C-53: Effect of data transformation on artificial neural networks

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The objective of this research was to study the effect of data transformation on the accuracy of neural network predictions. The problem chosen was the selection of reinforced concrete beam depth (d), given the 5 input variables of moment (M), concrete grade (f_{cu}), steel grade (f_y), reinforcement percentage (ρ), and width/depth ratio (b/d). The model was constructed for (i) the raw data, (ii) the data transformed into logarithmic form and (iii) the data transformed into non-dimensional form, where the input was ($\rho f_y/f_{cu}$) and the output [$M/\{f_{cu}(b/d)(d^3)\}$]. For each model, the accuracy of prediction (of beam depth) was measured by (i) mean average error (MAE), (ii) standard deviation of the ratio between predicted and desired depths (RSTD) and (iii) the absolute difference between unity and the average ratio between predicted and desired depths (|1-RAVG|).

The results showed that as one moves from the raw data through the logarithmic form to the non-dimensional form, there are two approximately order of magnitude jumps for MAE, RSTD and |1-RAVG|. The logarithmic transformation performs better probably because it reduces the ratio between the largest and smallest input and output values in the model. The non-dimensional transformation does well because (i) there is additional domain knowledge that is incorporated in the process of converting the data into a non-dimensional form and (ii) there is a reduction in the number of variables. It was also noted that higher absolute values of skewness of the weight distribution in the trained network resulted in lower percentages of test set examples that fell within the accuracy specified for training.