

## Supplementary information

### MODELING CREDIT APPROVAL DATA WITH NEURAL NETWORKS: AN EXPERIMENTAL INVESTIGATION AND OPTIMIZATION\*

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Table A1. Experimental results on the Australian credit database

No. of hidden neurons	SCM 40:60			SCM 50:50			SCM 90:10		
	Overall accuracy* (%)	Type-II Error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error
1	85.09	19.36	0.1652	86.73	16.37	0.1724	87.44	17.20	0.1594
2	83.19	21.56	0.1784	85.58	16.67	0.1885	84.68	16.24	0.1984
3	85.54	16.79	0.1589	83.78	17.37	0.1857	86.88	13.97	0.1657
4	83.63	20.92	0.1862	78.99	21.48	0.2756	82.74	18.71	0.2069
5	80.12	21.48	0.1942	85.75	15.92	0.1647	87.40	16.50	0.1836
6	80.00	29.48	0.2763	84.91	18.37	0.2061	87.21	15.93	0.1587
7	85.67	18.18	0.1539	84.34	20.00	0.2563	86.23	13.69	0.1752
8	84.24	21.09	0.1894	85.75	16.94	0.1789	86.29	12.74	0.1564
9	89.34	13.01	0.1468	86.81	16.30	0.1519	93.10	7.45	0.1341
10	90.86	9.56	0.1426	94.25	3.49	0.1352	89.57	13.33	0.1429
11	80.18	26.40	0.2528	83.06	20.93	0.2369	86.74	16.56	0.1867
12	85.13	22.15	0.2031	86.09	17.84	0.1486	80.31	17.02	0.1978
13	85.01	20.51	0.1917	84.86	16.13	0.1948	86.39	15.68	0.1743
14	86.38	18.12	0.1652	84.62	19.26	0.2162	87.71	12.73	0.1511
15	85.71	14.71	0.1763	86.49	18.58	0.1967	87.12	16.77	0.1966
16	85.06	20.44	0.1848	83.60	21.57	0.2660	87.98	13.02	0.1578
17	82.12	21.32	0.2093	85.31	18.54	0.2064	86.15	18.33	0.2185
18	82.41	25.95	0.1785	85.05	19.77	0.2282	86.31	13.59	0.1522
19	83.00	25.87	0.2458	83.68	20.75	0.2575	88.70	15.00	0.1764
20	85.12	20.65	0.1864	80.99	17.42	0.2141	86.55	14.74	0.1726
21	86.55	18.75	0.1698	84.67	16.30	0.1846	82.37	16.15	0.1954
22	85.15	18.18	0.2069	86.29	16.77	0.1538	77.81	11.96	0.2468

No. of hidden neurons	SCM 40:60			SCM 50:50			SCM 90:10		
	Overall accuracy* (%)	Type-II Error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error
23	87.32	19.33	0.1520	90.60	11.83	0.1459	89.47	13.75	0.1441
24	86.31	17.29	0.1642	84.17	20.69	0.2310	87.54	17.52	0.1897
25	83.75	20.77	0.2367	84.64	18.71	0.2019	88.15	15.41	0.1749
26	86.40	17.65	0.1658	85.86	14.02	0.1785	88.46	13.99	0.1658
27	86.10	17.86	0.1632	86.73	18.71	0.1915	86.01	17.82	0.1968
28	86.89	16.53	0.1911	86.40	15.19	0.1654	87.64	15.20	0.1694
29	84.44	20.13	0.2541	83.09	19.23	0.2152	87.82	16.83	0.1852
30	85.76	13.12	0.1563	81.34	24.54	0.2954	88.63	13.07	0.1513
31	86.25	16.78	0.1591	86.56	18.62	0.1987	88.09	14.13	0.1735
32	85.48	22.99	0.2432	86.14	19.58	0.2054	88.49	14.13	0.1767
33	86.16	20.00	0.2310	84.26	15.98	0.1786	87.71	13.79	0.1541
34	84.45	25.73	0.2937	84.26	17.90	0.1985	88.25	15.54	0.1984
35	85.63	22.46	0.2742	86.12	17.55	0.1889	87.40	14.84	0.2028
36	85.67	20.37	0.1986	83.95	18.13	0.2098	85.80	15.07	0.1829
37	80.66	23.49	0.2657	85.61	18.18	0.2163	88.62	13.76	0.1634
38	82.48	23.33	0.2469	84.00	19.65	0.2401	88.46	15.41	0.1886
39	84.86	22.01	0.1896	83.90	17.33	0.2059	76.94	26.63	0.3187
40	86.49	21.11	0.2284	85.68	14.20	0.1794	83.82	16.83	0.1857
41	85.63	22.92	0.2689	85.65	19.00	0.2156	87.89	14.77	0.1695
42	83.67	19.63	0.2154	85.15	19.00	0.2185	86.07	14.65	0.1720
43	85.92	19.75	0.1326	84.30	21.65	0.2569	87.23	17.49	0.2248
44	81.31	26.06	0.2812	83.41	19.62	0.2268	88.19	14.63	0.1863
45	84.93	22.08	0.2014	85.38	19.79	0.2296	88.48	14.33	0.1768
46	84.80	17.88	0.1858	84.35	20.71	0.2463	87.76	14.43	0.1781
47	85.49	17.14	0.2177	85.57	21.02	0.2325	85.67	10.20	0.1982
48	84.94	22.45	0.1968	83.46	20.96	0.2224	88.75	14.05	0.1869
49	86.30	19.44	0.1719	83.65	21.98	0.2473	86.45	14.08	0.2097
50	85.14	20.13	0.2389	84.02	19.19	0.2117	87.34	16.22	0.2154

\* Overall accuracy rate shows the average accuracy rates of training and testing datasets.

Table A2. Experimental results on the German credit database

No. of hidden neurons	SCM 40:60			SCM 50:50			SCM 90:10		
	Overall accuracy* (%)	Type-II Error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error
1	72.33	46.90	0.3157	70.92	50.60	0.3346	71.44	48.05	0.3264
2	73.62	42.79	0.2114	71.08	49.47	0.3154	68.68	63.33	0.4261
3	73.16	41.75	0.2203	71.23	48.86	0.3022	69.87	52.38	0.3658
4	72.28	43.10	0.2762	71.34	48.45	0.2864	70.05	66.67	0.4597
5	73.85	43.86	0.2631	71.02	49.76	0.2953	70.55	47.87	0.3187
6	73.74	43.75	0.2610	70.43	50.00	0.3279	70.22	45.00	0.2697
7	74.22	42.51	0.2524	70.61	51.05	0.3358	70.04	50.00	0.3358
8	72.06	45.11	0.2953	71.24	49.66	0.2957	71.43	43.43	0.1848
9	75.65	34.11	0.1384	73.36	44.00	0.1380	77.66	31.73	0.1427
10	77.58	31.52	0.1328	71.43	45.16	0.1479	79.00	30.53	0.1374
11	72.27	40.68	0.2051	71.24	49.13	0.2869	70.31	48.46	0.2495
12	73.35	40.95	0.2230	70.40	51.72	0.3285	71.33	46.94	0.2684
13	73.73	40.56	0.2264	70.01	51.43	0.3110	70.70	48.37	0.2891
14	73.30	42.17	0.2671	70.22	50.84	0.3354	69.78	51.20	0.3021
15	73.82	41.57	0.2303	70.27	52.59	0.3542	71.23	40.43	0.1880
16	72.91	40.68	0.1919	70.64	51.12	0.3014	71.19	48.40	0.2957
17	72.08	47.15	0.3261	69.56	55.46	0.3329	70.52	48.54	0.2981
18	72.64	44.00	0.2735	69.61	52.63	0.3150	70.71	42.86	0.2027
19	72.99	43.57	0.2651	71.33	49.75	0.2961	70.84	43.86	0.2157
20	72.12	44.44	0.2798	70.13	52.26	0.3215	71.30	44.64	0.2260
21	73.35	41.45	0.2130	71.28	48.07	0.2890	71.20	44.56	0.2361
22	72.41	44.34	0.2834	71.03	47.69	0.2781	71.29	46.67	0.2478
23	74.71	40.37	0.1441	73.96	41.57	0.1240	71.66	44.68	0.1456
24	73.62	40.17	0.1889	69.72	53.21	0.3367	70.81	47.15	0.2873
25	72.87	44.28	0.2469	71.41	47.87	0.2487	69.54	50.90	0.3159
26	73.21	44.51	0.2557	69.68	55.25	0.3697	67.70	57.58	0.3829
27	72.09	47.75	0.3353	69.28	53.43	0.3369	69.84	50.94	0.3277
28	72.98	42.37	0.2359	70.43	49.79	0.2891	71.03	44.63	0.1950
29	74.23	41.29	0.2218	70.98	49.14	0.2962	66.90	64.35	0.4268
30	74.65	42.60	0.2394	71.25	47.96	0.2651	71.19	44.32	0.2053
31	72.97	45.76	0.2841	70.25	51.83	0.3028	71.24	46.15	0.2139
32	73.80	43.45	0.2567	71.04	50.00	0.3219	71.53	44.44	0.1999

No. of hidden neurons	SCM 40:60			SCM 50:50			SCM 90:10		
	Overall accuracy* (%)	Type-II Error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error
33	73.32	40.71	0.1958	69.62	52.70	0.3691	69.64	55.88	0.3565
34	73.97	42.79	0.2390	70.30	48.56	0.2983	69.35	52.75	0.3210
35	74.10	39.49	0.1594	71.03	51.72	0.3320	71.30	45.73	0.2641
36	72.99	45.95	0.2258	70.20	51.72	0.3257	70.58	47.37	0.2850
37	74.46	40.44	0.2061	70.37	51.87	0.3124	70.84	44.19	0.1861
38	73.95	40.79	0.2127	69.58	54.82	0.3561	71.29	47.81	0.2257
39	74.60	41.12	0.2264	70.44	51.65	0.3121	71.30	47.39	0.2651
40	73.84	40.82	0.1988	70.03	52.73	0.3314	69.90	50.48	0.3098
41	73.87	43.28	0.2862	71.01	51.79	0.2963	71.33	46.39	0.2548
42	74.10	40.44	0.2089	69.19	53.13	0.3335	68.91	52.66	0.3369
43	74.48	42.53	0.2694	70.97	50.26	0.3128	71.63	44.00	0.1876
44	74.60	43.52	0.2631	69.32	52.66	0.3433	71.47	46.00	0.2250
45	73.09	41.88	0.2269	70.71	50.44	0.3027	70.38	49.30	0.2983
46	73.56	40.91	0.2198	70.50	51.30	0.3159	70.78	47.33	0.2957
47	74.33	38.71	0.1689	69.38	53.85	0.3467	70.78	48.54	0.2749
48	74.34	39.51	0.1830	68.32	56.03	0.3951	70.09	49.03	0.3108
49	72.40	40.59	0.2014	70.95	46.38	0.2863	71.06	48.21	0.2689
50	74.71	41.15	0.2231	71.41	49.53	0.2994	71.59	43.66	0.1944

\* Overall accuracy rate shows the average accuracy rates of training and testing datasets.

Table A3. Experimental results on the Japanese credit database

No. of hidden neurons	SCM 40:60			SCM 50:50			SCM 90:10		
	Overall accuracy* (%)	Type-II Error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error
1	86.63	10.11	0.1826	89.63	8.44	0.1511	86.20	14.17	0.2310
2	87.62	11.17	0.1887	87.12	8.37	0.1644	87.15	9.74	0.1757
3	87.46	10.35	0.1741	89.49	9.47	0.1836	86.86	10.12	0.1859
4	87.18	8.59	0.1592	88.53	9.71	0.1620	84.31	11.95	0.2046
5	87.72	8.50	0.1694	88.65	10.00	0.1462	83.86	14.49	0.2587
6	87.54	8.79	0.1837	87.65	10.53	0.1647	85.27	14.47	0.2154
7	87.57	5.81	0.1580	85.07	13.55	0.1701	86.94	11.96	0.1992
8	86.91	10.35	0.1929	86.71	11.58	0.1597	86.76	12.33	0.1759
9	89.94	5.77	0.1466	91.14	10.51	0.1529	88.00	9.94	0.1477
10	91.67	7.50	0.1412	91.38	7.63	0.1512	88.55	7.85	0.1458
11	87.20	12.06	0.2087	87.14	12.11	0.1823	85.85	13.98	0.2082
12	85.24	12.57	0.2149	88.78	10.43	0.1855	85.34	11.40	0.2039

No. of hidden neurons	SCM 40:60			SCM 50:50			SCM 90:10		
	Overall accuracy* (%)	Type-II Error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error
13	88.82	8.56	0.1498	88.35	9.21	0.1934	84.71	11.80	0.2181
14	85.59	12.70	0.1834	88.81	8.66	0.1827	83.51	17.27	0.2731
15	86.65	11.88	0.1752	87.53	10.30	0.1720	86.31	10.76	0.1993
16	87.61	12.44	0.2158	88.47	10.00	0.1928	86.57	11.81	0.1727
17	88.89	9.18	0.2031	87.73	10.42	0.2018	87.25	10.00	0.2047
18	83.59	13.40	0.2449	87.59	10.35	0.2133	86.66	11.30	0.1834
19	87.71	10.65	0.2031	88.34	11.39	0.2057	87.19	10.29	0.2150
20	88.04	10.84	0.1897	86.43	13.43	0.2210	85.87	11.53	0.2248
21	86.71	9.60	0.1883	87.78	10.20	0.1977	85.25	12.32	0.1839
22	87.09	12.30	0.2138	88.81	9.05	0.1754	86.85	11.27	0.1729
23	95.28	5.05	0.1405	89.87	5.56	0.1549	88.54	9.77	0.1443
24	87.89	10.42	0.1316	85.47	12.19	0.2134	77.66	23.76	0.3157
25	87.05	11.44	0.1419	88.84	10.26	0.2068	79.50	20.97	0.2759
26	87.84	10.77	0.1567	87.69	10.35	0.2259	86.09	12.05	0.2010
27	87.37	11.91	0.1962	89.47	8.58	0.1587	87.68	9.17	0.1679
28	87.23	12.18	0.2040	85.82	11.48	0.2359	86.82	9.12	0.1780
29	86.36	9.95	0.1510	89.29	8.77	0.1817	87.48	13.10	0.1824
30	89.02	9.33	0.1631	84.26	11.49	0.2294	86.23	10.63	0.1913
31	88.86	7.61	0.1974	89.31	8.23	0.1786	87.46	9.04	0.1548
32	88.42	9.09	0.2014	88.58	8.62	0.1894	85.78	10.44	0.1429
33	88.43	9.39	0.1737	87.44	11.67	0.1692	85.58	11.43	0.1618
34	87.68	12.69	0.1835	84.86	11.30	0.2011	86.13	12.12	0.2041
35	87.68	9.22	0.1547	88.72	7.55	0.1855	86.28	13.46	0.2186
36	88.08	8.42	0.1824	89.18	10.89	0.1638	86.88	10.99	0.1951
37	88.82	9.04	0.1720	89.41	8.48	0.1600	83.83	15.32	0.2475
38	89.61	10.78	0.2039	87.47	10.27	0.1840	87.44	10.41	0.1824
39	87.58	10.89	0.2157	88.46	9.46	0.1679	85.78	11.71	0.1933
40	87.46	8.70	0.2098	88.25	8.58	0.1587	86.93	8.36	0.1647
41	88.89	10.75	0.1931	84.86	16.42	0.2158	80.72	12.05	0.2139
42	88.44	8.90	0.1828	89.58	7.23	0.1581	87.56	9.30	0.1724
43	87.39	9.84	0.1479	88.40	10.33	0.1739	86.38	12.47	0.1847
44	89.49	8.47	0.1497	87.72	9.82	0.1840	84.24	12.64	0.1938
45	88.46	10.88	0.1848	88.52	10.59	0.1582	87.54	11.51	0.1722
46	87.92	9.38	0.1561	89.25	6.91	0.1351	86.09	10.96	0.1584
47	88.86	8.21	0.1795	87.59	11.45	0.1637	83.97	12.57	0.1892
48	89.29	11.05	0.1491	86.64	13.31	0.1873	84.16	14.60	0.2060
49	89.52	11.00	0.1469	85.58	9.52	0.2130	87.71	8.23	0.1738
50	89.23	6.40	0.1488	88.62	10.20	0.1754	87.24	10.06	0.1861

\* Overall accuracy rate shows the average accuracy rates of training and testing datasets.

Table A4. Experimental results on the Chinese credit database

No. of hidden neurons	SCM 40:60			SCM 50:50			SCM 90:10		
	Overall accuracy* (%)	Type-II Error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error
1	52.56	99.49	0.4431	50.15	98.62	0.5361	53.84	97.04	0.4127
2	53.77	98.85	0.4125	51.45	99.01	0.5302	55.15	98.47	0.4730
3	53.29	99.59	0.3698	49.57	98.70	0.6128	54.89	99.46	0.4454
4	53.44	97.41	0.3947	51.70	98.91	0.5531	57.15	99.59	0.5231
5	52.17	99.59	0.3862	51.95	98.74	0.5248	56.25	97.99	0.3860
6	53.47	98.91	0.3993	52.04	98.29	0.5001	58.23	98.28	0.3366
7	50.62	99.60	0.3736	52.27	99.73	0.4538	64.92	97.84	0.2931
8	51.35	98.45	0.2658	52.20	98.73	0.3957	63.83	97.75	0.2158
9	54.50	97.89	0.1789	69.67	95.97	0.1669	76.43	96.80	0.1547
10	59.07	98.53	0.1782	71.52	93.94	0.1642	78.83	95.29	0.1539
11	53.12	97.98	0.2384	52.06	99.09	0.4634	65.72	99.59	0.3235
12	52.13	98.32	0.2991	51.42	99.09	0.5106	64.92	98.72	0.3362
13	52.78	99.39	0.2671	51.48	99.54	0.5284	63.40	97.11	0.3850
14	50.51	97.06	0.3349	50.94	98.24	0.6137	64.07	97.35	0.3451
15	49.77	99.33	0.4265	49.70	98.70	0.6320	63.61	98.20	0.3924
16	53.45	97.43	0.3758	48.49	98.57	0.6653	65.33	97.82	0.4167
17	52.73	93.58	0.3816	50.07	97.57	0.6141	64.35	97.79	0.4468
18	51.65	98.82	0.3489	49.50	98.32	0.6137	63.61	99.13	0.4123
19	50.58	98.46	0.4160	48.97	99.65	0.6430	62.50	99.81	0.4830
20	54.23	99.57	0.3379	48.69	98.02	0.5826	62.68	99.33	0.3826
21	52.60	99.49	0.3918	49.60	98.64	0.5721	63.81	98.28	0.3150
22	53.15	99.37	0.2251	50.51	99.73	0.3953	64.59	98.15	0.3368
23	56.90	98.46	0.1785	52.43	96.16	0.1813	66.00	96.55	0.1687
24	50.53	98.16	0.2691	50.62	99.46	0.3834	64.98	97.74	0.2816
25	52.93	98.88	0.3557	50.08	98.80	0.3153	64.29	98.25	0.2904
26	53.33	97.96	0.3362	50.51	98.36	0.4629	63.64	98.48	0.3121
27	54.42	98.65	0.3694	49.35	98.62	0.6233	63.67	99.03	0.2953
28	51.30	98.63	0.4211	51.28	98.40	0.5136	65.52	99.39	0.2238
29	52.62	98.12	0.4226	49.72	98.63	0.5564	63.71	98.11	0.3260
30	51.30	98.27	0.4464	49.28	99.65	0.5622	62.92	99.52	0.3608
31	53.95	97.60	0.3567	50.48	99.65	0.5407	64.35	99.51	0.3334
32	50.58	98.47	0.4600	48.09	99.24	0.6079	62.45	99.72	0.3916
33	53.82	98.54	0.3720	49.46	98.79	0.5938	61.73	99.82	0.4121
34	53.55	99.16	0.3953	50.28	98.53	0.5731	62.65	99.62	0.4310
35	52.84	98.10	0.4186	48.15	98.66	0.6619	62.52	97.81	0.4409
36	52.52	98.59	0.4435	51.01	99.37	0.6010	61.18	98.23	0.4506
37	52.82	98.59	0.3953	49.83	98.19	0.6550	60.88	99.82	0.5007

No. of hidden neurons	SCM 40:60			SCM 50:50			SCM 90:10		
	Overall accuracy* (%)	Type-II Error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error
38	51.98	99.28	0.4729	49.49	99.13	0.6408	61.16	98.16	0.5137
39	52.51	99.19	0.5610	51.30	98.92	0.5473	60.79	98.22	0.4613
40	51.47	97.23	0.5583	48.50	98.79	0.6691	60.76	98.50	0.5433
41	53.44	97.98	0.4833	47.65	98.22	0.6734	60.05	99.47	0.5828
42	52.69	98.13	0.4917	50.23	99.12	0.6611	61.64	97.18	0.4873
43	52.74	98.75	0.5103	49.79	98.31	0.6832	60.54	99.82	0.5247
44	52.79	98.69	0.5561	48.19	98.27	0.5961	60.20	97.79	0.4563
45	53.26	98.40	0.5300	47.85	99.66	0.5549	60.79	97.91	0.4518
46	51.40	97.98	0.6428	49.72	98.53	0.4837	59.39	99.48	0.5834
47	53.69	99.57	0.5106	49.70	98.45	0.5536	58.54	98.24	0.5910
48	52.82	98.60	0.5068	51.46	98.39	0.5805	59.63	98.38	0.6008
49	49.58	99.33	0.6235	50.96	97.90	0.4723	58.83	98.02	0.5719
50	53.11	97.33	0.5620	49.63	98.51	0.7049	58.25	98.03	0.5950

\* Overall accuracy rate shows the average accuracy rates of training and testing datasets.

TableA5. Experimental results on the SPSS credit database

No. of hidden neurons	SCM 40:60			SCM 50:50			SCM 90:10		
	Overall accuracy* (%)	Type-II Error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error
1	77.60	40.63	0.1867	75.74	43.48	0.1937	72.71	53.24	0.2861
2	75.22	43.75	0.2152	74.65	40.00	0.1913	73.82	50.44	0.2753
3	78.31	50.00	0.2561	75.06	50.00	0.2394	73.22	52.89	0.2964
4	76.05	30.77	0.2130	73.98	45.83	0.2151	72.76	48.57	0.2767
5	75.97	41.03	0.2687	72.47	62.50	0.3283	73.68	50.68	0.2634
6	77.88	32.14	0.1948	75.64	43.33	0.2204	71.9	57.78	0.3200
7	73.68	42.11	0.2763	73.08	64.29	0.3567	70.50	59.06	0.3316
8	79.07	31.03	0.2001	74.78	49.44	0.2042	73.84	51.61	0.2768
9	91.22	8.24	0.1147	90.43	8.48	0.1264	88.29	9.14	0.1431
10	82.39	16.45	0.1492	75.88	24.11	0.1586	81.17	17.47	0.1537
11	77.46	36.11	0.2341	71.97	58.12	0.2958	73.68	52.78	0.2669
12	77.37	34.38	0.2319	73.49	68.42	0.3774	71.84	68.57	0.3767
13	72.01	59.09	0.2976	74.66	41.67	0.2367	73.90	50.00	0.2651
14	72.49	40.00	0.2854	75.58	22.73	0.1849	73.64	66.67	0.3724
15	76.37	19.00	0.1849	73.55	44.44	0.2560	70.62	67.93	0.3527

No. of hidden neurons	SCM 40:60			SCM 50:50			SCM 90:10		
	Overall accuracy* (%)	Type-II Error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error	Overall accuracy* (%)	Type-II error (%)	RMS error
16	75.34	33.33	0.1821	75.46	38.46	0.2389	73.80	53.33	0.2971
17	76.95	50.00	0.2794	74.16	53.85	0.2851	71.86	58.33	0.3159
18	75.74	35.14	0.2133	74.61	40.00	0.2418	72.82	53.38	0.2910
19	76.20	32.26	0.2287	74.60	36.67	0.1816	72.82	60.00	0.3616
20	77.64	29.17	0.1936	75.29	29.03	0.1958	73.72	51.16	0.2842
21	77.43	35.29	0.1882	73.71	45.00	0.2534	71.75	59.34	0.3363
22	75.28	44.00	0.2335	74.51	32.26	0.1829	73.78	51.27	0.2960
23	78.27	20.59	0.1654	76.23	23.30	0.1556	74.09	25.73	0.1681
24	77.35	20.69	0.1724	74.53	41.67	0.2305	73.97	50.00	0.2567
25	77.53	27.50	0.1887	75.06	41.18	0.2309	73.32	51.44	0.2530
26	76.08	33.33	0.2005	73.51	35.90	0.1957	72.40	59.65	0.2739
27	77.22	33.33	0.2141	74.44	25.00	0.1683	73.07	51.48	0.2458
28	76.15	40.00	0.2421	75.22	19.05	0.1609	73.20	54.32	0.2731
29	76.35	36.59	0.2039	74.08	66.67	0.3726	70.77	69.84	0.3929
30	78.15	22.73	0.1844	74.83	44.00	0.2549	73.15	50.47	0.2643
31	74.92	33.33	0.2019	73.12	29.41	0.2051	71.32	62.07	0.3534
32	77.65	40.00	0.2331	74.29	45.16	0.2694	72.95	60.00	0.3597
33	76.82	32.35	0.2110	75.58	26.67	0.2003	71.97	54.43	0.2819
34	75.37	22.22	0.2232	75.42	28.57	0.2158	70.19	62.50	0.3653
35	75.47	31.25	0.2408	74.27	41.94	0.2269	72.92	51.95	0.2717
36	78.20	27.78	0.2635	75.00	43.75	0.2407	71.84	57.65	0.2981
37	75.21	31.25	0.2851	74.02	34.29	0.1889	72.99	54.55	0.2563
38	77.40	33.33	0.2759	71.66	52.17	0.2818	70.94	57.25	0.2657
39	75.00	31.58	0.2232	73.84	49.55	0.2600	70.41	58.14	0.2928
40	78.02	32.50	0.2345	68.24	65.77	0.3871	70.15	61.96	0.3351
41	77.36	30.77	0.2021	71.80	51.43	0.2611	73.80	28.57	0.2241
42	77.22	29.03	0.2263	72.69	53.66	0.2743	73.91	50.58	0.2733
43	75.41	30.00	0.2451	74.60	30.00	0.2177	74.02	50.69	0.2667
44	78.15	10.98	0.1656	75.00	50.81	0.2738	74.01	33.33	0.1962
45	76.43	28.57	0.2330	70.26	67.24	0.3961	73.72	52.22	0.2710
46	76.62	33.80	0.2647	74.20	51.43	0.2863	73.45	52.58	0.2741
47	75.75	22.22	0.1930	72.43	55.36	0.3197	72.52	52.58	0.2654
48	73.87	40.00	0.2512	74.22	49.04	0.2638	72.34	55.24	0.2838
49	75.88	47.83	0.2682	74.87	36.48	0.2117	71.21	55.26	0.2693
50	77.19	38.46	0.2326	70.53	58.97	0.3333	73.65	52.08	0.2524

\* Overall accuracy rate shows the average accuracy rates of training and testing datasets.



Table B1. Results of Wilcoxon signed-ranks test for Australian database

SCM ratio (%)	Model X	Model Y	Overall accuracy		Type – I error		Type – II error	
			Improvement (%)	<i>p</i>	Improvement (%)	<i>p</i>	Improvement (%)	<i>p</i>
40:60	ANN – 2	ANN – 1	1.70	8.786E – 14**	– 45.33	3.572	– 7.80	2.067
		ANN – 3	4.04	3.726E – 19**	– 66.74	2.715E – 16**	50.56	8.205E – 20**
50:50	ANN – 2	ANN – 1	8.57	0.010**	32.67	1.085E – 20**	78.61	3.572E – 17**
		ANN – 3	4.04	2.935E – 17**	4.95	4.707E – 18**	70.51	1.205E – 13**
90:10	ANN – 1	ANN – 2	3.94	0.044*	18.78	9.198E – 24**	44.12	3.821E – 28**
		ANN – 3	4.07	1.787E – 7**	17.44	2.525E – 23**	45.82	3.821E – 28**

\* $\alpha = 0.05$ , \*\*  $\alpha = 0.01$ .

Table B2. Results of Wilcoxon signed-ranks test for German database

SCM ratio (%)	Model X	Model Y	Overall accuracy		Type – I error		Type – II error	
			Improvement (%)	<i>p</i>	Improvement (%)	<i>p</i>	Improvement (%)	<i>p</i>
40:60	ANN – 2	ANN – 1	2.54	2.759E – 22**	9.96	3.001E – 149**	7.60	1.923E – 43**
		ANN – 3	3.84	0.025*	1.46	4.532E – 13**	21.93	1.240E – 60**
50:50	ANN – 3	ANN – 1	0.82	7.670E – 8**	– 0.15	0.114	5.53	3.010E – 65**
		ANN – 2	3.55	1.920E – 25**	18.57	2.670E – 192**	7.96	9.148E – 38**
90:10	ANN – 2	ANN – 1	1.73	5.755E – 12**	8.39	5.577E – 131**	3.78	1.874E – 60**
		ANN – 3	10.24	3.459E – 6**	29.01	6.012E – 158**	31.67	3.807E – 59**

\* $\alpha = 0.05$ , \*\*  $\alpha = 0.01$ .

Table B3. Results of Wilcoxon signed-ranks test for Japanese database

SCM ratio (%)	Model X	Model Y	Overall accuracy		Type – I error		Type – II error	
			Improvement (%)	<i>p</i>	Improvement (%)	<i>p</i>	Improvement (%)	<i>p</i>
40:60	ANN – 3	ANN – 1	5.93	3.230E – 13**	73.40	1.577E – 14**	12.45	4.593E – 6**
		ANN – 2	3.94	5.166E – 11**	55.02	1.307E – 5**	32.66	9.634E – 7**
50:50	ANN – 2	ANN – 1	0.26	3.646E – 12**	– 56.36	0.205	27.40	3.948E – 21**
		ANN – 3	1.68	1.855E – 13**	34.44	1.085E – 20**	– 37.29	0.358
90:10	ANN – 2	ANN – 1	0.62	8.675E – 14**	– 7.85	0.012*	21.06	1.394E – 28**
		ANN – 3	0.01	0.845	– 15.33	0.475	19.67	3.821E – 28**

\* $\alpha = 0.05$ , \*\*  $\alpha = 0.01$ .

Table B4. Results of Wilcoxon signed-ranks test for Chinese database

SCM ratio (%)	Model X	Model Y	Overall accuracy		Type – I error		Type – II error	
			Improvement (%)	<i>p</i>	Improvement (%)	<i>p</i>	Improvement (%)	<i>p</i>
40:60	ANN – 2	ANN – 1	8.38	2.259E – 4**	– 72.66	0.000**	– 0.66	2.525E – 23**
		ANN – 3	3.82	0.037*	– 10.23	1.629E – 227**	– 0.07	0.635
50:50	ANN – 2	ANN – 1	2.64	4.503E – 8**	73.88	1.437E – 21**	2.11	0.751
		ANN – 3	36.39	4.351E – 46**	69.85	4.358E – 14**	3.31	0.357
90:10	ANN – 2	ANN – 1	3.15	1.338E – 6**	– 71.31	0.211	1.56	0.000**
		ANN – 3	19.44	1.086E – 16**	– 23.15	0.205	1.31	0.167

\* $\alpha = 0.05$ , \*\*  $\alpha = 0.01$ .

Table B5. Results of Wilcoxon signed-ranks test for SPSS database

SCM ratio (%)	Model X	Model Y	Overall accuracy		Type – I error		Type – II error	
			Improvement (%)	<i>p</i>	Improvement (%)	<i>p</i>	Improvement (%)	<i>p</i>
40:60	ANN – 2	ANN – 1	8.38	2.259E – 4**	– 72.66	0.000**	– 0.66	2.525E – 23**
		ANN – 3	16.54	1.192E – 4**	67.57	3.297E – 9**	59.96	4.475E – 39**
50:50	ANN – 1	ANN – 2	19.18	3.323E – 7**	45.45	2.035E – 7**	64.80	6.870E – 61**
		ANN – 3	18.62	4.029E – 11**	81.82	7.738E – 8**	63.59	1.039E – 58**
90:10	ANN – 1	ANN – 2	8.76	0.008**	22.20	7.870E – 27**	47.66	8.212E – 65**
		ANN – 3	19.16	3.719E – 9**	52.41	2.715E – 16**	64.46	2.682E – 95**

\* $\alpha = 0.05$ , \*\*  $\alpha = 0.01$ .