

# Neural Networks – Could we actually file one?

CAS RPM Seminar – March 2018

Example Rating Manual write-up

## Rating Algorithm

Rates are calculated using the following process.

**Step 1:** Normalize the policy characteristics.

For ordinal (numeric) characteristics, divide the difference between the maximum value and the given value but the difference between the maximum value and the minimum value.

$$\text{Normalization} = \frac{\text{MaxValue} - \text{Value}}{\text{MaxValue} - \text{MinValue}}$$

For the following fields, the min/max values are...

Field	Maximum Value	Minimum Value
Driver Age	99	15
Number of Drivers	4	1
...	...	...

For categorical fields, each level of the field is assigned a 0 or a 1, where 0 is assigned if the policy does not have that characteristic and 1 is assigned if it does. For example, Multi-Auto Discount has values of Y and N. If a policy *does* have this discount, the Multi-Auto Discount\_Y will equal 1 and Multi-Auto Discount\_N will equal 0.

**Step 2:** Determine the initial node values.

Multiply the normalized values for the policy characteristics by the corresponding weight for each node. Again for each node, sum the results of these multiplications together and add the node base weight for that node. The weights for each node is given in the following table.

Node	Age	# Drivers	Liab Only~N	Liab Only~Y	Multi-Auto~N	Multi-Auto~Y	Pol Tenure	Veh Age	Node Base
1	-1.45	0.09	0.46	-0.15	0.40	-0.02	-1.11	0.57	-0.52
2	-0.45	0.43	0.09	0.04	0.11	0.17	-4.00	0.69	0.00
3	0.85	0.72	1.72	-1.93	-0.03	0.00	0.49	0.01	0.07
4	-0.79	0.46	-0.07	-0.22	-0.16	-0.22	0.71	1.40	0.40
5	-0.24	-0.02	-0.38	0.58	0.27	0.26	-0.75	2.04	-0.20
6	-0.47	0.32	0.46	-0.02	-0.27	0.81	0.52	0.26	-0.67
7	-0.38	-0.18	0.18	-0.27	-0.04	-0.21	-0.44	0.54	0.05
8	-0.01	0.23	-0.05	-0.09	-0.11	0.08	0.11	0.02	0.07
9	0.54	0.23	0.63	-0.61	0.12	-0.04	-0.11	0.28	-0.18
10	-0.34	-0.04	-0.89	0.55	-0.30	0.04	-1.12	-0.09	0.33

**Step 3:** Determine the node output.

Take the exponential of the negative value of the initial node values. Add one to this and take the inverse. This is the node output.

$$\text{Node Output} = \frac{1}{(1 + e^{-(\text{Initial Node Value})})}$$

**Step 4:** Determine the premium.

Multiply the node output by the corresponding weight in the following table. Sum the results of these multiplications together and add the premium base weight (also in the table).

<b>Node</b>	<b>Weights</b>
<b>1</b>	-0.59
<b>2</b>	0.47
<b>3</b>	0.69
<b>4</b>	-0.23
<b>5</b>	-1.40
<b>6</b>	-1.02
<b>7</b>	-1.15
<b>8</b>	0.09
<b>9</b>	0.47
<b>10</b>	0.87
<b>Premium Base</b>	-1.43