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Lab: Neural networks

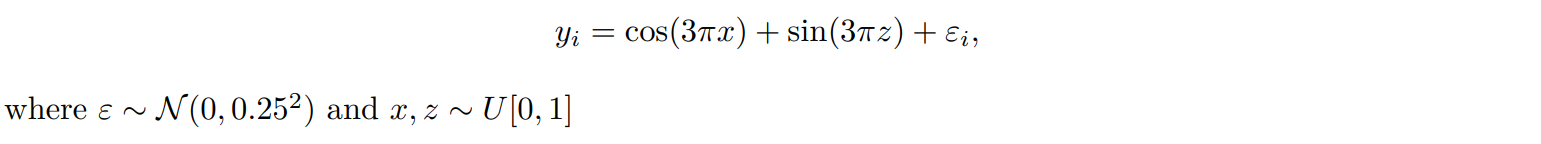
Objective:

In this lab we will illustrate the applications of neural networks in prediction of a numerical variable and classification via simulations. We will start with the simulation of the regression setting and build a neural network model to predict numerical response. Then we will simulate the classification setting and learn how neural networks can be applied to predict qualitative variable.

Prediction of a numerical outcome

To visualize and understand simulated data, we will limit ourselves to one response and two explanatory variable regression setting. It is recommended to standardize data before fitting neural networks.

Simulate uniformly distributed variables x and z and relate them to response y via the following formula:



Visualize the relationship between y and the independent variables.

Create a data frame (table) by combining x, y and z.

Install and load neuralnet library.

Build a neural network model and call output object, nn.

Plot nn.

To evaluate how well the neural network fits data, visualize the relationship between y and the independent variables individually. Does the model fit data well?

Play with parameters and see if you can improve the fit.

Classification

Now we will divide a square [0, 1] × [0, 1] of points whose components are uniformly distributed random variables into two classes: points that lie inside the circle  belong to class 1, while points outside the circle, belong to class 2.

Plot the data.

Create a data frame.

Build a logistic regression model. Use glm function to build a model, predict function to generate likelihoods, and ifelse function to perform classification. Plot data, logistic regression classifier and overlay the true classification boundary.

Fit neural network with one hidden layer.

Perform classification based on predicted probabilities using 0.5 threshold.

Plot the data and the NN classifier.

Does the model overfit the date? Apply the validation approach to answer this question.