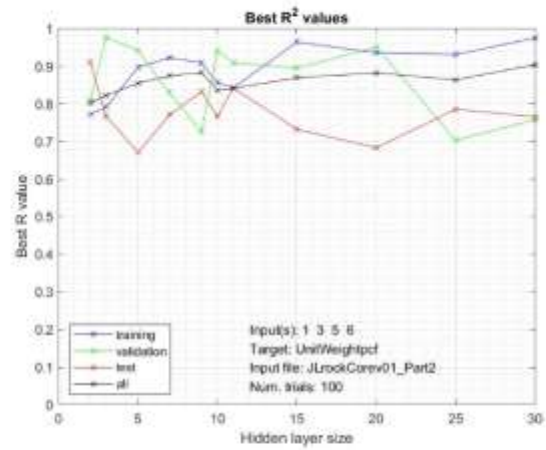

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 4 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

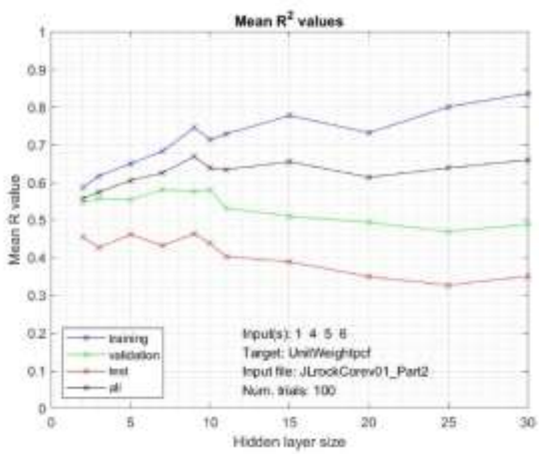

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 4 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100
Best R² values
Best R value
Input(s): 1 2 5 6
Input(s): 1 3 4 5

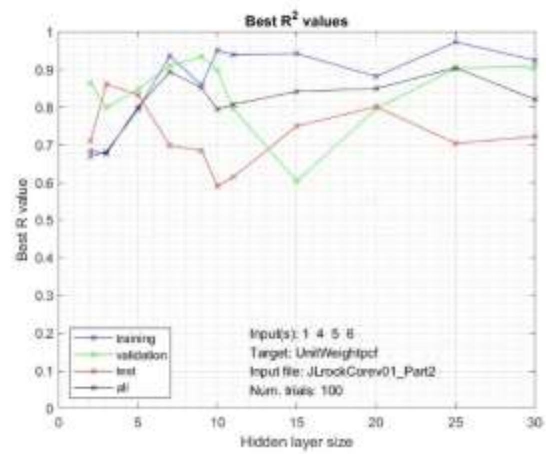

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

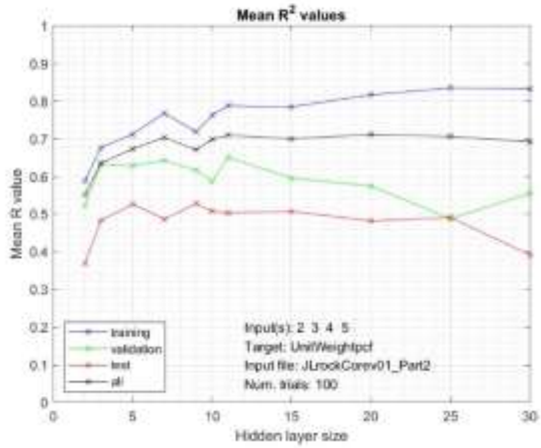

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

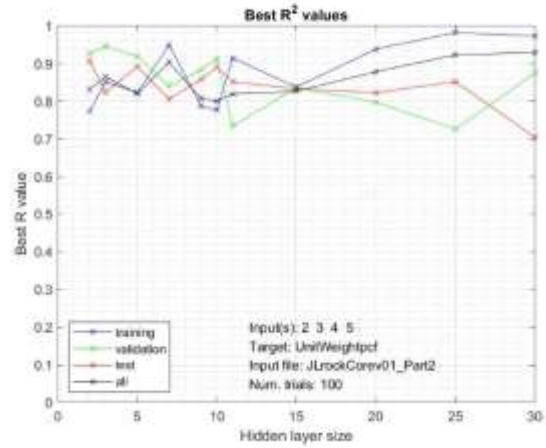

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

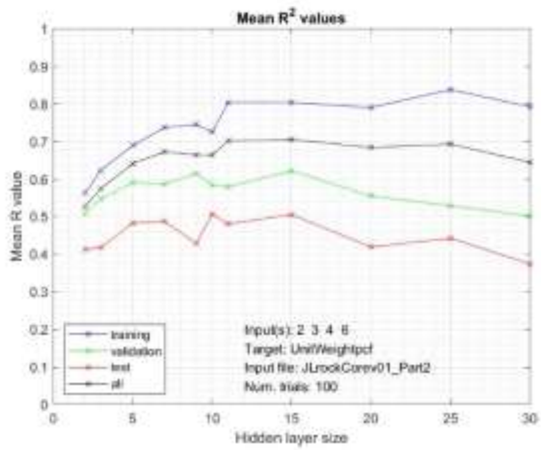

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

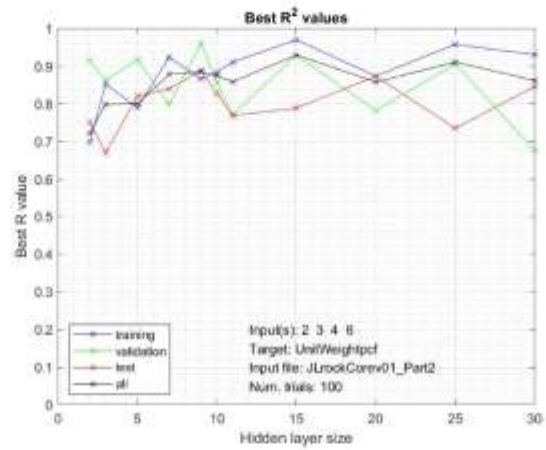

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

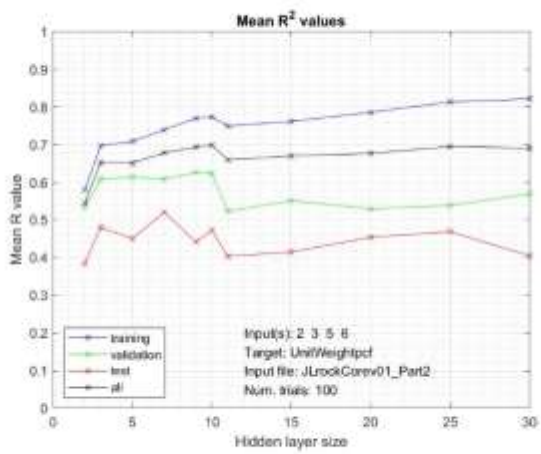

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 4 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

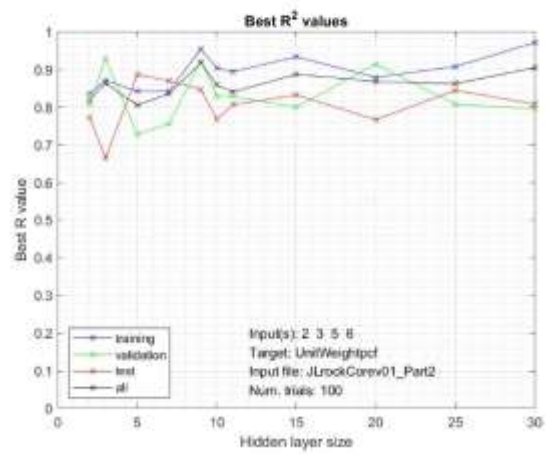

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

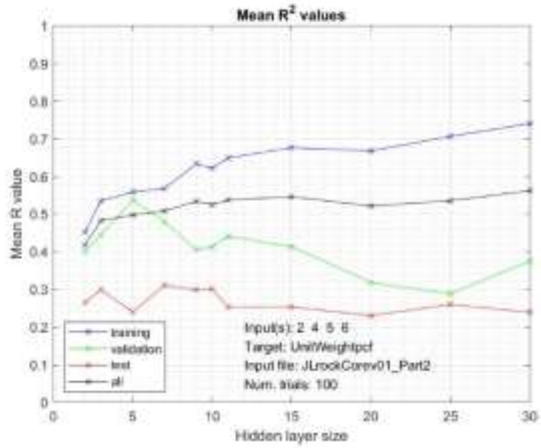

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

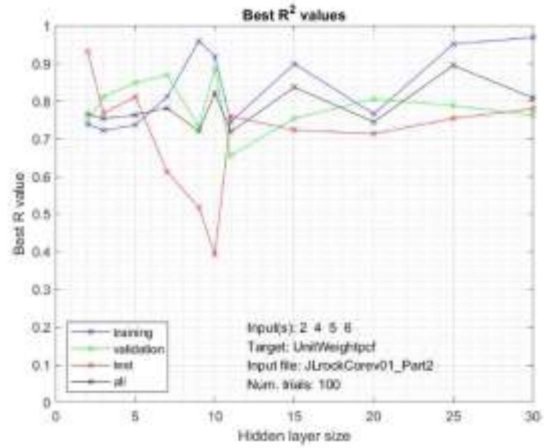

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

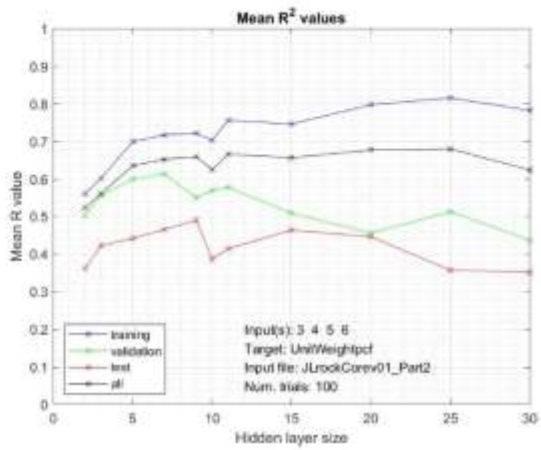

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

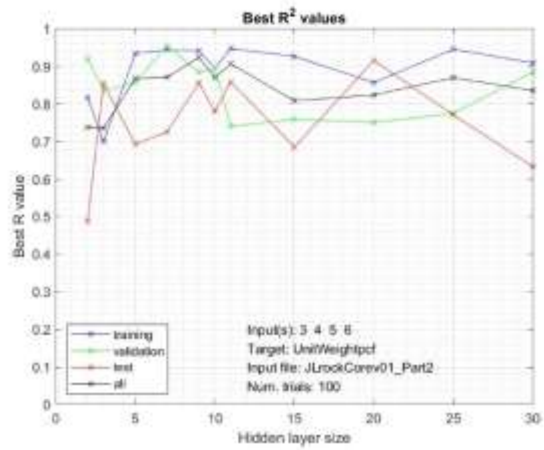

Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

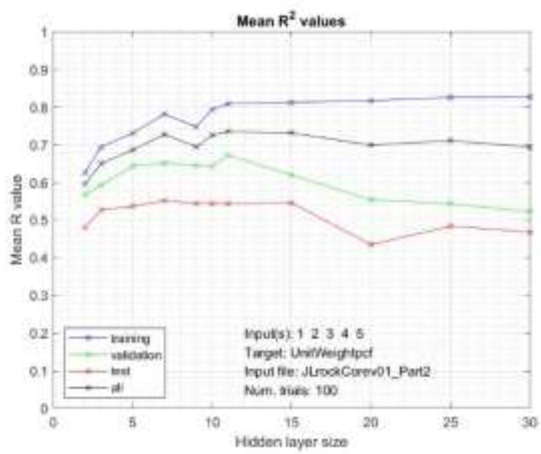

Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

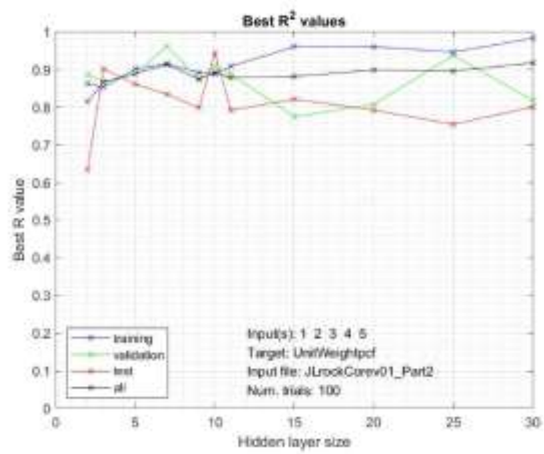

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 4 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

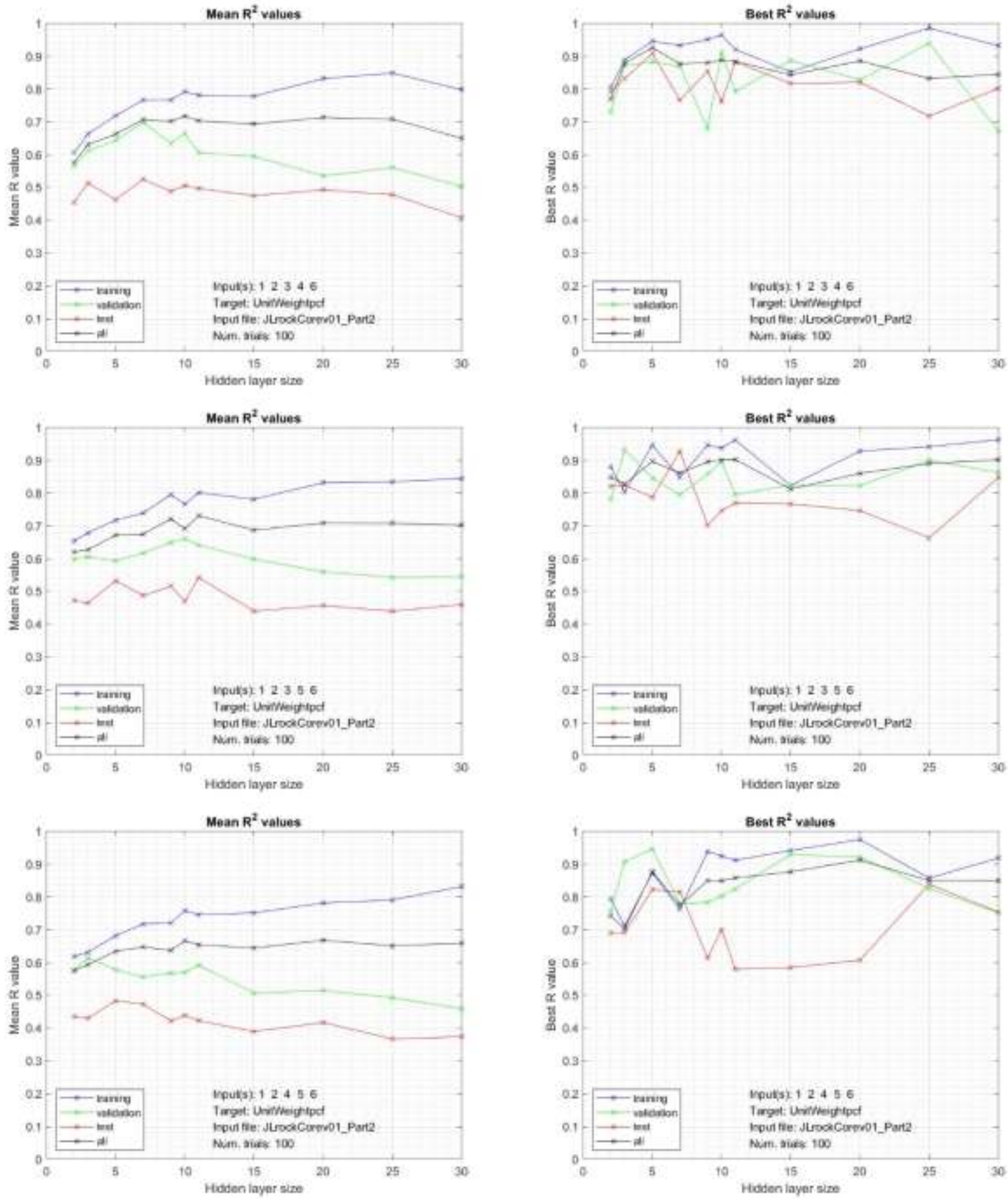

Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 4 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

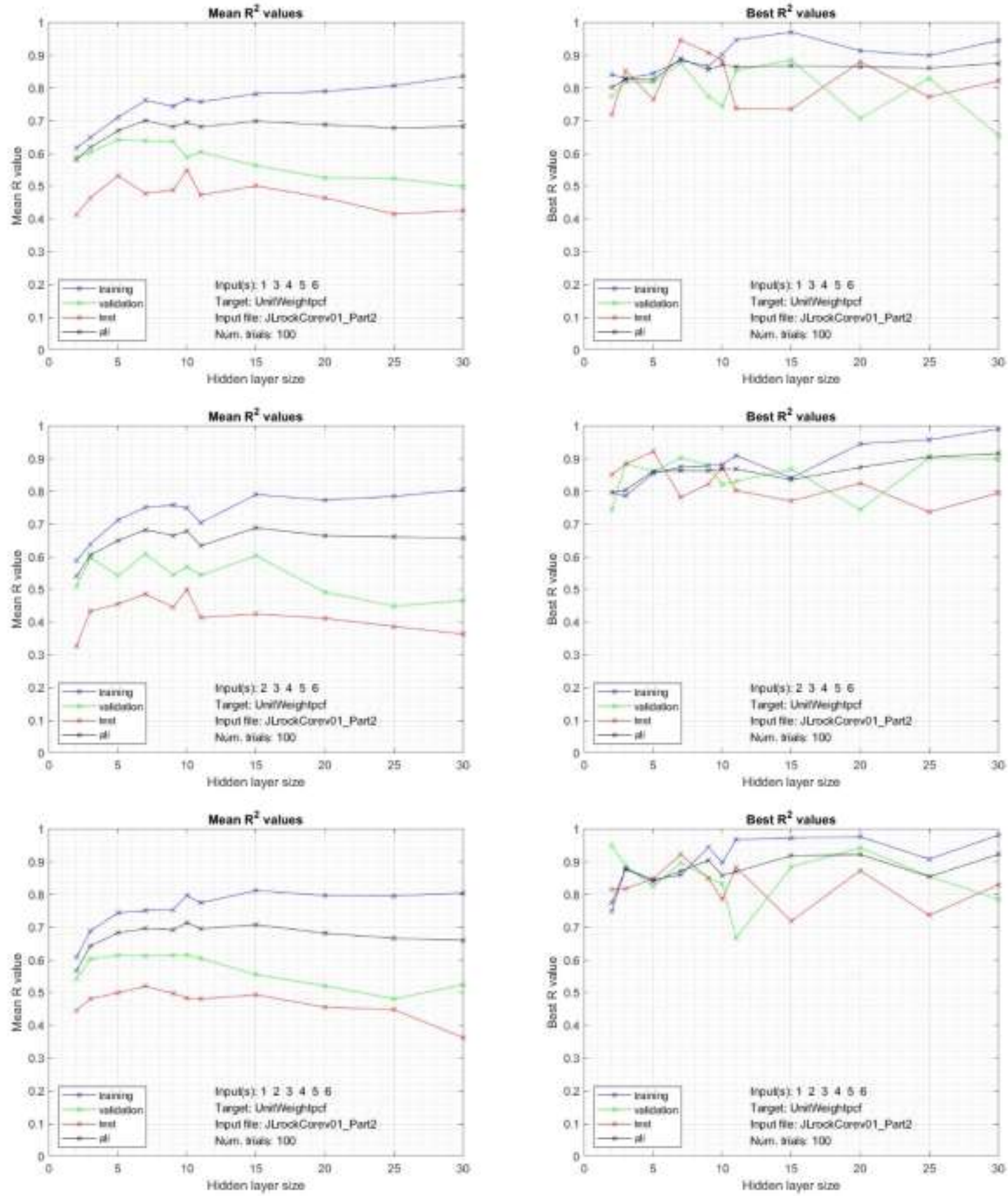

Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 3 4 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 3 4 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R^2 values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Best R^2 values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4 5
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100


Mean R² values
Best R² values
Mean R value
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4 6
Input(s): 1 2 3 5 6
Input(s): 1 2 4 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100



Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100
Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 3 4 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100
Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100
Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 2 3 4 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100
Mean R² values
Mean R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100
Best R² values
Best R value
Hidden layer size
training
validation
test
all
Input(s): 1 2 3 4 5 6
Target: UnitWeightpcf
Input file: JLrockCorev01_Part2
Num. trials: 100

Appendix F-2 – Mean and best R^2 results in text form for unit weight

Results for NN modelling of unit weight. Appendix F-2 contains a subset of the full text list of the 693 NN scenarios. This subset represents the six combinations of a single input (i.e. 1 to 6). These results are equivalent to single parameter linear regression.

```
Training INPUTS: 1  2  3  4  5  6

  Columns 1 through 4

    {'Depthfeet '}    {'PeakDownPressur…'}    {'RotationTorquel…'}    {'RotationSpeedre…'}

  Columns 5 through 6

    {'MovingSpeedfth '}    {'SpecificEnergyf…'}

--------------------

Training TARGETS: 9

    {'UnitWeightpcf '}

--------------------

--->  Target = UnitWeightpcf

--------------------

************ NUMBER OF COMBINATIONS = 1 ************

************ NUMBER OF COMBINATIONS = 1 ************
numIts = 100
inp = 1
--->  Input(s) = Depthfeet
        HL no.    all      train      val       test    Sum Bst R
        -----     ---      -----      ---       ----    ---------
MeanR =
          2    0.33824    0.38535    0.30147    0.20107
          3    0.36113    0.37836    0.34166    0.27158
          5    0.39833    0.44941     0.3795    0.21808
          7    0.41498    0.44779    0.39173    0.27051
          9    0.49754    0.55472    0.41608     0.3617
         10    0.484644    0.548523    0.431324    0.279997
         11    0.481282    0.554749    0.419258    0.276147
         15    0.555506    0.618048    0.498636    0.331666
         20    0.555332     0.63754    0.458719    0.394654
         25    0.554232    0.648006    0.468418    0.373932
         30    0.608294    0.724466    0.454184    0.400955
BestR =
          2    0.55994    0.50826    0.65545    0.74123     2.4649
          3    0.66082    0.65053    0.70699    0.69379     2.7121
          5    0.67074    0.60294    0.81759    0.77241     2.8637
          7     0.7233    0.68599    0.78335    0.83264     3.0253
          9    0.72619    0.68875    0.80378    0.84498     3.0637
```

```
        10    0.732861    0.707475     0.85554    0.690227      2.9861
        11    0.741045    0.710957    0.844842      0.7216    3.01844
        15    0.761601    0.759724    0.801986    0.772461     3.09577
        20    0.761485    0.777638    0.660445    0.835951     3.03552
        25    0.789174    0.808933    0.852054    0.720771     3.17093
        30    0.773582    0.784076    0.652137    0.857928     3.06772
inp = 2
---> Input(s) = PeakDownPressurepsi
      HL no.    all      train       val        test    Sum Bst R
      -----     ---      -----       ---        ----    ---------
MeanR =
         2    0.10638    0.11854    0.11727     0.0303
         3    0.22179      0.245    0.24619    0.11885
         5    0.22201     0.2383    0.23832    0.11288
         7    0.36391    0.40086    0.30523    0.24498
         9    0.35263    0.39625    0.34048    0.21334
        10    0.371788    0.439011     0.28946     0.21974
        11     0.35066    0.420808     0.30407    0.203763
        15    0.380693    0.480236    0.335322    0.181477
        20    0.403029    0.531015    0.336158    0.229479
        25    0.384777    0.519224    0.280888     0.20518
        30    0.409872    0.557809    0.302058    0.223308
BestR =
         2    0.55136    0.51298    0.69138    0.56907     2.3248
         3    0.53753    0.46344    0.65452    0.72854      2.384
         5      0.555    0.45061    0.84193    0.61992     2.4675
         7    0.57128     0.4885    0.88169    0.48042     2.4219
         9    0.59332    0.55189    0.62111    0.69482     2.4611
        10       0.585     0.56902    0.830403    0.469453     2.45388
        11    0.575937    0.537036    0.727013    0.627834     2.46782
        15    0.529693    0.514953    0.679547    0.598052     2.32225
        20    0.643653    0.677569    0.760678    0.338218     2.42012
        25    0.515262    0.523482    0.701142    0.581818      2.3217
        30    0.580387    0.665004    0.723539     0.46122     2.43015
inp = 3
---> Input(s) = RotationTorquelbft
      HL no.    all      train       val        test    Sum Bst R
      -----     ---      -----       ---        ----    ---------
MeanR =
         2    0.46231    0.45648    0.43213    0.36846
         3    0.43503    0.43316     0.4474    0.30425
         5    0.51966    0.51868    0.51527    0.33953
         7    0.52547    0.53896    0.48234    0.41259
         9    0.51201    0.54586    0.44076    0.27779
        10     0.53881    0.577333     0.52189     0.32824
        11    0.544966    0.612414    0.404981    0.321683
        15    0.544852    0.604767    0.432425    0.349868
        20    0.514158    0.630034    0.380853    0.244413
        25    0.607246    0.681723    0.416135    0.335392
        30    0.599984    0.706065    0.407013    0.310676
BestR =
```

```
    2    0.6275    0.55364    0.8677    0.77388    2.8227
    3    0.63178    0.58532    0.7742    0.71314    2.7044
    5    0.73838    0.73966    0.74587    0.78258    3.0065
    7    0.75475    0.68219    0.93839    0.86931    3.2446
    9    0.74976    0.74014    0.85059    0.73466    3.0752
    10    0.748878    0.728829    0.841637    0.9155    3.23484
    11    0.725033    0.69372    0.773573    0.859075    3.0514
    15    0.778914    0.770181    0.788257    0.808841    3.14619
    20    0.771286    0.790133    0.799994    0.710342    3.07175
    25    0.783795    0.793448    0.908446    0.645309    3.131
    30    0.778463    0.791161    0.802708    0.778657    3.15099
inp = 4
---> Input(s) = RotationSpeedrevmin
   HL no.    all    train    val    test    Sum Bst R
   -----    ---    -----    ---    ----    ---------
MeanR =
    2    0.28341    0.30872    0.26464    0.16084
    3    0.31575    0.33538    0.31622    0.18746
    5    0.36581    0.39047    0.31634    0.19843
    7    0.34567    0.37608    0.34374    0.19653
    9    0.43343    0.47146    0.3839    0.20008
    10    0.405519    0.453583    0.370461    0.199729
    11    0.455291    0.50325    0.351658    0.267844
    15    0.455829    0.517281    0.344953    0.243287
    20    0.468261    0.546089    0.374837    0.219693
    25    0.458077    0.562645    0.338285    0.220992
    30    0.442781    0.534831    0.371132    0.247201
BestR =
    2    0.45699    0.45058    0.72867    0.88459    2.5208
    3    0.4925    0.37231    0.67906    0.81227    2.3561
    5    0.52092    0.50081    0.58799    0.5819    2.1916
    7    0.49046    0.46497    0.7407    0.35071    2.0468
    9    0.52092    0.51514    0.66574    0.79832    2.5001
    10    0.578413    0.5799    0.67097    0.653602    2.48288
    11    0.566612    0.565799    0.59872    0.630511    2.36164
    15    0.629224    0.628406    0.590631    0.718181    2.56644
    20    0.585436    0.577969    0.69614    0.702703    2.56225
    25    0.679471    0.673057    0.564866    0.751625    2.66902
    30    0.703572    0.728012    0.79567    0.49388    2.72113
inp = 5
---> Input(s) = MovingSpeedfth
   HL no.    all    train    val    test    Sum Bst R
   -----    ---    -----    ---    ----    ---------
MeanR =
    2    0.2073    0.22405    0.17385    0.16912
    3    0.23082    0.25564    0.21244    0.1374
    5    0.24777    0.2843    0.20891    0.18892
    7    0.27221    0.3223    0.26393    0.16299
    9    0.2449    0.31203    0.22141    0.091723
    10    0.248907    0.306401    0.23127    0.132692
    11    0.233712    0.311114    0.193141    0.103624
```

```
        15    0.229122    0.320764     0.16374   0.0998928
        20    0.209318    0.339743    0.182341   0.0542047
        25    0.245931    0.382869    0.153716   0.0799338
        30    0.214409    0.360158    0.129161   0.0671115
BestR =
         2     0.2903    0.23117    0.42505    0.64494     1.5915
         3    0.32639    0.28948    0.58312     0.3182     1.5172
         5    0.36957    0.33718    0.46529    0.47646     1.6485
         7     0.3599    0.33211    0.67622    0.19485     1.5631
         9    0.36985    0.36874    0.26505    0.56844     1.5721
        10     0.35016    0.334721    0.341347    0.49581     1.52204
        11    0.347945    0.302916    0.541976    0.393387     1.58622
        15    0.461935    0.485488    0.363301    0.442389     1.75311
        20    0.471541    0.514172    0.298665    0.415678     1.70006
        25    0.428811    0.453495     0.56118   0.370374     1.81386
        30    0.445465    0.483917    0.344456    0.456067     1.72991
inp = 6
---> Input(s) = SpecificEnergyftlbft3
       HL no.    all      train       val        test    Sum Bst R
       -----     ---      -----       ---        ----    ---------
MeanR =
         2     0.2348    0.24635    0.20085    0.15893
         3    0.29719     0.3206    0.28994     0.2108
         5    0.24623    0.30746    0.24532   0.091078
         7    0.26712    0.34143    0.24815    0.10711
         9    0.33112    0.39623    0.28494    0.16151
        10     0.35961    0.429719    0.295668    0.143826
        11    0.332938    0.399839    0.276925    0.159141
        15    0.315669     0.41119    0.232751    0.115221
        20    0.344575    0.466465    0.218834    0.125212
        25    0.350108     0.47829    0.206196    0.172341
        30    0.387371    0.538175    0.239019    0.117708
BestR =
         2    0.38127    0.41594    0.44068    0.57087     1.8088
         3    0.46604    0.48583    0.44357     0.6511     2.0465
         5    0.44104    0.38437    0.72234    0.50585     2.0536
         7    0.45137    0.48405    0.66004    0.46641     2.0619
         9    0.51633    0.49599    0.46622    0.71726     2.1958
        10    0.490946    0.540703    0.583732    0.546707     2.16209
        11    0.527689    0.538848    0.707471     0.12008     1.89409
        15    0.553191    0.650362    0.608235    0.429763     2.24155
        20    0.483021    0.539891    0.690083    0.599688     2.31268
        25    0.613973     0.63617    0.731088    0.350775     2.33201
        30    0.617393    0.699651     0.50159    0.503966      2.3226
```

Appendix G – NN summary results for SPT blow counts

Training INPUTS: 1 2 3 4 5 6
Columns 1 through
4
{'Depthfeet '} {'PeakDownPressur…'} {'RotationTorquel…'} {'RotationSpeedre…'}
Columns 5 through
6
{'MovingSpeedfth '} {'SpecificEnergyf…'}

Training TARGETS: 7
{'BlowsPerFoot '}

---> Target = BlowsPerFoot

************ NUMBER OF COMBINATIONS = 1 ************
numIts =
100
inp =
1
---> Input(s) = Depthfeet

HL no.	all	train	val	test	Sum Bst R	
-----	---	-----	---	----	---------	

BestR =

2	0.71512	0.59868	0.96249	0.92731	3.2036	
3	0.77015	0.73441	0.89429	0.87183	3.2707	
5	0.75691	0.73734	0.91872	0.86166	3.2746	
7	0.78155	0.64827	0.92409	0.92472	3.2786	
9	0.74812	0.72637	0.93732	0.97377	3.3856	
10	0.7459	0.79578	0.89538	0.97501	3.4121	
11	0.79153	0.78595	0.79133	0.86234	3.2312	
15	0.76893	0.75993	0.8949	0.86422	3.288	
20	0.74021	0.77777	0.83594	0.92738	3.2813	
25	0.76601	0.82361	0.84884	0.83783	3.2763	
30	0.80622	0.82845	0.73628	0.92184	3.2928	3.4121

inp =
2
---> Input(s) = PeakDownPressurepsi

HL no.	all	train	val	test	Sum Bst R
-----	---	-----	---	----	---------

BestR =

2	0.65167	0.60122	0.61646	0.91233	2.7817
3	0.67619	0.6462	0.77293	0.78626	2.8816
5	0.65419	0.57509	0.84981	0.86355	2.9426
7	0.62331	0.62482	0.97894	0.72371	2.9508
9	0.72147	0.66039	0.87173	0.85125	3.1048
10	0.7242	0.64424	0.67808	0.9548	3.0013

11	0.68848	0.68882	0.88245	0.83868	3.0984	
15	0.76291	0.73398	0.84198	0.8066	3.1455	
20	0.65754	0.70299	0.94121	0.67532	2.9771	
25	0.6955	0.74397	0.76918	0.73791	2.9466	
30	0.71218	0.81701	0.59157	0.80663	2.9274	3.1455

inp =

3

---> Input(s) = RotationTorquelbft

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.50756	0.43607	0.79943	0.7795	2.5226	
3	0.49993	0.40252	0.90405	0.66955	2.4761	
5	0.50097	0.5215	0.67614	0.74891	2.4475	
7	0.55626	0.43276	0.68583	0.88745	2.5623	
9	0.52481	0.44687	0.50652	0.99529	2.4735	
10	0.5577	0.58306	0.72496	0.69859	2.5643	
11	0.60581	0.63215	0.76608	0.57695	2.581	
15	0.59556	0.7119	0.78382	0.56641	2.6577	
20	0.60103	0.56653	0.65285	0.85445	2.6749	
25	0.45207	0.69914	0.78553	0.64152	2.5783	
30	0.54933	0.81641	0.58798	0.85225	2.806	2.806

inp =

4

---> Input(s) = RotationSpeedrevmin

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.49004	0.50821	0.83692	0.56498	2.4001	
3	0.51445	0.47446	0.73886	0.72102	2.4488	
5	0.51841	0.48004	0.6531	0.86039	2.5119	
7	0.52236	0.4635	0.751	0.65096	2.3878	
9	0.67117	0.64938	0.61238	0.8	2.7329	
10	0.53967	0.48337	0.79286	0.57129	2.3872	
11	0.7253	0.79665	0.54789	0.53125	2.6011	
15	0.60752	0.67265	0.41378	0.74745	2.4414	
20	0.81899	0.80521	0.90215	0.50519	3.0315	
25	0.75711	0.80873	0.43948	0.86412	2.8694	
30	0.77732	0.84556	0.73359	0.65522	3.0117	3.0315

inp =

5

---> Input(s) = MovingSpeedfth

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.13866	0.042928	0.60244	0.47061	1.2546
3	0.43304	0.47721	0.76685	-0.28246	1.3946
5	0.38939	0.45498	0.33927	0.27183	1.4555

7	0.56925	0.6038	0.60676	0.59546	2.3753	
9	0.61084	0.74931	0.51754	0.5314	2.4091	
10	0.65188	0.68029	0.72679	0.66011	2.7191	
11	0.52773	0.51215	0.87071	0.31855	2.2291	
15	0.62463	0.61089	0.79489	0.60277	2.6332	
20	0.59308	0.63368	0.69908	0.84774	2.7736	
25	0.63401	0.65763	0.75426	0.75229	2.7982	
30	0.54985	0.62439	0.83859	0.38598	2.3988	2.7982

inp =

6

---> Input(s) = SpecificEnergyftlbft3

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.59926	0.66762	0.85687	0.7696	2.8933	
3	0.68432	0.61486	0.85636	0.77165	2.9272	
5	0.65817	0.6664	0.84747	0.83284	3.0049	
7	0.66758	0.6713	0.9785	0.67408	2.9915	
9	0.65183	0.67764	0.79459	0.93393	3.058	
10	0.69587	0.71497	0.68637	0.80645	2.9037	
11	0.65435	0.63989	0.95243	0.78223	3.0289	
15	0.65778	0.72856	0.72693	0.73795	2.8512	
20	0.72519	0.66985	0.83901	0.80674	3.0408	
25	0.73259	0.8197	0.81116	0.53158	2.895	
30	0.74172	0.73166	0.86593	0.8558	3.1951	3.1951

************ NUMBER OF COMBINATIONS = 2 ************

numIts =

100

inp =

1 2

---> Input(s) = Depthfeet PeakDownPressurepsi

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.82887	0.79468	0.95036	0.92967	3.5036	
3	0.8207	0.78952	0.95712	0.94218	3.5095	
5	0.83755	0.80109	0.96919	0.92097	3.5288	
7	0.8599	0.83149	0.91131	0.92288	3.5256	
9	0.82516	0.83598	0.87114	0.9237	3.456	
10	0.90423	0.90903	0.80215	0.81169	3.4271	
11	0.83929	0.849	0.76697	0.92629	3.3815	
15	0.89091	0.91963	0.87868	0.82929	3.5185	
20	0.90302	0.93026	0.86542	0.88325	3.582	
25	0.83705	0.86471	0.91235	0.85409	3.4682	
30	0.84321	0.8733	0.80524	0.93589	3.4576	3.582

inp =

1 3

---> Input(s) = Depthfeet RotationTorquelbft

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.74346	0.73125	0.85372	0.8843	3.2127	
3	0.78163	0.84287	0.82623	0.82649	3.2772	
5	0.767	0.75692	0.97813	0.75732	3.2594	
7	0.76197	0.74135	0.82554	0.89159	3.2205	
9	0.74257	0.92912	0.86519	0.75892	3.2958	
10	0.81928	0.81486	0.91603	0.74391	3.2941	
11	0.83099	0.78651	0.80064	0.95183	3.37	
15	0.78112	0.72663	0.91291	0.85583	3.2765	
20	0.81064	0.822	0.82454	0.68958	3.1468	
25	0.86557	0.90726	0.80551	0.88835	3.4667	
30	0.82092	0.81827	0.81953	0.9022	3.3609	3.4667

inp =

1 4

---> Input(s) = Depthfeet RotationSpeedrevmin

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.7756	0.7188	0.82103	0.86496	3.1804	
3	0.78486	0.75513	0.82174	0.86926	3.231	
5	0.83666	0.85403	0.92508	0.84683	3.4626	
7	0.72054	0.7996	0.90466	0.90042	3.3252	
9	0.86897	0.86569	0.7532	0.94818	3.436	
10	0.84418	0.82567	0.94357	0.88045	3.4939	
11	0.82008	0.81447	0.88512	0.90386	3.4235	
15	0.83102	0.85369	0.93411	0.58997	3.2088	
20	0.78863	0.89303	0.85907	0.87613	3.4169	
25	0.86243	0.85224	0.96613	0.77479	3.4556	
30	0.85134	0.94674	0.89635	0.63999	3.3344	3.4939

inp =

1 5

---> Input(s) = Depthfeet MovingSpeedfth

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.77888	0.80193	0.90558	0.86793	3.3543	
3	0.78952	0.74491	0.92251	0.84198	3.2989	
5	0.85213	0.83121	0.79534	0.91541	3.3941	
7	0.83977	0.86673	0.88007	0.75779	3.3444	
9	0.82006	0.77793	0.91404	0.88736	3.3994	
10	0.83101	0.80962	0.87126	0.90535	3.4172	
11	0.87277	0.8642	0.89598	0.88961	3.5226	
15	0.82222	0.77405	0.82331	0.95991	3.3795	
20	0.8141	0.84917	0.91398	0.81603	3.3933	
25	0.85905	0.94753	0.88694	0.58609	3.2796	
30	0.82062	0.89116	0.87703	0.56977	3.1586	3.5226

inp =
1 6
---> Input(s) = Depthfeet SpecificEnergyftlbft3
HL no. all train val test Sum Bst R
----- --- ----- --- ---- ---------
BestR =

2	0.82597	0.81235	0.90309	0.90302	3.4444	
3	0.81527	0.78437	0.91009	0.93313	3.4429	
5	0.81878	0.84359	0.79397	0.91998	3.3763	
7	0.81742	0.79441	0.91319	0.92855	3.4536	
9	0.79596	0.74167	0.90113	0.94561	3.3844	
10	0.85108	0.83899	0.94329	0.81037	3.4437	
11	0.89334	0.93588	0.89218	0.8192	3.5406	
15	0.83734	0.9121	0.78973	0.84796	3.3871	
20	0.84365	0.83353	0.84619	0.91393	3.4373	
25	0.84357	0.87542	0.83168	0.85803	3.4087	
30	0.82593	0.93057	0.90901	0.95768	3.6232	3.6232

inp =
2 3
---> Input(s) = PeakDownPressurepsi RotationTorquelbft
HL no. all train val test Sum Bst R
----- --- ----- --- ---- ---------
BestR =

2	0.65671	0.57712	0.8988	0.91569	3.0483	
3	0.65789	0.60468	0.86554	0.82021	2.9483	
5	0.72337	0.75011	0.77569	0.82449	3.0737	
7	0.78166	0.79289	0.9061	0.86337	3.344	
9	0.64462	0.80693	0.76239	0.84137	3.0553	
10	0.75297	0.75122	0.83114	0.83977	3.1751	
11	0.68093	0.65577	0.88204	0.76035	2.9791	
15	0.74731	0.73631	0.87485	0.81671	3.1752	
20	0.8441	0.88963	0.81549	0.70157	3.2508	
25	0.83409	0.98544	0.73642	0.85186	3.4078	
30	0.80578	0.85309	0.86934	0.81862	3.3468	3.4078

inp =
2 4
---> Input(s) = PeakDownPressurepsi RotationSpeedrevmin
HL no. all train val test Sum Bst R
----- --- ----- --- ---- ---------
BestR =

2	0.74285	0.77428	0.77441	0.7087	3.0002
3	0.75366	0.73818	0.90648	0.75111	3.1494
5	0.78963	0.82065	0.84335	0.78919	3.2428
7	0.78559	0.76359	0.95939	0.81107	3.3196
9	0.80839	0.80674	0.81918	0.87715	3.3115
10	0.83924	0.88006	0.8071	0.76847	3.2949
11	0.86097	0.88766	0.94574	0.88166	3.576
15	0.81433	0.80255	0.86509	0.87409	3.3561

20	0.85385	0.88694	0.89222	0.71756	3.3506	
25	0.88253	0.92789	0.77187	0.82826	3.4106	
30	0.75695	0.87969	0.75526	0.828	3.2199	3.576

inp =

2 5

---> Input(s) = PeakDownPressurepsi MovingSpeedfth

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.76346	0.77425	0.90653	0.67247	3.1167	
3	0.73473	0.69306	0.9532	0.86111	3.2421	
5	0.81066	0.86362	0.92633	0.89173	3.4923	
7	0.90529	0.91931	0.96092	0.86258	3.6481	
9	0.82868	0.83892	0.97115	0.7903	3.429	
10	0.87557	0.93359	0.94119	0.65647	3.4068	
11	0.86708	0.89695	0.85993	0.90196	3.5259	
15	0.81438	0.81508	0.86577	0.91331	3.4085	
20	0.88412	0.91667	0.90153	0.73294	3.4353	
25	0.86548	0.95439	0.79546	0.7234	3.3387	
30	0.85717	0.94302	0.73559	0.82119	3.357	3.6481

inp =

2 6

---> Input(s) = PeakDownPressurepsi SpecificEnergyftlbft3

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.58801	0.73069	0.78881	0.77052	2.878	
3	0.68299	0.64842	0.8119	0.82146	2.9648	
5	0.65787	0.72243	0.91187	0.87355	3.1657	
7	0.69715	0.6742	0.85573	0.78984	3.0169	
9	0.64263	0.65552	0.97224	0.72303	2.9934	
10	0.68579	0.67158	0.67395	0.95259	2.9839	
11	0.73771	0.8044	0.80406	0.85865	3.2048	
15	0.70905	0.76496	0.7678	0.83958	3.0814	
20	0.69887	0.69208	0.78732	0.90142	3.0797	
25	0.76005	0.77363	0.79214	0.78091	3.1067	
30	0.72377	0.80458	0.83723	0.82067	3.1863	3.2048

inp =

3 4

---> Input(s) = RotationTorquelbft RotationSpeedrevmin

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.64941	0.58135	0.91661	0.80571	2.9531
3	0.64376	0.49064	0.98101	0.89991	3.0153
5	0.69302	0.72889	0.75922	0.69265	2.8738
7	0.77296	0.85423	0.75087	0.65169	3.0297
9	0.65409	0.61916	0.92247	0.64383	2.8395

10	0.666	0.61018	0.89801	0.82441	2.9986	
11	0.79204	0.84715	0.78837	0.60973	3.0373	
15	0.65876	0.50341	0.82222	0.89898	2.8834	
20	0.63423	0.65727	0.58741	0.82911	2.708	
25	0.73387	0.76837	0.67449	0.66413	2.8409	
30	0.54992	0.57227	0.82151	0.70098	2.6447	3.0373

inp =

3 5

---> Input(s) = RotationTorquelbft MovingSpeedfth

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.61456	0.62642	0.56137	0.78624	2.5886	
3	0.49058	0.39457	0.86774	0.82055	2.5734	
5	0.61323	0.56421	0.94719	0.51664	2.6413	
7	0.7736	0.72599	0.92147	0.74705	3.1681	
9	0.64953	0.70115	0.70967	0.60128	2.6616	
10	0.65941	0.64456	0.68124	0.83416	2.8194	
11	0.68091	0.79316	0.67199	0.52693	2.673	
15	0.67769	0.73396	0.71972	0.66158	2.7929	
20	0.70401	0.69977	0.88302	0.62219	2.909	
25	0.69451	0.80514	0.74412	0.38104	2.6248	
30	0.66536	0.8043	0.66704	0.40369	2.5404	3.1681

inp =

3 6

---> Input(s) = RotationTorquelbft SpecificEnergyftlbft3

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.67377	0.62248	0.85522	0.90689	3.0584	
3	0.62654	0.58128	0.93975	0.84468	2.9923	
5	0.68281	0.67341	0.66508	0.91549	2.9368	
7	0.83995	0.87007	0.76845	0.87355	3.352	
9	0.66982	0.74935	0.7361	0.74783	2.9031	
10	0.87228	0.88078	0.81369	0.8904	3.4571	
11	0.78119	0.90601	0.66467	0.71521	3.0671	
15	0.7887	0.87041	0.7262	0.65284	3.0382	
20	0.74611	0.9039	0.71101	0.86261	3.2236	
25	0.8158	0.89894	0.54889	0.83437	3.098	
30	0.8335	0.91152	0.75569	0.7777	3.2784	3.4571

inp =

4 5

---> Input(s) = RotationSpeedrevmin MovingSpeedfth

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.58441	0.55245	0.77241	0.66621	2.5755
3	0.5684	0.48756	0.79768	0.78535	2.639

5	0.56525	0.48733	0.89402	0.79598	2.7426	
7	0.67671	0.75191	0.8753	0.33423	2.6381	
9	0.5727	0.63497	0.85793	0.62176	2.6874	
10	0.63306	0.58315	0.86673	0.78141	2.8643	
11	0.56257	0.65575	0.77535	0.8045	2.7982	
15	0.74912	0.83833	0.52472	0.7118	2.824	
20	0.81102	0.84065	0.80473	0.72445	3.1808	
25	0.76968	0.81854	0.68811	0.80712	3.0835	
30	0.74664	0.79309	0.56148	0.83794	2.9391	3.1808

inp =
4 6
---> Input(s) = RotationSpeedrevmin SpecificEnergyftlbft3
HL no. all train val test Sum Bst R
----- --- ----- --- ---- ---------
BestR =

2	0.77438	0.77774	0.90303	0.90572	3.3609	
3	0.7905	0.82549	0.79535	0.74533	3.1567	
5	0.84736	0.91032	0.91385	0.77922	3.4507	
7	0.78926	0.76081	0.83002	0.93684	3.3169	
9	0.80829	0.83922	0.91816	0.84007	3.4057	
10	0.82815	0.82332	0.92503	0.72682	3.3033	
11	0.79054	0.87518	0.77432	0.88384	3.3239	
15	0.83115	0.90146	0.74837	0.77935	3.2603	
20	0.85584	0.90999	0.90871	0.71251	3.387	
25	0.88353	0.94078	0.93116	0.64412	3.3996	
30	0.80017	0.93556	0.81132	0.9462	3.4932	3.4932

inp =
5 6
---> Input(s) = MovingSpeedfth SpecificEnergyftlbft3
HL no. all train val test Sum Bst R
----- --- ----- --- ---- ---------
BestR =

2	0.76309	0.72621	0.85585	0.79803	3.1432	
3	0.72492	0.72019	0.95482	0.88168	3.2816	
5	0.79503	0.84703	0.89539	0.62955	3.167	
7	0.80998	0.76314	0.96181	0.9036	3.4385	
9	0.88768	0.96534	0.73057	0.75629	3.3399	
10	0.84072	0.9027	0.95369	0.71369	3.4108	
11	0.72882	0.90682	0.94967	0.91191	3.4972	
15	0.83396	0.89052	0.84494	0.89439	3.4638	
20	0.88595	0.95363	0.72556	0.8309	3.396	
25	0.85823	0.87111	0.86556	0.86141	3.4563	
30	0.84074	0.93092	0.83289	0.87117	3.4757	3.4972

************ NUMBER OF COMBINATIONS = 3 ************
numIts =
100
inp =
1 2 3

---> Input(s) = Depthfeet PeakDownPressurepsi RotationTorquelbft

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.7817	0.80151	0.86892	0.86762	3.3198	
3	0.78372	0.81208	0.95609	0.7413	3.2932	
5	0.77897	0.6914	0.92604	0.9531	3.3495	
7	0.84786	0.88107	0.83186	0.77664	3.3374	
9	0.81846	0.78341	0.94896	0.92996	3.4808	
10	0.85032	0.76278	0.91871	0.94355	3.4754	
11	0.78835	0.90752	0.93447	0.72549	3.3558	
15	0.88101	0.88347	0.72945	0.95486	3.4488	
20	0.82995	0.94605	0.77928	0.69088	3.2462	
25	0.82181	0.90132	0.79114	0.78994	3.3042	
30	0.83121	0.83642	0.92498	0.88698	3.4796	3.4808

inp =

1 2 4

---> Input(s) = Depthfeet PeakDownPressurepsi RotationSpeedrevmin

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.84616	0.82337	0.86674	0.94074	3.477	
3	0.91395	0.94787	0.77849	0.92567	3.566	
5	0.83177	0.8272	0.92262	0.90017	3.4818	
7	0.88895	0.88764	0.94494	0.94961	3.6711	
9	0.84173	0.83994	0.89252	0.88558	3.4598	
10	0.8952	0.92605	0.87971	0.90817	3.6091	
11	0.91449	0.94638	0.84111	0.89942	3.6014	
15	0.93059	0.97397	0.98183	0.79696	3.6834	
20	0.89443	0.94448	0.879	0.8949	3.6128	
25	0.92537	0.96954	0.81687	0.89977	3.6116	
30	0.94922	0.98866	0.86389	0.81893	3.6207	3.6834

inp =

1 2 5

---> Input(s) = Depthfeet PeakDownPressurepsi MovingSpeedfth

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.79833	0.75768	0.89353	0.94253	3.3921
3	0.7855	0.83475	0.95047	0.91535	3.4861
5	0.89985	0.91057	0.88843	0.84779	3.5466
7	0.89659	0.9387	0.82674	0.86063	3.5227
9	0.91368	0.94559	0.9116	0.7453	3.5162
10	0.91559	0.90761	0.94349	0.91404	3.6807
11	0.86706	0.84837	0.96432	0.87348	3.5532
15	0.8705	0.90101	0.87857	0.88732	3.5374
20	0.89561	0.91442	0.94	0.83885	3.5889
25	0.86381	0.9636	0.83176	0.78575	3.4449

30	0.80042	0.88947	0.87147	0.93468	3.496	3.6807

inp =

1 2 6

---> Input(s) = Depthfeet PeakDownPressurepsi SpecificEnergyftlbft3

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.7773	0.79472	0.88513	0.88064	3.3378	
3	0.84731	0.83493	0.83995	0.91671	3.4389	
5	0.82691	0.83213	0.93121	0.79892	3.3892	
7	0.81118	0.7467	0.94213	0.90791	3.4079	
9	0.83864	0.85349	0.82905	0.91482	3.436	
10	0.81743	0.82993	0.78199	0.94555	3.3749	
11	0.83065	0.87292	0.72471	0.95603	3.3843	
15	0.82173	0.82397	0.82619	0.9307	3.4026	
20	0.77399	0.95101	0.86936	0.82611	3.4205	
25	0.73062	0.90309	0.91576	0.84891	3.3984	
30	0.84311	0.93825	0.88918	0.89007	3.5606	3.5606

inp =

1 3 4

---> Input(s) = Depthfeet RotationTorquelbft RotationSpeedrevmin

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.77572	0.79208	0.82616	0.81439	3.2084	
3	0.82358	0.78509	0.95448	0.77298	3.3361	
5	0.77537	0.77529	0.89603	0.77179	3.2185	
7	0.82977	0.79621	0.93334	0.89407	3.4534	
9	0.82256	0.85776	0.85371	0.78323	3.3173	
10	0.85711	0.83411	0.92428	0.88794	3.5034	
11	0.82759	0.87951	0.76129	0.80106	3.2695	
15	0.7886	0.85567	0.89652	0.72934	3.2701	
20	0.79587	0.76099	0.97657	0.82203	3.3555	
25	0.75633	0.83473	0.83532	0.90472	3.3311	
30	0.86484	0.91724	0.84647	0.84517	3.4737	3.5034

inp =

1 3 5

---> Input(s) = Depthfeet RotationTorquelbft MovingSpeedfth

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.85696	0.86057	0.77707	0.91795	3.4126
3	0.8686	0.86746	0.97141	0.69018	3.3976
5	0.89795	0.89876	0.95808	0.71692	3.4717
7	0.90427	0.90317	0.94619	0.86584	3.6195
9	0.89992	0.9436	0.95971	0.83241	3.6356
10	0.83802	0.81798	0.83014	0.94527	3.4314
11	0.89068	0.92145	0.95776	0.77097	3.5409

15	0.92141	0.97808	0.75131	0.89866	3.5495	
20	0.84635	0.9855	0.92363	0.92618	3.6817	
25	0.86759	1	0.91566	0.5975	3.3808	
30	0.84303	0.90217	0.81008	0.85027	3.4055	3.6817

inp =
1 3 6
---> Input(s) = Depthfeet RotationTorquelbft SpecificEnergyftlbft3
HL no. all train val test Sum Bst R
----- --- ----- --- ---- ---------
BestR =

2	0.82046	0.71536	0.94127	0.95166	3.4288	
3	0.81296	0.77501	0.93631	0.89028	3.4146	
5	0.80192	0.79143	0.92052	0.91085	3.4247	
7	0.87715	0.88766	0.89738	0.8715	3.5337	
9	0.83389	0.84798	0.8735	0.83918	3.3946	
10	0.82781	0.908	0.7356	0.83489	3.3063	
11	0.84443	0.83425	0.89336	0.94905	3.5211	
15	0.84693	0.8712	0.89852	0.86498	3.4816	
20	0.87723	0.89621	0.9048	0.79765	3.4759	
25	0.81868	0.93924	0.76864	0.8224	3.349	
30	0.80529	0.97179	0.83832	0.72535	3.3407	3.5337

inp =
1 4 5
---> Input(s) = Depthfeet RotationSpeedrevmin MovingSpeedfth
HL no. all train val test Sum Bst R
----- --- ----- --- ---- ---------
BestR =

2	0.79243	0.74879	0.91965	0.79593	3.2568	
3	0.82945	0.80281	0.9518	0.89371	3.4778	
5	0.83958	0.86579	0.95186	0.73093	3.3882	
7	0.82845	0.85264	0.80153	0.80315	3.2858	
9	0.86777	0.85825	0.96815	0.82305	3.5172	
10	0.86644	0.87387	0.88502	0.83584	3.4612	
11	0.80973	0.80921	0.90173	0.89951	3.4202	
15	0.8418	0.87135	0.85308	0.86007	3.4263	
20	0.86515	0.9379	0.60975	0.94767	3.3605	
25	0.7957	0.95364	0.9428	0.6008	3.2929	
30	0.8411	0.91105	0.94452	0.71105	3.4077	3.5172

inp =
1 4 6
---> Input(s) = Depthfeet RotationSpeedrevmin SpecificEnergyftlbft3
HL no. all train val test Sum Bst R
----- --- ----- --- ---- ---------
BestR =

2	0.85263	0.8482	0.90808	0.83513	3.444
3	0.8428	0.84689	0.87972	0.84208	3.4115
5	0.85796	0.88655	0.95993	0.84574	3.5502
7	0.86306	0.85356	0.86701	0.9274	3.511

9	0.85351	0.86095	0.94407	0.85105	3.5096	
10	0.78312	0.86669	0.92821	0.89142	3.4694	
11	0.91128	0.97288	0.83516	0.859	3.5783	
15	0.92277	0.96258	0.94895	0.93246	3.7668	
20	0.87341	0.85498	0.77522	0.9591	3.4627	
25	0.88688	0.93661	0.78779	0.87905	3.4903	
30	0.91684	0.95231	0.86929	0.95071	3.6892	3.7668

inp =
1 5 6
---> Input(s) = Depthfeet MovingSpeedfth SpecificEnergyftlbft3

HL no.	all	train	val	test	Sum Bst R	
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BestR =

2	0.81577	0.83567	0.87593	0.84471	3.3721	
3	0.85866	0.81215	0.93832	0.92264	3.5318	
5	0.8761	0.8711	0.87073	0.91656	3.5345	
7	0.90025	0.91882	0.88821	0.87785	3.5851	
9	0.88062	0.94609	0.86306	0.92906	3.6188	
10	0.86981	0.88668	0.86386	0.91383	3.5342	
11	0.89666	0.94072	0.82274	0.91336	3.5735	
15	0.86538	0.87804	0.93778	0.86431	3.5455	
20	0.89752	0.93786	0.94859	0.8779	3.6619	
25	0.89299	0.95932	0.80606	0.9271	3.5855	
30	0.91508	0.94206	0.89238	0.8349	3.5844	3.6619

inp =
2 3 4
---> Input(s) = PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin

HL no.	all	train	val	test	Sum Bst R	
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BestR =

2	0.69897	0.62198	0.875	0.90525	3.1012	
3	0.80094	0.82574	0.90239	0.75098	3.2801	
5	0.76598	0.77093	0.92148	0.79053	3.2489	
7	0.83225	0.94568	0.97113	0.73021	3.4793	
9	0.8541	0.91208	0.78609	0.75382	3.3061	
10	0.73589	0.82855	0.77609	0.80302	3.1436	
11	0.86253	0.90355	0.89462	0.78792	3.4486	
15	0.87907	0.88257	0.87426	0.85796	3.4939	
20	0.85514	0.89801	0.91323	0.90831	3.5747	
25	0.91635	0.99414	0.85036	0.7311	3.4919	
30	0.88812	0.99503	0.77105	0.48479	3.139	3.5747

inp =
2 3 5
---> Input(s) = PeakDownPressurepsi RotationTorquelbft MovingSpeedfth

HL no.	all	train	val	test	Sum Bst R	
-----	---	-----	---	----	---------	

BestR =

2	0.72187	0.84344	0.75173	0.85846	3.1755

3	0.77857	0.82279	0.88738	0.65361	3.1423	
5	0.74314	0.81938	0.75594	0.9092	3.2277	
7	0.79942	0.89265	0.92438	0.80396	3.4204	
9	0.74413	0.7626	0.91687	0.8363	3.2599	
10	0.72005	0.73113	0.92191	0.8318	3.2049	
11	0.78194	0.81202	0.83634	0.89713	3.3274	
15	0.91072	0.92713	0.86121	0.88153	3.5806	
20	0.76389	0.96687	0.80233	0.87035	3.4034	
25	0.85065	0.94459	0.63831	0.95852	3.3921	
30	0.83032	0.90403	0.8154	0.61664	3.1664	3.5806

inp =

2 3 6

---> Input(s) = PeakDownPressurepsi RotationTorquelbft SpecificEnergyftlbft3

HL no.	all	train	val	test	Sum Bst R	
-----	---	-----	---	----	---------	

BestR =

2	0.66705	0.59386	0.76547	0.91238	2.9388	
3	0.66609	0.61446	0.84551	0.88307	3.0091	
5	0.76323	0.71082	0.9039	0.86194	3.2399	
7	0.76894	0.81834	0.72958	0.81943	3.1363	
9	0.75867	0.78473	0.78268	0.90379	3.2299	
10	0.78398	0.79028	0.83963	0.77841	3.1923	
11	0.79933	0.87608	0.61568	0.67492	2.966	
15	0.80947	0.88805	0.76978	0.82129	3.2886	
20	0.88252	0.99274	0.84843	0.68916	3.4128	
25	0.80083	0.91096	0.76021	0.87843	3.3504	
30	0.76429	0.85168	0.66299	0.75456	3.0335	3.4128

inp =

2 4 5

---> Input(s) = PeakDownPressurepsi RotationSpeedrevmin MovingSpeedfth

HL no.	all	train	val	test	Sum Bst R	
-----	---	-----	---	----	---------	

BestR =

2	0.80501	0.78368	0.81384	0.91724	3.3198	
3	0.84731	0.82808	0.91043	0.9137	3.4995	
5	0.84134	0.85281	0.95467	0.76468	3.4135	
7	0.86633	0.90973	0.81236	0.91533	3.5037	
9	0.84639	0.83906	0.94679	0.85796	3.4902	
10	0.84649	0.87263	0.79577	0.91172	3.4266	
11	0.85199	0.89166	0.91086	0.92327	3.5778	
15	0.85273	0.83481	0.84983	0.93891	3.4763	
20	0.88507	0.92199	0.81609	0.82716	3.4503	
25	0.83134	0.92653	0.73459	0.83156	3.324	
30	0.85254	0.88844	0.83029	0.92798	3.4993	3.5778

inp =

2 4 6

---> Input(s) = PeakDownPressurepsi RotationSpeedrevmin SpecificEnergyftlbft3

HL no.	all	train	val	test	Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.74078	0.68701	0.9112	0.81277	3.1518	
3	0.80287	0.82099	0.63313	0.88926	3.1462	
5	0.77285	0.84902	0.96314	0.67376	3.2588	
7	0.7575	0.82433	0.97246	0.89379	3.4481	
9	0.82185	0.82959	0.90617	0.84108	3.3987	
10	0.78965	0.82054	0.87557	0.76191	3.2477	
11	0.77667	0.77807	0.86647	0.84651	3.2677	
15	0.86226	0.88529	0.88273	0.78013	3.4104	
20	0.80069	0.82459	0.89025	0.85055	3.3661	
25	0.76322	0.87179	0.97574	0.84872	3.4595	
30	0.84579	0.85113	0.891	0.78187	3.3698	3.4595

inp =

2 5 6

---> Input(s) = PeakDownPressurepsi MovingSpeedfth SpecificEnergyftlbft3

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.7657	0.73013	0.87666	0.8682	3.2407	
3	0.78567	0.7575	0.96527	0.87653	3.385	
5	0.74907	0.70892	0.89975	0.93975	3.2975	
7	0.82755	0.79885	0.90088	0.91716	3.4444	
9	0.80277	0.821	0.84964	0.86894	3.3423	
10	0.84507	0.80791	0.89454	0.96938	3.5169	
11	0.83326	0.82723	0.93972	0.85179	3.452	
15	0.83504	0.80599	0.90752	0.93902	3.4876	
20	0.85489	0.88174	0.8561	0.78063	3.3734	
25	0.87481	0.94579	0.87233	0.81304	3.506	
30	0.88887	0.91666	0.86782	0.87812	3.5515	3.5515

inp =

3 4 5

---> Input(s) = RotationTorquelbft RotationSpeedrevmin MovingSpeedfth

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.70228	0.67655	0.90362	0.74818	3.0306	
3	0.67626	0.56264	0.90024	0.82626	2.9654	
5	0.73952	0.78054	0.85538	0.67341	3.0488	
7	0.73074	0.70661	0.80422	0.93908	3.1806	
9	0.74224	0.76673	0.79433	0.91863	3.2219	
10	0.73527	0.729	0.77085	0.80323	3.0383	
11	0.75216	0.74838	0.78412	0.83844	3.1231	
15	0.74219	0.75131	0.69636	0.69761	2.8875	
20	0.75657	0.76467	0.81998	0.84398	3.1852	
25	0.71183	0.76429	0.70366	0.64698	2.8268	
30	0.76923	0.85034	0.63517	0.75859	3.0133	3.2219

inp =

3 4 6

---> Input(s) = RotationTorquelbft RotationSpeedrevmin SpecificEnergyftlbft3

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.74168	0.79832	0.86947	0.83415	3.2436	
3	0.78913	0.80614	0.82227	0.74579	3.1633	
5	0.78319	0.75885	0.92197	0.83957	3.3036	
7	0.78083	0.82909	0.74885	0.95438	3.3131	
9	0.81823	0.82923	0.84657	0.77297	3.267	
10	0.85005	0.9201	0.85204	0.76876	3.391	
11	0.89471	0.96135	0.91314	0.77265	3.5418	
15	0.87068	0.97461	0.90631	0.72094	3.4725	
20	0.8311	0.87759	0.78569	0.80295	3.2973	
25	0.93739	0.96815	0.76478	0.87286	3.5432	
30	0.86678	0.99434	0.7662	0.74824	3.3756	3.5432

inp =

3 5 6

---> Input(s) = RotationTorquelbft MovingSpeedfth SpecificEnergyftlbft3

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.78014	0.75406	0.85667	0.78729	3.1782	
3	0.80258	0.77823	0.87329	0.85955	3.3136	
5	0.84897	0.87202	0.96535	0.80606	3.4924	
7	0.77717	0.82596	0.76992	0.96657	3.3396	
9	0.78176	0.83052	0.83238	0.85228	3.2969	
10	0.73305	0.666	0.90611	0.95686	3.262	
11	0.81907	0.91459	0.75859	0.95647	3.4487	
15	0.81336	0.91765	0.94411	0.6587	3.3338	
20	0.78982	0.84765	0.63047	0.9191	3.187	
25	0.7559	0.88901	0.75866	0.91983	3.3234	
30	0.81191	0.9411	0.84931	0.48054	3.0829	3.4924

inp =

4 5 6

---> Input(s) = RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.81001	0.76075	0.96147	0.94628	3.4785
3	0.79711	0.76639	0.90916	0.9126	3.3853
5	0.85332	0.85648	0.96521	0.75508	3.4301
7	0.86725	0.85847	0.87076	0.98567	3.5822
9	0.81817	0.90664	0.78165	0.87585	3.3823
10	0.85115	0.87309	0.98164	0.89736	3.6032
11	0.88053	0.8904	0.93326	0.92402	3.6282
15	0.85367	0.91485	0.9615	0.87145	3.6015
20	0.86627	0.9177	0.79788	0.84567	3.4275

25	0.83973	0.91338	0.85422	0.78317	3.3905	
30	0.90178	0.97457	0.79166	0.87233	3.5403	3.6282

************ NUMBER OF COMBINATIONS = 4 ************

numIts =

100

inp =

1 2 3 4

---> Input(s) = Depthfeet PeakDownPressurepsi RotationTorquelbft RotationSpeedrevmin

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.80024	0.74159	0.9521	0.94246	3.4364	
3	0.90645	0.91319	0.91229	0.86623	3.5981	
5	0.87236	0.90347	0.93016	0.76451	3.4705	
7	0.90588	0.93046	0.82824	0.90072	3.5653	
9	0.89746	0.98346	0.9179	0.70338	3.5022	
10	0.90843	0.94201	0.97363	0.70193	3.526	
11	0.8251	0.97942	0.84602	0.89173	3.5423	
15	0.90911	0.97812	0.96921	0.81235	3.6688	
20	0.91723	0.99763	0.8904	0.59369	3.3989	
25	0.89437	0.99222	0.7542	0.83803	3.4788	
30	0.871	0.95096	0.78451	0.943	3.5495	3.6688

inp =

1 2 3 5

---> Input(s) = Depthfeet PeakDownPressurepsi RotationTorquelbft MovingSpeedfth

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.84996	0.8317	0.94997	0.83555	3.4672	
3	0.88634	0.88514	0.98084	0.86701	3.6193	
5	0.92756	0.97261	0.96012	0.85638	3.7167	
7	0.89387	0.88408	0.94641	0.91742	3.6418	
9	0.90414	0.99208	0.97983	0.78089	3.6569	
10	0.86856	0.95035	0.80122	0.88789	3.508	
11	0.84097	0.97138	0.91503	0.81929	3.5467	
15	0.92266	0.96288	0.95631	0.79124	3.6331	
20	0.92034	0.97531	0.86645	0.98425	3.7464	
25	0.82929	0.95376	0.83353	0.75078	3.3674	
30	0.86998	0.92031	0.83638	0.88036	3.507	3.7464

inp =

1 2 3 6

---> Input(s) = Depthfeet PeakDownPressurepsi RotationTorquelbft SpecificEnergyftlbft3

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.7858	0.78394	0.89333	0.88083	3.3439
3	0.83433	0.78571	0.99067	0.84671	3.4574
5	0.80524	0.80192	0.87431	0.88953	3.371

7	0.82577	0.8018	0.93423	0.88457	3.4464	
9	0.85189	0.88346	0.91969	0.75121	3.4062	
10	0.79223	0.88197	0.87653	0.77199	3.3227	
11	0.81342	0.82355	0.89073	0.83134	3.359	
15	0.77816	0.72891	0.86754	0.88892	3.2635	
20	0.87293	0.94255	0.78587	0.75523	3.3566	
25	0.88351	0.9664	0.77078	0.77802	3.3987	
30	0.90997	0.91113	0.8384	0.97996	3.6395	3.6395

inp =

1 2 4 5

---> Input(s) = Depthfeet PeakDownPressurepsi RotationSpeedrevmin MovingSpeedfth

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.85807	0.85949	0.93306	0.83548	3.4861	
3	0.87703	0.93157	0.9134	0.79601	3.518	
5	0.87317	0.9233	0.8163	0.95749	3.5703	
7	0.90995	0.93742	0.86369	0.94469	3.6558	
9	0.89564	0.93709	0.84614	0.93142	3.6103	
10	0.89531	0.885	0.95775	0.8656	3.6037	
11	0.90723	0.95508	0.92634	0.87376	3.6624	
15	0.91238	0.95102	0.97485	0.88053	3.7188	
20	0.90598	0.92562	0.91762	0.93275	3.682	
25	0.86104	0.85137	0.83309	0.9218	3.4673	
30	0.89552	0.98424	0.81169	0.93243	3.6239	3.7188

inp =

1 2 4 6

---> Input(s) = Depthfeet PeakDownPressurepsi RotationSpeedrevmin SpecificEnergyftlbft3

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.79198	0.84379	0.83481	0.91642	3.387	
3	0.83002	0.85508	0.82426	0.85294	3.3623	
5	0.90815	0.93948	0.92897	0.82066	3.5973	
7	0.85468	0.89021	0.7605	0.97058	3.476	
9	0.85574	0.96016	0.81131	0.86125	3.4885	
10	0.91972	0.94942	0.85748	0.90338	3.63	
11	0.88635	0.91614	0.77643	0.92486	3.5038	
15	0.87828	0.95896	0.81984	0.83241	3.4895	
20	0.9521	0.98624	0.97108	0.75334	3.6628	
25	0.87162	0.87084	0.9157	0.93378	3.5919	
30	0.85892	0.91969	0.90684	0.78515	3.4706	3.6628

inp =

1 2 5 6

---> Input(s) = Depthfeet PeakDownPressurepsi MovingSpeedfth SpecificEnergyftlbft3

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.84513	0.83476	0.83176	0.89638	3.408	
3	0.83365	0.82767	0.84587	0.87327	3.3805	
5	0.8548	0.8669	0.94748	0.87447	3.5436	
7	0.8879	0.93669	0.90211	0.82254	3.5492	
9	0.90974	0.9584	0.9925	0.66182	3.5225	
10	0.90063	0.93442	0.89663	0.83728	3.569	
11	0.89294	0.91566	0.91576	0.90283	3.6272	
15	0.91343	0.95981	0.95528	0.91733	3.7459	
20	0.84055	0.97664	0.86602	0.87539	3.5586	
25	0.82589	0.95794	0.78346	0.86049	3.4278	
30	0.78212	0.89099	0.88768	0.91496	3.4757	3.7459

inp =

1 3 4 5

---> Input(s) = Depthfeet RotationTorquelbft RotationSpeedrevmin MovingSpeedfth

HL no.	all	train	val	test	Sum Bst R	
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BestR =

2	0.82585	0.86255	0.7979	0.84183	3.3281	
3	0.8718	0.89452	0.82	0.77753	3.3639	
5	0.92787	0.94643	0.86759	0.83037	3.5723	
7	0.87609	0.94251	0.89762	0.89793	3.6142	
9	0.91126	0.92586	0.93805	0.85488	3.6301	
10	0.80722	0.98754	0.88103	0.62798	3.3038	
11	0.83498	0.80883	0.93968	0.91053	3.494	
15	0.88525	0.94154	0.69381	0.88168	3.4023	
20	0.83142	0.83339	0.86835	0.92776	3.4609	
25	0.91513	0.9913	0.97121	0.59936	3.477	
30	0.89346	0.95701	0.77409	0.82803	3.4526	3.6301

inp =

1 3 4 6

---> Input(s) = Depthfeet RotationTorquelbft RotationSpeedrevmin SpecificEnergyftlbft3

HL no.	all	train	val	test	Sum Bst R	
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BestR =

2	0.85151	0.86432	0.84747	0.84243	3.4057	
3	0.85191	0.83076	0.98509	0.85424	3.522	
5	0.87661	0.84941	0.96518	0.94128	3.6325	
7	0.90002	0.93437	0.90124	0.8563	3.5919	
9	0.91205	0.95826	0.8745	0.80809	3.5529	
10	0.86657	0.97078	0.94699	0.77946	3.5638	
11	0.88199	0.93267	0.84571	0.87737	3.5377	
15	0.89382	0.8919	0.93756	0.90624	3.6295	
20	0.91704	0.94183	0.84117	0.93985	3.6399	
25	0.88785	0.99367	0.74665	0.69145	3.3196	
30	0.86942	0.99737	0.83537	0.76693	3.4691	3.6399

inp =

1 3 5 6

---> Input(s) = Depthfeet RotationTorquelbft MovingSpeedfth SpecificEnergyftlbft3

HL no. all train val test Sum Bst R
----- --- ----- --- ---- ---------
BestR =

2	0.8493	0.84893	0.86565	0.96166	3.5255	
3	0.8452	0.89252	0.92241	0.89367	3.5538	
5	0.90977	0.92598	0.94341	0.87798	3.6571	
7	0.91771	0.92555	0.96753	0.87269	3.6835	
9	0.91923	0.95531	0.8504	0.85526	3.5802	
10	0.84557	0.86607	0.93845	0.89994	3.55	
11	0.86765	0.87147	0.97519	0.84686	3.5612	
15	0.90165	0.95853	0.87958	0.83486	3.5746	
20	0.86741	0.83204	0.87868	0.9029	3.481	
25	0.90025	0.99784	0.88527	0.74194	3.5253	
30	0.8878	0.99613	0.83707	0.95943	3.6804	3.6835

inp =
1 4 5 6
---> Input(s) = Depthfeet RotationSpeedrevmin MovingSpeedfth SpecificEnergyftlbft3
HL no. all train val test Sum Bst R
----- --- ----- --- ---- ---------
BestR =

2	0.84211	0.83522	0.93973	0.94089	3.5579	
3	0.87972	0.90091	0.85347	0.95969	3.5938	
5	0.84856	0.83691	0.91789	0.9359	3.5393	
7	0.93104	0.9646	0.9547	0.77906	3.6294	
9	0.8817	0.98064	0.85686	0.85224	3.5714	
10	0.86558	0.86565	0.92299	0.87293	3.5272	
11	0.9135	0.96466	0.87726	0.87171	3.6271	
15	0.92779	0.92134	0.97717	0.96182	3.7881	
20	0.87916	0.92135	0.78941	0.91516	3.5051	
25	0.91298	0.91494	0.7954	0.9251	3.5484	
30	0.87715	0.85243	0.97104	0.93047	3.6311	3.7881

inp =
2 3 4 5
HL no. all train val test Sum Bst R
----- --- ----- --- ---- ---------
BestR =

2	0.77982	0.81944	0.88884	0.79264	3.2807	
3	0.88101	0.91856	0.91885	0.80763	3.526	
5	0.8115	0.90608	0.9553	0.83956	3.5124	
7	0.86874	0.9331	0.91254	0.73367	3.448	
9	0.85764	0.93984	0.89327	0.8216	3.5124	
10	0.78919	0.77993	0.84863	0.90767	3.3254	
11	0.83402	0.93736	0.83993	0.78809	3.3994	
15	0.89277	0.97774	0.91184	0.80192	3.5843	
20	0.83618	0.86404	0.78037	0.85136	3.3319	
25	0.84266	0.92399	0.91654	0.87262	3.5558	
30	0.87362	0.97692	0.91725	0.61283	3.3806	3.5843

inp =

2 3 4 6

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.65803	0.59084	0.85499	0.8783	2.9822	
3	0.82136	0.80352	0.88333	0.86985	3.3781	
5	0.83248	0.89822	0.78814	0.72488	3.2437	
7	0.88228	0.90993	0.83031	0.71834	3.3409	
9	0.83697	0.90671	0.77832	0.7501	3.2721	
10	0.74823	0.93148	0.92987	0.93769	3.5473	
11	0.75806	0.74115	0.8472	0.92274	3.2692	
15	0.91011	0.94853	0.92499	0.60341	3.3871	
20	0.84785	0.88384	0.86825	0.86153	3.4615	
25	0.84063	0.9173	0.89204	0.70783	3.3578	
30	0.86423	0.99279	0.62601	0.72059	3.2036	3.5473

inp =

2 3 5 6

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.82819	0.85284	0.93457	0.75792	3.3735	
3	0.78813	0.79508	0.89561	0.81637	3.2952	
5	0.78899	0.83762	0.82658	0.8618	3.315	
7	0.81712	0.92064	0.80077	0.80103	3.3396	
9	0.8108	0.9055	0.96007	0.61118	3.2875	
10	0.84423	0.87253	0.79522	0.89009	3.4021	
11	0.82636	0.91985	0.89733	0.77753	3.4211	
15	0.88791	0.95505	0.83486	0.76959	3.4474	
20	0.8215	0.81437	0.89149	0.89547	3.4228	
25	0.86564	0.93164	0.81307	0.88612	3.4965	
30	0.77862	0.87699	0.75268	0.7669	3.1752	3.4965

inp =

2 4 5 6

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.79527	0.77543	0.94198	0.80648	3.3192	
3	0.7989	0.80443	0.88806	0.86126	3.3527	
5	0.83738	0.851	0.8429	0.95303	3.4843	
7	0.85679	0.88735	0.93026	0.84631	3.5207	
9	0.86583	0.89036	0.84804	0.89698	3.5012	
10	0.86946	0.88035	0.90551	0.88136	3.5367	
11	0.85514	0.94791	0.90363	0.86291	3.5696	
15	0.88907	0.91872	0.83639	0.90622	3.5504	
20	0.87143	0.88289	0.85756	0.86252	3.4744	
25	0.87795	0.96256	0.83344	0.88511	3.5591	
30	0.83279	0.90942	0.84494	0.86527	3.4524	3.5696

inp =

3 4 5 6

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.81678	0.84944	0.92276	0.65199	3.241	
3	0.83292	0.82491	0.83939	0.88721	3.3844	
5	0.83775	0.83023	0.8924	0.87235	3.4327	
7	0.85526	0.87455	0.89473	0.78363	3.4082	
9	0.83326	0.89069	0.88521	0.73116	3.3403	
10	0.84558	0.97522	0.81559	0.68162	3.318	
11	0.85024	0.93228	0.87315	0.85443	3.5101	
15	0.79314	0.82822	0.78823	0.86766	3.2772	
20	0.86404	0.98576	0.76165	0.7804	3.3919	
25	0.82519	0.94048	0.93835	0.55712	3.2611	
30	0.83324	0.98072	0.85299	0.74174	3.4087	3.5101

************ NUMBER OF COMBINATIONS = 5 ************

numIts =

100

inp =

1 2 3 4 5

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.85752	0.87336	0.9064	0.83006	3.4673	
3	0.87316	0.84322	0.95377	0.90728	3.5774	
5	0.88503	0.87199	0.96372	0.8686	3.5893	
7	0.89567	0.94511	0.93939	0.88939	3.6696	
9	0.90784	0.93883	0.75411	0.891	3.4918	
10	0.90684	0.90673	0.95371	0.97629	3.7436	
11	0.92252	0.93893	0.95785	0.86246	3.6818	
15	0.88772	0.99748	0.81922	0.92252	3.6269	
20	0.93098	0.98764	0.84701	0.92166	3.6873	
25	0.86168	0.97202	0.82897	0.85436	3.517	
30	0.94951	0.99999	0.902	0.85348	3.705	3.7436

inp =

1 2 3 4 6

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.81078	0.82034	0.96478	0.88079	3.4767
3	0.85533	0.88802	0.94025	0.75685	3.4404
5	0.83251	0.90682	0.88124	0.84458	3.4651
7	0.86813	0.93559	0.71248	0.95508	3.4713
9	0.87307	0.90352	0.90424	0.88824	3.5691
10	0.87934	0.89515	0.86584	0.80424	3.4446
11	0.8842	0.98002	0.73128	0.85174	3.4472

15	0.88832	0.98832	0.74123	0.81488	3.4327	
20	0.84088	0.92332	0.75131	0.81308	3.3286	
25	0.88848	0.98549	0.73372	0.75824	3.3659	
30	0.8851	0.94047	0.91871	0.72885	3.4731	3.5691

inp =

1 2 3 5 6

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.79374	0.88353	0.94801	0.84958	3.4749	
3	0.91382	0.93947	0.98272	0.74961	3.5856	
5	0.93178	0.91853	0.97699	0.92387	3.7512	
7	0.91258	0.95648	0.95628	0.88961	3.715	
9	0.91607	0.91038	0.94207	0.93657	3.7051	
10	0.8642	0.88366	0.97635	0.91708	3.6413	
11	0.93198	0.9833	0.96011	0.8881	3.7635	
15	0.91787	0.9517	0.85185	0.91966	3.6411	
20	0.8613	0.92869	0.8054	0.91016	3.5056	
25	0.883	0.95858	0.68512	0.86209	3.3888	
30	0.81409	0.8314	0.9029	0.83349	3.3819	3.7635

inp =

1 2 4 5 6

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.82436	0.87022	0.88765	0.81667	3.3989	
3	0.83404	0.78515	0.95107	0.86911	3.4394	
5	0.87408	0.88813	0.86714	0.96579	3.5951	
7	0.92274	0.92262	0.96153	0.89918	3.7061	
9	0.94402	0.98548	0.85598	0.89666	3.6821	
10	0.8852	0.96493	0.87865	0.96643	3.6952	
11	0.88925	0.88741	0.94097	0.92478	3.6424	
15	0.90888	0.96617	0.91686	0.75821	3.5501	
20	0.85378	0.89063	0.83265	0.99069	3.5677	
25	0.90025	0.92507	0.86054	0.97043	3.6563	
30	0.93508	0.97973	0.84836	0.87933	3.6425	3.7061

inp =

1 3 4 5 6

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.8461	0.82687	0.98359	0.88815	3.5447
3	0.88154	0.89013	0.86599	0.92891	3.5666
5	0.92334	0.93523	0.90614	0.86093	3.6256
7	0.90432	0.94201	0.92345	0.80927	3.5791
9	0.90172	0.97265	0.86095	0.96587	3.7012

10	0.88977	0.93871	0.92007	0.8726	3.6212	
11	0.94303	0.99489	0.89962	0.75401	3.5915	
15	0.92349	0.96308	0.93333	0.84037	3.6603	
20	0.87848	0.88528	0.91353	0.94989	3.6272	
25	0.92858	0.93677	0.915	0.8927	3.673	
30	0.83209	0.90875	0.85147	0.80628	3.3986	3.7012

inp =

2 3 4 5 6

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.797	0.79947	0.92266	0.70112	3.2202	
3	0.84211	0.83843	0.88805	0.86806	3.4367	
5	0.87367	0.88909	0.9004	0.87567	3.5388	
7	0.83531	0.81872	0.91918	0.90634	3.4796	
9	0.85263	0.87592	0.93822	0.75307	3.4198	
10	0.85332	0.88976	0.82386	0.92884	3.4958	
11	0.88025	0.98204	0.80722	0.84082	3.5103	
15	0.87583	0.91566	0.95783	0.86052	3.6098	
20	0.86482	0.94057	0.78983	0.93606	3.5313	
25	0.8656	0.92423	0.72677	0.81578	3.3324	
30	0.87254	0.95721	0.68734	0.75218	3.2693	3.6098

************ NUMBER OF COMBINATIONS = 6 ************

numIts =

100

inp =

1 2 3 4 5 6

HL no. all train val test Sum Bst R

----- --- ----- --- ---- ---------

BestR =

2	0.86078	0.85989	0.94276	0.81037	3.4738	
3	0.92659	0.94318	0.96158	0.85184	3.6832	
5	0.88652	0.8781	0.93722	0.95834	3.6602	
7	0.92351	0.93579	0.93284	0.917	3.7091	
9	0.88143	0.88478	0.9348	0.88501	3.586	
10	0.92823	0.94981	0.84976	0.89888	3.6267	
11	0.90514	0.94659	0.92289	0.85751	3.6321	
15	0.89717	0.9281	0.8674	0.86786	3.5605	
20	0.87424	0.96722	0.93972	0.82196	3.6031	
25	0.89605	0.95983	0.8238	0.90701	3.5867	
30	0.90464	1	0.77481	0.83503	3.5145	3.7091

Elapsed time is 5261.830468 seconds.

Elapsed time is 87.6972 minutes.

COUNT		693	
	MAX		3.7881

Training INPUTS: 1 2 3 4 5 6

Columns 1 through

4

```
    {'Depthfeet '}    {'PeakDownPressur…'}    {'RotationTorquel…'}    {'RotationSpeedre…'}
  Columns 5 through
6
    {'MovingSpeedfth '}    {'SpecificEnergyf…'}
--------------------
Training TARGETS: 7
    {'BlowsPerFoot '}
--------------------

------------  Finished readGeotechData_Part2_v01.m
```

Appendix H – NN summary results for UCS

******* *****	NUMBER	OF	COMBINATIO NS	=	1	************	
numIts	=	100					
inp	=	1					
--->	Input(s)	=	Depthfeet				
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.55994	0.50826	0.65545	0.74123	2.4649	
	3	0.66082	0.65053	0.70699	0.69379	2.7121	
	5	0.67074	0.60294	0.81759	0.77241	2.8637	
	7	0.7233	0.68599	0.78335	0.83264	3.0253	
	9	0.72619	0.68875	0.80378	0.84498	3.0637	
	10	0.732861	0.707475	0.85554	0.690227	2.9861	
	11	0.741045	0.710957	0.844842	0.7216	3.01844	
	15	0.761601	0.759724	0.801986	0.772461	3.09577	
	20	0.761485	0.777638	0.660445	0.835951	3.03552	
	25	0.789174	0.808933	0.852054	0.720771	3.17093	
	30	0.773582	0.784076	0.652137	0.857928	3.06772	3.17093
inp	=	2					
--->	Input(s)	=	PeakDownPressurepsi				
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.55136	0.51298	0.69138	0.56907	2.3248	
	3	0.53753	0.46344	0.65452	0.72854	2.384	
	5	0.555	0.45061	0.84193	0.61992	2.4675	
	7	0.57128	0.4885	0.88169	0.48042	2.4219	
	9	0.59332	0.55189	0.62111	0.69482	2.4611	
	10	0.585	0.56902	0.830403	0.469453	2.45388	
	11	0.575937	0.537036	0.727013	0.627834	2.46782	
	15	0.529693	0.514953	0.679547	0.598052	2.32225	
	20	0.643653	0.677569	0.760678	0.338218	2.42012	
	25	0.515262	0.523482	0.701142	0.581818	2.3217	
	30	0.580387	0.665004	0.723539	0.46122	2.43015	2.46782
inp	=	3					
--->	Input(s)	=	RotationTorquelbft				
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.6275	0.55364	0.8677	0.77388	2.8227	
	3	0.63178	0.58532	0.7742	0.71314	2.7044	
	5	0.73838	0.73966	0.74587	0.78258	3.0065	
	7	0.75475	0.68219	0.93839	0.86931	3.2446	
	9	0.74976	0.74014	0.85059	0.73466	3.0752	

		10	0.748878	0.728829	0.841637	0.9155	3.23484	
		11	0.725033	0.69372	0.773573	0.859075	3.0514	
		15	0.778914	0.770181	0.788257	0.808841	3.14619	
		20	0.771286	0.790133	0.799994	0.710342	3.07175	
		25	0.783795	0.793448	0.908446	0.645309	3.131	
		30	0.778463	0.791161	0.802708	0.778657	3.15099	3.2446
inp	=		4					
--->	Input(s)	=	RotationSpeedrevmin					
	HL	no.	all	train	val	test	Sum	
	-----	---	-----	---	----	---------		
BestR	=							
		2	0.45699	0.45058	0.72867	0.88459	2.5208	
		3	0.4925	0.37231	0.67906	0.81227	2.3561	
		5	0.52092	0.50081	0.58799	0.5819	2.1916	
		7	0.49046	0.46497	0.7407	0.35071	2.0468	
		9	0.52092	0.51514	0.66574	0.79832	2.5001	
		10	0.578413	0.5799	0.67097	0.653602	2.48288	
		11	0.566612	0.565799	0.59872	0.630511	2.36164	
		15	0.629224	0.628406	0.590631	0.718181	2.56644	
		20	0.585436	0.577969	0.69614	0.702703	2.56225	
		25	0.679471	0.673057	0.564866	0.751625	2.66902	
		30	0.703572	0.728012	0.79567	0.49388	2.72113	2.72113
inp	=		5					
--->	Input(s)	=	MovingSpeedfth					
	HL	no.	all	train	val	test	Sum	
	-----	---	-----	---	----	---------		
BestR	=							
		2	0.2903	0.23117	0.42505	0.64494	1.5915	
		3	0.32639	0.28948	0.58312	0.3182	1.5172	
		5	0.36957	0.33718	0.46529	0.47646	1.6485	
		7	0.3599	0.33211	0.67622	0.19485	1.5631	
		9	0.36985	0.36874	0.26505	0.56844	1.5721	
		10	0.35016	0.334721	0.341347	0.49581	1.52204	
		11	0.347945	0.302916	0.541976	0.393387	1.58622	
		15	0.461935	0.485488	0.363301	0.442389	1.75311	
		20	0.471541	0.514172	0.298665	0.415678	1.70006	
		25	0.428811	0.453495	0.56118	0.370374	1.81386	
		30	0.445465	0.483917	0.344456	0.456067	1.72991	1.81386
inp	=		6					
--->	Input(s)	=	SpecificEnergyftlbft3					
	HL	no.	all	train	val	test	Sum	
	-----	---	-----	---	----	---------		
BestR	=							
		2	0.38127	0.41594	0.44068	0.57087	1.8088	
		3	0.46604	0.48583	0.44357	0.6511	2.0465	
		5	0.44104	0.38437	0.72234	0.50585	2.0536	
		7	0.45137	0.48405	0.66004	0.46641	2.0619	
		9	0.51633	0.49599	0.46622	0.71726	2.1958	

	10	0.490946	0.540703	0.583732	0.546707	2.16209	
	11	0.527689	0.538848	0.707471	0.12008	1.89409	
	15	0.553191	0.650362	0.608235	0.429763	2.24155	
	20	0.483021	0.539891	0.690083	0.599688	2.31268	
	25	0.613973	0.63617	0.731088	0.350775	2.33201	
	30	0.617393	0.699651	0.50159	0.503966	2.3226	2.33201
*******			COMBINATIO				
*****	NUMBER	OF	NS	=	2	************	
numIts	=	100					
inp	=	1	2				
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.72674	0.71733	0.85151	0.73207	3.0276	
	3	0.72803	0.62909	0.84014	0.86408	3.0613	
	5	0.73659	0.69143	0.68692	0.84885	2.9638	
	7	0.75401	0.76898	0.84598	0.57086	2.9398	
	9	0.67621	0.57793	0.81359	0.70745	2.7752	
	10	0.710454	0.67076	0.773405	0.808203	2.96282	
	11	0.75019	0.752752	0.910541	0.385205	2.79869	
	15	0.767078	0.737197	0.78978	0.774063	3.06812	
	20	0.739399	0.74685	0.749684	0.783459	3.01939	
	25	0.719396	0.766447	0.830712	0.560846	2.8774	
	30	0.823757	0.85644	0.867228	0.613177	3.1606	3.1606
inp	=	1	3				
--->	Input(s)	=	Depthfeet	RotationTorquelbft			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.61685	0.57854	0.67242	0.78733	2.6551	
	3	0.62956	0.613	0.79765	0.60618	2.6464	
	5	0.73029	0.76053	0.63253	0.82302	2.9464	
	7	0.7487	0.78221	0.82972	0.589	2.9496	
	9	0.79548	0.85867	0.67433	0.761	3.0895	
	10	0.749604	0.778316	0.806133	0.579275	2.91333	
	11	0.771397	0.791128	0.789131	0.847377	3.19903	
	15	0.784367	0.833652	0.698039	0.729797	3.04585	
	20	0.754852	0.840245	0.780973	0.676835	3.0529	
	25	0.742416	0.763307	0.741612	0.722993	2.97033	
	30	0.746059	0.843758	0.655557	0.676364	2.92174	3.19903
inp	=	1	4				
--->	Input(s)	=	Depthfeet	RotationSpeedrevmin			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.6199	0.52204	0.82234	0.91104	2.8753	
	3	0.62468	0.53512	0.86003	0.70622	2.726	

	5	0.74756	0.764	0.75863	0.66475	2.9349	
	7	0.75003	0.73619	0.89125	0.68197	3.0594	
	9	0.76659	0.77234	0.75158	0.65584	2.9464	
	10	0.756327	0.717439	0.847059	0.821336	3.14216	
	11	0.790648	0.781999	0.786898	0.828267	3.18781	
	15	0.789823	0.863826	0.80719	0.578327	3.03917	
	20	0.759291	0.804283	0.818891	0.753254	3.13572	
	25	0.805118	0.830898	0.847635	0.423177	2.90683	
	30	0.725195	0.749391	0.811499	0.649515	2.9356	3.18781
inp	=	1	5				
--->	Input(s)	=	Depthfeet	MovingSpeedfth			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.58565	0.52916	0.74712	0.65692	2.5188	
	3	0.59817	0.5756	0.60142	0.79305	2.5682	
	5	0.6468	0.66757	0.61609	0.59215	2.5226	
	7	0.74283	0.79428	0.78376	0.55255	2.8734	
	9	0.79431	0.80409	0.90222	0.68626	3.1869	
	10	0.75708	0.789961	0.807067	0.47396	2.82807	
	11	0.755706	0.811446	0.717571	0.651815	2.93654	
	15	0.793345	0.860368	0.656674	0.493105	2.80349	
	20	0.744696	0.880348	0.859596	0.528509	3.01315	
	25	0.815074	0.87221	0.786749	0.513308	2.98734	
	30	0.801843	0.781315	0.827185	0.683182	3.09352	3.1869
inp	=	1	6				
--->	Input(s)	=	Depthfeet	SpecificEnergyftlbft3			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.57545	0.66533	0.73036	0.64421	2.6153	
	3	0.60459	0.61771	0.84669	0.51897	2.588	
	5	0.64503	0.62614	0.79612	0.73948	2.8068	
	7	0.7836	0.82508	0.84386	0.53045	2.983	
	9	0.66162	0.68294	0.56365	0.8387	2.7469	
	10	0.723603	0.783656	0.756831	0.639373	2.90346	
	11	0.670303	0.629995	0.813378	0.716162	2.82984	
	15	0.663009	0.716381	0.807578	0.632376	2.81934	
	20	0.705198	0.777214	0.694916	0.716115	2.89344	
	25	0.786503	0.806404	0.825392	0.7865	3.2048	
	30	0.811516	0.866978	0.793881	0.697139	3.16951	3.2048
inp	=	2	3				
--->	Input(s)	=	PeakDownPressurepsi	RotationTorquelbft			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.75765	0.64817	0.84033	0.88489	3.131	

	3	0.75672	0.75704	0.83831	0.7316	3.0837	
	5	0.79555	0.7757	0.64588	0.94235	3.1595	
	7	0.78768	0.82656	0.80635	0.76759	3.1882	
	9	0.76681	0.78934	0.81631	0.71335	3.0858	
	10	0.76513	0.76753	0.762474	0.770438	3.06557	
	11	0.762855	0.789126	0.8213	0.669003	3.04228	
	15	0.81331	0.814382	0.8064	0.848646	3.28274	
	20	0.798978	0.829391	0.85999	0.673401	3.16176	
	25	0.796576	0.840577	0.632997	0.852284	3.12243	
	30	0.816833	0.914508	0.820349	0.567166	3.11886	3.28274
inp	=	2	4				
--->	Input(s)	=	PeakDownPre ssurepsi	RotationSpeedrevmin			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.66135	0.62895	0.79585	0.70506	2.7912	
	3	0.6055	0.62858	0.53556	0.60263	2.3723	
	5	0.72209	0.72211	0.89147	0.63184	2.9675	
	7	0.69291	0.68957	0.77308	0.65801	2.8136	
	9	0.75811	0.82193	0.84001	0.75012	3.1702	
	10	0.724823	0.742678	0.731145	0.736543	2.93519	
	11	0.649084	0.532875	0.772322	0.768718	2.723	
	15	0.770966	0.805712	0.652606	0.788281	3.01756	
	20	0.708334	0.714686	0.619502	0.738594	2.78112	
	25	0.684253	0.849921	0.679891	0.664532	2.8786	
	30	0.658822	0.824941	0.808961	0.739441	3.03216	3.1702
inp	=	2	5				
--->	Input(s)	=	PeakDownPre ssurepsi	MovingSpeedfth			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.70544	0.69378	0.84534	0.45088	2.6954	
	3	0.65843	0.64622	0.67558	0.7793	2.7595	
	5	0.66594	0.67738	0.67577	0.61635	2.6354	
	7	0.663	0.67072	0.55659	0.80249	2.6928	
	9	0.70204	0.71549	0.75091	0.65918	2.8276	
	10	0.720153	0.70574	0.728145	0.780724	2.93476	
	11	0.612916	0.575863	0.64371	0.72745	2.55994	
	15	0.706915	0.699305	0.628674	0.825656	2.86055	
	20	0.699601	0.763646	0.711284	0.532962	2.70749	
	25	0.640807	0.642531	0.750613	0.588896	2.62285	
	30	0.743119	0.787305	0.770638	0.55216	2.85322	2.93476
inp	=	2	6				
--->	Input(s)	=	PeakDownPre ssurepsi	SpecificEnergyftlbft3			
	HL	no.	all	train	val	test	Sum

	-----	---	-----	---	----	---------	
BestR	=						
	2	0.67587	0.59707	0.81083	0.76772	2.8515	
	3	0.67805	0.65693	0.90397	0.65258	2.8915	
	5	0.61405	0.49563	0.88489	0.8063	2.8009	
	7	0.72479	0.73055	0.84283	0.62135	2.9195	
	9	0.70636	0.7399	0.81421	0.69751	2.958	
	10	0.751666	0.80976	0.655884	0.590548	2.80786	
	11	0.740858	0.751784	0.788128	0.830859	3.11163	
	15	0.726465	0.805169	0.683313	0.680854	2.8958	
	20	0.724456	0.718199	0.707961	0.796754	2.94737	
	25	0.762736	0.819095	0.764354	0.71197	3.05815	
	30	0.753708	0.784037	0.647605	0.820085	3.00543	3.11163
inp	=	3	4				
--->	Input(s)	=	RotationTorquelbft	RotationSpeedrevmin			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.5978	0.57502	0.75334	0.656	2.5822	
	3	0.7373	0.73489	0.71087	0.83968	3.0227	
	5	0.66538	0.64013	0.73048	0.72717	2.7632	
	7	0.72197	0.64399	0.80673	0.83076	3.0035	
	9	0.61816	0.61929	0.74166	0.71993	2.699	
	10	0.705988	0.732323	0.805558	0.765308	3.00918	
	11	0.579152	0.620943	0.806891	0.708947	2.71593	
	15	0.687197	0.688574	0.6721	0.772907	2.82078	
	20	0.674091	0.744267	0.842169	0.58295	2.84348	
	25	0.632644	0.747744	0.830835	0.700925	2.91215	
	30	0.640461	0.723437	0.707474	0.760762	2.83213	3.0227
inp	=	3	5				
--->	Input(s)	=	RotationTorquelbft	MovingSpeedfth			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.62661	0.55855	0.86829	0.62827	2.6817	
	3	0.68333	0.69677	0.60683	0.81411	2.8011	
	5	0.7036	0.61122	0.78576	0.85768	2.9583	
	7	0.65838	0.74278	0.72926	0.7157	2.8461	
	9	0.79308	0.81256	0.66435	0.84463	3.1146	
	10	0.738526	0.749627	0.522645	0.8812	2.892	
	11	0.740042	0.750988	0.780746	0.699183	2.97096	
	15	0.772833	0.789167	0.747273	0.78154	3.09081	
	20	0.788197	0.805646	0.86613	0.786904	3.24688	
	25	0.78315	0.840084	0.781923	0.57332	2.97848	
	30	0.746253	0.743388	0.792133	0.776867	3.05864	3.24688
inp	=	3	6				

--->	Input(s)	=	RotationTorq uelbft	SpecificEnergyftlbft3			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.7204	0.73459	0.67439	0.81226	2.9416	
	3	0.71638	0.66834	0.89171	0.84178	3.1182	
	5	0.74806	0.76379	0.91129	0.54863	2.9718	
	7	0.66525	0.63156	0.77132	0.82972	2.8979	
	9	0.66691	0.63711	0.78333	0.71231	2.7997	
	10	0.709934	0.680224	0.809391	0.573314	2.77286	
	11	0.694951	0.742788	0.806065	0.567409	2.81121	
	15	0.727697	0.711377	0.82184	0.7148	2.97571	
	20	0.702868	0.728651	0.699088	0.710796	2.8414	
	25	0.763686	0.830123	0.628098	0.648675	2.87058	
	30	0.731268	0.809968	0.773616	0.678982	2.99383	3.1182
inp	=	4	5				
--->	Input(s)	=	RotationSpee drevmin	MovingSpeedfth			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.34827	0.20792	0.70554	0.5929	1.8546	
	3	0.38418	0.26677	0.78838	0.6879	2.1272	
	5	0.54869	0.63006	0.73572	0.40077	2.3152	
	7	0.62658	0.62649	0.27591	0.69718	2.2262	
	9	0.57893	0.60146	0.4721	0.70657	2.3591	
	10	0.615933	0.657087	0.403994	0.591585	2.2686	
	11	0.451124	0.669199	0.649323	0.409943	2.17959	
	15	0.578043	0.647833	0.260083	0.788079	2.27404	
	20	0.627534	0.665127	0.642189	0.537602	2.47245	
	25	0.638021	0.626586	0.719643	0.628284	2.61253	
	30	0.460572	0.833288	0.509159	0.652045	2.45506	2.61253
inp	=	4	6				
--->	Input(s)	=	RotationSpee drevmin	SpecificEnergyftlbft3			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.51787	0.56643	0.84536	0.70404	2.6337	
	3	0.688	0.6917	0.63758	0.74306	2.7603	
	5	0.74301	0.74784	0.66914	0.804	2.964	
	7	0.64519	0.6065	0.71376	0.78008	2.7455	
	9	0.6939	0.70262	0.65535	0.84324	2.8951	
	10	0.741161	0.720026	0.809237	0.707796	2.97822	
	11	0.716257	0.702168	0.817973	0.732622	2.96902	
	15	0.733744	0.724799	0.886854	0.695095	3.04049	
	20	0.803637	0.850542	0.537186	0.813454	3.00482	

	25	0.790874	0.772841	0.832349	0.855072	3.25114	
	30	0.810079	0.850977	0.697975	0.809306	3.16834	3.25114
inp	=	5	6				
--->	Input(s)	=	MovingSpeedfth	SpecificEnergyftlbft3			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.36601	0.25995	0.87617	0.41703	1.9192	
	3	0.6503	0.68227	0.54738	0.66709	2.547	
	5	0.59114	0.55477	0.79424	0.54631	2.4865	
	7	0.74324	0.75923	0.86161	0.41407	2.7782	
	9	0.75657	0.78094	0.80427	0.62786	2.9696	
	10	0.78343	0.779504	0.825258	0.626645	3.01484	
	11	0.605545	0.675896	0.834608	0.381925	2.49797	
	15	0.70895	0.760806	0.672489	0.680696	2.82294	
	20	0.691499	0.760814	0.662117	0.612473	2.7269	
	25	0.592062	0.591744	0.566393	0.730176	2.48038	
	30	0.691975	0.721304	0.680542	0.632494	2.72631	3.01484
************	NUMBER	OF	COMBINATIONS	=	3	************	
numIts	=	100					
inp	=	1	2	3			
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi	RotationTorquelbft		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.66808	0.67892	0.62274	0.70928	2.679	
	3	0.6255	0.62637	0.85669	0.6973	2.8059	
	5	0.75918	0.78305	0.74028	0.77276	3.0553	
	7	0.77865	0.80771	0.68047	0.86467	3.1315	
	9	0.77763	0.86149	0.75638	0.56395	2.9594	
	10	0.814701	0.868181	0.740335	0.754947	3.17816	
	11	0.746083	0.726187	0.718843	0.863966	3.05508	
	15	0.742067	0.76854	0.717157	0.795084	3.02285	
	20	0.760394	0.827132	0.776914	0.620949	2.98539	
	25	0.807463	0.879249	0.687197	0.686404	3.06031	
	30	0.786437	0.858234	0.777993	0.589547	3.01221	3.17816
inp	=	1	2	4			
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi	RotationSpeedrevmin		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.69745	0.71782	0.67279	0.73059	2.8187	
	3	0.60285	0.79752	0.79077	0.75373	2.9449	
	5	0.7159	0.66543	0.87116	0.64146	2.894	
	7	0.78021	0.80753	0.80674	0.66869	3.0632	

		9	0.74727	0.74618	0.79707	0.76813	3.0587	
		10	0.765463	0.768213	0.688892	0.83891	3.06148	
		11	0.770397	0.825565	0.818501	0.579273	2.99374	
		15	0.76911	0.78472	0.669711	0.815899	3.03944	
		20	0.797181	0.79524	0.783526	0.837906	3.21385	
		25	0.738579	0.749993	0.571274	0.798134	2.85798	
		30	0.80215	0.823289	0.696149	0.87969	3.20128	3.21385
inp	=		1	2	5			
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi	MovingSpeedfth			
	HL	no.	all	train	val	test	Sum	
	-----	---	-----	---	----	---------		
BestR	=							
		2	0.77132	0.702	0.80699	0.92622	3.2065	
		3	0.66333	0.60212	0.79359	0.80867	2.8677	
		5	0.75454	0.71131	0.83832	0.80154	3.1057	
		7	0.78145	0.81864	0.6088	0.83561	3.0445	
		9	0.81738	0.85464	0.66814	0.83565	3.1758	
		10	0.774883	0.730357	0.833383	0.852309	3.19093	
		11	0.812871	0.880872	0.861302	0.457289	3.01233	
		15	0.78617	0.835535	0.52972	0.856837	3.00826	
		20	0.789036	0.850418	0.827254	0.7045	3.17121	
		25	0.716723	0.826792	0.666315	0.617384	2.82721	
		30	0.760423	0.798589	0.823665	0.553752	2.93643	3.2065
inp	=		1	2	6			
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi	SpecificEnergyftlbft3			
	HL	no.	all	train	val	test	Sum	
	-----	---	-----	---	----	---------		
BestR	=							
		2	0.75194	0.73907	0.84616	0.67923	3.0164	
		3	0.77088	0.76027	0.82431	0.77928	3.1347	
		5	0.75897	0.77229	0.75601	0.74708	3.0343	
		7	0.72444	0.74288	0.80463	0.6894	2.9613	
		9	0.75492	0.74013	0.77939	0.75445	3.0289	
		10	0.718982	0.764377	0.930149	0.436648	2.85016	
		11	0.746155	0.778773	0.622526	0.723837	2.87129	
		15	0.726443	0.706736	0.737532	0.812532	2.98324	
		20	0.796386	0.929225	0.643553	0.72941	3.09857	
		25	0.78311	0.845852	0.818307	0.515347	2.96262	
		30	0.773247	0.834033	0.661997	0.710972	2.98025	3.1347
inp	=		1	3	4			
--->	Input(s)	=	Depthfeet	RotationTorquelbft	RotationSpeedrevmin			
	HL	no.	all	train	val	test	Sum	
	-----	---	-----	---	----	---------		
BestR	=							
		2	0.66999	0.60389	0.82761	0.79964	2.9011	

	3	0.7501	0.7265	0.83748	0.79735	3.1114	
	5	0.71627	0.69836	0.79741	0.692	2.904	
	7	0.78961	0.80947	0.85636	0.73369	3.1891	
	9	0.78882	0.83791	0.82693	0.27871	2.7324	
	10	0.707667	0.788371	0.865834	0.477391	2.83926	
	11	0.749769	0.851453	0.863555	0.480873	2.94565	
	15	0.727184	0.791142	0.72704	0.536659	2.78203	
	20	0.69057	0.724987	0.825042	0.51144	2.75204	
	25	0.727936	0.826197	0.644411	0.639051	2.8376	
	30	0.672633	0.761751	0.712445	0.66001	2.80684	3.1891
inp	=	1	3	5			
--->	Input(s)	=	Depthfeet	RotationTorq uelbft	MovingSpeedfth		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.61442	0.49149	0.82709	0.76714	2.7001	
	3	0.70466	0.71313	0.84004	0.66712	2.925	
	5	0.67182	0.67654	0.78458	0.57859	2.7115	
	7	0.5518	0.51081	0.71171	0.79594	2.5703	
	9	0.7363	0.73486	0.87766	0.70292	3.0517	
	10	0.773335	0.789053	0.81699	0.824989	3.20437	
	11	0.69582	0.774449	0.795935	0.640015	2.90622	
	15	0.73584	0.78591	0.762213	0.643414	2.92738	
	20	0.720227	0.772833	0.754455	0.511208	2.75872	
	25	0.733767	0.801162	0.751242	0.674884	2.96105	
	30	0.698434	0.750775	0.525702	0.734921	2.70983	3.20437
inp	=	1	3	6			
--->	Input(s)	=	Depthfeet	RotationTorq uelbft	SpecificEnergyftlbft3		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.70944	0.68708	0.81615	0.77033	2.983	
	3	0.63019	0.53405	0.83007	0.77801	2.7723	
	5	0.65206	0.55633	0.84162	0.876	2.926	
	7	0.65247	0.60814	0.87849	0.79103	2.9301	
	9	0.7625	0.74984	0.69885	0.84645	3.0576	
	10	0.70914	0.740727	0.710194	0.639	2.79906	
	11	0.763461	0.805222	0.815905	0.719776	3.10436	
	15	0.771952	0.869427	0.817867	0.435436	2.89468	
	20	0.737058	0.772568	0.712251	0.736097	2.95797	
	25	0.762504	0.795406	0.733663	0.735797	3.02737	
	30	0.826041	0.910225	0.781457	0.713123	3.23084	3.23084
inp	=	1	4	5			
--->	Input(s)	=	Depthfeet	RotationSpee drevmin	MovingSpeedfth		
	HL	no.	all	train	val	test	Sum

	-----		---	-----	---	----	---------	
BestR	=							
		2	0.63927	0.53128	0.83221	0.78826	2.791	
		3	0.64835	0.57857	0.73469	0.84231	2.8039	
		5	0.75415	0.79739	0.86411	0.4474	2.863	
		7	0.67774	0.63521	0.76849	0.82127	2.9027	
		9	0.69968	0.69198	0.75984	0.7213	2.8728	
		10	0.73486	0.765127	0.497435	0.806251	2.80367	
		11	0.708209	0.766043	0.59511	0.642002	2.71136	
		15	0.662433	0.693265	0.545606	0.737223	2.63853	
		20	0.748177	0.851419	0.640685	0.62107	2.86135	
		25	0.826906	0.913258	0.851575	0.5393	3.13104	
		30	0.739243	0.783742	0.751781	0.731708	3.00647	3.13104
inp	=		1	4	6			
--->	Input(s)		=	Depthfeet	RotationSpee drevmin	SpecificEnergyftlbft3		
	HL		no.	all	train	val	test	Sum
	-----		---	-----	---	----	---------	
BestR	=							
		2	0.64127	0.51439	0.92233	0.76237	2.8404	
		3	0.70208	0.66694	0.88999	0.71478	2.9738	
		5	0.63962	0.58665	0.83398	0.76532	2.8256	
		7	0.76502	0.77955	0.68811	0.77419	3.0069	
		9	0.79152	0.87807	0.78065	0.557	3.0072	
		10	0.766408	0.811725	0.866364	0.578512	3.02301	
		11	0.73096	0.839847	0.514414	0.848514	2.93374	
		15	0.682654	0.645329	0.767063	0.821007	2.91605	
		20	0.703016	0.808446	0.659709	0.816659	2.98783	
		25	0.755628	0.762539	0.791913	0.701729	3.01181	
		30	0.778427	0.889733	0.591478	0.563957	2.82359	3.02301
inp	=		1	5	6			
--->	Input(s)		=	Depthfeet	MovingSpeed fth	SpecificEnergyftlbft3		
	HL		no.	all	train	val	test	Sum
	-----		---	-----	---	----	---------	
BestR	=							
		2	0.65911	0.62109	0.79496	0.70843	2.7836	
		3	0.72285	0.73559	0.63861	0.8102	2.9073	
		5	0.63949	0.62655	0.75146	0.64637	2.6639	
		7	0.75694	0.7512	0.76141	0.77529	3.0448	
		9	0.64392	0.67408	0.52835	0.87164	2.718	
		10	0.749951	0.854692	0.872108	0.462619	2.93937	
		11	0.694188	0.659613	0.767988	0.791231	2.91302	
		15	0.833567	0.855445	0.836499	0.706616	3.23213	
		20	0.743015	0.855951	0.823595	0.332156	2.75472	
		25	0.827276	0.932067	0.707651	0.640134	3.10713	
		30	0.782728	0.859186	0.724308	0.570517	2.93674	3.23213
inp	=		2	3	4			

--->	Input(s)	=	PeakDownPressurepsi	RotationTorquelbft	RotationSpeedrevmin		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.61518	0.60414	0.78593	0.89471	2.8999	
	3	0.69048	0.69213	0.80849	0.67113	2.8622	
	5	0.64296	0.73974	0.81442	0.87867	3.0758	
	7	0.78194	0.79275	0.76893	0.76696	3.1106	
	9	0.82639	0.88797	0.77078	0.56352	3.0487	
	10	0.74037	0.768818	0.853206	0.703419	3.06581	
	11	0.776056	0.801078	0.778376	0.755813	3.11132	
	15	0.763216	0.739805	0.879292	0.677766	3.06008	
	20	0.785294	0.790755	0.820708	0.789466	3.18622	
	25	0.817602	0.875023	0.916223	0.644432	3.25328	
	30	0.761698	0.753019	0.848372	0.772366	3.13546	3.25328
inp	=	2	3	5			
--->	Input(s)	=	PeakDownPressurepsi	RotationTorquelbft	MovingSpeedfth		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.68211	0.6152	0.80677	0.82087	2.925	
	3	0.75246	0.71798	0.77692	0.82379	3.0712	
	5	0.71589	0.69105	0.77185	0.81023	2.989	
	7	0.70227	0.68807	0.64327	0.89607	2.9297	
	9	0.79188	0.79451	0.86858	0.63977	3.0947	
	10	0.764322	0.827561	0.855653	0.641295	3.08883	
	11	0.770827	0.834079	0.766276	0.730787	3.10197	
	15	0.758812	0.819909	0.703962	0.725172	3.00786	
	20	0.816653	0.893474	0.740424	0.728098	3.17865	
	25	0.784137	0.824113	0.761534	0.722605	3.09239	
	30	0.775315	0.842852	0.668159	0.745819	3.03214	3.17865
inp	=	2	3	6			
--->	Input(s)	=	PeakDownPressurepsi	RotationTorquelbft	SpecificEnergyftlbft3		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.71793	0.74511	0.53226	0.77968	2.775	
	3	0.72631	0.74505	0.75444	0.64824	2.874	
	5	0.77458	0.76065	0.88846	0.66875	3.0924	
	7	0.74988	0.74409	0.74959	0.83572	3.0793	
	9	0.76953	0.76938	0.88419	0.47412	2.8972	
	10	0.83617	0.840948	0.918698	0.923027	3.51884	
	11	0.821429	0.882588	0.741016	0.675668	3.1207	
	15	0.804822	0.846406	0.86533	0.67777	3.19433	
	20	0.799721	0.849686	0.754352	0.728466	3.13222	

	25	0.831226	0.904718	0.565704	0.822551	3.1242	
	30	0.833409	0.925908	0.711604	0.763918	3.23484	3.51884
inp	=	2	4	5			
--->	Input(s)	=	PeakDownPre ssurepsi	RotationSpee drevmin	MovingSpeedfth		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.67824	0.65666	0.82061	0.62998	2.7855	
	3	0.6623	0.66415	0.46803	0.72742	2.5219	
	5	0.62799	0.52379	0.86471	0.78264	2.7991	
	7	0.75375	0.81744	0.70762	0.61257	2.8914	
	9	0.71707	0.85101	0.77332	0.43823	2.7796	
	10	0.759782	0.766862	0.749396	0.739907	3.01595	
	11	0.669174	0.798683	0.664486	0.580035	2.71238	
	15	0.733507	0.78907	0.713868	0.623134	2.85958	
	20	0.7686	0.838596	0.837856	0.507757	2.95281	
	25	0.785165	0.876222	0.744093	0.464295	2.86978	
	30	0.700567	0.842681	0.672544	0.570142	2.78593	3.01595
inp	=	2	4	6			
--->	Input(s)	=	PeakDownPre ssurepsi	RotationSpee drevmin	SpecificEnergyftlbft3		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.62376	0.60786	0.69232	0.68196	2.6059	
	3	0.72917	0.7488	0.73978	0.66141	2.8792	
	5	0.66711	0.66599	0.62901	0.81297	2.7751	
	7	0.74765	0.75557	0.79636	0.64934	2.9489	
	9	0.78936	0.84317	0.7753	0.6887	3.0965	
	10	0.770531	0.82509	0.59412	0.812315	3.00206	
	11	0.72542	0.791156	0.799877	0.734834	3.05129	
	15	0.84459	0.924706	0.561888	0.677313	3.0085	
	20	0.752218	0.783381	0.751469	0.558707	2.84577	
	25	0.816075	0.902077	0.796444	0.460224	2.97482	
	30	0.780242	0.901138	0.782284	0.606211	3.06988	3.0965
inp	=	2	5	6			
--->	Input(s)	=	PeakDownPre ssurepsi	MovingSpeed fth	SpecificEnergyftlbft3		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.72497	0.72982	0.79847	0.66584	2.9191	
	3	0.72582	0.72692	0.70227	0.77036	2.9254	
	5	0.74291	0.78828	0.80991	0.70058	3.0417	
	7	0.78791	0.82113	0.6334	0.773	3.0154	
	9	0.75568	0.76143	0.66628	0.84974	3.0331	
	10	0.805431	0.838696	0.889819	0.645258	3.1792	

	11	0.75744	0.792609	0.713152	0.702261	2.96546	
	15	0.793682	0.879764	0.754738	0.640949	3.06913	
	20	0.810746	0.809567	0.919581	0.684153	3.22405	
	25	0.816493	0.872622	0.77698	0.661564	3.12766	
	30	0.811123	0.887474	0.779262	0.655553	3.13341	3.22405
inp	=	3	4	5			
--->	Input(s)	=	RotationTorquelbft	RotationSpeedrevmin	MovingSpeedfth		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.59144	0.5169	0.81593	0.87868	2.8029	
	3	0.59997	0.54868	0.69112	0.84813	2.6879	
	5	0.58343	0.55721	0.62241	0.7342	2.4973	
	7	0.70668	0.71941	0.73564	0.60623	2.768	
	9	0.6609	0.61044	0.80708	0.75322	2.8316	
	10	0.659576	0.676283	0.657352	0.802023	2.79523	
	11	0.678174	0.650171	0.628556	0.772628	2.72953	
	15	0.608746	0.593604	0.724981	0.661759	2.58909	
	20	0.702708	0.787636	0.630534	0.522838	2.64371	
	25	0.740227	0.797857	0.637341	0.643695	2.81912	
	30	0.756216	0.826689	0.595854	0.763127	2.94189	2.94189
inp	=	3	4	6			
--->	Input(s)	=	RotationTorquelbft	RotationSpeedrevmin	SpecificEnergyftlbft3		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.73092	0.74766	0.8663	0.64893	2.9938	
	3	0.72742	0.73807	0.61938	0.8148	2.8997	
	5	0.67693	0.67385	0.82229	0.71439	2.8875	
	7	0.68463	0.62803	0.80222	0.71736	2.8322	
	9	0.69142	0.65929	0.83919	0.72474	2.9146	
	10	0.782805	0.794533	0.828262	0.672423	3.07802	
	11	0.670157	0.794616	0.721329	0.724002	2.9101	
	15	0.745579	0.765798	0.849097	0.852513	3.21299	
	20	0.646019	0.820247	0.786373	0.740143	2.99278	
	25	0.720629	0.782848	0.719043	0.656941	2.87946	
	30	0.813562	0.889996	0.452189	0.778418	2.93416	3.21299
inp	=	3	5	6			
--->	Input(s)	=	RotationTorquelbft	MovingSpeedfth	SpecificEnergyftlbft3		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.62381	0.51344	0.88469	0.85394	2.8759	
	3	0.74226	0.76338	0.70735	0.74636	2.9594	
	5	0.78841	0.80551	0.83073	0.6687	3.0934	

	7	0.82937	0.87975	0.8363	0.70029	3.2457	
	9	0.78515	0.8394	0.79986	0.63849	3.0629	
	10	0.786918	0.853394	0.745489	0.695113	3.08091	
	11	0.733379	0.713963	0.833677	0.743362	3.02438	
	15	0.781204	0.856304	0.823446	0.631113	3.09207	
	20	0.751884	0.743443	0.810392	0.723332	3.02905	
	25	0.775068	0.800787	0.807232	0.71845	3.10154	
	30	0.783126	0.933562	0.769651	0.619488	3.10583	3.2457
inp	=	4	5	6			
--->	Input(s)	=	RotationSpeedrevmin	MovingSpeedfth	SpecificEnergyftlbft3		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.59286	0.58852	0.62446	0.77486	2.5807	
	3	0.69041	0.68152	0.69431	0.78734	2.8536	
	5	0.67078	0.68483	0.69635	0.80826	2.8602	
	7	0.67385	0.64808	0.81716	0.66929	2.8084	
	9	0.69648	0.76676	0.58365	0.60492	2.6518	
	10	0.633364	0.624424	0.617252	0.82196	2.697	
	11	0.664545	0.697183	0.745116	0.60836	2.7152	
	15	0.694172	0.698621	0.768912	0.725133	2.88684	
	20	0.786934	0.852443	0.844693	0.677436	3.16151	
	25	0.729373	0.804505	0.891421	0.399092	2.82439	
	30	0.792285	0.920093	0.728962	0.479724	2.92106	3.16151
************	NUMBER	OF	COMBINATIONS	=	4	************	
numIts	=	100					
inp	=	1	2	3	4		
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi	RotationTorquelbft	RotationSpeedrevmin	
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.68412	0.61548	0.85586	0.84841	3.0039	
	3	0.70026	0.63183	0.73904	0.85472	2.9259	
	5	0.72317	0.7053	0.75603	0.80943	2.9939	
	7	0.75054	0.73051	0.84173	0.80618	3.129	
	9	0.69622	0.62727	0.82598	0.83157	2.981	
	10	0.690285	0.816353	0.83559	0.568622	2.91085	
	11	0.730293	0.736653	0.739566	0.73835	2.94486	
	15	0.725028	0.759114	0.767986	0.702692	2.95482	
	20	0.749334	0.813322	0.743139	0.628212	2.93401	
	25	0.790639	0.887423	0.80568	0.652899	3.13664	
	30	0.764526	0.805235	0.619497	0.740438	2.9297	3.13664
inp	=	1	2	3	5		
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi	RotationTorquelbft	MovingSpeedfth	
	HL	no.	all	train	val	test	Sum

	-----	---	-----	---	----	---------	
BestR	=						
	2	0.78726	0.75362	0.85455	0.8233	3.2187	
	3	0.77814	0.81244	0.8311	0.67352	3.0952	
	5	0.74746	0.64707	0.86553	0.84753	3.1076	
	7	0.71834	0.80933	0.79379	0.67156	2.993	
	9	0.76365	0.87492	0.71669	0.59491	2.9502	
	10	0.748563	0.7835	0.664295	0.796309	2.99267	
	11	0.768823	0.832027	0.695374	0.694108	2.99033	
	15	0.792428	0.917518	0.848712	0.620586	3.17924	
	20	0.73402	0.733133	0.824906	0.786416	3.07848	
	25	0.803127	0.853882	0.795472	0.772217	3.2247	
	30	0.823728	0.888155	0.778608	0.821163	3.31165	3.31165
inp	=	1	2	3	6		
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi	RotationTorquelbft	SpecificEnergyftlbft3	
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.66685	0.66223	0.65717	0.92566	2.9119	
	3	0.72625	0.76493	0.71225	0.73258	2.936	
	5	0.74724	0.77257	0.75816	0.66083	2.9388	
	7	0.78131	0.79737	0.74148	0.73506	3.0552	
	9	0.72963	0.82799	0.69248	0.7607	3.0108	
	10	0.80085	0.885931	0.741151	0.577919	3.00585	
	11	0.697931	0.668486	0.770365	0.798202	2.93498	
	15	0.747597	0.765474	0.67985	0.791676	2.9846	
	20	0.786687	0.836549	0.797496	0.609427	3.03016	
	25	0.849585	0.882209	0.819434	0.832682	3.38391	
	30	0.7828	0.932441	0.687509	0.540481	2.94323	3.38391
inp	=	1	2	4	5		
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi	RotationSpeedrevmin	MovingSpeedfth	
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.70443	0.67195	0.8032	0.62852	2.8081	
	3	0.7566	0.7755	0.76008	0.68781	2.98	
	5	0.67125	0.64758	0.69697	0.76029	2.7761	
	7	0.76276	0.8065	0.81439	0.54036	2.924	
	9	0.77914	0.80373	0.74942	0.75926	3.0915	
	10	0.738026	0.856826	0.827416	0.708331	3.1306	
	11	0.766362	0.824884	0.843542	0.656485	3.09127	
	15	0.759115	0.834464	0.48461	0.669192	2.74738	
	20	0.746285	0.778679	0.714036	0.68902	2.92802	
	25	0.748189	0.812239	0.631881	0.667163	2.85947	
	30	0.793481	0.867288	0.575884	0.665537	2.90219	3.1306
inp	=	1	2	4	6		

--->	Input(s)	=	Depthfeet	PeakDownPre ssurepsi	RotationSpee drevmin	SpecificEnergyftlbft3	
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.63487	0.56435	0.84582	0.83819	2.8832	
	3	0.62367	0.51009	0.64505	0.93792	2.7167	
	5	0.71158	0.68992	0.71931	0.82138	2.9422	
	7	0.8009	0.82159	0.83872	0.64126	3.1025	
	9	0.62624	0.61696	0.81393	0.64949	2.7066	
	10	0.773859	0.855284	0.593661	0.692819	2.91562	
	11	0.708846	0.809731	0.594785	0.627336	2.7407	
	15	0.744673	0.887244	0.75091	0.680341	3.06317	
	20	0.759756	0.843262	0.707528	0.600212	2.91076	
	25	0.75583	0.904513	0.555385	0.602505	2.81823	
	30	0.830617	0.912803	0.750516	0.648307	3.14224	3.14224
inp	=	1	2	5	6		
--->	Input(s)	=	Depthfeet	PeakDownPre ssurepsi	MovingSpeed fth	SpecificEnergyftlbft3	
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.70593	0.80692	0.77044	0.30165	2.5849	
	3	0.7568	0.78057	0.74444	0.70735	2.9892	
	5	0.73459	0.6959	0.8826	0.75449	3.0676	
	7	0.7342	0.7247	0.74194	0.76831	2.9692	
	9	0.75167	0.78886	0.74186	0.68995	2.9723	
	10	0.734975	0.768626	0.627537	0.767125	2.89826	
	11	0.763667	0.813054	0.763926	0.704623	3.04527	
	15	0.795692	0.870122	0.630915	0.795906	3.09264	
	20	0.642421	0.641172	0.787649	0.770096	2.84134	
	25	0.746577	0.897691	0.751833	0.329155	2.72526	
	30	0.775985	0.835575	0.65548	0.707125	2.97417	3.09264
inp	=	1	3	4	5		
--->	Input(s)	=	Depthfeet	RotationTorq uelbft	RotationSpee drevmin	MovingSpeedfth	
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.62624	0.54909	0.78138	0.8449	2.8016	
	3	0.66182	0.61815	0.8283	0.65767	2.7659	
	5	0.68386	0.64007	0.85532	0.73783	2.9171	
	7	0.73074	0.7574	0.7265	0.49053	2.7052	
	9	0.65098	0.66013	0.79603	0.60308	2.7102	
	10	0.704446	0.791795	0.897417	0.306615	2.70027	
	11	0.657302	0.886017	0.767244	0.339546	2.65011	
	15	0.672705	0.716276	0.577752	0.787312	2.75405	
	20	0.731603	0.773123	0.591334	0.741176	2.83724	

		25	0.766007	0.90952	0.572855	0.548761	2.79714	
		30	0.692269	0.790828	0.764101	0.613058	2.86026	2.9171
inp	=		1	3	4	6		
--->	Input(s)		=	Depthfeet	RotationTorq uelbft	RotationSpee drevmin	SpecificEnergyftlbft3	
	HL		no.	all	train	val	test	Sum
	-----		---	-----	---	----	---------	
BestR	=							
		2	0.63263	0.6093	0.75095	0.70798	2.7009	
		3	0.66771	0.615	0.81139	0.79043	2.8845	
		5	0.65498	0.73105	0.92713	0.57061	2.8838	
		7	0.71334	0.66732	0.79119	0.81252	2.9844	
		9	0.78938	0.85322	0.80061	0.66875	3.112	
		10	0.738901	0.771925	0.77609	0.814364	3.10128	
		11	0.684639	0.683066	0.622879	0.834319	2.8249	
		15	0.787978	0.820144	0.762975	0.625351	2.99645	
		20	0.714229	0.68025	0.732324	0.829963	2.95677	
		25	0.663459	0.645681	0.904291	0.651918	2.86535	
		30	0.754906	0.785778	0.727894	0.705894	2.97447	3.112
inp	=		1	3	5	6		
--->	Input(s)		=	Depthfeet	RotationTorq uelbft	MovingSpeed fth	SpecificEnergyftlbft3	
	HL		no.	all	train	val	test	Sum
	-----		---	-----	---	----	---------	
BestR	=							
		2	0.62751	0.57675	0.86906	0.80205	2.8754	
		3	0.76629	0.76002	0.64613	0.77988	2.9523	
		5	0.75269	0.73342	0.86612	0.72954	3.0818	
		7	0.73288	0.78931	0.77465	0.64684	2.9437	
		9	0.79667	0.85687	0.77846	0.65897	3.091	
		10	0.811195	0.847744	0.888407	0.658825	3.20617	
		11	0.79972	0.877612	0.835523	0.734527	3.24738	
		15	0.781416	0.820155	0.745395	0.774394	3.12136	
		20	0.722764	0.657059	0.892192	0.787704	3.05972	
		25	0.797692	0.854357	0.723179	0.816453	3.19168	
		30	0.708911	0.704678	0.824766	0.70044	2.9388	3.24738
inp	=		1	4	5	6		
--->	Input(s)		=	Depthfeet	RotationSpee drevmin	MovingSpeed fth	SpecificEnergyftlbft3	
	HL		no.	all	train	val	test	Sum
	-----		---	-----	---	----	---------	
BestR	=							
		2	0.66617	0.67186	0.74678	0.67317	2.758	
		3	0.71069	0.76286	0.70678	0.64679	2.8271	
		5	0.62448	0.58092	0.71034	0.74161	2.6573	
		7	0.74772	0.76331	0.72176	0.73014	2.9629	
		9	0.71309	0.74672	0.84399	0.38152	2.6853	
		10	0.682196	0.706815	0.813734	0.423059	2.6258	

		11	0.641542	0.565573	0.896086	0.721332	2.82453	
		15	0.669509	0.623904	0.846052	0.589195	2.72866	
		20	0.788091	0.925332	0.418023	0.726902	2.85835	
		25	0.761097	0.819101	0.752432	0.553282	2.88591	
		30	0.711475	0.850876	0.629188	0.50364	2.69518	2.9629
inp	=		2	3	4	5		
--->	Input(s)		=	PeakDownPre ssurepsi	RotationTorq uelbft	RotationSpee drevmin	MovingSpeedfth	
	HL		no.	all	train	val	test	Sum
	-----		---	-----	---	----	---------	
BestR	=							
		2	0.71251	0.68356	0.77939	0.85182	3.0273	
		3	0.7625	0.76294	0.81318	0.76066	3.0993	
		5	0.73773	0.65593	0.83559	0.79677	3.026	
		7	0.75196	0.70179	0.75418	0.91915	3.1271	
		9	0.77081	0.79522	0.64899	0.84682	3.0618	
		10	0.781224	0.772752	0.845105	0.853768	3.25285	
		11	0.792699	0.824164	0.662542	0.765889	3.04529	
		15	0.770949	0.818894	0.766884	0.730326	3.08705	
		20	0.731098	0.867214	0.728434	0.7679	3.09465	
		25	0.780055	0.923097	0.736017	0.810448	3.24962	
		30	0.820782	0.885234	0.884948	0.805791	3.39675	3.39675
inp	=		2	3	4	6		
--->	Input(s)		=	PeakDownPre ssurepsi	RotationTorq uelbft	RotationSpee drevmin	SpecificEnergyftlbft3	
	HL		no.	all	train	val	test	Sum
	-----		---	-----	---	----	---------	
BestR	=							
		2	0.69893	0.63547	0.86303	0.87519	3.0726	
		3	0.7428	0.69491	0.89393	0.8109	3.1425	
		5	0.75926	0.74632	0.79504	0.78452	3.0851	
		7	0.75059	0.81967	0.7852	0.74236	3.0978	
		9	0.79996	0.87535	0.88507	0.70322	3.2636	
		10	0.758308	0.884543	0.81149	0.620692	3.07503	
		11	0.802842	0.836732	0.768939	0.781633	3.19015	
		15	0.808215	0.858121	0.766844	0.77098	3.20416	
		20	0.798651	0.829585	0.770231	0.722789	3.12126	
		25	0.792096	0.784211	0.70539	0.865944	3.14764	
		30	0.824749	0.883672	0.616921	0.713628	3.03897	3.2636
inp	=		2	3	5	6		
--->	Input(s)		=	PeakDownPre ssurepsi	RotationTorq uelbft	MovingSpeed fth	SpecificEnergyftlbft3	
	HL		no.	all	train	val	test	Sum
	-----		---	-----	---	----	---------	
BestR	=							
		2	0.72076	0.73648	0.6618	0.83839	2.9574	
		3	0.7805	0.85628	0.6823	0.659	2.9781	
		5	0.78032	0.76566	0.81256	0.85994	3.2185	

	7	0.78562	0.81763	0.81616	0.72622	3.1456	
	9	0.77591	0.807	0.80196	0.71195	3.0968	
	10	0.736336	0.784613	0.702228	0.81127	3.03445	
	11	0.716924	0.784385	0.837167	0.612039	2.95052	
	15	0.79458	0.886075	0.716284	0.737193	3.13413	
	20	0.810322	0.912545	0.838444	0.651581	3.21289	
	25	0.789575	0.844568	0.692638	0.735371	3.06215	
	30	0.777765	0.907726	0.681732	0.653047	3.02027	3.2185
inp	=	2	4	5	6		
--->	Input(s)	=	PeakDownPressurepsi	RotationSpeedrevmin	MovingSpeedfth	SpecificEnergyftlbft3	
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.71791	0.699	0.59701	0.86306	2.877	
	3	0.61991	0.60267	0.60147	0.84353	2.6676	
	5	0.78816	0.80663	0.75997	0.84411	3.1989	
	7	0.80507	0.86249	0.69199	0.69553	3.0551	
	9	0.79086	0.83043	0.69546	0.80891	3.1257	
	10	0.705427	0.817563	0.791614	0.646059	2.96066	
	11	0.735631	0.787566	0.546234	0.776168	2.8456	
	15	0.713231	0.797947	0.627798	0.712247	2.85122	
	20	0.758879	0.800127	0.701468	0.661259	2.92173	
	25	0.788984	0.878275	0.774349	0.53541	2.97702	
	30	0.762218	0.782703	0.707924	0.782329	3.03517	3.1989
inp	=	3	4	5	6		
--->	Input(s)	=	RotationTorquelbft	RotationSpeedrevmin	MovingSpeedfth	SpecificEnergyftlbft3	
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.71985	0.72179	0.66761	0.78235	2.8916	
	3	0.65031	0.63963	0.76859	0.66773	2.7263	
	5	0.70883	0.72087	0.66713	0.73982	2.8367	
	7	0.76111	0.77277	0.63534	0.78659	2.9558	
	9	0.66606	0.59037	0.84995	0.85475	2.9611	
	10	0.713027	0.682299	0.763388	0.801779	2.96049	
	11	0.717928	0.666972	0.799024	0.774027	2.95795	
	15	0.770974	0.817676	0.825597	0.73292	3.14717	
	20	0.753412	0.82766	0.789013	0.53343	2.90352	
	25	0.758795	0.81619	0.768805	0.782124	3.12591	
	30	0.734703	0.771358	0.823131	0.766061	3.09525	3.14717
************	NUMBER	OF	COMBINATIONS	=	5	************	
numIts	=	100					
inp	=	1	2	3	4	5	
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi	RotationTorquelbft	RotationSpeedrevmin	MovingSpeedfth
	HL	no.	all	train	val	test	Sum

	-----	---	-----	---	----	---------	
BestR	=						
	2	0.72215	0.71802	0.74619	0.82433	3.0107	
	3	0.72837	0.69914	0.8336	0.91602	3.1771	
	5	0.68943	0.72351	0.82427	0.65205	2.8893	
	7	0.81519	0.85938	0.78406	0.71027	3.1689	
	9	0.81336	0.85479	0.64992	0.7481	3.0662	
	10	0.808878	0.900471	0.706195	0.652138	3.06768	
	11	0.758017	0.89501	0.871975	0.774145	3.29915	
	15	0.772827	0.803614	0.757673	0.705143	3.03926	
	20	0.734927	0.671203	0.882899	0.812872	3.1019	
	25	0.771892	0.841306	0.824645	0.651512	3.08936	
	30	0.744611	0.852564	0.684064	0.6018	2.88304	3.29915
inp	=	1	2	3	4	6	
--->	Input(s)	=	Depthfeet	PeakDownPre ssurepsi	RotationTorq uelbft	RotationSpee drevmin	SpecificEner gyftlbft3
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.71052	0.67998	0.81505	0.85464	3.0602	
	3	0.69014	0.66413	0.81881	0.75922	2.9323	
	5	0.75638	0.76387	0.79492	0.73814	3.0533	
	7	0.73516	0.76379	0.80677	0.77629	3.082	
	9	0.74488	0.76032	0.61498	0.81176	2.9319	
	10	0.735362	0.759019	0.824662	0.752087	3.07113	
	11	0.775008	0.79241	0.696156	0.889038	3.15261	
	15	0.806815	0.888032	0.769382	0.608506	3.07273	
	20	0.820592	0.901016	0.703989	0.7561	3.1817	
	25	0.748981	0.758	0.793812	0.709427	3.01022	
	30	0.779463	0.894503	0.782409	0.678119	3.13449	3.1817
inp	=	1	2	3	5	6	
--->	Input(s)	=	Depthfeet	PeakDownPre ssurepsi	RotationTorq uelbft	MovingSpeed fth	SpecificEner gyftlbft3
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.7359	0.73293	0.72293	0.82102	3.0128	
	3	0.78298	0.81831	0.81798	0.63834	3.0576	
	5	0.65757	0.6249	0.84891	0.78826	2.9196	
	7	0.74328	0.76499	0.7746	0.6615	2.9444	
	9	0.79285	0.79162	0.85803	0.50457	2.9471	
	10	0.698432	0.77179	0.784986	0.567739	2.82295	
	11	0.691211	0.674062	0.696347	0.782378	2.844	
	15	0.777494	0.922866	0.762467	0.589517	3.05234	
	20	0.829918	0.899453	0.724867	0.806375	3.26061	
	25	0.8134	0.832306	0.859472	0.730647	3.23582	
	30	0.812631	0.866903	0.76148	0.672126	3.11314	3.26061
inp	=	1	2	4	5	6	

--->	Input(s)	=	Depthfeet	PeakDownPressurepsi	RotationSpeedrevmin	MovingSpeedfth	SpecificEnergyftlbft3
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.64064	0.61028	0.80174	0.741	2.7937	
	3	0.67293	0.75886	0.81948	0.73581	2.9871	
	5	0.76357	0.77793	0.8224	0.58439	2.9483	
	7	0.81371	0.82739	0.5991	0.88633	3.1265	
	9	0.67319	0.84663	0.73564	0.65226	2.9077	
	10	0.754473	0.783355	0.774832	0.658837	2.9715	
	11	0.775341	0.820904	0.710579	0.750828	3.05765	
	15	0.786074	0.837918	0.757079	0.586843	2.96791	
	20	0.683956	0.687638	0.689171	0.753716	2.81448	
	25	0.72973	0.797573	0.64532	0.65554	2.82816	
	30	0.746667	0.873769	0.501895	0.632611	2.75494	3.1265
inp	=	1	3	4	5	6	
--->	Input(s)	=	Depthfeet	RotationTorquelbft	RotationSpeedrevmin	MovingSpeedfth	SpecificEnergyftlbft3
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.72607	0.77816	0.71272	0.628	2.8449	
	3	0.74224	0.84256	0.74623	0.55149	2.8825	
	5	0.78862	0.82475	0.77317	0.65613	3.0427	
	7	0.65345	0.59937	0.66414	0.88413	2.8011	
	9	0.66686	0.60378	0.82934	0.81736	2.9173	
	10	0.741951	0.846703	0.543069	0.700298	2.83202	
	11	0.763267	0.79304	0.751318	0.638881	2.94651	
	15	0.67484	0.585036	0.789114	0.801312	2.8503	
	20	0.757091	0.767503	0.633594	0.838201	2.99639	
	25	0.711235	0.959488	0.601179	0.492266	2.76417	
	30	0.669023	0.919266	0.560318	0.63684	2.78545	3.0427
inp	=	2	3	4	5	6	
--->	Input(s)	=	PeakDownPressurepsi	RotationTorquelbft	RotationSpeedrevmin	MovingSpeedfth	SpecificEnergyftlbft3
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.65384	0.70222	0.908	0.80451	3.0686	
	3	0.80717	0.82237	0.76198	0.75347	3.145	
	5	0.74599	0.72529	0.81566	0.80125	3.0882	
	7	0.82012	0.84959	0.89456	0.53189	3.0962	
	9	0.73175	0.78512	0.69419	0.88007	3.0911	
	10	0.710833	0.696738	0.770294	0.817546	2.99541	
	11	0.699368	0.824296	0.836375	0.665423	3.02546	
	15	0.777096	0.773847	0.707244	0.891285	3.14947	
	20	0.824211	0.900581	0.67283	0.728745	3.12637	

	25	0.840489	0.900828	0.595035	0.844606	3.18096	
	30	0.784045	0.904393	0.73454	0.719206	3.14218	3.18096
*******			COMBINATIO				
*****	NUMBER	OF	NS	=	6	************	
numIts	=	100					
inp	=	1	2	3	4	5	
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi	RotationTorquelbft	RotationSpeedrevmin	MovingSpeedfth
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.69836	0.64236	0.85321	0.79376	2.9877	
	3	0.72414	0.715	0.69648	0.86458	3.0002	
	5	0.70095	0.82902	0.76549	0.7737	3.0692	
	7	0.7721	0.83843	0.74769	0.6124	2.9706	
	9	0.77569	0.79205	0.83789	0.71987	3.1255	
	10	0.76131	0.759682	0.864078	0.699339	3.08441	
	11	0.770388	0.819833	0.754267	0.801743	3.14623	
	15	0.757962	0.830311	0.786575	0.693139	3.06799	
	20	0.721862	0.693648	0.812104	0.729431	2.95704	
	25	0.727207	0.758753	0.752246	0.648199	2.8864	
	30	0.832994	0.937284	0.741285	0.608277	3.11984	3.14623
Elapsed	time	is	100.9127	minutes.			

Training	INPUTS:	1	2	3	4	5	6
Depthfeet	PeakDownPressurepsi	RotationTorquelbft	RotationSpeedrevmin	MovingSpeedfth	SpecificEnergyftlbft3		

Training	TARGETS:	8					
UCSpsi							
--------------------						MAX	3.51884

Appendix I – NN summary results for unit weight

*******			COMBINATIO				
*****	NUMBER	OF	NS	=	1	************	
numIts	=	100					
inp	=	1					
--->	Input(s)	=	Depthfeet				
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.62299	0.6361	0.59591	0.79471	2.6497	
	3	0.63231	0.57025	0.79093	0.73053	2.724	
	5	0.6701	0.65784	0.69862	0.75058	2.7771	
	7	0.73256	0.73199	0.72248	0.75322	2.9403	
	9	0.79674	0.81323	0.81867	0.70659	3.1352	
	10	0.761509	0.76263	0.796044	0.70999	3.03017	
	11	0.776591	0.780244	0.86386	0.737467	3.15816	
	15	0.824257	0.794273	0.870462	0.946487	3.43548	
	20	0.8169	0.83925	0.766125	0.830976	3.25325	
	25	0.843588	0.841965	0.816287	0.93494	3.43678	
	30	0.823963	0.843641	0.907818	0.735341	3.31076	3.43678
inp	=	2					
--->	Input(s)	=	PeakDownPressurepsi				
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.3967	0.28218	0.60083	0.75219	2.0319	
	3	0.58936	0.5493	0.75228	0.48537	2.3763	
	5	0.60295	0.53984	0.75566	0.79331	2.6918	
	7	0.6484	0.67018	0.82926	0.67321	2.821	
	9	0.70703	0.72452	0.55699	0.75149	2.74	
	10	0.688314	0.617148	0.864998	0.807247	2.97771	
	11	0.69309	0.722027	0.830188	0.538811	2.78412	
	15	0.680738	0.635215	0.737566	0.817137	2.87066	
	20	0.697004	0.695862	0.705855	0.719063	2.81778	
	25	0.732749	0.704438	0.718951	0.804258	2.9604	
	30	0.729007	0.710978	0.84689	0.647744	2.93462	2.97771
inp	=	3					
--->	Input(s)	=	RotationTorquelbft				
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.51317	0.37115	0.79924	0.77178	2.4553	
	3	0.58599	0.62509	0.85523	0.33997	2.4063	
	5	0.55274	0.43415	0.68337	0.76801	2.4383	
	7	0.6516	0.61554	0.77933	0.68706	2.7335	
	9	0.65608	0.60801	0.57844	0.82987	2.6724	
	10	0.566338	0.623737	0.785584	0.891822	2.86748	
	11	0.655514	0.630112	0.917308	0.787125	2.99006	
	15	0.66918	0.754203	0.735339	0.762805	2.92153	

		20	0.550789	0.677798	0.86156	0.830714	2.92086	
		25	0.715969	0.693985	0.738776	0.808116	2.95685	
		30	0.674946	0.708164	0.7287	0.892484	3.00429	3.00429
inp	=		4					
--->	Input(s)	=	RotationSpeedrevmin					
	HL	no.	all	train	val	test	Sum	
	-----	---	-----	---	----	---------		
BestR	=							
		2	0.31027	0.28117	0.47261	0.24991	1.314	
		3	0.46808	0.44781	0.53409	0.5068	1.9568	
		5	0.5721	0.57979	0.72576	0.30959	2.1872	
		7	0.6288	0.60733	0.70243	0.7567	2.6953	
		9	0.6407	0.60105	0.66028	0.68185	2.5839	
		10	0.658611	0.653134	0.827951	0.565559	2.70525	
		11	0.776519	0.790593	0.845756	0.520129	2.933	
		15	0.827378	0.850311	0.868916	0.669803	3.21641	
		20	0.776267	0.802804	0.801942	0.707949	3.08896	
		25	0.77779	0.831237	0.734713	0.722047	3.06579	
		30	0.742106	0.831361	0.767532	0.674509	3.01551	3.21641
inp	=		5					
--->	Input(s)	=	MovingSpeedfth					
	HL	no.	all	train	val	test	Sum	
	-----	---	-----	---	----	---------		
BestR	=							
		2	0.3268	0.20721	0.35033	0.67052	1.5549	
		3	0.31542	0.19171	0.68088	0.49109	1.6791	
		5	0.31298	0.30048	0.55692	0.33374	1.5041	
		7	0.33382	0.25138	0.53052	0.55187	1.6676	
		9	0.24791	0.27525	0.47949	0.75524	1.7579	
		10	0.335948	0.235561	0.541295	0.52223	1.63503	
		11	0.496666	0.55589	0.420821	0.29634	1.76972	
		15	0.4814	0.496887	0.509226	0.478053	1.96557	
		20	0.511959	0.51778	0.766109	0.223724	2.01957	
		25	0.542579	0.621467	0.543081	0.274296	1.98142	
		30	0.556815	0.594637	0.544142	0.360142	2.05573	2.05573
inp	=		6					
--->	Input(s)	=	SpecificEnergyftlbft3					
	HL	no.	all	train	val	test	Sum	
	-----	---	-----	---	----	---------		
BestR	=							
		2	0.37433	0.33674	0.44949	0.78585	1.9464	
		3	0.40372	0.35455	0.85963	0.31117	1.9291	
		5	0.36477	0.28777	0.7638	0.5337	1.95	
		7	0.4324	0.36822	0.68111	0.50622	1.9879	
		9	0.48148	0.43098	0.70293	0.64053	2.2559	
		10	0.392075	0.346003	0.522225	0.764399	2.0247	
		11	0.437807	0.354123	0.728158	0.592387	2.11248	
		15	0.461997	0.434444	0.670702	0.743567	2.31071	
		20	0.483553	0.489418	0.567662	0.48098	2.02161	
		25	0.612816	0.659853	0.502435	0.501023	2.27613	

	30	0.533937	0.595614	0.737788	0.811231	2.67857	2.67857
*******			COMBINATIO				
*****	NUMBER	OF	NS	=	2	************	
numIts	=	100					
inp	=	1	2				
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.62534	0.47154	0.93575	0.89809	2.9307	
	3	0.79798	0.78401	0.92882	0.71038	3.2212	
	5	0.8286	0.82804	0.82885	0.82954	3.315	
	7	0.75955	0.66811	0.9536	0.91107	3.2923	
	9	0.86462	0.8833	0.82941	0.83413	3.4115	
	10	0.859306	0.863844	0.835157	0.868077	3.42638	
	11	0.807203	0.748961	0.971458	0.952103	3.47972	
	15	0.866797	0.883201	0.720893	0.908003	3.37889	
	20	0.850346	0.857912	0.881641	0.82282	3.41272	
	25	0.813351	0.795607	0.932581	0.779221	3.32076	
	30	0.889826	0.939164	0.800922	0.837997	3.46791	3.47972
inp	=	1	3				
--->	Input(s)	=	Depthfeet	RotationTorquelbft			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.64821	0.61191	0.64656	0.95549	2.8622	
	3	0.71578	0.74483	0.61426	0.7494	2.8243	
	5	0.73571	0.70196	0.82791	0.74762	3.0132	
	7	0.75829	0.72054	0.88273	0.81372	3.1753	
	9	0.80295	0.80705	0.86073	0.7767	3.2474	
	10	0.827232	0.858448	0.891304	0.69174	3.26872	
	11	0.822341	0.863041	0.820607	0.768534	3.27452	
	15	0.833737	0.841866	0.890311	0.821634	3.38755	
	20	0.884189	0.908989	0.946396	0.765073	3.50465	
	25	0.865162	0.908215	0.905928	0.701949	3.38125	
	30	0.903947	0.937672	0.86341	0.858772	3.5638	3.5638
inp	=	1	4				
--->	Input(s)	=	Depthfeet	RotationSpeedrevmin			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.78394	0.71976	0.92218	0.87542	3.3013	
	3	0.75998	0.7391	0.67941	0.91739	3.0959	
	5	0.77513	0.75077	0.93109	0.77383	3.2308	
	7	0.80967	0.81243	0.89592	0.73526	3.2533	
	9	0.82432	0.83222	0.79507	0.89326	3.3449	
	10	0.882071	0.928312	0.953662	0.686461	3.45051	
	11	0.858304	0.850464	0.844514	0.886434	3.43972	
	15	0.915126	0.964342	0.897905	0.847609	3.62498	
	20	0.882154	0.881389	0.827811	0.947552	3.53891	
	25	0.93738	0.965592	0.927402	0.886358	3.71673	

	30	0.90575	0.959162	0.804201	0.844804	3.51392	3.71673
inp	=	1	5				
--->	Input(s)	=	Depthfeet	MovingSpeedfth			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.60724	0.55589	0.73488	0.6659	2.5639	
	3	0.58859	0.57267	0.60685	0.63481	2.4029	
	5	0.65162	0.63409	0.80796	0.38078	2.4745	
	7	0.66501	0.68431	0.65729	0.63506	2.6417	
	9	0.66627	0.65177	0.71217	0.75342	2.7836	
	10	0.763947	0.773357	0.791327	0.779737	3.10837	
	11	0.669686	0.682933	0.5595	0.772187	2.68431	
	15	0.801358	0.873625	0.713701	0.630856	3.01954	
	20	0.673887	0.826735	0.890581	0.668051	3.05925	
	25	0.845513	0.863334	0.880621	0.771354	3.36082	
	30	0.763196	0.781765	0.752134	0.781712	3.07881	3.36082
inp	=	1	6				
--->	Input(s)	=	Depthfeet	SpecificEnergyftlbft3			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.66973	0.61655	0.91617	0.77866	2.9811	
	3	0.67779	0.65918	0.75697	0.72704	2.821	
	5	0.75054	0.70778	0.72923	0.94085	3.1284	
	7	0.80266	0.79466	0.78462	0.85567	3.2376	
	9	0.75374	0.78929	0.67011	0.7624	2.9755	
	10	0.852017	0.876521	0.785864	0.785863	3.30026	
	11	0.830053	0.808507	0.904832	0.814474	3.35787	
	15	0.818993	0.836505	0.808105	0.770864	3.23447	
	20	0.871867	0.898403	0.884244	0.774561	3.42907	
	25	0.818652	0.813276	0.787954	0.899133	3.31901	
	30	0.879312	0.91667	0.844923	0.820693	3.4616	3.4616
inp	=	2	3				
--->	Input(s)	=	PeakDownPressurepsi	RotationTorquelbft			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.6721	0.62847	0.83677	0.70119	2.8385	
	3	0.78003	0.78601	0.87068	0.65849	3.0952	
	5	0.78123	0.78198	0.88619	0.67319	3.1226	
	7	0.81423	0.777	0.8845	0.87299	3.3487	
	9	0.83263	0.86748	0.69323	0.87351	3.2669	
	10	0.855886	0.835861	0.885684	0.913998	3.49143	
	11	0.821816	0.873223	0.915181	0.713135	3.32336	
	15	0.862703	0.897079	0.8781	0.780876	3.41876	
	20	0.869512	0.969889	0.900593	0.761189	3.50118	
	25	0.871941	0.889643	0.866033	0.824818	3.45244	
	30	0.886035	0.939029	0.901929	0.802619	3.52961	3.52961
inp	=	2	4				

			PeakDownPre				
--->	Input(s)	=	ssurepsi	RotationSpeedrevmin			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.60087	0.58582	0.71674	0.67415	2.5776	
	3	0.69143	0.62771	0.86806	0.92226	3.1095	
	5	0.79136	0.84076	0.67946	0.71777	3.0294	
	7	0.79965	0.75127	0.92865	0.82097	3.3005	
	9	0.76804	0.7525	0.87675	0.79786	3.1952	
	10	0.749459	0.740513	0.732655	0.848146	3.07077	
	11	0.698203	0.645884	0.769148	0.856044	2.96928	
	15	0.905053	0.915286	0.921051	0.854829	3.59622	
	20	0.829631	0.800862	0.864761	0.908474	3.40373	
	25	0.789011	0.880812	0.904225	0.679431	3.25348	
	30	0.848751	0.869668	0.94386	0.663199	3.32548	3.59622
inp	=	2	5				
			PeakDownPre				
--->	Input(s)	=	ssurepsi	MovingSpeedfth			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.54771	0.52902	0.62299	0.53673	2.2364	
	3	0.61019	0.64619	0.64717	0.56705	2.4706	
	5	0.68689	0.71177	0.72332	0.58268	2.7047	
	7	0.57962	0.6726	0.75386	0.62863	2.6347	
	9	0.66942	0.69509	0.60438	0.64425	2.6131	
	10	0.574396	0.540482	0.605128	0.780614	2.50062	
	11	0.529846	0.648124	0.660537	0.556789	2.3953	
	15	0.68152	0.735048	0.912981	0.152917	2.48247	
	20	0.699813	0.751228	0.890165	0.521556	2.86276	
	25	0.678263	0.676915	0.723095	0.661763	2.74003	
	30	0.702879	0.75987	0.84533	0.407341	2.71542	2.86276
inp	=	2	6				
			PeakDownPre				
--->	Input(s)	=	ssurepsi	SpecificEnergyftlbft3			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.60924	0.56032	0.71583	0.79243	2.6778	
	3	0.69247	0.66078	0.78791	0.85253	2.9937	
	5	0.72846	0.71104	0.73347	0.83864	3.0116	
	7	0.79937	0.81301	0.74817	0.7917	3.1522	
	9	0.7857	0.72914	0.81363	0.92883	3.2573	
	10	0.801976	0.829132	0.769488	0.738243	3.13884	
	11	0.802728	0.820871	0.675755	0.850541	3.1499	
	15	0.81924	0.827063	0.882695	0.736725	3.26572	
	20	0.808161	0.804751	0.881946	0.85151	3.34637	
	25	0.845063	0.869979	0.840303	0.777543	3.33289	
	30	0.844433	0.845653	0.821436	0.856425	3.36795	3.36795
inp	=	3	4				

--->	Input(s)	=	RotationTorq uelbft	RotationSpeedrevmin			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.55555	0.48384	0.63381	0.84249	2.5157	
	3	0.66469	0.65702	0.6729	0.80593	2.8005	
	5	0.69312	0.74428	0.6163	0.63915	2.6928	
	7	0.78828	0.82703	0.81449	0.71456	3.1444	
	9	0.7901	0.83348	0.60254	0.7515	2.9776	
	10	0.812406	0.844681	0.696868	0.881766	3.23572	
	11	0.806398	0.826709	0.778362	0.81213	3.2236	
	15	0.725297	0.799327	0.857773	0.645107	3.0275	
	20	0.790017	0.813663	0.742487	0.806635	3.1528	
	25	0.769738	0.785787	0.858145	0.731642	3.14531	
	30	0.778376	0.787337	0.811287	0.780782	3.15778	3.23572
inp	=	3	5				
--->	Input(s)	=	RotationTorq uelbft	MovingSpeedfth			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.50281	0.4212	0.64723	0.77661	2.3479	
	3	0.51802	0.44509	0.65742	0.8907	2.5112	
	5	0.6391	0.62978	0.78667	0.58037	2.6359	
	7	0.65599	0.66091	0.63425	0.69164	2.6428	
	9	0.68655	0.72637	0.61752	0.5652	2.5956	
	10	0.718447	0.763854	0.761728	0.536246	2.78027	
	11	0.64978	0.695659	0.643878	0.669404	2.65872	
	15	0.728108	0.730496	0.824175	0.601986	2.88477	
	20	0.754907	0.843687	0.523081	0.592109	2.71378	
	25	0.66909	0.697967	0.687194	0.719508	2.77376	
	30	0.690293	0.717652	0.639567	0.74006	2.78757	2.88477
inp	=	3	6				
--->	Input(s)	=	RotationTorq uelbft	SpecificEnergyftlbft3			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.6628	0.55239	0.95011	0.80284	2.9681	
	3	0.67155	0.595	0.76831	0.94617	2.981	
	5	0.7854	0.78916	0.86883	0.75135	3.1947	
	7	0.8046	0.79567	0.8609	0.86199	3.3232	
	9	0.81402	0.86053	0.89324	0.61955	3.1873	
	10	0.757951	0.734589	0.832115	0.836302	3.16096	
	11	0.803926	0.82405	0.759102	0.87904	3.26612	
	15	0.806284	0.808273	0.711479	0.920556	3.24659	
	20	0.831873	0.831467	0.67475	0.944996	3.28309	
	25	0.853184	0.901057	0.848609	0.673607	3.27646	
	30	0.791413	0.903718	0.742911	0.699605	3.13765	3.3232
inp	=	4	5				

--->	Input(s)	=	RotationSpeedrevmin	MovingSpeedfth			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.32154	0.27472	0.60784	0.52241	1.7265	
	3	0.35362	0.36502	0.4747	0.36877	1.5621	
	5	0.53044	0.46811	0.67947	0.6021	2.2801	
	7	0.57221	0.61387	0.53558	0.58409	2.3057	
	9	0.60235	0.65539	0.56301	0.4635	2.2842	
	10	0.521516	0.525284	0.651025	0.488972	2.1868	
	11	0.582447	0.630433	0.595077	0.401775	2.20973	
	15	0.597342	0.710824	0.634298	0.459417	2.40188	
	20	0.730265	0.77868	0.690102	0.410407	2.60945	
	25	0.69633	0.857757	0.622561	0.562158	2.73881	
	30	0.703853	0.787938	0.841264	0.725312	3.05837	3.05837
inp	=	4	6				
--->	Input(s)	=	RotationSpeedrevmin	SpecificEnergyftlbft3			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.63525	0.53521	0.76563	0.87827	2.8144	
	3	0.63391	0.61062	0.72897	0.69491	2.6684	
	5	0.74446	0.72064	0.90788	0.76525	3.1382	
	7	0.79194	0.78144	0.96027	0.589	3.1227	
	9	0.84476	0.86816	0.72917	0.84929	3.2914	
	10	0.796158	0.854062	0.846072	0.782703	3.27899	
	11	0.817223	0.831995	0.69491	0.927612	3.27174	
	15	0.856066	0.890463	0.791158	0.763041	3.30073	
	20	0.846804	0.887736	0.847962	0.772794	3.3553	
	25	0.833607	0.84934	0.778619	0.853473	3.31504	
	30	0.864527	0.896928	0.780742	0.78112	3.32332	3.3553
inp	=	5	6				
--->	Input(s)	=	MovingSpeedfth	SpecificEnergyftlbft3			
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.47792	0.41727	0.81269	0.54026	2.2481	
	3	0.49681	0.52519	0.49192	0.74954	2.2635	
	5	0.58986	0.57655	0.5877	0.69828	2.4524	
	7	0.47112	0.43668	0.77646	0.74403	2.4283	
	9	0.60796	0.65833	0.72028	0.29036	2.2769	
	10	0.72133	0.750909	0.79383	0.426649	2.69272	
	11	0.612076	0.647912	0.653313	0.435772	2.34907	
	15	0.721796	0.764899	0.73997	0.638132	2.8648	
	20	0.670341	0.664573	0.722187	0.641215	2.69832	
	25	0.689197	0.792575	0.612904	0.748071	2.84275	
	30	0.768176	0.820955	0.672412	0.687397	2.94894	2.94894

************	NUMBER	OF	COMBINATIONS	=	3	************	
numIts	=	100					
inp	=	1	2	3			
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi	RotationTorquelbft		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.74356	0.75256	0.60608	0.92931	3.0315	
	3	0.76472	0.74675	0.77471	0.89335	3.1795	
	5	0.82645	0.86401	0.75588	0.82849	3.2748	
	7	0.86124	0.90755	0.90089	0.69646	3.3661	
	9	0.93655	0.96225	0.94376	0.77078	3.6133	
	10	0.862214	0.856064	0.833462	0.897052	3.44879	
	11	0.878778	0.919484	0.877561	0.788823	3.46465	
	15	0.917122	0.942928	0.853022	0.867572	3.58064	
	20	0.914193	0.9756	0.855676	0.857844	3.60331	
	25	0.857347	0.878885	0.831846	0.916889	3.48497	
	30	0.903834	0.992226	0.918832	0.774962	3.58985	3.6133
inp	=	1	2	4			
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi	RotationSpeedrevmin		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.7257	0.6929	0.91571	0.6901	3.0244	
	3	0.75068	0.75392	0.78537	0.83632	3.1263	
	5	0.81892	0.7989	0.86505	0.88381	3.3667	
	7	0.81763	0.83387	0.76088	0.87504	3.2874	
	9	0.81814	0.83799	0.80709	0.83731	3.3005	
	10	0.819972	0.809374	0.814411	0.883428	3.32718	
	11	0.865884	0.891391	0.834039	0.878739	3.47005	
	15	0.853971	0.891015	0.823654	0.781252	3.34989	
	20	0.834101	0.836766	0.895305	0.808292	3.37446	
	25	0.857753	0.903787	0.805444	0.769942	3.33693	
	30	0.837737	0.868699	0.894366	0.804698	3.4055	3.47005
inp	=	1	2	5			
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi	MovingSpeedfth		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.66172	0.66109	0.76356	0.59007	2.6764	
	3	0.68263	0.70172	0.73211	0.59019	2.7067	
	5	0.74074	0.84519	0.91594	0.50025	3.0021	
	7	0.78412	0.78276	0.90027	0.50287	2.97	
	9	0.67856	0.673	0.89434	0.74221	2.9881	
	10	0.779053	0.798144	0.706819	0.768101	3.05212	
	11	0.716689	0.6841	0.824844	0.699304	2.92494	
	15	0.791785	0.825678	0.778839	0.651552	3.04785	

	20	0.835343	0.884459	0.786219	0.802551	3.30857	
	25	0.809316	0.831284	0.803975	0.78839	3.23297	
	30	0.824793	0.886978	0.714194	0.720047	3.14601	3.30857
inp	=	1	2	6			
				PeakDownPre			
--->	Input(s)	=	Depthfeet	ssurepsi	SpecificEnergyftlbft3		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.73439	0.71913	0.8256	0.71664	2.9958	
	3	0.76129	0.75813	0.75572	0.77222	3.0474	
	5	0.81772	0.83683	0.91509	0.69975	3.2694	
	7	0.86346	0.88856	0.90917	0.70591	3.3671	
	9	0.8782	0.90522	0.81991	0.81092	3.4142	
	10	0.868957	0.899626	0.768795	0.821216	3.35859	
	11	0.857839	0.905611	0.773596	0.854105	3.39115	
	15	0.908284	0.950484	0.788441	0.821692	3.4689	
	20	0.880208	0.898141	0.898853	0.719199	3.3964	
	25	0.877891	0.888356	0.891106	0.896152	3.55351	
	30	0.910207	0.955984	0.862248	0.728494	3.45693	3.55351
inp	=	1	3	4			
				RotationTorq			
--->	Input(s)	=	Depthfeet	uelbft	RotationSpeedrevmin		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.66009	0.61118	0.81296	0.66969	2.7539	
	3	0.80562	0.81078	0.85522	0.77603	3.2476	
	5	0.77352	0.80817	0.68018	0.76065	3.0225	
	7	0.8375	0.88019	0.88594	0.77233	3.3759	
	9	0.87452	0.91561	0.85851	0.78763	3.4363	
	10	0.896936	0.936197	0.90345	0.717316	3.4539	
	11	0.878528	0.866228	0.917493	0.941786	3.60404	
	15	0.907834	0.952413	0.906288	0.773374	3.53991	
	20	0.893351	0.971961	0.864343	0.807044	3.5367	
	25	0.889438	0.944908	0.855407	0.759186	3.44894	
	30	0.838659	0.887405	0.879521	0.866845	3.47243	3.60404
inp	=	1	3	5			
				RotationTorq			
--->	Input(s)	=	Depthfeet	uelbft	MovingSpeedfth		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.62832	0.60619	0.57971	0.77734	2.5916	
	3	0.66847	0.68762	0.83171	0.72233	2.9101	
	5	0.77876	0.8157	0.7595	0.64953	3.0035	
	7	0.72217	0.72159	0.75494	0.7464	2.9451	
	9	0.77172	0.91107	0.84113	0.34263	2.8666	
	10	0.765783	0.844447	0.764837	0.84138	3.21645	
	11	0.791891	0.829317	0.800418	0.707216	3.12884	
	15	0.827598	0.87085	0.793981	0.666271	3.1587	

	20	0.770618	0.813123	0.629285	0.866292	3.07932	
	25	0.903223	0.980587	0.775604	0.650625	3.31004	
	30	0.840705	0.873745	0.760043	0.801834	3.27633	3.31004
inp	=	1	3	6			
--->	Input(s)	=	Depthfeet	RotationTorq uelbft	SpecificEnergyftlbft3		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.7355	0.72417	0.78063	0.76025	3.0005	
	3	0.77889	0.76337	0.8581	0.85574	3.2561	
	5	0.90187	0.93304	0.84757	0.84833	3.5308	
	7	0.85832	0.88591	0.85939	0.83484	3.4385	
	9	0.83961	0.8878	0.85957	0.7448	3.3318	
	10	0.869427	0.908252	0.865608	0.709925	3.35321	
	11	0.8527	0.877781	0.911047	0.856392	3.49792	
	15	0.86734	0.845047	0.947005	0.81387	3.47326	
	20	0.860613	0.898564	0.876406	0.738081	3.37366	
	25	0.901227	0.937255	0.85093	0.796459	3.48587	
	30	0.906672	0.941736	0.914254	0.791521	3.55418	3.55418
inp	=	1	4	5			
--->	Input(s)	=	Depthfeet	RotationSpee drevmin	MovingSpeedfth		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.64584	0.60918	0.69054	0.88222	2.8278	
	3	0.69193	0.633	0.90325	0.78273	3.0109	
	5	0.81762	0.84335	0.83935	0.74304	3.2434	
	7	0.78457	0.80755	0.80044	0.75467	3.1472	
	9	0.77661	0.85675	0.91912	0.55651	3.109	
	10	0.902347	0.951044	0.898954	0.666478	3.41882	
	11	0.884273	0.948759	0.841895	0.755193	3.43012	
	15	0.82992	0.856429	0.798816	0.815415	3.30058	
	20	0.836023	0.899231	0.819154	0.766149	3.32056	
	25	0.88603	0.94851	0.64509	0.805292	3.28492	
	30	0.764312	0.912132	0.799058	0.743253	3.21876	3.43012
inp	=	1	4	6			
--->	Input(s)	=	Depthfeet	RotationSpee drevmin	SpecificEnergyftlbft3		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.69918	0.65765	0.68565	0.89018	2.9327	
	3	0.77156	0.78081	0.89102	0.70853	3.1519	
	5	0.80831	0.81136	0.82482	0.89234	3.3368	
	7	0.83729	0.8163	0.8918	0.8106	3.356	
	9	0.82846	0.87537	0.79528	0.77006	3.2692	
	10	0.866056	0.875038	0.906109	0.825706	3.47291	
	11	0.92986	0.954811	0.806829	0.927067	3.61857	
	15	0.859134	0.89501	0.816345	0.811945	3.38243	

	20	0.86053	0.855662	0.908671	0.859111	3.48397	
	25	0.877528	0.897673	0.86638	0.852559	3.49414	
	30	0.899803	0.931963	0.89665	0.886061	3.61448	3.61857
inp	=	1	5	6			
--->	Input(s)	=	Depthfeet	MovingSpeed fth	SpecificEnergyftlbft3		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.66742	0.63192	0.87539	0.59809	2.7728	
	3	0.67608	0.63237	0.69706	0.79653	2.802	
	5	0.73772	0.72183	0.8097	0.76022	3.0295	
	7	0.7868	0.88004	0.90122	0.4663	3.0344	
	9	0.72406	0.81674	0.59371	0.72413	2.8586	
	10	0.803753	0.855598	0.794847	0.720762	3.17496	
	11	0.860261	0.936851	0.752795	0.655263	3.20517	
	15	0.764242	0.902828	0.885044	0.506732	3.05885	
	20	0.882626	0.956499	0.874468	0.596249	3.30984	
	25	0.877493	0.917959	0.552882	0.871783	3.22012	
	30	0.88741	0.94766	0.665259	0.613755	3.11408	3.30984
inp	=	2	3	4			
--->	Input(s)	=	PeakDownPre ssurepsi	RotationTorq uelbft	RotationSpeedrevmin		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.7435	0.6962	0.75769	0.91503	3.1124	
	3	0.86724	0.87523	0.9574	0.7104	3.4103	
	5	0.8845	0.89064	0.85534	0.90189	3.5324	
	7	0.85048	0.85649	0.82906	0.86091	3.3969	
	9	0.78788	0.77583	0.83877	0.87	3.2725	
	10	0.841358	0.940294	0.896805	0.655554	3.33401	
	11	0.841685	0.857828	0.906951	0.709495	3.31596	
	15	0.834817	0.828316	0.823167	0.884514	3.37081	
	20	0.879542	0.954193	0.767875	0.825545	3.42715	
	25	0.880797	0.964379	0.8015	0.708142	3.35482	
	30	0.874251	0.900223	0.849942	0.821222	3.44564	3.5324
inp	=	2	3	5			
--->	Input(s)	=	PeakDownPre ssurepsi	RotationTorq uelbft	MovingSpeedfth		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.80623	0.78404	0.78215	0.94495	3.3174	
	3	0.86268	0.85895	0.92806	0.8143	3.464	
	5	0.84198	0.8739	0.80634	0.87817	3.4004	
	7	0.86325	0.82887	0.93576	0.87523	3.5031	
	9	0.84746	0.85292	0.75395	0.88916	3.3435	
	10	0.887069	0.905538	0.879973	0.876671	3.54925	
	11	0.852419	0.906591	0.854713	0.78241	3.39613	
	15	0.896241	0.904415	0.915013	0.890796	3.60647	

		20	0.878169	0.90639	0.945456	0.74495	3.47497	
		25	0.873359	0.948844	0.85761	0.770903	3.45072	
		30	0.857759	0.922864	0.838493	0.653795	3.27291	3.60647
inp	=		2	3	6			
--->	Input(s)	=		PeakDownPressurepsi	RotationTorquelbft	SpecificEnergyftlbft3		
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.7418	0.74115	0.72465	0.8098	3.0174	
		3	0.7421	0.71274	0.88308	0.76689	3.1048	
		5	0.79215	0.77836	0.90339	0.72836	3.2023	
		7	0.85489	0.85892	0.8723	0.8245	3.4106	
		9	0.89389	0.88166	0.92306	0.96048	3.6591	
		10	0.824444	0.926322	0.930964	0.671074	3.3528	
		11	0.883197	0.916573	0.923238	0.73397	3.45698	
		15	0.882916	0.913581	0.90282	0.763453	3.46277	
		20	0.919075	0.956314	0.885723	0.794485	3.5556	
		25	0.893407	0.912968	0.85784	0.884362	3.54858	
		30	0.91693	0.969288	0.829644	0.797678	3.51354	3.6591
inp	=		2	4	5			
--->	Input(s)	=		PeakDownPressurepsi	RotationSpeedrevmin	MovingSpeedfth		
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.60087	0.70225	0.75763	0.26437	2.3251	
		3	0.65228	0.74743	0.77977	0.34363	2.5231	
		5	0.68239	0.69067	0.79296	0.54572	2.7117	
		7	0.70999	0.78846	0.77542	0.58191	2.8558	
		9	0.67324	0.90206	0.8929	0.45778	2.926	
		10	0.758033	0.851941	0.811618	0.460666	2.88226	
		11	0.76423	0.908882	0.782536	0.354118	2.80977	
		15	0.771762	0.924489	0.849351	0.333645	2.87925	
		20	0.782814	0.861747	0.694283	0.425765	2.76461	
		25	0.786875	0.847779	0.666726	0.822953	3.12433	
		30	0.793295	0.876877	0.697916	0.631716	2.9998	3.12433
inp	=		2	4	6			
--->	Input(s)	=		PeakDownPressurepsi	RotationSpeedrevmin	SpecificEnergyftlbft3		
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.62798	0.54508	0.80997	0.80956	2.7926	
		3	0.67343	0.65354	0.68558	0.85197	2.8645	
		5	0.75272	0.74075	0.82532	0.82185	3.1406	
		7	0.82925	0.8401	0.90808	0.79381	3.3712	
		9	0.81029	0.89951	0.82185	0.59434	3.126	
		10	0.872757	0.914072	0.824959	0.702192	3.31398	
		11	0.811848	0.809236	0.800442	0.856853	3.27838	
		15	0.891027	0.912912	0.873609	0.839264	3.51681	

		20	0.859152	0.973337	0.885937	0.620031	3.33846	
		25	0.85497	0.893496	0.751631	0.847137	3.34723	
		30	0.878756	0.913392	0.828219	0.834629	3.455	3.51681
inp	=		2	5	6			
--->	Input(s)	=		PeakDownPressurepsi	MovingSpeedfth	SpecificEnergyftlbft3		
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.63083	0.62481	0.82122	0.76355	2.8404	
		3	0.63025	0.60224	0.69241	0.76551	2.6904	
		5	0.76046	0.83257	0.52841	0.71322	2.8347	
		7	0.80296	0.78504	0.81533	0.89435	3.2977	
		9	0.85903	0.86924	0.89654	0.72966	3.3545	
		10	0.770957	0.778783	0.878454	0.619822	3.04802	
		11	0.874337	0.895587	0.861897	0.821228	3.45305	
		15	0.704964	0.934465	0.786397	0.771418	3.19724	
		20	0.862927	0.94691	0.886327	0.666927	3.36309	
		25	0.875541	0.909997	0.782015	0.778867	3.34642	
		30	0.8934	0.961476	0.768665	0.853604	3.47714	3.47714
inp	=		3	4	5			
--->	Input(s)	=		RotationTorquelbft	RotationSpeedrevmin	MovingSpeedfth		
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.5183	0.4982	0.58309	0.61748	2.2171	
		3	0.59169	0.56849	0.80378	0.51585	2.4798	
		5	0.77874	0.83364	0.61417	0.71182	2.9384	
		7	0.7772	0.82332	0.84026	0.52104	2.9618	
		9	0.77616	0.85707	0.60823	0.634	2.8754	
		10	0.746236	0.796257	0.68172	0.579052	2.80326	
		11	0.647419	0.631217	0.749978	0.737624	2.76624	
		15	0.709168	0.748206	0.634276	0.764925	2.85658	
		20	0.713621	0.767475	0.513227	0.853685	2.84801	
		25	0.771339	0.823277	0.698068	0.760412	3.0531	
		30	0.782647	0.866377	0.869159	0.510056	3.02824	3.0531
inp	=		3	4	6			
--->	Input(s)	=		RotationTorquelbft	RotationSpeedrevmin	SpecificEnergyftlbft3		
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.7117	0.70569	0.84105	0.6958	2.9542	
		3	0.78899	0.76619	0.88753	0.85903	3.3017	
		5	0.84591	0.84614	0.901	0.82536	3.4184	
		7	0.88086	0.93435	0.73927	0.82347	3.378	
		9	0.90643	0.94055	0.92896	0.73658	3.5125	
		10	0.853035	0.878038	0.898886	0.804575	3.43453	
		11	0.900358	0.920039	0.942571	0.823171	3.58614	
		15	0.85397	0.899717	0.829196	0.89131	3.47419	

	20	0.896239	0.940795	0.836867	0.842193	3.51609	
	25	0.898521	0.93667	0.92117	0.7809	3.53726	
	30	0.898197	0.945054	0.873867	0.786812	3.50393	3.58614
inp	=	3	5	6			
--->	Input(s)	=	RotationTorquelbft	MovingSpeedfth	SpecificEnergyftlbft3		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.79051	0.82408	0.70954	0.73611	3.0602	
	3	0.78477	0.74886	0.9466	0.80419	3.2844	
	5	0.86251	0.9063	0.95649	0.63091	3.3562	
	7	0.84614	0.86793	0.90836	0.7572	3.3796	
	9	0.88453	0.94466	0.85052	0.60598	3.2857	
	10	0.834121	0.899419	0.788376	0.787746	3.30966	
	11	0.858242	0.928052	0.873815	0.682797	3.34291	
	15	0.884155	0.941789	0.913621	0.696025	3.43559	
	20	0.8001	0.808374	0.716074	0.827037	3.15158	
	25	0.745011	0.82572	0.900745	0.879542	3.35102	
	30	0.77063	0.986038	0.842785	0.553422	3.15288	3.43559
inp	=	4	5	6			
--->	Input(s)	=	RotationSpeedrevmin	MovingSpeedfth	SpecificEnergyftlbft3		
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.67869	0.63384	0.73593	0.82035	2.8688	
	3	0.68169	0.66555	0.89464	0.68843	2.9303	
	5	0.72246	0.67828	0.73365	0.88672	3.0211	
	7	0.77316	0.81158	0.8391	0.64633	3.0702	
	9	0.79016	0.84975	0.61328	0.58528	2.8385	
	10	0.81303	0.883639	0.891657	0.306725	2.89505	
	11	0.789509	0.849361	0.880209	0.568994	3.08807	
	15	0.805822	0.859541	0.791335	0.607283	3.06398	
	20	0.779703	0.848659	0.845829	0.529686	3.00388	
	25	0.806101	0.81443	0.656523	0.834354	3.11141	
	30	0.890274	0.9547	0.813454	0.552723	3.21115	3.21115
*******			COMBINATIO				
*****	NUMBER	OF	NS	=	4	************	
numIts	=	100					
inp	=	1	2	3	4		
--->	Input(s)	=	Depthfeet	PeakDownPressurepsi	RotationTorquelbft	RotationSpeedrevmin	
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.74072	0.70554	0.78098	0.8393	3.0665	
	3	0.89504	0.92046	0.88965	0.8206	3.5257	
	5	0.80398	0.77563	0.95987	0.78009	3.3196	
	7	0.85243	0.88466	0.85867	0.80074	3.3965	
	9	0.86	0.90351	0.86396	0.74592	3.3734	

		10	0.850134	0.87723	0.897366	0.738765	3.3635	
		11	0.872532	0.905241	0.836363	0.855981	3.47012	
		15	0.852086	0.858095	0.971968	0.772422	3.45457	
		20	0.87524	0.88963	0.948075	0.718156	3.4311	
		25	0.909567	0.988597	0.622954	0.857289	3.37841	
		30	0.922194	0.981562	0.877094	0.781206	3.56206	3.56206
inp	=		1	2	3	5		
					PeakDownPre	RotationTorq		
--->	Input(s)		=	Depthfeet	ssurepsi	uelbft	MovingSpeedfth	
	HL		no.	all	train	val	test	Sum
	-----		---	-----	---	----	---------	
BestR	=							
		2	0.86043	0.85213	0.82184	0.93938	3.4738	
		3	0.8757	0.91569	0.90557	0.83894	3.5359	
		5	0.88404	0.88927	0.9076	0.86537	3.5463	
		7	0.89139	0.90023	0.88323	0.88095	3.5558	
		9	0.88479	0.87227	0.86113	0.94196	3.5601	
		10	0.882492	0.894509	0.913846	0.87362	3.56447	
		11	0.899037	0.969424	0.852813	0.750853	3.47213	
		15	0.874894	0.912928	0.719385	0.882617	3.38982	
		20	0.873358	0.901341	0.824466	0.853227	3.45239	
		25	0.857763	0.895108	0.812827	0.810003	3.3757	
		30	0.920661	0.949375	0.860295	0.882871	3.6132	3.6132
inp	=		1	2	3	6		
					PeakDownPre	RotationTorq		
--->	Input(s)		=	Depthfeet	ssurepsi	uelbft	SpecificEnergyftlbft3	
	HL		no.	all	train	val	test	Sum
	-----		---	-----	---	----	---------	
BestR	=							
		2	0.78874	0.83396	0.5489	0.88887	3.0605	
		3	0.80337	0.79658	0.92347	0.70569	3.2291	
		5	0.83541	0.83079	0.88892	0.85502	3.4101	
		7	0.88081	0.92079	0.77087	0.80139	3.3739	
		9	0.89583	0.90517	0.94061	0.74672	3.4883	
		10	0.883194	0.916789	0.915909	0.775861	3.49175	
		11	0.840139	0.859279	0.778979	0.874895	3.35329	
		15	0.859553	0.887026	0.839645	0.890266	3.47649	
		20	0.866644	0.98031	0.873095	0.677934	3.39798	
		25	0.897659	0.944682	0.788423	0.815593	3.44636	
		30	0.90856	0.960482	0.876192	0.786964	3.5322	3.5322
inp	=		1	2	4	5		
					PeakDownPre	RotationSpee		
--->	Input(s)		=	Depthfeet	ssurepsi	drevmin	MovingSpeedfth	
	HL		no.	all	train	val	test	Sum
	-----		---	-----	---	----	---------	
BestR	=							
		2	0.66731	0.66004	0.83626	0.607	2.7706	
		3	0.71292	0.67523	0.87253	0.67225	2.9329	
		5	0.82475	0.83929	0.84255	0.67773	3.1843	
		7	0.90621	0.94322	0.83634	0.73102	3.4168	
		9	0.87204	0.92379	0.83831	0.64096	3.2751	

		10	0.862734	0.896602	0.864212	0.784163	3.40771	
		11	0.85712	0.90494	0.878045	0.712553	3.35266	
		15	0.880699	0.902211	0.904487	0.803626	3.49102	
		20	0.875384	0.951627	0.797333	0.779396	3.40374	
		25	0.86847	0.955233	0.923339	0.602645	3.34969	
		30	0.904113	0.957649	0.837684	0.594714	3.29416	3.49102
inp	=		1	2	4	6		
--->	Input(s)	=		Depthfeet	PeakDownPre ssurepsi	RotationSpee drevmin	SpecificEnergyftlbft3	
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.63777	0.54453	0.91853	0.88108	2.9819	
		3	0.78314	0.77066	0.74198	0.89227	3.188	
		5	0.81844	0.80448	0.81897	0.86658	3.3085	
		7	0.82643	0.82613	0.80543	0.90645	3.3644	
		9	0.85278	0.88827	0.77744	0.80559	3.3241	
		10	0.808319	0.783424	0.789623	0.926291	3.30766	
		11	0.869296	0.963627	0.87057	0.623246	3.32674	
		15	0.855676	0.87343	0.789591	0.879681	3.39838	
		20	0.855338	0.889591	0.905418	0.69191	3.34226	
		25	0.888583	0.926996	0.728313	0.885379	3.42927	
		30	0.82541	0.847425	0.736196	0.784045	3.19308	3.42927
inp	=		1	2	5	6		
--->	Input(s)	=		Depthfeet	PeakDownPre ssurepsi	MovingSpeed fth	SpecificEnergyftlbft3	
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.73369	0.81727	0.74033	0.66213	2.9534	
		3	0.7576	0.77394	0.76555	0.72391	3.021	
		5	0.81536	0.83108	0.77235	0.82991	3.2487	
		7	0.83013	0.89985	0.72429	0.75798	3.2122	
		9	0.77314	0.75558	0.8092	0.84779	3.1857	
		10	0.833361	0.856738	0.838397	0.886047	3.41454	
		11	0.807452	0.904841	0.857729	0.507047	3.07707	
		15	0.884107	0.930537	0.9243	0.703121	3.44207	
		20	0.843205	0.856726	0.882421	0.751022	3.33337	
		25	0.903069	0.958832	0.75373	0.852994	3.46862	
		30	0.869569	0.906606	0.902796	0.582062	3.26103	3.46862
inp	=		1	3	4	5		
--->	Input(s)	=		Depthfeet	RotationTorq uelbft	RotationSpee drevmin	MovingSpeedfth	
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.77249	0.7893	0.81796	0.64317	3.0229	
		3	0.6519	0.61729	0.69192	0.75182	2.7129	
		5	0.74621	0.71679	0.85738	0.77201	3.0924	
		7	0.87508	0.89983	0.92185	0.73354	3.4303	
		9	0.75908	0.77909	0.6632	0.79382	2.9952	

		10	0.828138	0.84333	0.777182	0.864601	3.31325	
		11	0.891724	0.929333	0.890173	0.796851	3.50808	
		15	0.832385	0.957922	0.887359	0.691414	3.36908	
		20	0.85628	0.866533	0.84478	0.90729	3.47488	
		25	0.853779	0.946691	0.827323	0.585339	3.21313	
		30	0.867166	0.948426	0.805078	0.588051	3.20872	3.50808
inp	=		1	3	4	6		
--->	Input(s)	=		Depthfeet	RotationTorquelbft	RotationSpeedrevmin	SpecificEnergyftlbft3	
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.76466	0.73248	0.84865	0.89047	3.2363	
		3	0.8468	0.86232	0.88907	0.76435	3.3625	
		5	0.84243	0.88196	0.81993	0.78296	3.3273	
		7	0.84799	0.84025	0.84515	0.89863	3.432	
		9	0.89113	0.9199	0.8666	0.79779	3.4754	
		10	0.937386	0.968843	0.930035	0.87261	3.70887	
		11	0.85834	0.896596	0.861869	0.755376	3.37218	
		15	0.905526	0.946975	0.688709	0.928966	3.47018	
		20	0.906993	0.984926	0.795605	0.71891	3.40643	
		25	0.895009	0.950887	0.883232	0.685726	3.41486	
		30	0.881062	0.987577	0.875687	0.678667	3.42299	3.70887
inp	=		1	3	5	6		
--->	Input(s)	=		Depthfeet	RotationTorquelbft	MovingSpeedfth	SpecificEnergyftlbft3	
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.80204	0.77236	0.80982	0.91045	3.2947	
		3	0.8228	0.79126	0.97709	0.76648	3.3576	
		5	0.85525	0.89766	0.94214	0.6708	3.3659	
		7	0.87495	0.92287	0.82924	0.7709	3.398	
		9	0.88287	0.90908	0.72575	0.83274	3.3504	
		10	0.835561	0.856732	0.94112	0.766312	3.39972	
		11	0.841691	0.84267	0.909998	0.842535	3.43689	
		15	0.869701	0.964784	0.895606	0.73233	3.46242	
		20	0.882494	0.93595	0.951041	0.683521	3.45301	
		25	0.864164	0.931443	0.703563	0.78598	3.28515	
		30	0.90436	0.975392	0.75827	0.765534	3.40356	3.46242
inp	=		1	4	5	6		
--->	Input(s)	=		Depthfeet	RotationSpeedrevmin	MovingSpeedfth	SpecificEnergyftlbft3	
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.68404	0.66944	0.86506	0.70991	2.9285	
		3	0.67675	0.6815	0.79876	0.86159	3.0186	
		5	0.80135	0.7944	0.84732	0.83251	3.2756	
		7	0.89395	0.93625	0.91007	0.69802	3.4383	
		9	0.85197	0.85939	0.9346	0.68588	3.3318	

		10	0.794341	0.951337	0.899475	0.589756	3.23491	
		11	0.807588	0.939405	0.795867	0.615234	3.15809	
		15	0.84209	0.942619	0.603567	0.749955	3.13823	
		20	0.849875	0.882139	0.796478	0.801469	3.32996	
		25	0.904847	0.973339	0.903203	0.704498	3.48589	
		30	0.820816	0.925094	0.910224	0.722049	3.37818	3.48589
inp	=		2	3	4	5		
--->	Input(s)	=		PeakDownPre ssurepsi	RotationTorq uelbft	RotationSpee drevmin	MovingSpeedfth	
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.83161	0.77336	0.9261	0.90699	3.4381	
		3	0.86499	0.8516	0.94675	0.82394	3.4873	
		5	0.82032	0.82335	0.91921	0.89167	3.4546	
		7	0.90334	0.94981	0.8415	0.80554	3.5002	
		9	0.8076	0.78744	0.88344	0.85768	3.3362	
		10	0.800775	0.776162	0.912513	0.890188	3.37964	
		11	0.819533	0.914822	0.734275	0.85137	3.32	
		15	0.826881	0.837574	0.836189	0.833469	3.33411	
		20	0.878364	0.938777	0.797552	0.822643	3.43734	
		25	0.923167	0.982306	0.725921	0.852171	3.48357	
		30	0.930077	0.973209	0.874572	0.704244	3.4821	3.5002
inp	=		2	3	4	6		
--->	Input(s)	=		PeakDownPre ssurepsi	RotationTorq uelbft	RotationSpee drevmin	SpecificEnergyftlbft3	
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.72291	0.69869	0.91568	0.75174	3.089	
		3	0.79884	0.85279	0.86248	0.66978	3.1839	
		5	0.80097	0.78988	0.91705	0.82075	3.3287	
		7	0.87857	0.92403	0.79852	0.84001	3.4411	
		9	0.88589	0.86614	0.96168	0.8889	3.6026	
		10	0.874901	0.8842	0.85661	0.827786	3.4435	
		11	0.858562	0.911488	0.771184	0.769038	3.31027	
		15	0.930301	0.970222	0.92948	0.788876	3.61888	
		20	0.858202	0.874103	0.78265	0.873801	3.38876	
		25	0.911241	0.958439	0.906448	0.735407	3.51154	
		30	0.862428	0.930714	0.676422	0.846243	3.31581	3.61888
inp	=		2	3	5	6		
--->	Input(s)	=		PeakDownPre ssurepsi	RotationTorq uelbft	MovingSpeed fth	SpecificEnergyftlbft3	
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.81925	0.83578	0.80767	0.77323	3.2359	
		3	0.86412	0.87181	0.93028	0.665	3.3312	
		5	0.80539	0.84228	0.72809	0.88743	3.2632	
		7	0.83658	0.84312	0.75631	0.87013	3.3061	
		9	0.9181	0.95447	0.92311	0.84717	3.6429	

		10	0.859153	0.90383	0.830177	0.768227	3.36139	
		11	0.84046	0.894363	0.829578	0.806531	3.37093	
		15	0.887767	0.934234	0.800429	0.83296	3.45539	
		20	0.868331	0.879362	0.914748	0.767206	3.42965	
		25	0.86276	0.908266	0.807692	0.844913	3.42363	
		30	0.905147	0.972121	0.796329	0.80879	3.48239	3.6429
inp	=		2	4	5	6		
--->	Input(s)	=		PeakDownPre ssurepsi	RotationSpee drevmin	MovingSpeed fth	SpecificEnergyftlbft3	
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.76602	0.73995	0.74904	0.93326	3.1883	
		3	0.75388	0.72295	0.81167	0.76798	3.0565	
		5	0.76396	0.73696	0.84988	0.81233	3.1631	
		7	0.78255	0.81198	0.86994	0.6125	3.077	
		9	0.72073	0.96077	0.73283	0.51792	2.9323	
		10	0.821976	0.919169	0.88833	0.392329	3.0218	
		11	0.718924	0.745235	0.656067	0.759641	2.87987	
		15	0.837438	0.899727	0.754866	0.723998	3.21603	
		20	0.74505	0.766407	0.806348	0.713782	3.03159	
		25	0.895356	0.951955	0.788417	0.754874	3.3906	
		30	0.808927	0.969998	0.76236	0.779557	3.32084	3.3906
inp	=		3	4	5	6		
--->	Input(s)	=		RotationTorq uelbft	RotationSpee drevmin	MovingSpeed fth	SpecificEnergyftlbft3	
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.73834	0.81778	0.92034	0.48848	2.9649	
		3	0.73681	0.69969	0.83701	0.85455	3.1281	
		5	0.86798	0.93518	0.85782	0.69317	3.3541	
		7	0.87161	0.94401	0.95458	0.72606	3.4963	
		9	0.92393	0.94189	0.88478	0.85618	3.6068	
		10	0.870752	0.895743	0.895078	0.780181	3.44175	
		11	0.906794	0.94787	0.740932	0.858863	3.45446	
		15	0.808734	0.926977	0.759275	0.685769	3.18075	
		20	0.824378	0.85735	0.750758	0.915813	3.3483	
		25	0.870144	0.945786	0.775239	0.771192	3.36236	
		30	0.836008	0.909511	0.885106	0.633447	3.26407	3.6068
******* *****	NUMBER	OF		COMBINATIO NS	=	5	************	
numIts	=		100					
inp	=		1	2	3	4	5	
--->	Input(s)	=		Depthfeet	PeakDownPre ssurepsi	RotationTorq uelbft	RotationSpee drevmin	MovingSpee dfth
	HL	no.		all	train	val	test	Sum
	-----	---		-----	---	----	---------	
BestR	=							
		2	0.8152	0.86297	0.88687	0.63441	3.1994	
		3	0.86672	0.85348	0.86834	0.90173	3.4903	

		5	0.88961	0.90208	0.88837	0.86124	3.5413	
		7	0.91381	0.91569	0.96147	0.83469	3.6257	
		9	0.87442	0.89192	0.8743	0.7983	3.4389	
		10	0.892551	0.888851	0.908767	0.945486	3.63565	
		11	0.878072	0.908928	0.888556	0.792025	3.46758	
		15	0.882183	0.961263	0.775329	0.821537	3.44031	
		20	0.899232	0.960568	0.808005	0.792336	3.46014	
		25	0.896261	0.946747	0.937865	0.755056	3.53593	
		30	0.917815	0.983215	0.818083	0.800829	3.51994	3.63565
inp	=		1	2	3	4	6	
--->	Input(s)		=	Depthfeet	PeakDownPressurepsi	RotationTorquelbft	RotationSpeedrevmin	SpecificEnergyftlbft3
	HL		no.	all	train	val	test	Sum
	-----		---	-----	---	----	---------	
BestR	=							
		2	0.76997	0.805	0.73133	0.79126	3.0976	
		3	0.87912	0.88933	0.87251	0.83241	3.4734	
		5	0.92627	0.94603	0.88295	0.90867	3.6639	
		7	0.87715	0.9333	0.86955	0.76645	3.4465	
		9	0.88003	0.95153	0.68059	0.85458	3.3667	
		10	0.888446	0.965152	0.910645	0.762277	3.52652	
		11	0.884401	0.920803	0.793251	0.882277	3.48073	
		15	0.843399	0.85269	0.887181	0.817572	3.40084	
		20	0.88584	0.92288	0.8284	0.82093	3.45805	
		25	0.832262	0.986111	0.940217	0.717773	3.47636	
		30	0.845327	0.932837	0.671539	0.802018	3.25172	3.6639
inp	=		1	2	3	5	6	
--->	Input(s)		=	Depthfeet	PeakDownPressurepsi	RotationTorquelbft	MovingSpeedfth	SpecificEnergyftlbft3
	HL		no.	all	train	val	test	Sum
	-----		---	-----	---	----	---------	
BestR	=							
		2	0.84876	0.87947	0.78136	0.82106	3.3306	
		3	0.82825	0.80309	0.93263	0.82422	3.3882	
		5	0.89672	0.94622	0.84668	0.7874	3.477	
		7	0.86121	0.84826	0.79511	0.9273	3.4319	
		9	0.89521	0.94649	0.85754	0.70184	3.4011	
		10	0.901507	0.938042	0.896027	0.746009	3.48159	
		11	0.902781	0.961773	0.79578	0.770136	3.43047	
		15	0.812557	0.823463	0.824573	0.767287	3.22788	
		20	0.860548	0.92854	0.823361	0.746991	3.35944	
		25	0.890348	0.941953	0.900287	0.663618	3.39621	
		30	0.901993	0.962903	0.86333	0.84754	3.57577	3.57577
inp	=		1	2	4	5	6	
--->	Input(s)		=	Depthfeet	PeakDownPressurepsi	RotationSpeedrevmin	MovingSpeedfth	SpecificEnergyftlbft3
	HL		no.	all	train	val	test	Sum
	-----		---	-----	---	----	---------	
BestR	=							
		2	0.7427	0.79416	0.75663	0.68946	2.983	
		3	0.70368	0.71143	0.90728	0.69154	3.0139	

	5	0.87669	0.87329	0.94672	0.82229	3.519	
	7	0.77509	0.76257	0.78044	0.81521	3.1333	
	9	0.84984	0.93873	0.78346	0.61451	3.1865	
	10	0.849223	0.924958	0.802769	0.700696	3.27765	
	11	0.858338	0.912063	0.825053	0.580327	3.17578	
	15	0.876832	0.941792	0.929703	0.584734	3.33306	
	20	0.912425	0.975415	0.921851	0.607349	3.41704	
	25	0.850124	0.857541	0.825917	0.838615	3.3722	
	30	0.850085	0.918991	0.752247	0.753806	3.27513	3.519
inp	=	1	3	4	5	6	
--->	Input(s)	=	Depthfeet	RotationTorq uelbft	RotationSpee drevmin	MovingSpeed fth	SpecificEner gyftlbft3
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.80186	0.84155	0.77499	0.71942	3.1378	
	3	0.82635	0.8287	0.81786	0.85286	3.3258	
	5	0.8253	0.84417	0.81712	0.76529	3.2519	
	7	0.89011	0.88396	0.87648	0.94675	3.5973	
	9	0.85602	0.86754	0.77462	0.90771	3.4059	
	10	0.871201	0.901812	0.744954	0.885616	3.40358	
	11	0.864712	0.94692	0.853427	0.737171	3.40223	
	15	0.867962	0.97108	0.886034	0.735551	3.46063	
	20	0.8654	0.913599	0.707275	0.880261	3.36654	
	25	0.861165	0.899846	0.830189	0.773168	3.36437	
	30	0.875949	0.944626	0.655796	0.822065	3.29844	3.5973
inp	=	2	3	4	5	6	
--->	Input(s)	=	PeakDownPre ssurepsi	RotationTorq uelbft	RotationSpee drevmin	MovingSpeed fth	SpecificEner gyftlbft3
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	
BestR	=						
	2	0.79726	0.79637	0.74512	0.85063	3.1894	
	3	0.80405	0.7862	0.88512	0.88332	3.3587	
	5	0.86202	0.85526	0.85985	0.92251	3.4996	
	7	0.86347	0.87473	0.90306	0.78205	3.4233	
	9	0.86293	0.87818	0.88011	0.82204	3.4433	
	10	0.868422	0.882771	0.820872	0.874665	3.44673	
	11	0.868728	0.909527	0.830291	0.80253	3.41108	
	15	0.835843	0.841065	0.868273	0.770837	3.31602	
	20	0.873703	0.945608	0.743933	0.825028	3.38827	
	25	0.905312	0.958272	0.901668	0.736992	3.50224	
	30	0.915715	0.990255	0.898819	0.795337	3.60013	3.60013
******* *****	NUMBER	OF	COMBINATIO NS	=	6	************	
numIts	=	100					
inp	=	1	2	3	4	5	
--->	Input(s)	=	Depthfeet	PeakDownPre ssurepsi	RotationTorq uelbft	RotationSpee drevmin	MovingSpee dfth
	HL	no.	all	train	val	test	Sum
	-----	---	-----	---	----	---------	

BestR	=						
		2	0.77424	0.74929	0.94908	0.8152	3.2878	
		3	0.87767	0.87969	0.88887	0.81786	3.4641	
		5	0.83976	0.84581	0.82412	0.84799	3.3577	
		7	0.87128	0.85947	0.89715	0.92192	3.5498	
		9	0.90469	0.94509	0.85129	0.84951	3.5506	
		10	0.858668	0.89719	0.833545	0.784883	3.37429	
		11	0.869531	0.967958	0.666544	0.884075	3.38811	
		15	0.918933	0.972699	0.884071	0.718561	3.49426	
		20	0.922017	0.976371	0.942641	0.873399	3.71443	
		25	0.854643	0.908254	0.855489	0.736894	3.35528	
		30	0.92268	0.98151	0.785374	0.830002	3.51957	3.71443
Elapsed	time	is	97.5264	minutes.			

Training	INPUTS:	1	2	3	4	5	6
Depthfeet	PeakDownPressurepsi	RotationTorquelbft	RotationSpeedrevmin	MovingSpeedfth	SpecificEnergyftlbft3		

Training	TARGETS:	9					
UnitWeightpcf						MAX	3.71673
