Diane Nguyen
MSBA 645
Class Assignment 7
4/16/19

- **Part 1. Complete the given Excel spreadsheet to simulate the training process until the classification improves. You don't have to but if you continue you will achieve 100% accuracy.**

	years	salary	Target	normyears	normsalary		Initial Weigt for Years	Initial Weight for Salary	Theta	Learning Rate
1	4	43	0	-0.5500567	-1.2402159		0.05	0.01	-0.03	0.1
2	18	65	1	1.458846	-0.4134053					
3	1	53	0	-0.9805358	-0.8643929					
4	3	95	0	-0.6935497	0.71406373					
5	15	88	1	1.0283668	0.45098762					
6	6	112	1	-0.2630706	1.35296285					
mean	7.833333333	76								
std dev	6.968978883	26.60826939								

Epoch1

	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.05	0.01	-0.03	0.4825309	-0.1204855	0	0	0.037951454	-0.002048546	-0.042048546
2	0.037951454	-0.002048546	-0.042048546	0.5035409	0.12410856	1	1	0.05036231	0.01036231	-0.02963769
3	0.05036231	0.01036231	-0.02963769	0.47802	-0.119274	0	0	0.038434905	-0.001565095	-0.041565095
4	0.038434905	-0.001565095	-0.041565095	0.4826721	-0.1205231	0	0	0.026382594	-0.013617406	-0.053617406
5	0.026382594	-0.013617406	-0.053617406	0.4918438	0.12700525	0	1	0.039083119	-0.000916881	-0.040916881
6	0.039083119	-0.000916881	-0.040916881	0.4868933	0.12818854	0	1	0.051901973	0.011901973	-0.028098027

Epoch2

	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.051901973	0.011901973	-0.028098027	0.4821556	-0.1203854	0	0	0.039863437	-0.000136563	-0.040136563
2	0.039863437	-0.000136563	-0.040136563	0.5045185	0.12386026	1	1	0.052249462	0.012249462	-0.027750538
3	0.052249462	0.012249462	-0.027750538	0.4776221	-0.1191664	0	0	0.040332827	0.000332827	-0.039667173
4	0.040332827	0.000332827	-0.039667173	0.4831558	-0.1206519	0	0	0.028267641	-0.011732359	-0.051732359
5	0.028267641	-0.011732359	-0.051732359	0.493012	0.12672225	0	1	0.040939866	0.000939866	-0.039060134
6	0.040939866	0.000939866	-0.039060134	0.4878627	0.12795887	0	1	0.053735753	0.013735753	-0.026264247

Epoch3

	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.053735753	0.013735753	-0.026264247	0.4817937	-0.1202887	0	0	0.04170688	0.00170688	-0.03829312
2	0.04170688	0.00170688	-0.03829312	0.5054611	0.12361998	1	1	0.054068878	0.014068878	-0.025931122
3	0.054068878	0.014068878	-0.025931122	0.4772386	-0.1190624	0	0	0.042162638	0.002162638	-0.037837362
4	0.042162638	0.002162638	-0.037837362	0.4836221	-0.1207758	0	0	0.030085058	-0.009914942	-0.049914942
5	0.030085058	-0.009914942	-0.049914942	0.4941383	0.12644805	0	1	0.042729863	0.002729863	-0.037270137
6	0.042729863	0.002729863	-0.037270137	0.4887974	0.12773648	0	1	0.055503511	0.015503511	-0.024496489

Epoch4

	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.055503511	0.015503511	-0.024496489	0.481445	-0.1201955	0	0	0.043483963	0.003483963	-0.036516037
2	0.043483963	0.003483963	-0.036516037	0.5063697	0.12338755	1	1	0.055822718	0.015822718	-0.024177282
3	0.055822718	0.015822718	-0.024177282	0.4768689	-0.1189621	0	0	0.043926511	0.003926511	-0.036073489
4	0.043926511	0.003926511	-0.036073489	0.4840717	-0.1208951	0	0	0.031837001	-0.008162999	-0.048162999
5	0.031837001	-0.008162999	-0.048162999	0.4952241	0.12618247	0	1	0.044455248	0.004455248	-0.035544752
6	0.044455248	0.004455248	-0.035544752	0.4896985	0.12752122	0	1	0.05720737	0.01720737	-0.02279263

Epoch5

	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.05720737	0.01720737	-0.02279263	0.4811088	-0.1201055	0	0	0.045196819	0.005196819	-0.034803181
2	0.045196819	0.005196819	-0.034803181	0.5072454	0.12316278	1	1	0.057513098	0.017513098	-0.022486902
3	0.057513098	0.017513098	-0.022486902	0.4765126	-0.1188653	0	0	0.04562657	0.00562657	-0.03437343
4	0.04562657	0.00562657	-0.03437343	0.484505	-0.1210099	0	0	0.033525578	-0.006474422	-0.046474422
5	0.033525578	-0.006474422	-0.046474422	0.4962706	0.12592533	0	1	0.046118112	0.006118112	-0.033881888
6	0.046118112	0.006118112	-0.033881888	0.490567	0.12731293	0	1	0.058849405	0.018849405	-0.021150595

Epoch6

	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.058849405	0.018849405	-0.021150595	0.4807849	-0.1200187	0	0	0.046847535	0.006847535	-0.033152465
2	0.046847535	0.006847535	-0.033152465	0.5080893	0.12294548	1	1	0.059142083	0.019142083	-0.020857917
3	0.059142083	0.019142083	-0.020857917	0.4761693	-0.1187719	0	0	0.047264893	0.007264893	-0.032735107
4	0.047264893	0.007264893	-0.032735107	0.4849226	-0.1211204	0	0	0.035152852	-0.004847148	-0.044847148
5	0.035152852	-0.004847148	-0.044847148	0.4972792	0.12567647	0	1	0.047720499	0.007720499	-0.032279501
6	0.047720499	0.007720499	-0.032279501	0.4914039	0.12711144	0	1	0.060431644	0.020431644	-0.019568356

Epoch7	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.060431644	0.020431644	-0.019568356	0.4804727	-0.119935	0	0	0.048438147	0.008438147	-0.031561853
2	0.048438147	0.008438147	-0.031561853	0.5089025	0.12273547	1	1	0.060711693	0.020711693	-0.019288307
3	0.060711693	0.020711693	-0.019288307	0.4758385	-0.1186818	0	0	0.048843509	0.008843509	-0.031156491
4	0.048843509	0.008843509	-0.031156491	0.485325	-0.1212267	0	0	0.036720837	-0.003279163	-0.043279163
5	0.036720837	-0.003279163	-0.043279163	0.4982511	0.12543568	0	1	0.049264406	0.009264406	-0.030735594
6	0.049264406	0.009264406	-0.030735594	0.4922103	0.12691661	0	1	0.061956066	0.021956066	-0.018043934

Epoch8	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.061956066	0.021956066	-0.018043934	0.480172	-0.1198542	0	0	0.049970644	0.009970644	-0.030029356
2	0.049970644	0.009970644	-0.030029356	0.5096858	0.12253254	1	1	0.062223898	0.022223898	-0.017776102
3	0.062223898	0.022223898	-0.017776102	0.4755198	-0.118595	0	0	0.050364399	0.010364399	-0.029635601
4	0.050364399	0.010364399	-0.029635601	0.4857126	-0.121329	0	0	0.038231498	-0.001768502	-0.041768502
5	0.038231498	-0.001768502	-0.041768502	0.4991875	0.1252028	0	1	0.050751777	0.010751777	-0.029248223
6	0.050751777	0.010751777	-0.029248223	0.4929873	0.12672825	0	1	0.063424602	0.023424602	-0.016575398

Epoch9	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.063424602	0.023424602	-0.016575398	0.4798823	-0.1197764	0	0	0.051446966	0.011446966	-0.028553034
2	0.051446966	0.011446966	-0.028553034	0.5104405	0.12233652	1	1	0.063680618	0.023680618	-0.016319382
3	0.063680618	0.023680618	-0.016319382	0.4752129	-0.1185112	0	0	0.051829493	0.011829493	-0.028170507
4	0.051829493	0.011829493	-0.028170507	0.4860861	-0.1214274	0	0	0.03968675	-0.00031325	-0.04031325
5	0.03968675	-0.00031325	-0.04031325	0.5000895	0.12497762	1	1	0.052184512	0.012184512	-0.027815488
6	0.052184512	0.012184512	-0.027815488	0.4937357	0.12654621	0	1	0.064839133	0.024839133	-0.015160867

Epoch10	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.064839133	0.024839133	-0.015160867	0.4796033	-0.1197013	0	0	0.052869002	0.012869002	-0.027130998
2	0.052869002	0.012869002	-0.027130998	0.5111673	0.12214721	1	1	0.065083723	0.025083723	-0.014916277
3	0.065083723	0.025083723	-0.014916277	0.4749172	-0.1184305	0	0	0.053240672	0.013240672	-0.026759328
4	0.053240672	0.013240672	-0.026759328	0.4864459	-0.1215221	0	0	0.041088461	0.001088461	-0.038911539
5	0.041088461	0.001088461	-0.038911539	0.5009583	0.12475996	1	1	0.053564457	0.013564457	-0.026435543
6	0.053564457	0.013564457	-0.026435543	0.4944566	0.12637032	0	1	0.066201489	0.026201489	-0.013798511

Epoch11	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.066201489	0.026201489	-0.013798511	0.4793346	-0.119629	0	0	0.054238593	0.014238593	-0.025761407
2	0.054238593	0.014238593	-0.025761407	0.5118673	0.12196444	1	1	0.066435037	0.026435037	-0.013564963
3	0.066435037	0.026435037	-0.013564963	0.4746325	-0.1183527	0	0	0.054599767	0.014599767	-0.025400233
4	0.054599767	0.014599767	-0.025400233	0.4867924	-0.1216132	0	0	0.042438449	0.002438449	-0.037561551
5	0.042438449	0.002438449	-0.037561551	0.5017951	0.12454962	1	1	0.054893411	0.014893411	-0.025106589
6	0.054893411	0.014893411	-0.025106589	0.4951509	0.12620042	0	1	0.067513452	0.027513452	-0.012486548

Epoch12	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.067513452	0.027513452	-0.012486548	0.4790759	-0.1195592	0	0	0.05555753	0.01555753	-0.02444247
2	0.05555753	0.01555753	-0.02444247	0.5141481	0.12136573	1	1	0.067694103	0.027694103	-0.012305897
3	0.067694103	0.027694103	-0.012305897	0.4743672	-0.1182801	0	0	0.05586609	0.01586609	-0.02413391
4	0.05586609	0.01586609	-0.02413391	0.4871152	-0.1216979	0	0	0.043696296	0.003696296	-0.036303704
5	0.043696296	0.003696296	-0.036303704	0.5025748	0.12435301	1	1	0.056131597	0.016131597	-0.023868403
6	0.056131597	0.016131597	-0.023868403	0.4957977	0.12604167	0	1	0.068735764	0.028735764	-0.011264236

Epoch13	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.068735764	0.028735764	-0.011264236	0.4788348	-0.1194942	0	0	0.056786343	0.016786343	-0.023213657
2	0.056786343	0.016786343	-0.023213657	0.5131693	0.12162325	1	1	0.068948668	0.028948668	-0.011051332
3	0.068948668	0.028948668	-0.011051332	0.4741029	-0.1182078	0	0	0.057127891	0.017127891	-0.022872109
4	0.057127891	0.017127891	-0.022872109	0.487437	-0.1217823	0	0	0.04494966	0.00494966	-0.03505034
5	0.04494966	0.00494966	-0.03505034	0.5033516	0.12415652	1	1	0.057365312	0.017365312	-0.022634688
6	0.057365312	0.017365312	-0.022634688	0.4964423	0.12588306	0	1	0.069953618	0.029953618	-0.010046382

Epoch14	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.069953618	0.029953618	-0.010046382	0.4785946	-0.1194294	0	0	0.05801068	0.01801068	-0.02198932
2	0.05801068	0.01801068	-0.02198932	0.5137949	0.12145875	1	1	0.070156555	0.030156555	-0.009843445
3	0.070156555	0.030156555	-0.009843445	0.4738485	-0.1181381	0	0	0.05834275	0.01834275	-0.02165725
4	0.05834275	0.01834275	-0.02165725	0.4877467	-0.1218634	0	0	0.046156405	0.006156405	-0.033843595
5	0.046156405	0.006156405	-0.033843595	0.5040996	0.12396678	1	1	0.058553083	0.018553083	-0.021446917
6	0.058553083	0.018553083	-0.021446917	0.4970628	0.12572996	0	1	0.071126078	0.031126078	-0.008873922

Epoch15	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.071126078	0.031126078	-0.008873922	0.4783634	-0.1193669	0	0	0.059189387	0.019189387	-0.020810613
2	0.059189387	0.019189387	-0.020810613	0.5143972	0.12130005	1	1	0.071319392	0.031319392	-0.008680608
3	0.071319392	0.031319392	-0.008680608	0.4736035	-0.1180709	0	0	0.059512303	0.019512303	-0.020487697
4	0.059512303	0.019512303	-0.020487697	0.4880449	-0.1219415	0	0	0.047318155	0.007318155	-0.032681845
5	0.047318155	0.007318155	-0.032681845	0.5048196	0.1237836	1	1	0.059696515	0.019696515	-0.020303485
6	0.059696515	0.019696515	-0.020303485	0.4976602	0.1255822	0	1	0.072254735	0.032254735	-0.007745265

Epoch16	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.072254735	0.032254735	-0.007745265	0.4781409	-0.1193068	0	0	0.06032406	0.02032406	-0.01967594
2	0.06032406	0.02032406	-0.01967594	0.5149769	0.12114698	1	1	0.072438758	0.032438758	-0.007561242
3	0.072438758	0.032438758	-0.007561242	0.4733678	-0.1180062	0	0	0.060638139	0.020638139	-0.019361861
4	0.060638139	0.020638139	-0.019361861	0.488332	-0.1220165	0	0	0.048436487	0.008436487	-0.031563513
5	0.048436487	0.008436487	-0.031563513	0.4992227	0.12519403	0	1	0.06095589	0.02095589	-0.01904411
6	0.06095589	0.02095589	-0.01904411	0.4983182	0.12541903	0	1	0.073497793	0.033497793	-0.006502207

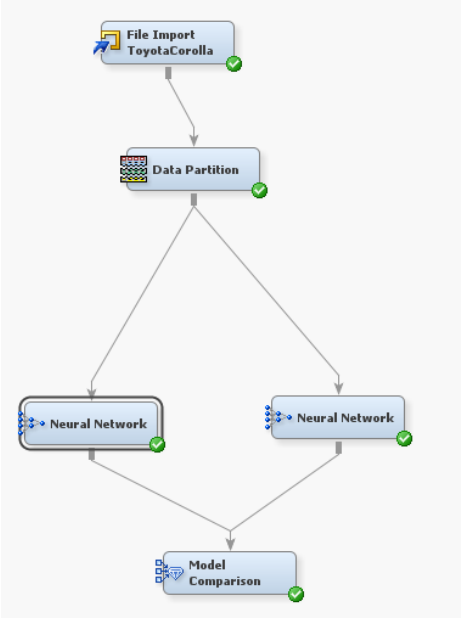
Epoch17	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.073497793	0.033497793	-0.006502207	0.4778958	-0.1192404	0	0	0.06157375	0.02157375	-0.01842625
2	0.06157375	0.02157375	-0.01842625	0.5156153	0.12097805	1	1	0.073671555	0.033671555	-0.006328445
3	0.073671555	0.033671555	-0.006328445	0.4731081	-0.1179349	0	0	0.061878066	0.021878066	-0.018121934
4	0.061878066	0.021878066	-0.018121934	0.4886482	-0.1220991	0	0	0.049668159	0.009668159	-0.030331841
5	0.049668159	0.009668159	-0.030331841	0.506276	0.12341154	1	1	0.062009313	0.022009313	-0.017990687
6	0.062009313	0.022009313	-0.017990687	0.4988686	0.12528222	0	1	0.074537535	0.034537535	-0.005462465

Epoch18	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.074537535	0.034537535	-0.005462465	0.4776907	-0.1191849	0	0	0.062619041	0.022619041	-0.017380959
2	0.062619041	0.022619041	-0.017380959	0.5161493	0.12083648	1	1	0.07470269	0.03470269	-0.00529731
3	0.07470269	0.03470269	-0.00529731	0.4728909	-0.1178752	0	0	0.062915169	0.022915169	-0.017084831
4	0.062915169	0.022915169	-0.017084831	0.4889126	-0.1221681	0	0	0.050698364	0.010698364	-0.029301636
5	0.050698364	0.010698364	-0.029301636	0.5069145	0.1232478	1	1	0.063023144	0.023023144	-0.016976856
6	0.063023144	0.023023144	-0.016976856	0.4993983	0.12515025	0	1	0.075538169	0.035538169	-0.004461831

Epoch19	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.075538169	0.035538169	-0.004461831	0.4774934	-0.1191315	0	0	0.06362502	0.02362502	-0.01637498
2	0.06362502	0.02362502	-0.01637498	0.5166632	0.1207	1	1	0.07569502	0.03569502	-0.00430498
3	0.07569502	0.03569502	-0.00430498	0.4726819	-0.1178177	0	0	0.063913247	0.023913247	-0.016086753
4	0.063913247	0.023913247	-0.016086753	0.4891671	-0.1222344	0	0	0.051689809	0.011689809	-0.028310191
5	0.051689809	0.011689809	-0.028310191	0.5075289	0.12308986	1	1	0.063998795	0.023998795	-0.016001205
6	0.063998795	0.023998795	-0.016001205	0.499908	0.12502299	0	1	0.076501094	0.036501094	-0.003498906

Epoch20	WeightYears	WeightSalary	Theta	Output	Error	Predicted	Actual	new_WeightYears	new_WeightSalary	new_Theta
1	0.076501094	0.036501094	-0.003498906	0.4773036	-0.11908	0	0	0.064593092	0.024593092	-0.015406908
2	0.064593092	0.024593092	-0.015406908	0.5171576	0.12056845	1	1	0.076649936	0.036649936	-0.003350064
3	0.076649936	0.036649936	-0.003350064	0.4724808	-0.1177624	0	0	0.064873697	0.024873697	-0.015126303
4	0.064873697	0.024873697	-0.015126303	0.4894121	-0.1222982	0	0	0.052643881	0.012643881	-0.027356119
5	0.052643881	0.012643881	-0.027356119	0.5081201	0.12293754	1	1	0.064937635	0.024937635	-0.015062365
6	0.064937635	0.024937635	-0.015062365	0.5003985	0.12490029	1	1	0.077427664	0.037427664	-0.002572336

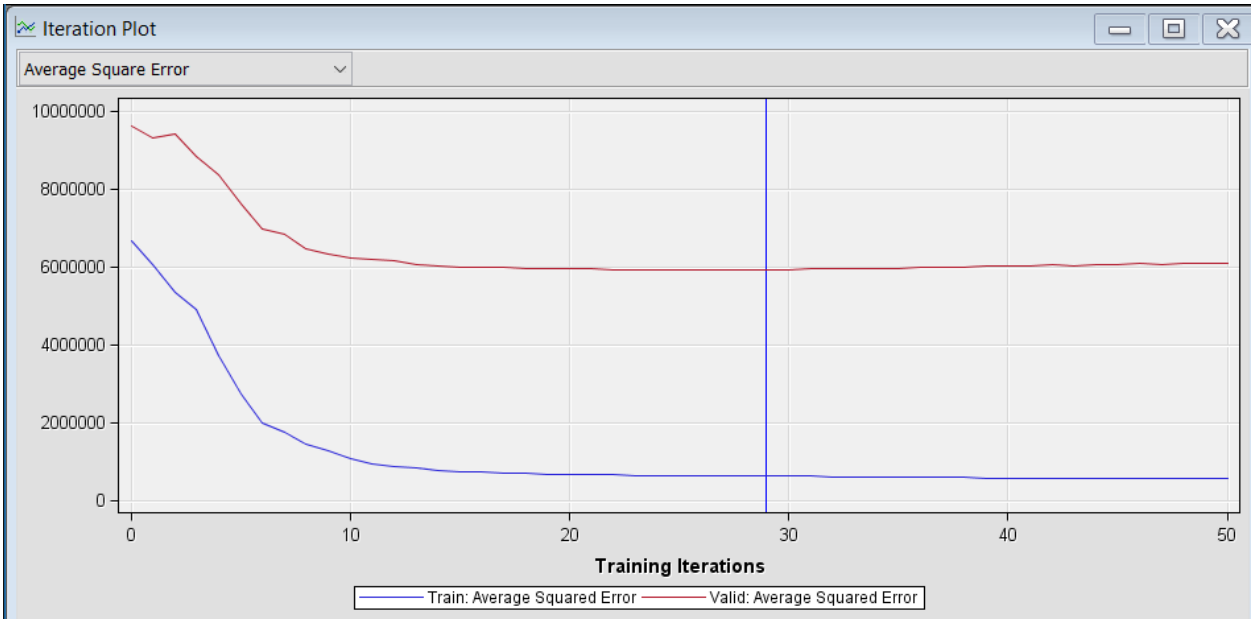
- **Part 2. Develop a neural network to predict the price of a used Corolla using the Excel file from a previous assignment. Create a two-layered network with one hidden layer. Use three units in the hidden layer. For the hidden use the linear combination function and hyperbolic tangent as the activation function. For the output layer use the exponential activation function and Poisson error function. Use Average Error as the model selection criterion. Answer the following questions:**



- **Turn in the Iteration Plot. What is the number of iterations? Why did the neural network adopt the weights at that number of iterations?**
  View → model→iteration plot

There were 50 iterations. The neural network adopted the weights at that number of iterations because that is where the maximum number of iterations was set to stop. It stopped the iteration process once it has stabilized at a certain point which is assumed to be the local minima. We cannot say for sure that it is some global minima, but it is possible.

- **Build another Neural Network node and choose Softmax as the activation function for the hidden layer. Which is the better model? Why? What does this comparison result tell you about how to select the best model?**



Selected Model	Predecessor Node	Model Node	Model Description	Target	Target Label	Selection Criterion: Valid: Average Squared Error	Valid: Root Mean Squared Error	Valid: Average Squared Error	Valid: Sum of Squared Errors	Valid: Mean Squared Error
Y	Neural3	Neural3	Neural Network-SoftMax	Price	Price	5915489	2432.178	5915489	3.3896E9	5915489
	Neural	Neural	Neural Network	Price	Price	5939411	2437.091	5939411	3.4033E9	5939411

SoftMax is better because it stops iterating sooner than the first model. Therefore, it will save you time when running the model. The SoftMax model stabilizes much sooner than the other model. The SoftMax model has a lower Root Mean Squared Error as well as a lower Average Squared Error. The results say that we should select the model that has the lowest number of iterations so that we can have significant gains in processing time as well as gains in the RMSE.