

# Boosted NNs and Medical Costs

Fit Model - JMP Pro

**Model Specification**

Select Columns: 8 Columns

- age
- sex
- bmi
- children
- smoker
- region
- charges
- Validation

Pick Role Variables:

Y: charges (optional)

Weight: optional numeric

Freq: optional numeric

Validation: Validation

By: optional

Personality: Standard Least Squares

Emphasis: Minimal Report

Buttons: Help, Run, Recall, Remove

Keep dialog open: ☐

Construct Model Effects:

Add: age, sex, bmi, children, smoker, region

Cross:

Nest:

Macros:

Degree: 2

Attributes:

Transform:

No Intercept: ☐

Insurance - Fit Least Squares - JMP Pro

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**Response charges**

**Effect Summary**

Source	LogWorth	PValue
smoker	209.523	0.00000
age	55.832	0.00000
bmi	18.983	0.00000
children	2.172	0.00673
region	0.334	0.46336
sex	0.093	0.80812

Remove Add Edit ☐ FDR

**Lack Of Fit**

**Summary of Fit**

**Analysis of Variance**

**Parameter Estimates**

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	-2004.777	1295.782	-1.55	0.1222
age	273.72998	15.92103	17.19	<.0001*
sex[female]	-53.70744	221.0747	-0.24	0.8081
bmi	358.25731	38.40219	9.33	<.0001*
children	487.01976	179.2319	2.72	0.0067*
smoker[no]	-11634.73	269.7824	-43.13	<.0001*
region[northeast]	560.56902	405.4498	1.38	0.1672
region[northwest]	35.996699	385.8613	0.09	0.9257
region[southeast]	-122.959	385.1716	-0.32	0.7496

**Effect Tests**

**Crossvalidation**

Source	RSquare	RASE	Freq
Training Set	0.7391	6207.9	803
Validation Set	0.7507	5981.9	268
Test Set	0.7792	5665.9	267

## Boosted NNs and Medical Costs

Neural - JMP Pro

Predicts one or more response variables using a flexible function of the input variables.

Select Columns

9 Columns

- age
- sex
- bmi
- children
- smoker
- region
- charges
- Validation
- OLS Predicted charges

☐ Informative Missing

Set Random Seed

Cast Selected Columns into Roles

Y, Response	charges <i>optional</i>
X, Factor	age sex bmi children smoker region
Freq	<i>optional numeric</i>
Validation	Validation
By	<i>optional</i>

Action

OK

Cancel

Remove

Recall

Help

## Boosted NNs and Medical Costs

Insurance - Neural of charges - JMP P...

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**Neural**

Validation Column: Validation

**Model Launch**

Hidden Layer Structure

Number of nodes of each activation type

Activation Sigmoid Identity Radial

Layer	TanH	Linear	Gaussian
First	3	0	0
Second	0	0	0

Second layer is closer to X's in two layer models.

Boosting

Fit an additive sequence of models scaled by the learning rate.

Number of Models 40

Learning Rate 0.1

Fitting Options

☐ Transform Covariates

☐ Robust Fit

Penalty Method Squared

Number of Tours 20

Go

Initial setup was for 40 models but the results came back with 40 models, so the model count was increased by 10 models until the number of models in the results were less than the number of models in the setup.

Insurance - Neural of charges - JMP Pro

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Window Help

**Neural**

Validation Column: Validation

**Model Launch**

**Model NTanH(3)NBoost(40)**

Training		Validation	Test	
charges			charges	
Measures	Value		Measures	Value
RSquare	0.8490766		RSquare	0.8870085
RASE	4721.698		RASE	4052.8323
Mean Abs Dev	2958.5872		Mean Abs Dev	2537.8485
-LogLikelihood	7932.7264		-LogLikelihood	2596.8713
SSE	1.79e+10		SSE	4.3856e+9
Sum Freq	803		Sum Freq	267

# Boosted NNs and Medical Costs

Insurance - Neural of charges - JMP P...

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View Window Help

**Neural**

Validation Column: Validation

**Model Launch**

Hidden Layer Structure

Number of nodes of each activation type

Activation Sigmoid Identity Radial

Layer	TanH	Linear	Gaussian
First	3	0	0
Second	0	0	0

Second layer is closer to X's in two layer models.

Boosting

Fit an additive sequence of models scaled by the learning rate.

Number of Models 50

Learning Rate 0.1

Fitting Options

☐ Transform Covariates

☐ Robust Fit

Penalty Method Squared

Number of Tours 20

Go

Insurance - Neural of charges - JMP Pro

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Window Help

**Neural**

Validation Column: Validation

**Model Launch**

**Model NTanH(3)NBoost(40)**

**Model NTanH(3)NBoost(47)**

Training		Test	
charges		charges	
Measures	Value	Measures	Value
RSquare	0.8514882	RSquare	0.8885294
RASE	4683.8218	RASE	4025.4633
Mean Abs Dev	2900.4974	Mean Abs Dev	2491.3039
-LogLikelihood	7926.259	-LogLikelihood	2595.0621
SSE	1.762e+10	SSE	4.3266e+9
Sum Freq	803	Sum Freq	267



## Boosted NNs and Medical Costs

Insurance - Neural of charges - JMP Pro

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**Neural**

**Model Launch**

Activation Sigmoid Identity Radial

Layer	TanH	Linear	Gaussian
First	3	0	0
Second	0	0	0

Second layer is closer to X's in two layer models.

Boosting

Fit an additive sequence of models scaled by the learning rate.

Number of Models 40

Learning Rate 0.1

Fitting Options

☐ Transform Covariates

☐ Robust Fit

Penalty Method Absolute

Number of Tours 20

Go

Insurance - Neural of charges - JMP Pro

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Neural

Validation Column: Validation

Model Launch

Model NTanH(3)NBoost(40)

Model NTanH(3)NBoost(47)

Model NTanH(3)NBoost(34)

Training

charges

Measures	Value
RSquare	0.8496159
RASE	4713.253
Mean Abs Dev	2975.2179
-LogLikelihood	7931.2889
SSE	1.784e+10
Sum Freq	803

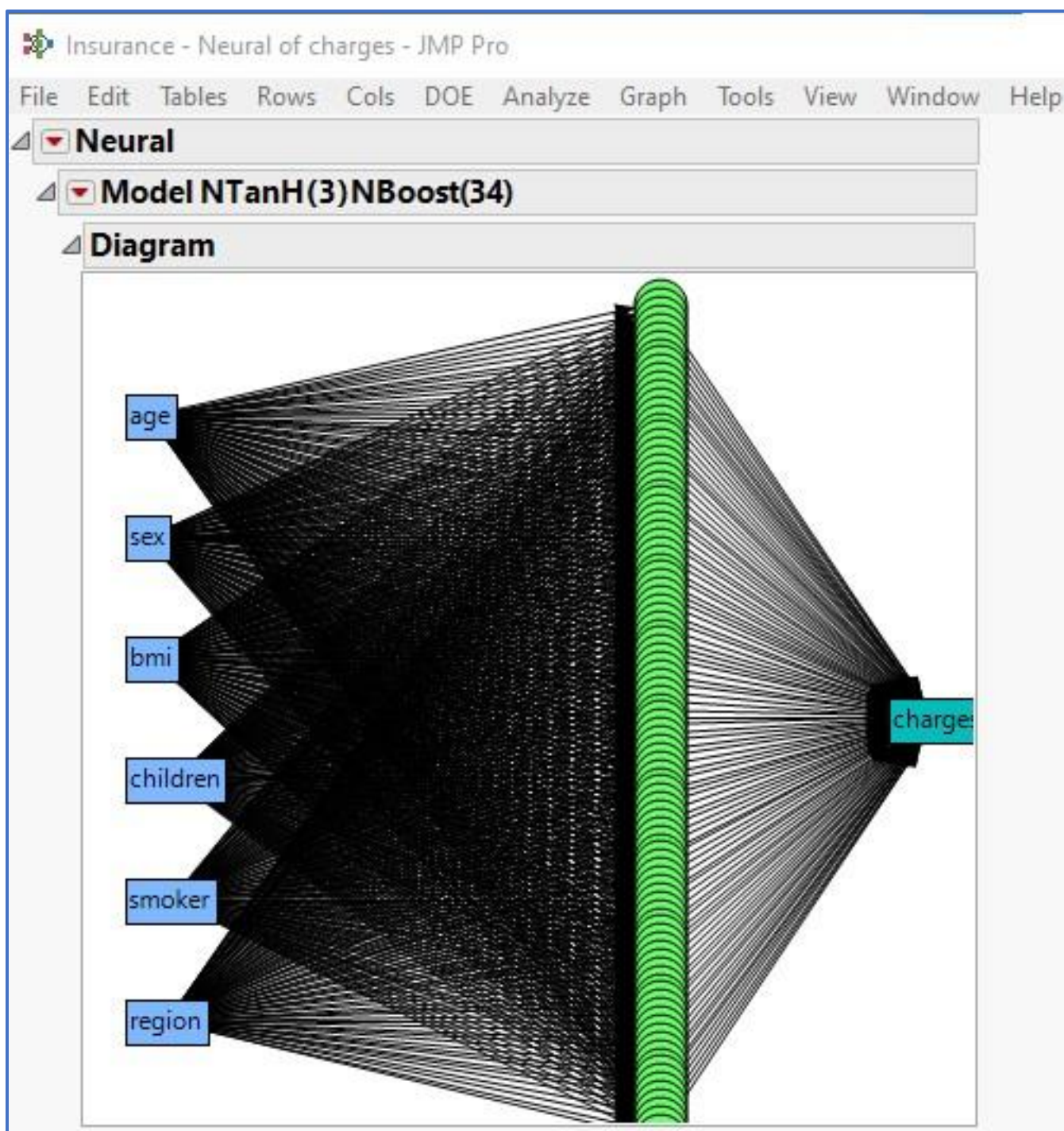
Validation

Test

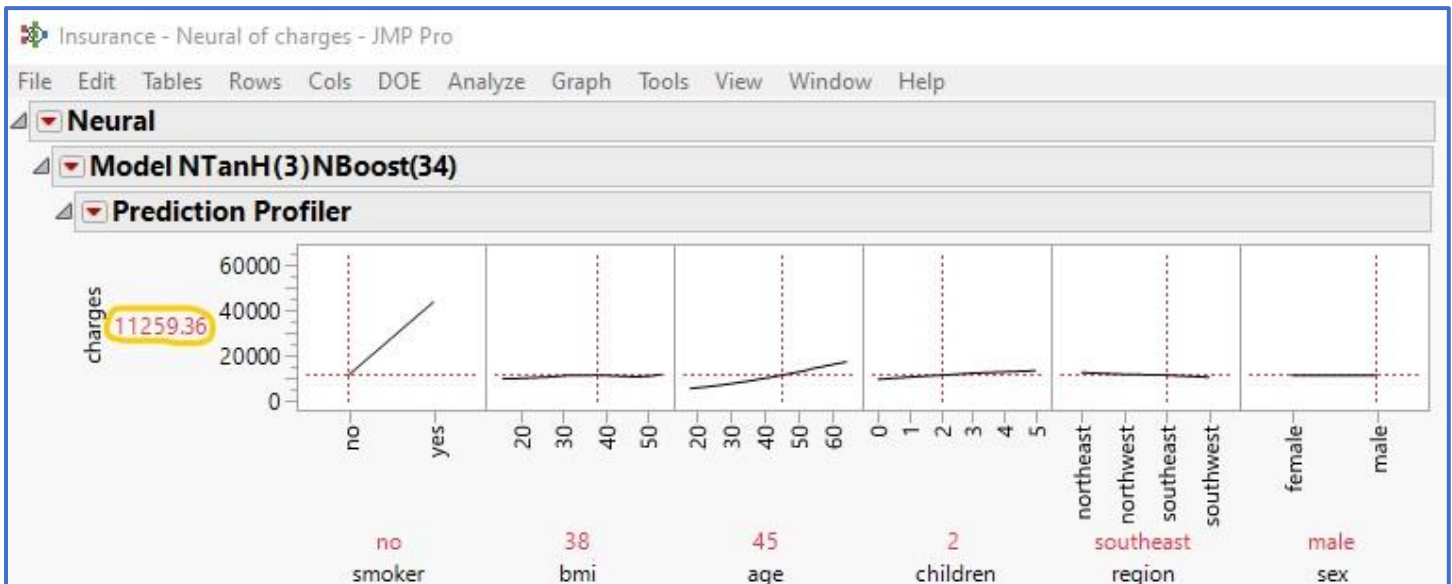
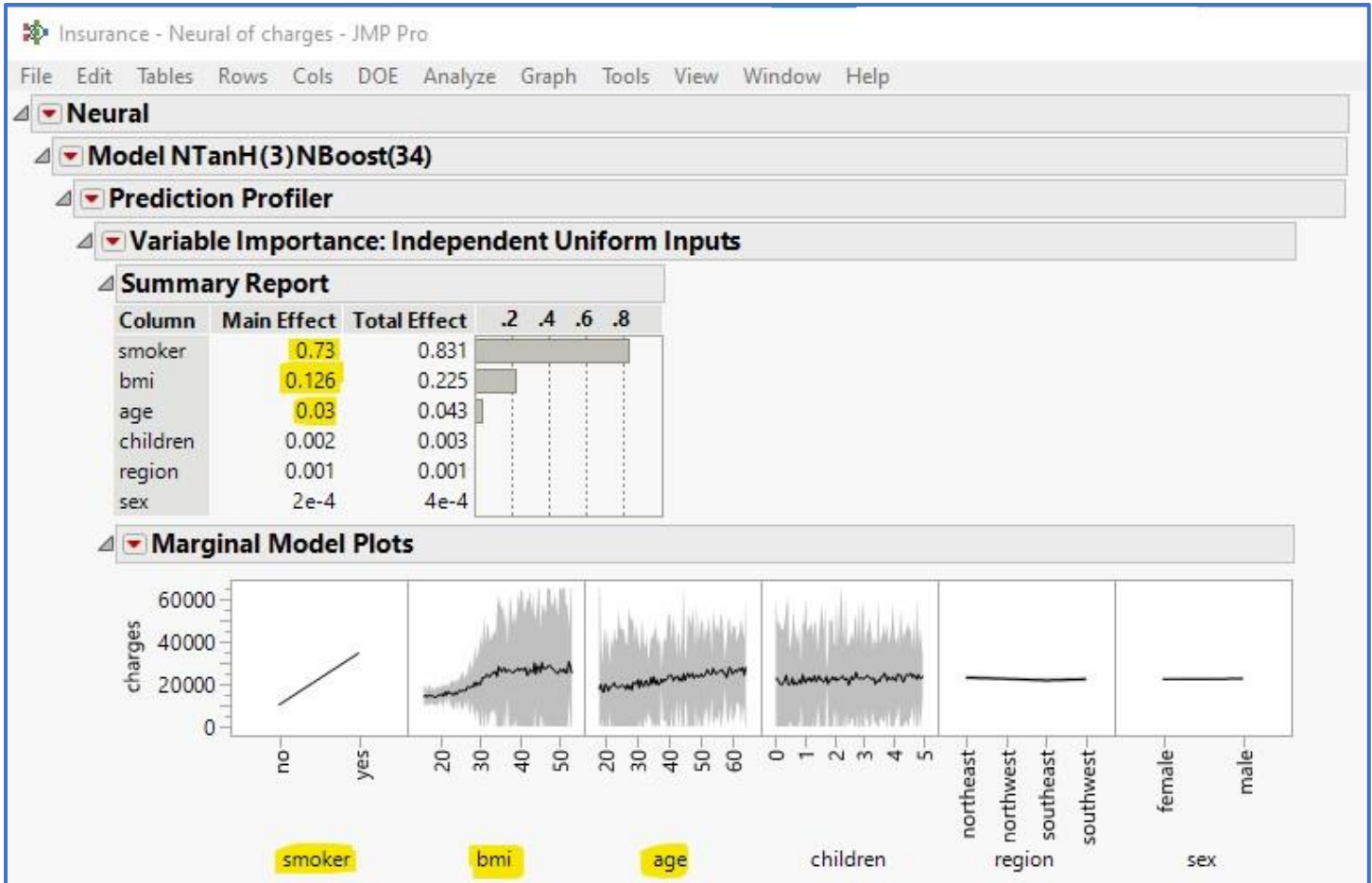
charges

Measures	Value
RSquare	0.8894395
RASE	4008.996
Mean Abs Dev	2521.5857
-LogLikelihood	2593.9677
SSE	4.2912e+9
Sum Freq	267

## Boosted NNs and Medical Costs



# Boosted NNs and Medical Costs



# Boosted NNs and Medical Costs

Insurance - Neural of charges - JMP P... — □ ×

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View Window Help

Neural

Validation Column: Validation

Model Launch

Hidden Layer Structure

Number of nodes of each activation type

Activation Sigmoid Identity Radial

Layer	TanH	Linear	Gaussian
First	1	0	0
Second	0	0	0

Second layer is closer to X's in two layer models.

Boosting

Fit an additive sequence of models scaled by the learning rate.

Number of Models 40

Learning Rate 0.1

Fitting Options

☐ Transform Covariates

☐ Robust Fit

Penalty Method Squared

Number of Tours 20

Go

Insurance - Neural of charges - JMP Pro — □ ×

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Window Help

Neural

Validation Column: Validation

Model Launch

Model NTanH(3)NBoost(40)

Model NTanH(3)NBoost(47)

Model NTanH(3)NBoost(34)

Model NTanH(1)NBoost(40)

Training		Test	
charges		charges	
Measures	Value	Measures	Value
RSquare	0.8273304	RSquare	0.8673267
RASE	5050.4229	RASE	4391.6473
Mean Abs Dev	3302.4878	Mean Abs Dev	2837.9181
-LogLikelihood	7986.7711	-LogLikelihood	2618.3083
SSE	2.048e+10	SSE	5.1495e+9
Sum Freq	803	Sum Freq	267



# Boosted NNs and Medical Costs

Insurance - Neural of charges - JMP P... — □ ×

File Edit Tables Rows Cols DOE Analyze Graph Tools  
View Window Help

Neural

Validation Column: Validation

Model Launch

Hidden Layer Structure

Number of nodes of each activation type

Activation Sigmoid Identity Radial

Layer	TanH	Linear	Gaussian
First	1	0	0
Second	0	0	0

Second layer is closer to X's in two layer models.

Boosting

Fit an additive sequence of models scaled by the learning rate.

Number of Models 40

Learning Rate 0.1

Fitting Options

☐ Transform Covariates

☐ Robust Fit

Penalty Method Absolute

Number of Tours 20

Go

Initial setup was for 40 models but the results came back with 40 models, so the model count was increased by 10 models until the number of models in the results were less than the number of models in the setup.

Insurance - Neural of charges - JMP Pro — □ ×

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Window Help

Neural

Validation Column: Validation

Model Launch

- Model NTanH(3)NBoost(40)
- Model NTanH(3)NBoost(47)
- Model NTanH(3)NBoost(34)
- Model NTanH(1)NBoost(40)
- Model NTanH(1)NBoost(84)
- Model NTanH(1)NBoost(40)

Training		Test	
charges		charges	
Measures	Value	Measures	Value
RSquare	0.8296357	RSquare	0.874521
RASE	5016.5968	RASE	4270.9175
Mean Abs Dev	3312.1627	Mean Abs Dev	2840.2813
-LogLikelihood	7981.3748	-LogLikelihood	2610.8655
SSE	2.021e+10	SSE	4.8703e+9
Sum Freq	803	Sum Freq	267

# Boosted NNs and Medical Costs

Insurance - Neural of charges - JMP Pro

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**Neural**

Validation Column: Validation

**Model Launch**

Hidden Layer Structure

Number of nodes of each activation type

Activation Sigmoid Identity Radial

Layer	TanH	Linear	Gaussian
First	1	0	0
Second	0	0	0

Second layer is closer to X's in two layer models.

Boosting

Fit an additive sequence of models scaled by the learning rate.

Number of Models 70

Learning Rate 0.1

Fitting Options

☐ Transform Covariates

☐ Robust Fit

Penalty Method Absolute

Number of Tours 20

Go

Insurance - Neural of charges - JMP Pro

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**Neural**

Validation Column: Validation

**Model Launch**

- Model NTanH(3)NBoost(40)
- Model NTanH(3)NBoost(47)
- Model NTanH(3)NBoost(34)
- Model NTanH(1)NBoost(40)
- Model NTanH(1)NBoost(84)
- Model NTanH(1)NBoost(40)
- Model NTanH(1)NBoost(61)

**Training**

Measures	Value
RSquare	0.8427751
RASE	4819.2624
Mean Abs Dev	2887.7271
-LogLikelihood	7949.1497
SSE	1.865e+10
Sum Freq	803

**Test**

Measures	Value
RSquare	0.8861724
RASE	4067.7985
Mean Abs Dev	2393.5898
-LogLikelihood	2597.8555
SSE	4.418e+9
Sum Freq	267

# Boosted NNs and Medical Costs

Insurance - Model Comparison 3 - JMP Pro

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Model Comparison

Predictors

Measures of Fit for charges

Validation	Predictor	Creator	.2 .4 .6 .8	RSquare	RASE	AAE	Freq
Training	NTanH(3) 40Mod 10% Sq 20x Predicted charges	Neural		0.8491	4721.7	2958.6	803
Training	NTanH(3) 47Mod 10% Sq 20x Predicted charges	Neural		0.8515	4683.8	2900.5	803
Training	NTanH(3) 34Mod 10% Abs 20x Predicted charges	Neural		0.8496	4713.3	2975.2	803
Validation	NTanH(3) 40Mod 10% Sq 20x Predicted charges	Neural		0.8516	4614.8	2693.8	268
Validation	NTanH(3) 47Mod 10% Sq 20x Predicted charges	Neural		0.8532	4590.1	2642.0	268
Validation	NTanH(3) 34Mod 10% Abs 20x Predicted charges	Neural		0.8533	4587.8	2702.0	268
Test	NTanH(3) 40Mod 10% Sq 20x Predicted charges	Neural		0.8870	4052.8	2537.8	267
Test	NTanH(3) 47Mod 10% Sq 20x Predicted charges	Neural		0.8885	4025.5	2491.3	267
Test	NTanH(3) 34Mod 10% Abs 20x Predicted charges	Neural		0.8894	4009.0	2521.6	267

Insurance - Model Comparison 2 - JMP Pro

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Model Comparison

Predictors

Measures of Fit for charges

Validation	Predictor	Creator	.2 .4 .6 .8	RSquare	RASE	AAE	Freq
Training	NTanH(1) 40Mod 10% Sq 20x Predicted charges	Neural		0.8273	5050.4	3302.5	803
Training	NTanH(1) 84Mod 10% Sq 20x Predicted charges	Neural		0.8423	4826.0	3068.2	803
Training	NTanH(1) 40Mod 10% Abs 20x Predicted charges	Neural		0.8296	5016.6	3312.2	803
Training	NTanH(1) 61Mod 10% Abs 20x Predicted charges	Neural		0.8428	4819.3	2887.7	803
Validation	NTanH(1) 40Mod 10% Sq 20x Predicted charges	Neural		0.8355	4858.2	2951.5	268
Validation	NTanH(1) 84Mod 10% Sq 20x Predicted charges	Neural		0.8476	4676.6	2791.1	268
Validation	NTanH(1) 40Mod 10% Abs 20x Predicted charges	Neural		0.8361	4849.8	3019.5	268
Validation	NTanH(1) 61Mod 10% Abs 20x Predicted charges	Neural		0.8463	4695.9	2578.9	268
Test	NTanH(1) 40Mod 10% Sq 20x Predicted charges	Neural		0.8673	4391.6	2837.9	267
Test	NTanH(1) 84Mod 10% Sq 20x Predicted charges	Neural		0.8798	4179.4	2635.4	267
Test	NTanH(1) 40Mod 10% Abs 20x Predicted charges	Neural		0.8745	4270.9	2840.3	267
Test	NTanH(1) 61Mod 10% Abs 20x Predicted charges	Neural		0.8862	4067.8	2393.6	267

Insurance - Model Comparison - JMP Pro

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Model Comparison

Predictors

Measures of Fit for charges

Validation	Predictor	Creator	.2 .4 .6 .8	RSquare	RASE	AAE	Freq
Training	NTanH(1) 61Mod 10% Abs 20x Predicted charges	Neural		0.8428	4819.3	2887.7	803
Training	NTanH(3) 34Mod 10% Abs 20x Predicted charges	Neural		0.8496	4713.3	2975.2	803
Training	OLS Predicted charges	Fit Least Squares		0.7391	6207.9	4447.6	803
Validation	NTanH(1) 61Mod 10% Abs 20x Predicted charges	Neural		0.8463	4695.9	2578.9	268
Validation	NTanH(3) 34Mod 10% Abs 20x Predicted charges	Neural		0.8533	4587.8	2702.0	268
Validation	OLS Predicted charges	Fit Least Squares		0.7507	5981.9	4097.9	268
Test	NTanH(1) 61Mod 10% Abs 20x Predicted charges	Neural		0.8862	4067.8	2393.6	267
Test	NTanH(3) 34Mod 10% Abs 20x Predicted charges	Neural		0.8894	4009.0	2521.6	267
Test	OLS Predicted charges	Fit Least Squares		0.7792	5665.9	4019.3	267