Points Property Prediction

Points property prediction using Lineal regression, ACE regression, Neural Network regression or Random Forest regression

User Manual

IPLAB

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1. Introduction

The **Points Property Prediction** IP_Seismic plug-in (version: 2017.1.0.0, release date: July 2017) can be used to predict a dependent variable (response) using one or more independent variables (predictors or covariates).

To do the prediction there are two main calculation studies:

1. Training stage – to get prediction operator (coefficients of the operator) according set of training pairs (one response and one or more predictors). Prediction operator can be Linear Regression, ACE regression (Alternating Conditional Expectation, LEO BREIMAN and JEROME H. FRIEDMAN, 1985), Neural Network regression or Random Forest regression.
2. Calculation stage – to calculate values of response based on prediction operator for all predictors.

2. Start

start: Surface Attributes**->**

Surface Property Prediction

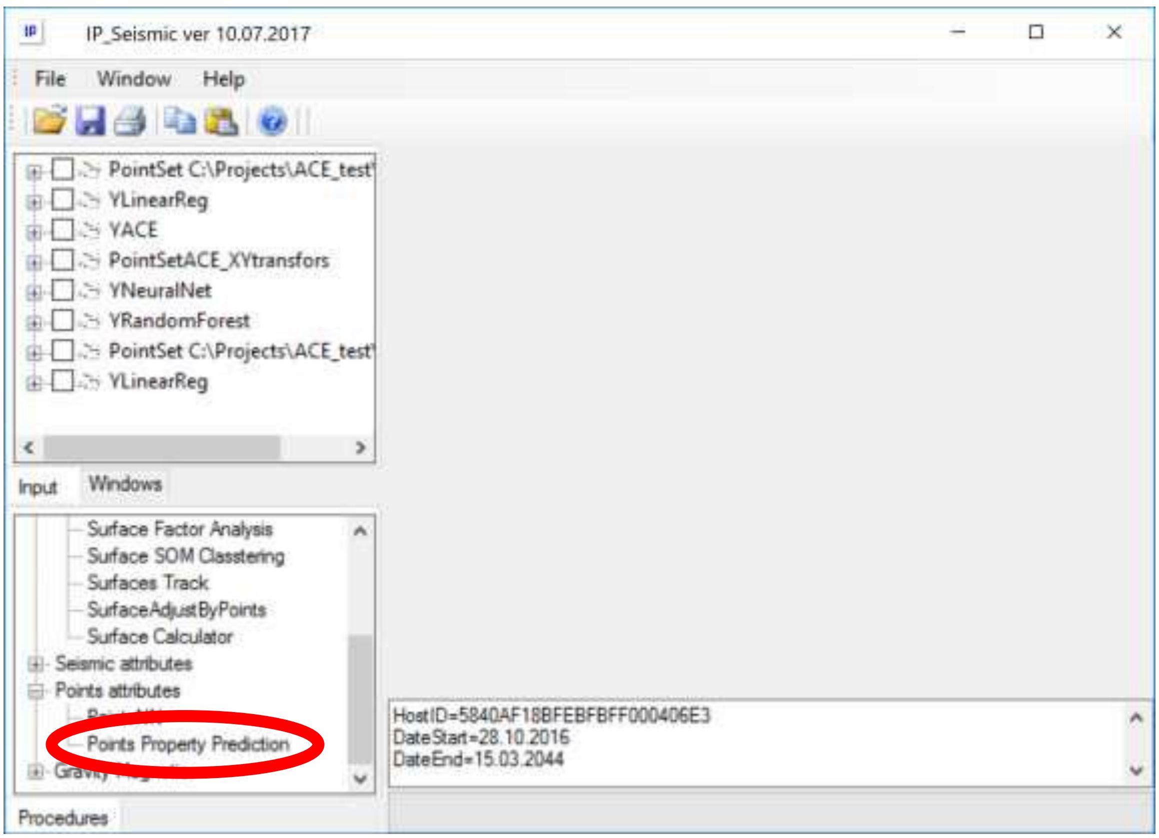


Figure 1: Project tree and programs tree to start ***Surface Property Prediction***

3. Input parameters

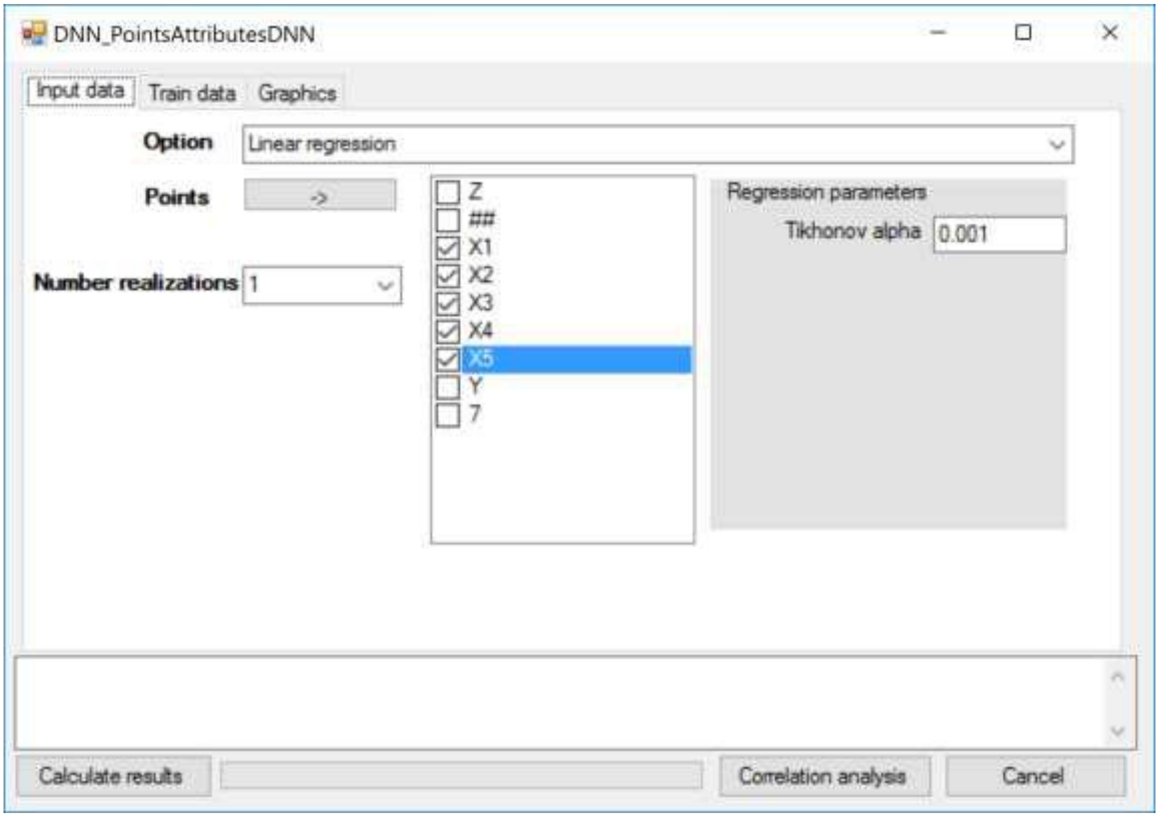


Figure 2: Input surface attributes data tab dialog view **Points Property Prediction**

Parameters have to be defined before calculation:

Points: allow select points with set of attributes from the project tree. All marked attributes will be used for calculations like Predictors.

Option:

> ***Linear Regression:*** prediction based on Linear Regression.
> ***ACE Regression:*** prediction based on ACE Regression
> ***Neural Network:*** prediction based on Neural Network Regression
> ***Random Forest:*** prediction based on Random Forest Regression.

Parameters for different options:

Tikhonov alpha: >0 and <1 allow avoid overlearning effect or instability for prediction. If alpha=0 then we can get very good approximation of the training set but the predictability can be very low and results can be very different for every realization. If alpha > 0 then training quality (correlation coefficient) will be less if use alpha=0, but predictability will be much higher (quality control with "blend well" test).

Iteration: allow define maximum iteration during training stage to teach the neural network.

Cross validation (%): (>=0 and <=99) allow define percent of training pairs what will not be used for training and will be used only for quality control.

Deep learning option: Not used default, ***Kohonen SOM, Restricted Boltzmann machine . Autoencoder.*** Option allow to generalized first layers.

Hidden layer 1 (2, 3, 4, 5) nodes: allow to define number nodes in 1st (2nd, 3rd, 4th, 5th) hidden layer for neural network definition.

To select production points attributes need to use second tab:

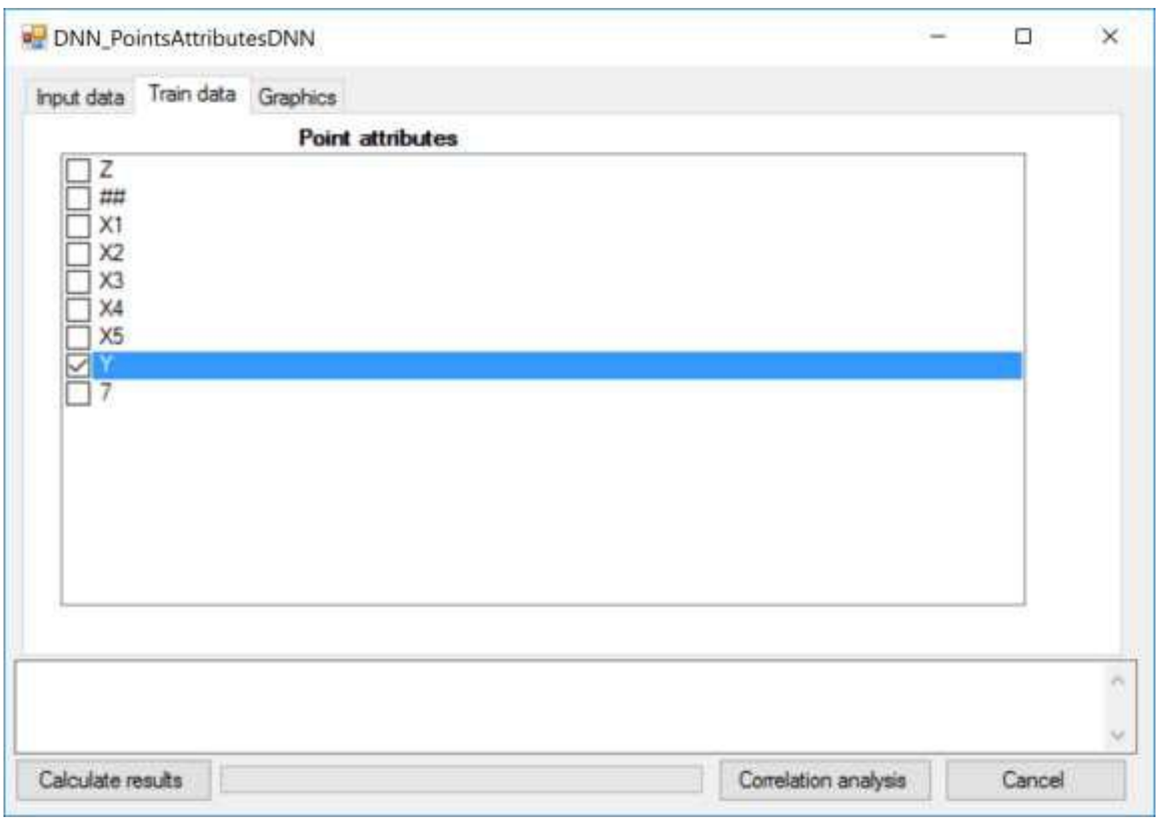
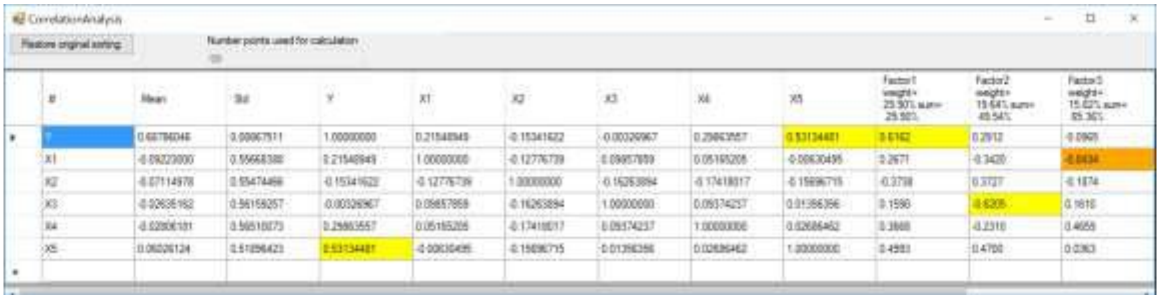


Figure 3: Response attribute from points attributes tab dialog

To do correlation analysis need to push *"Correlation Analysis" bottom. After calculation you can see correlation table (see Figure 4) with cress correlation values* *and with Principal components (shift table to right). Table is sortable for every column (click to column name). Double click – sort from big to small.*



CorrelationAnalysis

Restore original sorting

Number points used for calculation

#	Mean	Std	Y	X1	X2	X3	X4	X5	Factor1 weight= 25.90% sum= 25.90%	Factor2 weight= 19.64% sum= 45.54%	Factor3 weight= 15.82% sum= 65.36%
Y	0.66786046	0.00067511	1.00000000	0.21548949	-0.15341622	-0.00326967	0.29863557	0.53134481	0.6162	0.2912	-0.0905
X1	-0.09223000	0.55668380	0.21548949	1.00000000	-0.12776739	0.09857859	0.05165208	-0.00630495	0.2671	-0.3420	-0.8434
X2	-0.07114978	0.55474466	-0.15341622	-0.12776739	1.00000000	-0.16263894	-0.17418017	-0.15696715	-0.3798	0.3727	-0.1874
X3	-0.02636182	0.56158257	-0.00326967	0.09857858	-0.16263894	1.00000000	0.09374257	0.01396356	0.1590	-0.6205	0.1610
X4	-0.02806101	0.56510073	0.29863557	0.05165205	-0.17418017	0.09374257	1.00000000	0.02686462	0.3848	-0.2310	0.4658
X5	0.06026124	0.51096423	0.53134481	-0.00630495	-0.15696715	0.01396356	0.02686462	1.00000000	0.4583	0.4700	0.0363

Figure 4: Correlation table results according Correlation Analysis bottom

4. Calculation

To start the prediction need to push “Calculate result” buttom (during training stage error and correlation curves will be calculated in Graphics window (see Figure 5)

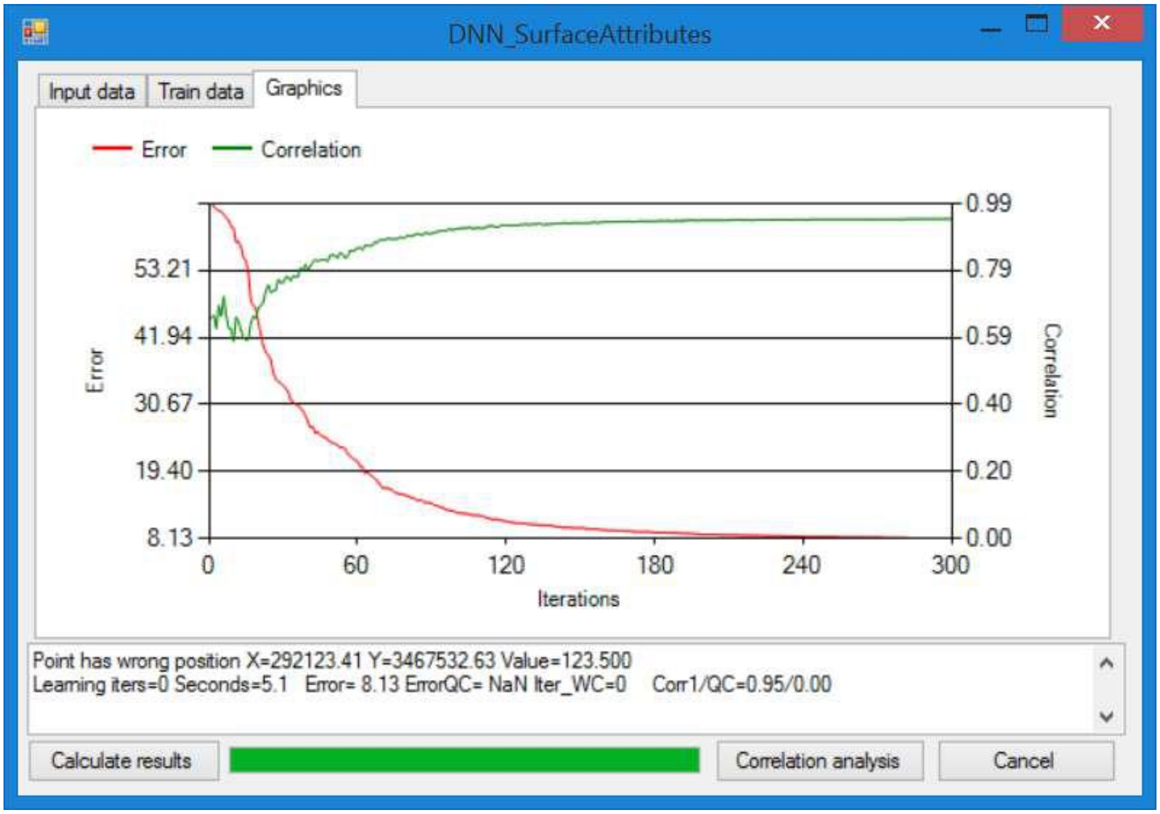


Figure 5: Output graphics window (only for Neural Network option) with error and correlation values during learning iterations

5. Results

As results of the calculations will be only new points set with measured an predicted response variable.

For ACE regression option will created new point sets with Transfors functions for every used variables (response and predictor)

6. Test

To test the procedures, we can recommend doing the following test workflow (*D. Wang and M. Murphy, 2004, Estimating Optimal Transformations for Multiple Regression Using the ACE Algorithm*):

1. Create Excel worksheet with several columns

X1	X2	X3	X4	X5	Y
-.342749805	-.560210799	0.023656124	0.171211726	-.618720465	0.478112647
-.145980504	-.362085949	0.786882801	-.262804618	-.078953371	0.64075565
0.035345863	0.507438205	-0.02095473	0.988718677	0.950364055	0.396192053

…………

Where X1, X2, X3, X4, X5 are random (-1,1) variables and

Y = log[4+sin(4X1)+|X2|+ X2 3 + X3 4 + X5 + .1]

The Transform function for it will be following:

$\theta*(Y) = \exp(Y)$

$\varphi*\ 1(X1) = \sin(4X1)$

$\varphi*\ 2(X2)=|X2|$

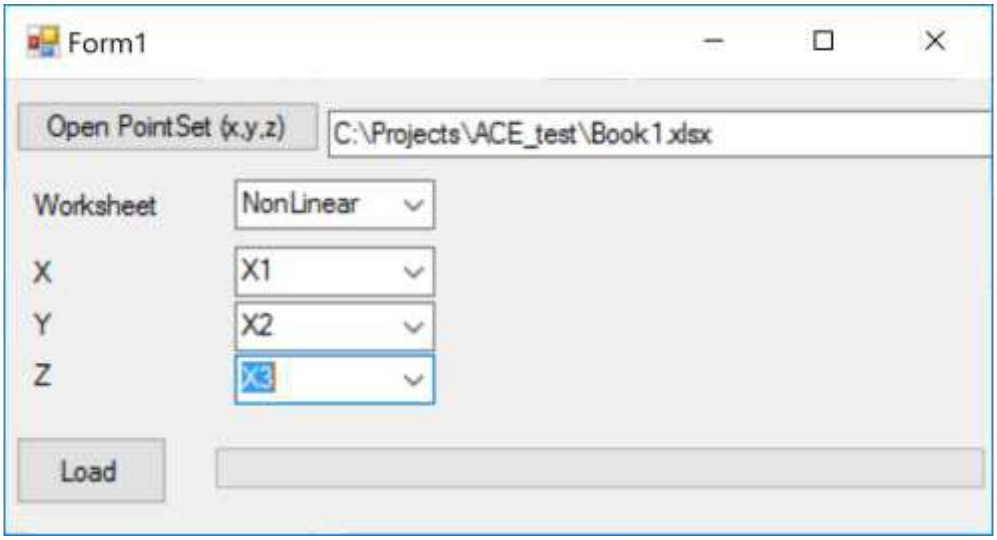
$\varphi*\ 3(X3)=X3^2$

$\varphi*\ 4(X4)=X4^3$

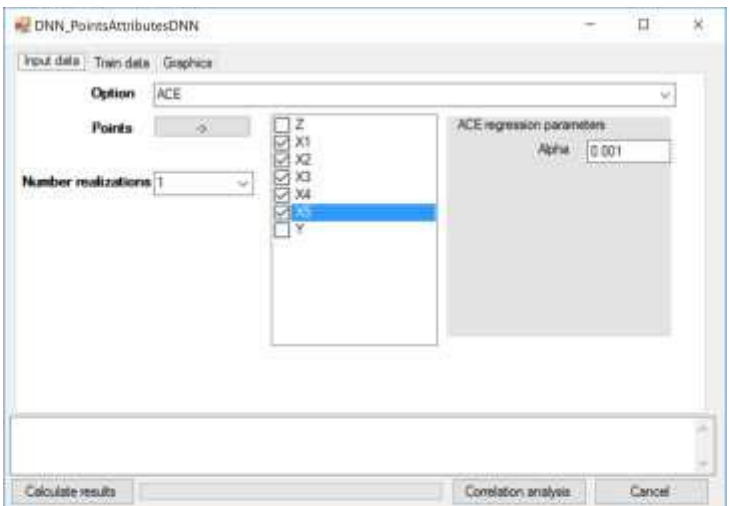
$\varphi*\ 5(X5)=X5$

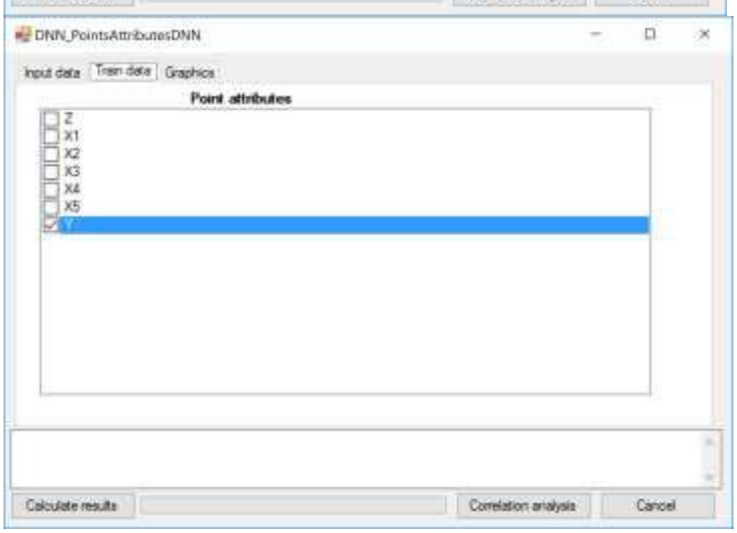
Total need to create more then 100 rows

2. Load the Excel worksheet using Excel Points attribute loader:



3. Do ACE regression analysis using Points Property Prediction module:





4. See results using Function window- all transform function can be restoried by ACE algorithm: