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Deep Neural Network For Steamflood Recovery Factor Prediction

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Abstract
Proxy model to predict recovery factor is essential as a preliminary screening of steamflooding Enhanced Oil Recovery (EOR) design to find potential scenarios before it is simulated in reservoir simulator. This study uses Deep Neural Network to develop the steamflood proxy model. It consists of 2 hidden layers with 50 neurons each. The model development has considered bias-variance trade-off using dataset splitting (train-val-test split), and several diagnostic curves (Learning curve and Validation Curve). The dataset is generated using Latin Hypercube sampling towards steamflood screening criteria and several steamflood fields properties to represent worldwide steamflood project. The resulting prediction is presented in an Actual vs Prediction plot using root mean squared error and coefficient of determination as metrics. The proxy model has good performance, applicable for different reservoir flow properties, representative towards worldwide steamflood EOR project, and also a very fast prediction. The trained parameters (weights and biases) are also presented in Appendix.

Keywords: Proxy Model, Deep Neural Network, Recovery Factor, Steamflooding, Machine Learning.

1. Introduction

1.1 Background

Steamflooding is a thermal Enhanced Oil Recovery (EOR) method that mainly applied to heavy oil reservoir. Typically, a steamflood has three major stages of production which every stage is dominated by initial oil viscosity, hot-oil mobility, and reservoir permeability, and remaining mobile fraction of Original Oil in Place (OOIP), respectively (Jones, 1981). Steamflood is well-known as one of the most successful EOR method which can give a high recovery factor in a heavy oil field up to 80% of the OOIP as done by Chevron (Brown, 2015). Recovery factor prediction is essential to evaluate the execution of an EOR steamflood project and further can give an information for the proper execution. Three mathematical models (analytical, numerical, and statistical models) are often used to predict steamflood performance.

Analytical model used a mathematical approach that serves the expense of accuracy and flexibility for various reservoir types and properties, yet it is very difficult to get a representative model. For many years, several investigators have attempted to provide analytical model (Marx and Langenheim 1959; Boberg, 1966; Mandl and Volek, 1969; Neuman, 1975; Myhill and Stegemeier, 1978; Jones, 1981; van Lookeren, 1977; Farouq Ali, 1970; Miller and Leung, 1985; Rhee et al., 1978; Aydelotte et al., 1982, Chandra and Mamora, 2007).

The numerical model usually requires a large amount of data input with lengthy calculation using computers, and they are usually CPU-, manpower-, and time-consuming, also, expensive. They may be extremely comprehensive and better serve as tools for research or advanced reservoir analysis. Gomaa (1980) has attempted in providing this model.

Statistical models are based on the historical data of steamflood performance from other reservoirs which have similar oil and rock properties. A statistical model, however, does not include all the flow parameters and thus may be inaccurate for a particular reservoir. The most recent investigator (Wiratma, 2012; Wiriando, 2016; and Tja, 2017) used sensitivity analysis of parametric studies in building the recovery factor correlation. However, this model only valid for a particular reservoir.

Nowadays, several companies have provided some commercial software that has an ability to make a proxy model to predict recovery factor, one of those is CMG-CMOST. This software can build a proxy model by using two methods: polynomial regression and Radial Basis Function Network (RBFN) after being done a sensitivity analysis of some parameters. We have evaluated the performance of this tool by applying these methods to generate a proxy model of a generated data. The performance of the two methods are measured by Root Mean Squared Error (RMSE) and coefficient of determination (R^2) which are shown by actual vs predicted plot in Figure 1. RBFN regression has a better performance than polynomial regression in building the proxy model. It gives lower RMSE and higher R^2 value than polynomial which means the prediction is more accurate. Unfortunately, it did not perform well outside the training data (test data). This means that the model is overfitting and not general enough to be applied to a wide range dataset.

In our transition into the fourth industrial revolution, machine learning and deep learning has become the major aspect of the revolution. Machine learning can speed up our current state of statistical analysis, and deep learning can model a very complex problem. Petroleum industry will also be affected by the revolution and should take benefit of this technology to optimize its performance. For example, a recovery factor proxy model can be built using machine learning technology, which can save a lot of time by taking a role of preliminary screening agent to find a potential EOR operating condition before it is simulated in reservoir simulator.

This study aims to develop a proxy model that is able to predict recovery factor of a wide range of various steamflood field parameters by using Deep Neural Network.

1.2 Machine Learning

Machine learning (also known as predictive analytics or statistical learning) is a research field at the intersection of statistics, artificial intelligence, and computer science (Muller et al., 2017). It programs computers to optimize performance criterion based on example data or past experience (Alpaydin, 2014). The model is build up from some parameters, and learning is the execution of an algorithm to optimize the parameters using training data or past experience (Alpaydin, 2014). The model can either be predictive to make predictions or descriptive to gain knowledge from data (Alpaydin, 2014).

In general, machine learning is classified into two categories: supervised learning and unsupervised learning. The main goal of supervised learning is to find a function that maps the input to an explicitly given target output, such as classification and regression. While in unsupervised learning, there is no such explicit target, but the task is to find meaning only from the provided input, for example, clustering task.

A few common machine learning algorithms for supervised learning are linear regression, logistic regression, linear discriminant analysis, decision trees, naive Bayes, k-Nearest Neighbor (kNN), Artificial Neural Network (ANN), Support Vector Machine (SVM), and random forest.

1.3 Artificial Neural Networks

The human brain can process the information gathered from a vast number (~1011) of processing unit called neuron (Alpaydin, 2014). The neuron can pass a signal to another neuron through a synapse. ANN is inspired by such system where a node represents a neuron, and a weight represents a synapse. In ANN, those interconnected group of nodes is organized in 3 main layers: input layer, hidden layer, and output layer (see Figure 2). An ANN with multiple hidden layers between the input layer and output layer is known as Deep Neural Network (DNN). The training process of ANN will be explained in section 1.5.

1.4 Dataset Splitting

In supervised learning, a dataset contains a large number of samples (also called as instances), where there are input features and target output of each sample. Preprocessing the dataset by splitting is necessary because training with all of the data is prone to overfitting. In most recent practices, it was common to split the dataset into a training set, a validation set, and a test set. This way, the model is more general because the model should be able to predict data out of the training set.

Each training, validation, and test set has different purposes. The training set is used in the training process of the model, validation set is used in hyperparameter tuning, feature engineering or screening, and other applications regarding the diagnostic of the model performance, while test set is used to test the performance of the model and to ensure the model is not overfitting.

1.5 Training Process on Neural Network

There are 2 stages of training an ANN: calculate the error and parameters update. Feedforward is the coined term for ANN error calculation process, while in optimizing this error, either gradient-based or non-gradient-based method can be applied to update the parameters. The famous algorithm to calculate the error gradient towards each parameter is known as backpropagation algorithm but only applied if the gradient-based update is used.

1.5.1 Feedforward

Feedforward or forward propagation is a process of calculating the output from the given input data based on the ANN architecture. In a nutshell, each node starting from the first hidden layer compute input signal x, which are values of all nodes in the previous layer, into a weighted sum z with weight w, then, added with bias b. After obtaining the weighted sum, apply a nonlinear activation on them to induce nonlinearity into the model. The activated output is used as the input for the next layer until it reaches the output layer. Table 1 shows several common activation functions used in ANN.

Then, the ANN performance can be evaluated by comparing the computed output with the target output. The error of each sample data is called loss, calculated through a defined loss function. The most common type of loss function for regression is squared error, while for classification is cross entropy. The cost function is used to represent all the losses as one value so that it can be used as the optimization objective. The commonly used cost function for regression is RMSE (root mean squared error). Figure 3 illustrates the computation in feedforward algorithm.

1.5.2 Back Propagation

The main objective after the computation of cost in feedforward algorithm is to minimize the cost. In ANN, the weight and bias are the parameters to be optimized. Non-gradient-based solver such as Nelder-Mead Simplex, Particle Swarm Optimization (PSO), Artificial Bee Colony (ABC), and Firefly Algorithm (FA), or apply gradient-based solver such as gradient descent, conjugate gradient, Newton Raphson, Gauss-Newton, and Levenberg-Marquardt. ANN model is segmented into layer, hence, the gradient computation is done through a systematic chain rule from the output layer to the input weight and bias, namely the backpropagation algorithm. Figure 4 illustrates the backpropagation algorithm.

The backpropagation algorithm updates the weight and bias value, hence, the feedforward algorithm is conducted to obtain the new cost and is then repeated in cycle until the gradient-based solver reached its stopping criteria.

1.6 Bias-Variance Trade-Off

The real relationship that maps the input and target output are completely unknown. For illustration, a simple straight line can be used to model the relationship, but it may results in a high error (high bias). On the other hand, higher order polynomial model can be applied, but it may lead to overfitting (high variance). This problem is illustrated in Figure 5. Hence, there is a bias-variance trade-off. Bias and variance are defined as a reducible error, while there is also an irreducible error, such as error from data noise. A good model lies in between, where it has a relatively low reducible error, which means that the error does not have to be minimum, but low enough and still consider the generality of the model.

1.7 Diagnostic Curve

Troubleshooting the bias-variance problem, and the generality of the model is done through diagnostic plots, for instance, learning curve and validation curve.

1.7.1 Learning Curve

A learning curve is a cost vs number of training sample plot. It is designed to see the dependencies of the model towards the size of a training set. This plot is useful in evaluating the bias-variance and the data splitting. The training error starts with a very low cost because a few training samples can easily be fitted with ANN, most likely would get to zero cost, but when it is applied to the validation set, which is set of sample outside the training set, the model fails to generalize results in high validation error (see Figure 6A). Continue with more training sample, ANN is trained into a more general model, which will decrease the validation error, but increase the training error (see Figure 6B). At some point, the increase of training sample will not affect the model significant enough, hence each training and validation error converge. This can be used to determine whether additional training sample is needed or not, or the data splitting needs to be modified.

The converging properties can help the determination of bias-variance problem. For a high bias problem, the model could not predict both training and validation set well enough so both errors converge to a high cost (see Figure 7A). On the other hand, high variance problem shows when the model fits the training sample well but not general enough to fit the validation set. This can be identified by a large gap in convergence, together with low training error may be a signal of overfitting (see Figure 7B). The model is a good fit when it has both acceptable bias and variance, which has medium bias and a good generality (see Figure 7C).

High bias problem can be handled with a more complex model, such as using more variables (features), more hidden layer and nodes, or higher polynomial order. For a high variance problem, the key idea is to decrease the model complexity to reduce overfitting. It can be done through the addition of more training samples, reducing the number of inputs (features) or lowering the polynomial order, reducing ANN size, and applying regularization.

Regularization is parameter penalization to lower the variance. This is done by considering the parameter itself into cost calculation. For instance, the L2 regularization adds the squared weight into the cost (see Equation 1) as the following:

$$cost = RMSE + \lambda \sum w^2 \quad (1)$$

where lambda (λ) is called a regularization parameter. By this way, the high-valued weight contributes a higher cost, hence, they are penalized proportionally to λ when the cost is optimized. Figure 8 illustrated the effect of regularization.

1.7.2 Validation Curve

Validation curve is a cost vs λ plot. This is necessary to avoid over-regularization, and to find a reasonable value of λ. Before regularization ($\lambda = 0$), the training error would be low, but the model does not perform well for validation error. By increasing λ, the training error increases as a trade-off to lower the validation error, hence, a more general model, but at some point, the model is over-generalized, and both errors increase and converge. The value of λ is taken before the validation error increases as shown in Figure 9.

2. Methodology

2.1 Base Case Model

The DNN proxy model needs a dataset to train the neural network weights and biases. We use the data of several steamflood fields provided in the literature (Jones, 1981; Gael et al., 1994) and EOR screening criteria for steamflood (Taber et al., 1997; Aladasani et al., 2010) to create a base model in CMG-STARS. Reservoir and fluid parameters are obtained from the average value provided in the steamflood screening criteria, while the rests are obtained by averaging the parameters from several steamflood fields. Figure 10 shows the base model and its information. Table 2 summarizes the base model reservoir properties.

2.1.1 Viscosity Model

The oil viscosity depends on the oil °API gravity. We cannot simply include viscosity in the Latin Hypercube sampling because it may cause conflict with the oil density. For example, Latin Hypercube may sample a low viscosity value together with a high oil density (low API gravity), while we know that low API gravity oil should have a high viscosity. This problem can be avoided by excluding oil viscosity from the sampling, and simply apply viscosity model. In this study, we use a simple linear interpolation between the sample data created from EOR screening criteria (Taber et al., 1997; Aladasani et al., 2010) as shown in Table 3.

2.1.2 Operation Condition

We apply the average of the operating condition from a few fields for the operating condition of production and injection well of the base model. Those fields are Brea, Coalinga, El Dorado, Inglewood, Kern River, Schoonebeek, Slocum, Smackover, Tatums, Tia Juana, Yorba Linda, and Duri field. Table 4 summarizes the operating condition.

2.2 Deep Neural Network Model

This study utilized MATLAB in the programming of the DNN model. The DNN model received 12 inputs (depth, permeability, net pay thickness, initial oil saturation, oil density, rock heat capacity, injection rate, injector BHP, steam quality, injection temperature, injection pressure, and duration) and produces one output (recovery factor).

2.2.1 Mean Normalization

Since the range of values of inputs varies widely, the solver needs to find a small weight to high-valued input, and vice versa for the low-valued input. It is better to normalize the inputs so that each input is on the same scale and the solver can find a solution faster and better. In this study, the DNN model used mean normalization as shown by Eq. 3. Mean normalization scale each input into zero mean and unit variance.

$$x' = \frac{x - \bar{x}}{\sigma} \quad (3)$$

where,

x' = Normalized input

x = Original input

$\bar{x}$ = Mean of input

σ = Standard deviation of input

2.2.2 Random Seed on Data Splitting

After input normalization, data set will be randomly permutated and then classified into training, validation, and test data. We use 70-15-15 split to split the data set.

2.2.3 Activation Function

Our target is to estimate the recovery factor, which has a non-negative attribute. Rectified Linear Unit (ReLU) is the suitable activation function because it always results in a non-negative value while providing nonlinearity in our model. ReLU is also the state-of-the-art activation function because it has a constant gradient value, which avoids the vanishing gradient problem (such as in sigmoid function) resulting in a faster learning.

2.2.4 Cost Function and Solver

In backpropagation algorithm, it is common to use half of the mean squared error as a cost function because it results in a cleaner derivative formula. Equation 4 represents the cost function. This cost is then optimized with a conjugate gradient solver.

$$cost = \frac{1}{2m}\sum_{i=1}^{m}(y_i - \hat{y}_i)^2 \quad (4)$$

2.2.5 Evaluation Metrics

We use root mean squared error (RMSE) as the metric to evaluate our DNN performance. We also evaluate the coefficient of determination (R^2) value to help assess overfitting or generality of the model. Equation 5 and 6 are the mathematical formulation of RMSE and R^2. RMSE and R-Squared will be calculated for each training, validation, and test set and visualized in Actual vs Prediction plot.

$$RMSE = \sqrt{\frac{1}{m}\sum_{i=1}^{m}(y_i - \hat{y}_i)^2} \quad (5)$$

$$R^2 = 1 - \frac{\sum_{i=1}^{m}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{m}(y_i - \bar{y})^2} \quad (6)$$

2.2.6 Bias-Variance Problem Diagnosis

We recognize the problem as high bias or high variance problem by using the learning curve on a chosen inputs, DNN architecture, and data splitting. If high variance persists, we apply L2-norm regularization.

2.2.7 Hyperparameter Tuning

A parameter that does not directly affect the model is called hyperparameter. Hyperparameter can be learning rate if gradient descent solver is used, or regularization parameter (λ) if we apply regularization, and many more. In this study, we focus on tuning the regularization parameter by using validation curve, with specified inputs, DNN architecture, and data splitting from the previous bias-variance diagnostic.

2.3 Generating Data

Now we have a base model, we can generate more data based on EOR screening criteria (Taber et al., 1997; Aladasani et al., 2010) to ensure that the data still represent typical reservoir parameters of worldwide steamflood EOR project. Table 5 shows the mentioned screening criteria. We then use Latin Hypercube sampling to generate data based on this criteria. Latin Hypercube sampling simulates the inputs by varying them towards specified distribution. We use triangle distribution for the known parameters in the screening criteria, while parameters beyond the screening criteria use a normal distribution. The Latin Hypercube sampling is also included in CMG-CMOST software. The whole input variables, their range, and the probability distribution are shown in Table 6. The generated input data set from Latin Hypercube sampling are then used in the base model for reservoir simulation to get the recovery factor value.

2.4 Workflow

The workflow of this study can be summarized with a flowchart (see Figure 11)

3. Result and Discussion

3.1 Generated Dataset and Sampling Consistency

We have created a dataset from 633 steamflood EOR simulation using CMG-CMOST and it is presented in Appendix A. Each of those samples has been randomly categorized into a train, validation, and test set. The data generated by Latin Hypercube sampling has a consistent result with the specified distribution as shown in Figure 12.

3.2 Proposed DNN Model

3.2.1 DNN Architecture

We proposed a DNN consists of 2 hidden layers with 50 neurons each and ReLU activation function for all neurons (see Figure 13). The inputs are reservoir depth (ft), Injector BHP (psi), Injection pressure (psi), Steam quality (fraction), Injection rate (bbl/d), Injection temperature (°F), Oil density (lbm/ft3), Net pay thickness (ft/block), permeability (mD), rock heat capacity (btu/ft3.°F), oil saturation (fraction), and injection duration (years), with recovery factor (%) as the target.

3.2.2 Learning Curve

We started with bias-variance problem identification for our DNN model with a learning curve. Figure 14 illustrates the learning curve, and we can identify our DNN model as overfitting (high variance) from the big gap between training and validation error. This means that our DNN is successful in modeling actual recovery factor for training data, but just too much that it fails to model the validation set.

Both training and validation error has also started to be stagnant, so we assume that the sample data is enough. Therefore, increasing the sample data will not improve the model, but we can apply regularization instead to improve generality of the DNN.

3.2.3 Validation Curve

The DNN model experiences a high variance problem, and regularization is one of the solutions to deal with it. The idea is to penalize the trained weight and bias so that we can trade-off some of the low training error for a lower validation error, which means that we increase the generality of the model. Validation curve helps in tuning the regularization parameter λ that would give acceptable training error trade-off for a model that can capture a wider range of data. Figure 15 shows the resulting validation curve and we choose λ equals to 100.

3.2.4 Training the DNN

We have decided the DNN architecture, a number of sample data, data splitting, and the regularization parameter. Next, we trained the model with those parameters. The trained weights and biases are presented in Appendix B.

3.2.5 DNN Model Performance

In this section, we present the DNN model performance in an Actual vs Prediction plot (see Figure 16) of the recovery factor.

We can see the increase of RMSE from the training set, to the test set. The R^2 also decreased. This is normal because the test set is totally out-of-train data. The most important is that the performance of the model towards the test set is not extremely lower than the train set because it would mean that the model is overfitting, and also the train set should have a high R^2 (or low RMSE), otherwise it is underfitting (having a high bias). In general, we can see that if the model is conducted towards all of the data, it has R^2 of 0.86, which is acceptable considering it also has generality towards out-of-train data. Therefore, we can conclude that the model gives a satisfying result and desired generality. The model can be used as a screening method to find a potential operating condition for steamflood EOR before it is conducted in reservoir simulation. It can save a lot of time because recovery factor prediction with DNN model is incredibly fast, making it a great proxy model.

4. Conclusion

We have generated a steamflood EOR dataset from literature and application of Latin Hypercube sampling. We split the dataset into train, validation, and test set, then, used it to train a Deep Neural Network Model as a proxy to predict steamflood EOR recovery factor. It had 2 hidden layers with 50 neurons each. The learning curve and validation curve are also applied to handle the bias-variance problem. The model is successful and its performance is presented in Figure 16. It can save a lot of time by using it as a screening method to find a potential operating condition for steamflood EOR before it is conducted in reservoir simulation.

5. Recommendation

1. Feature engineering is recommended for further research by:
   - Dimensionality reduction using feature extraction methods such as Principal Component Analysis (PCA), or Linear Discriminant Analysis (LDA).
   - Using fewer features, but include the combination of inputs, such as kh (permeability-net thickness) and higher degree inputs (for example, k^2).
2. Apply nonlinear viscosity model, such as Alomair correlation for heavy oil, instead of simple linear interpolation.
3. Conduct performance comparison with other machine learning methods such as Support Vector Machine (SVM), and Radial Basis Function Network (RBFN), or with analytical methods.
4. Determination of the most influencing parameters towards the recovery factor in order to get insights for a better steamflood EOR project execution.
5. Try a different DNN architecture, such as a deeper network with fewer neurons in each layer.

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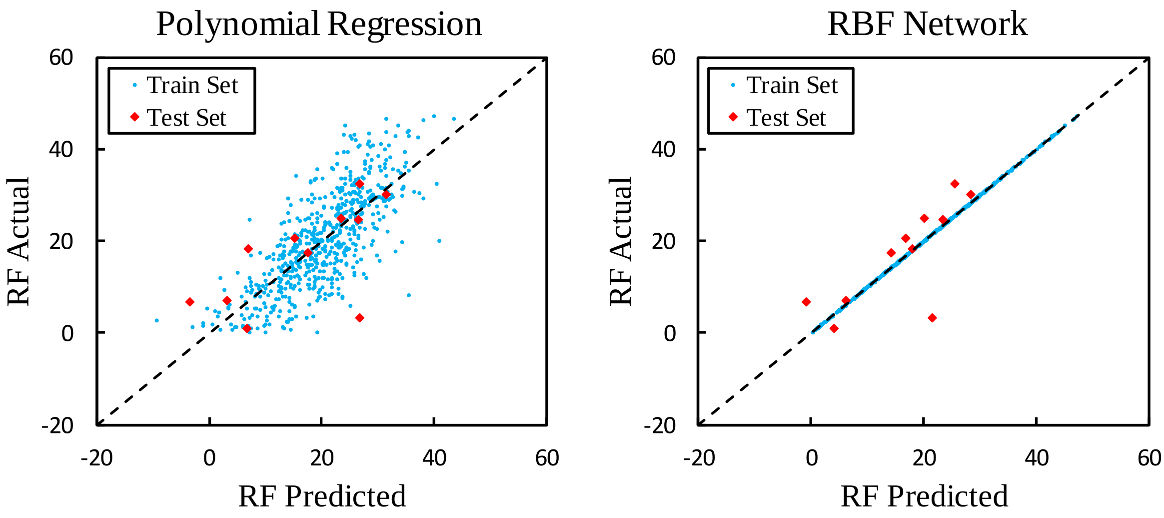


Figure 1. Actual vs Prediction Plot for Polynomial regression and RBF Network. Both model are done in CMG-CMOST. We can see that the polynomial regression only has $R^2$of 0.56, which is not good, while RBF Network has R^2 of 1 for train set, but only 0.58 for the test set, which means it has experienced overfit.

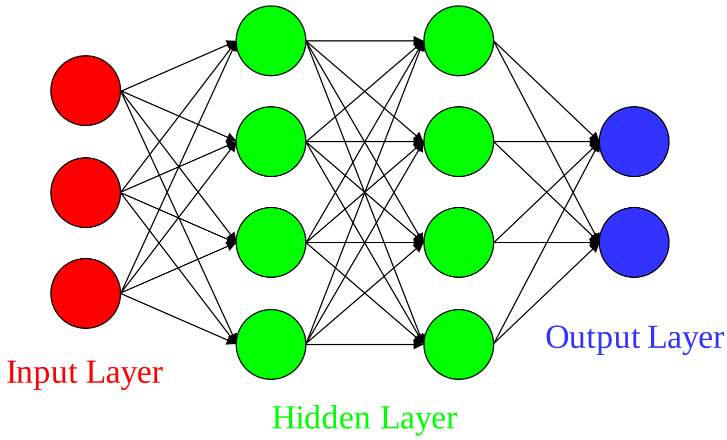


Figure 2 Artificial Neural Network Architecture

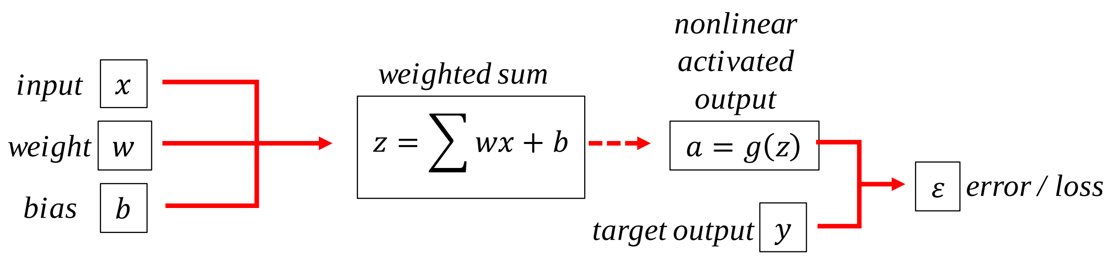


Figure 3 Feedforward Algorithm

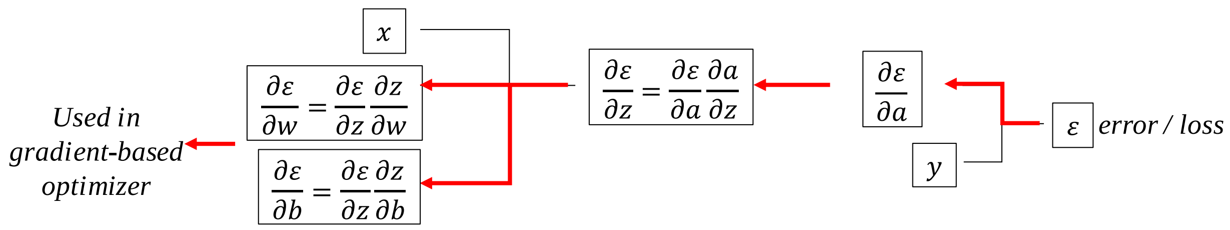


Figure 4 Backpropagation Algorithm

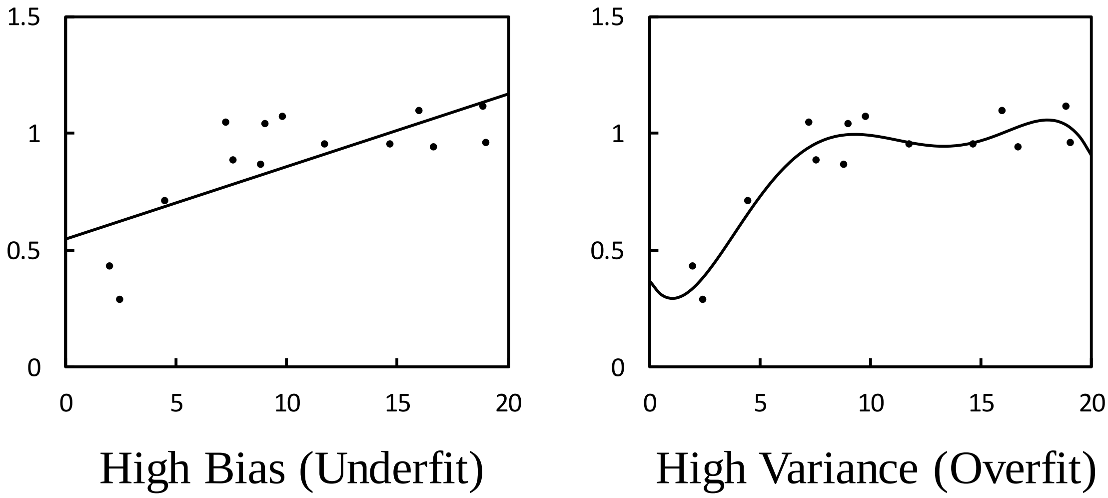


Figure 5 High bias and high variance

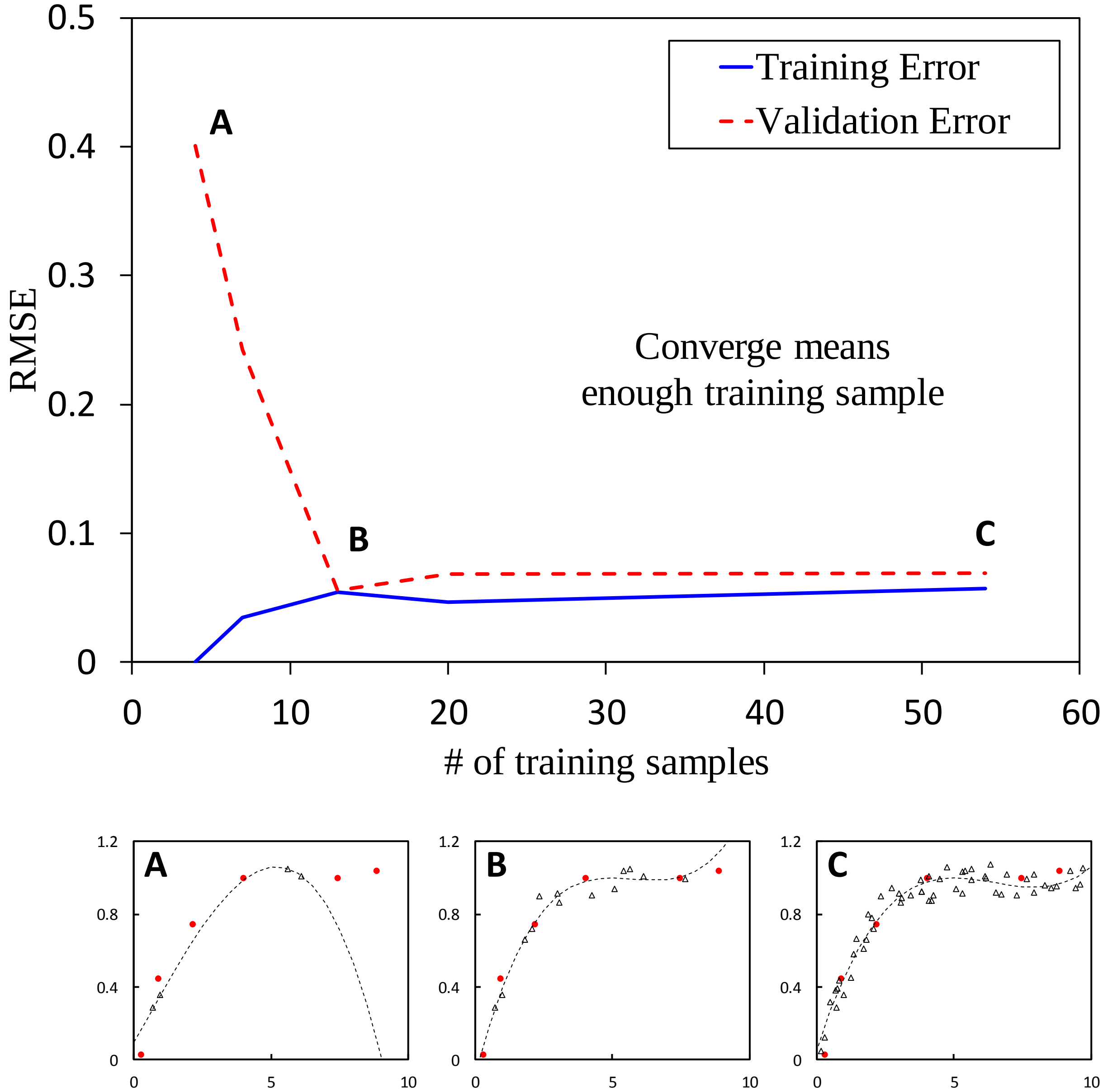


Figure 6 Learning Curve. (A) Low training sample results in low training error, but high validation error; (B) more training example help the model to generalize better; (C) at some point, increase in training sample will not affect the training and validation error.

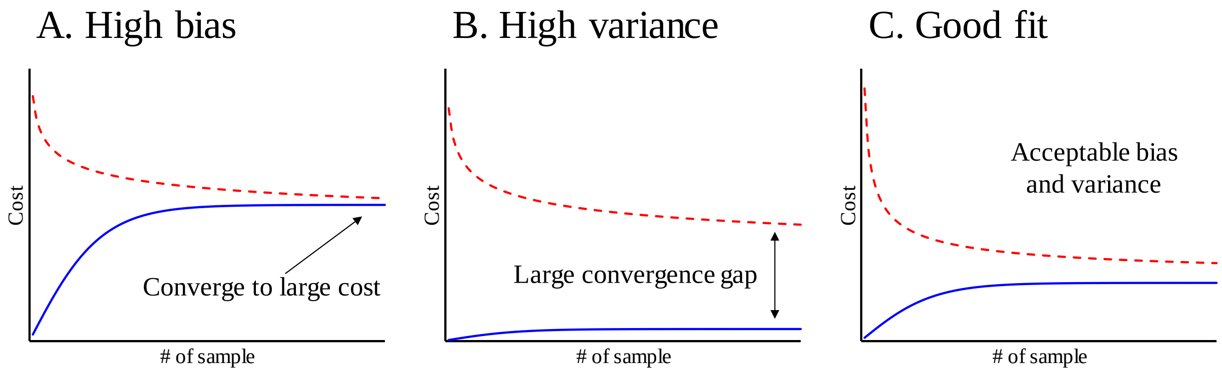


Figure 7 Typical learning curve diagnostic. (A) high bias, both error converge to a high cost; (B) high variance, low error after training, but not able to generalize for validation set; (C) good fit, good tolerance for both sample set.

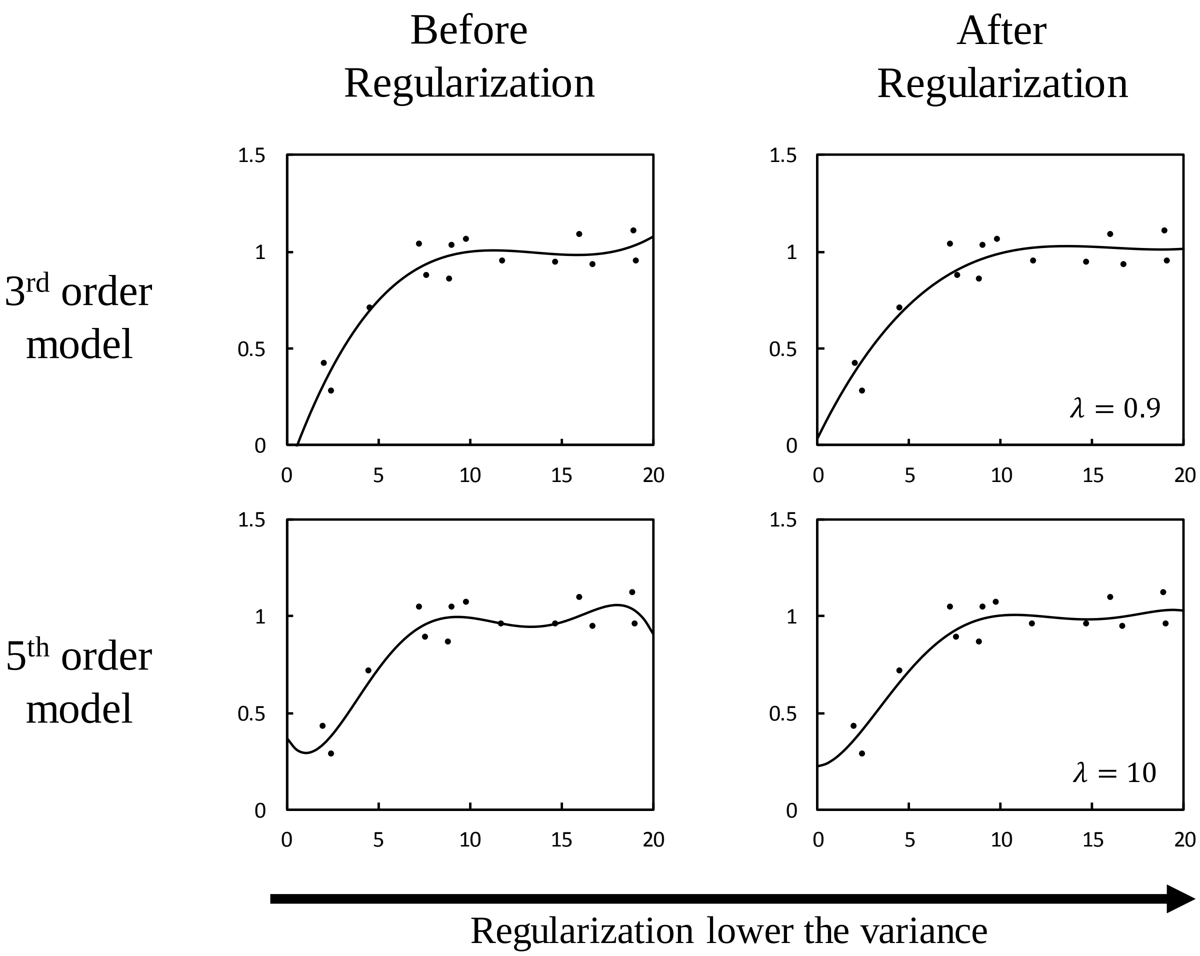


Figure 8 Effect of Regularization. Before regularization, both model have higher variance (more fluctuative model). It can provide lower error, but prone to overfit, also, did not capture the trend. After regularization, we can see that both models are smoother (have less variance), which also better in capturing the trend of data.

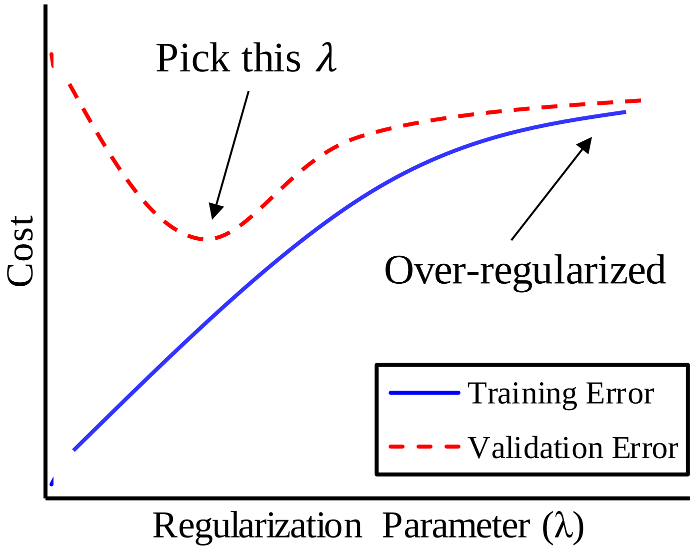
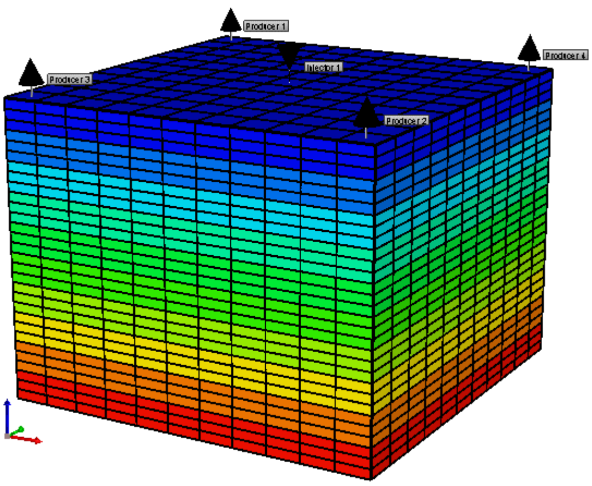


Figure 9 Typical Validation Curve. The trade-off between the increase of training error to have a lower validation error. There is a point where the increase of training error is not worth the decrease of validation error, also, too much regularization cause the model to be over-regularized, which has both high training and validation error.



Coordinate	:	cartesian
Pattern	:	Inverted 5-spot
Pattern Area	:	11.5 acres
Block thickness	:	~20 ft
Block side length	:	~75 ft
Dimension	:	11×11×30 grids

Figure 10 The base model for sample data generation.

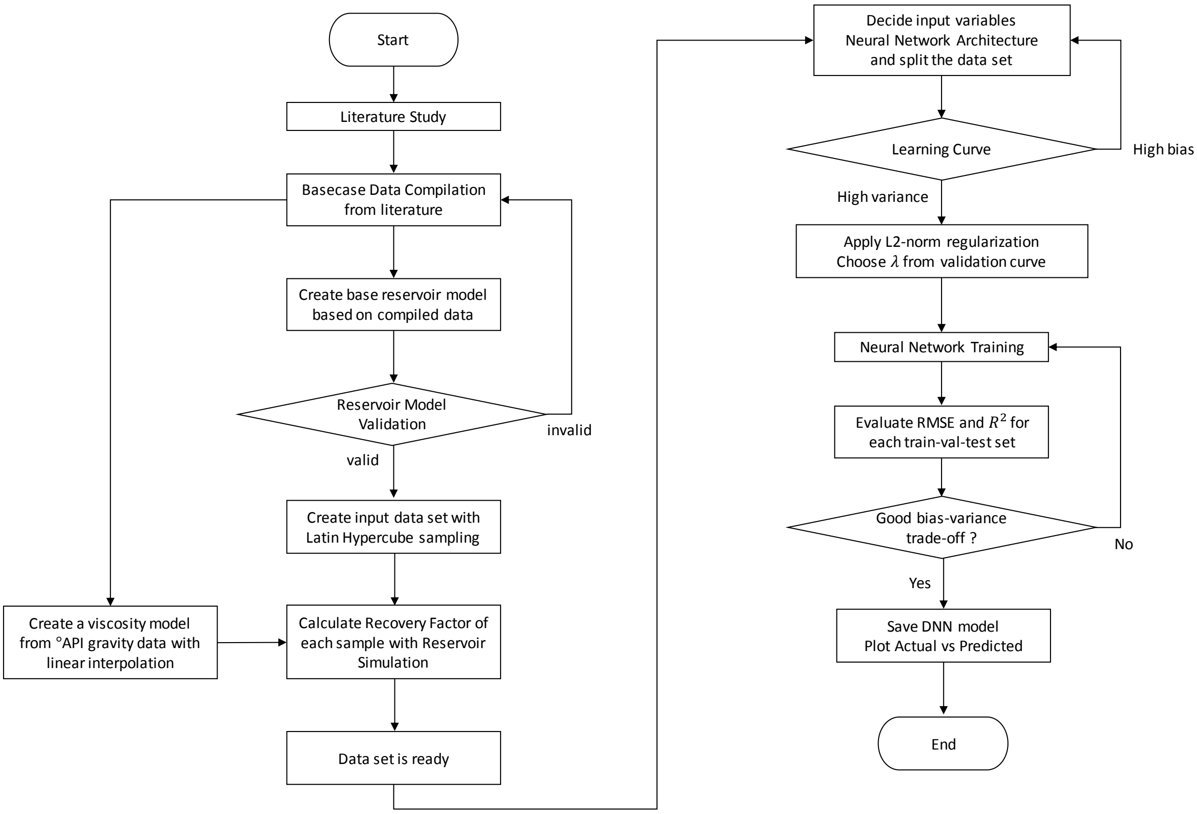


Figure 11 Flowchart showing the workflow of this study.

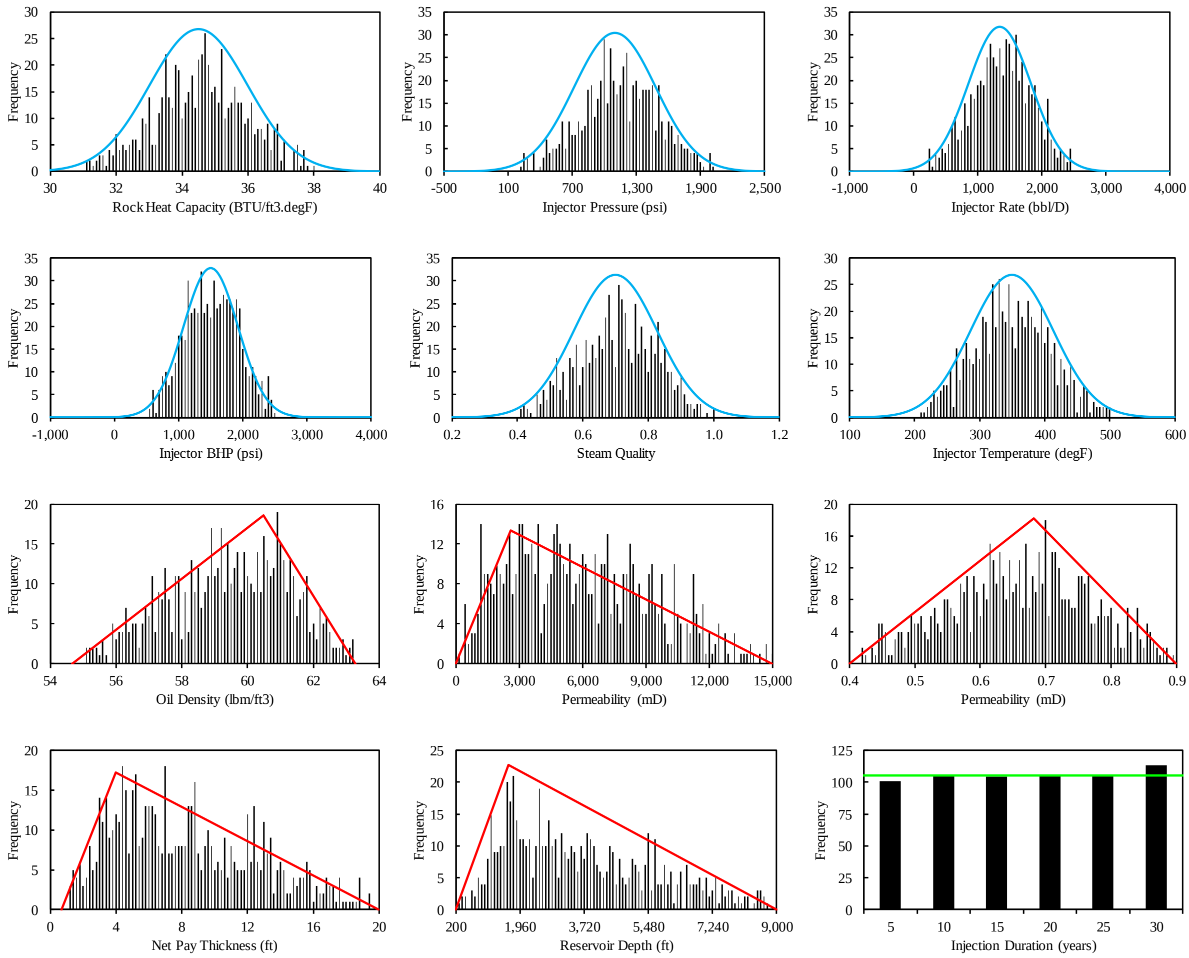


Figure 12 Specified distribution overlayed to the sampled data histogram. Overall, the Latin Hypercube sampling has provided data consistent with its specified distribution.

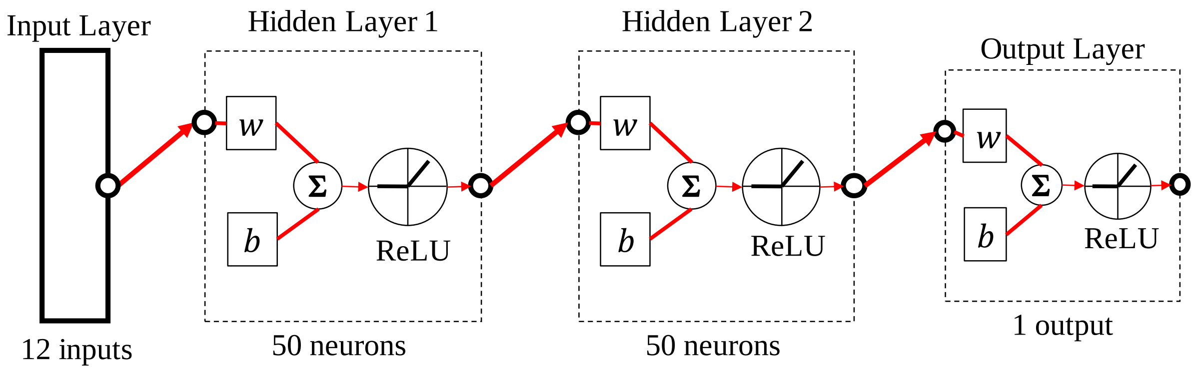


Figure 13 The DNN architecture

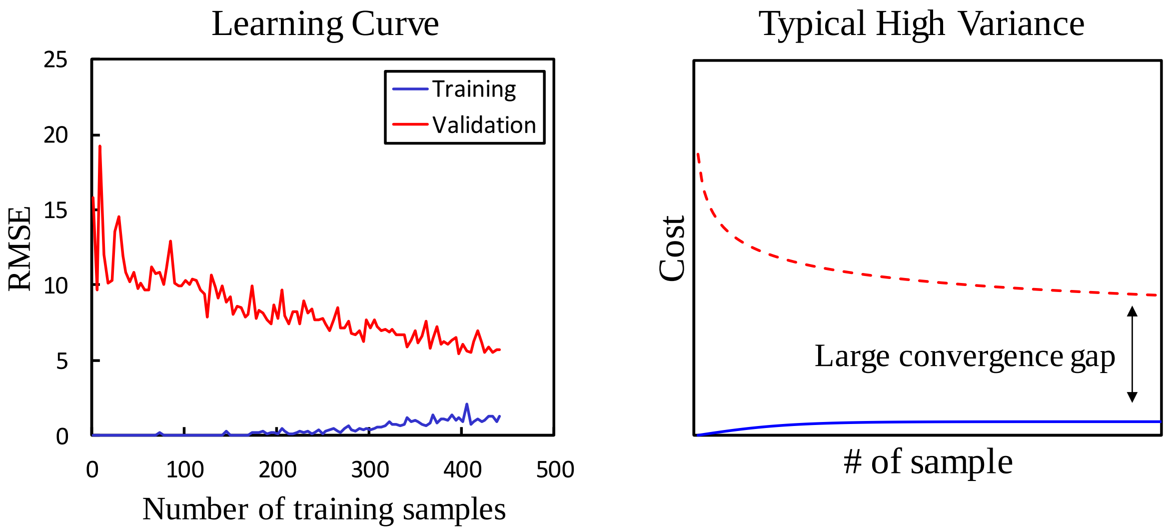


Figure 14 Learning curve result. We can deduct that the proxy model experiences a high variance problem

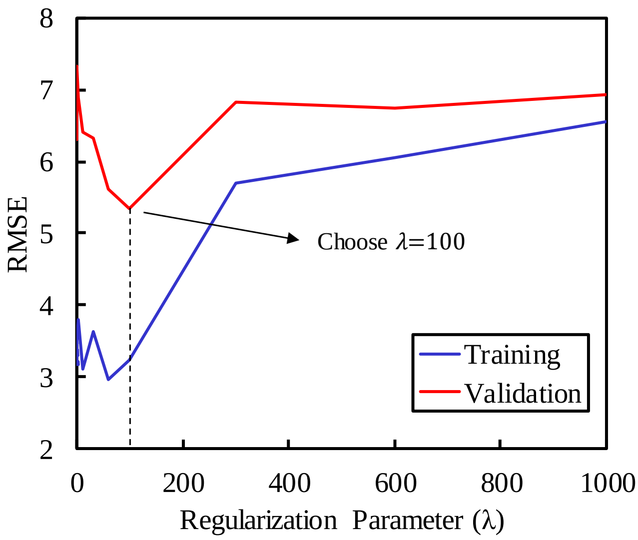


Figure 15 Validation curve of the proxy model

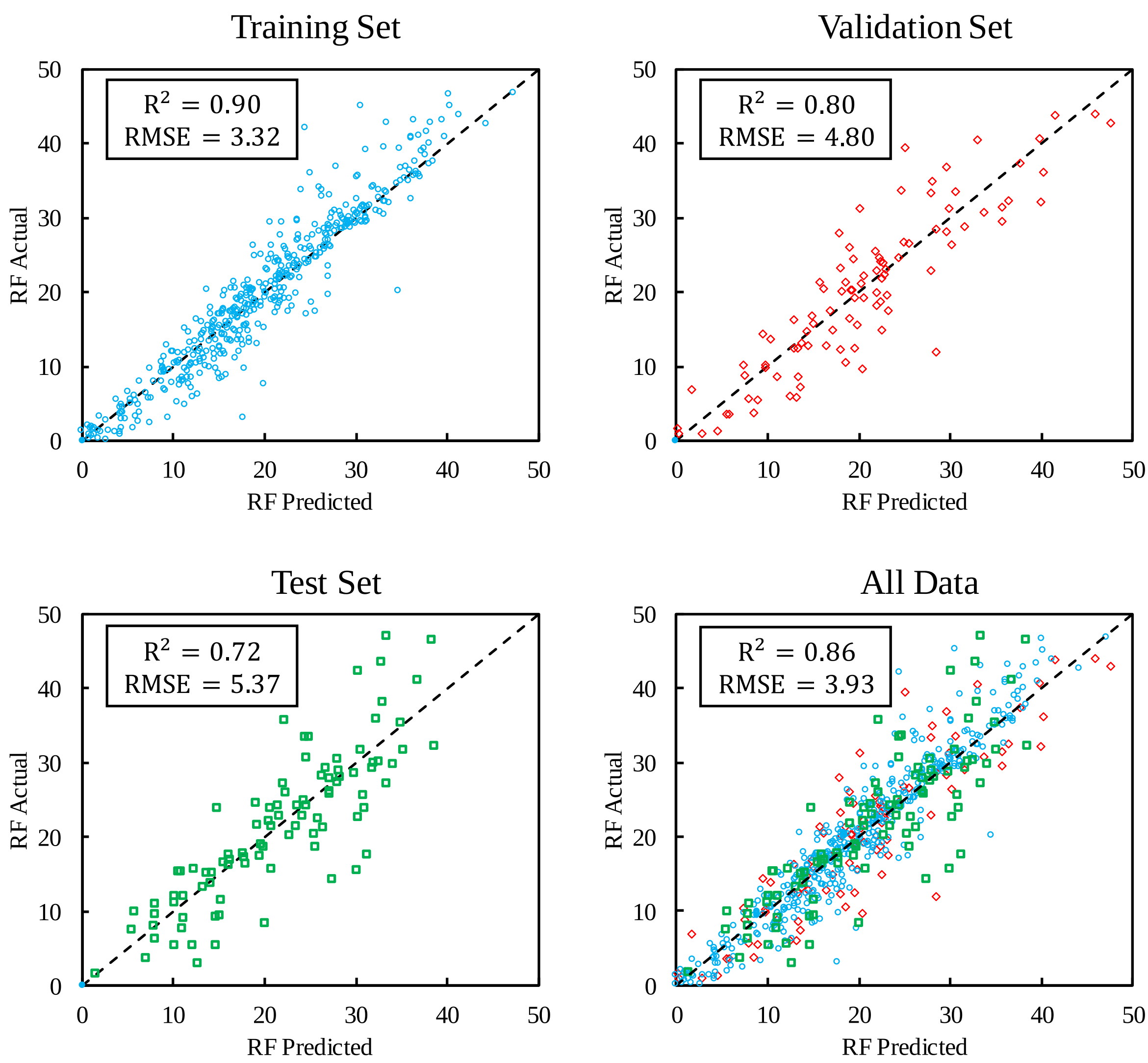


Figure 16 Actual vs Prediction plot of recovery factor.

List of Tables

Table 1 Common nonlinear activation function for ANN

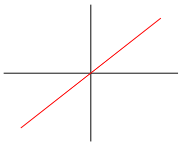
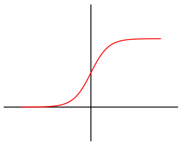
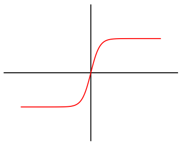
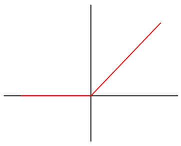
Name	Plot	Equation	Range
Identity		$f(x) = x$	(-∞,∞)
Sigmoid		$f(x) = \frac{1}{1 + e^{-x}}$	(0,1)
tanh		$f(x) = \tanh(x)$	(-1,1)
Rectified Linear Unit (ReLU)		$f(x) = \max(0, x)$	[0, ∞)

Table 2 Base model reservoir properties

Properties	Value
Top of Reservoir	$1644\ ft$
Pressure gradient	$0.465\ psi/ft$
Pressure	$712\ psi$
Temperature gradient	$0.0135\ °F/ft$
Surface temperature	$77\ °F$
Temperature	$99.5\ °F$
Gross thickness	$600\ ft$
Net pay thickness	$150\ ft$
Horizontal permeability	$2605.7\ mD$
Vertical permeability	$260.57\ mD$
Porosity	32.2%
Rock compressibility	$5.7 \cdot 10^{-5}\ psi^{-1}$
Formation heat capacity	$33.2\ BTU/ft^3.°F$
Reservoir thermal conductivity	$27.4\ BTU/ft^3.°F.day$
Formation type	Unconsolidated sand
Initial oil saturation	66%
Residual oil saturation to water	25%
Residual oil saturation to steam	10%

Irreducible water saturation	27%

Table 3 Viscosity vs oil $°API$ gravity data

$Gravity (°API)$	$Oil\ viscosity\ (cp)$
8	200000
14.5	4700
30	250

Table 4 Well constrain data

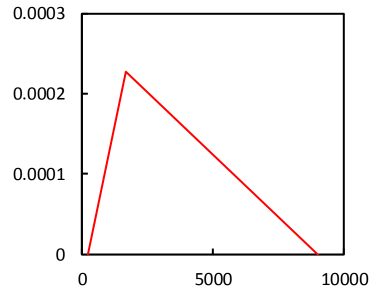
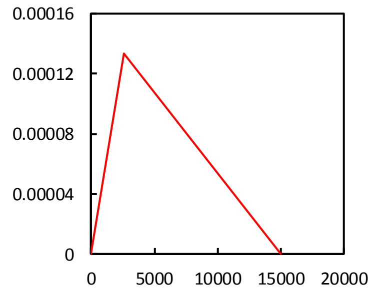
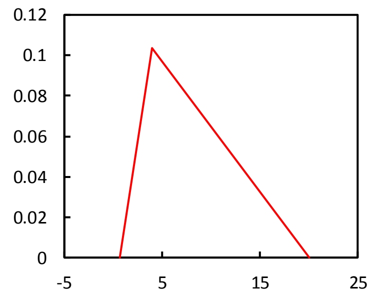
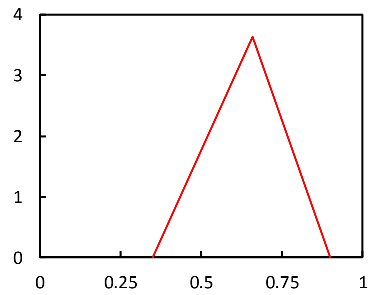
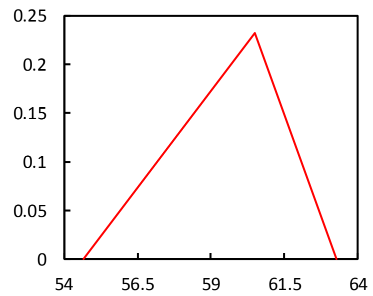
Parameter		Injection well	Production well
Simulation duration (years)		20	
Bottom hole pressure (psi) (OPERATE)		1000*	40
Bottom hole pressure (psi) (MONITOR)		250	–
Surface water rate (bbl/d) (OPERATE)		1000	–
Water cut (fraction) (MONITOR)		–	0.9999
Injected fluid (pure water)	Water mole fraction	1	–
	Temperature (^{0}F)	300	–
	Steam quality	0.7	–
	Pressure (psi)	600	–
Layer pressure gradient (psi/ft)		0.7	–

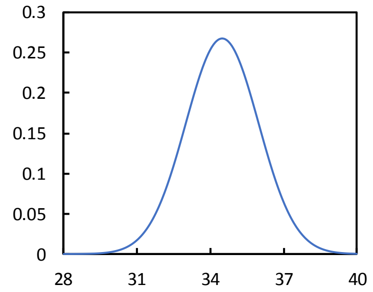
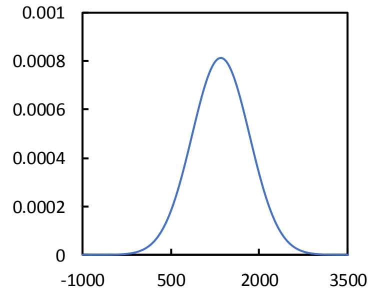
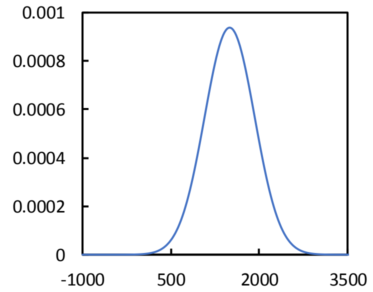
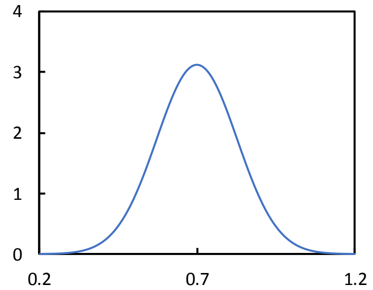
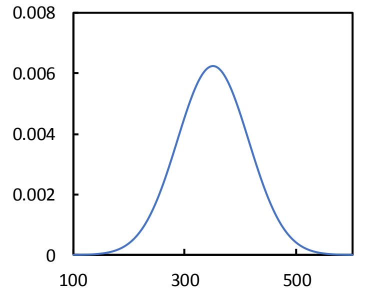
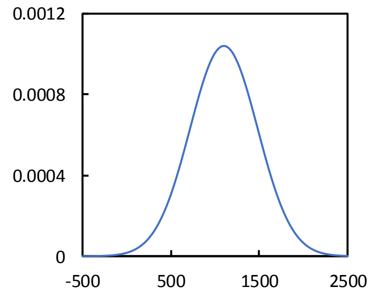
* The maximum bottom hole pressure is assumed to be set at the formation fracture pressure

Table 5 Screening criteria for steamflooding

Parameter	Data Range
Oil gravity (^{0}API)	8 – 30 [14.5]
Oil viscosity (cp)	250 – 200000 [4700]
Porosity (%)	12 – 65 [32.2]
Oil saturation (% PV)	35 – 90 [66]
Formation type	Sandstone
Permeability (mD)	1 – 15000 [2605.7]
Net thickness (ft)	[>20]
Depth (ft)	200 – 9000 [1643.6]
Temperature (^{0}F)	10 – 350 [105.8]

Table 6 Input features data range and distribution

Input Variable	**Data Range**	**Distribution Type**	**Probability Density**
Reservoir depth	200 – 9000 ft Most likely 1644 ft	Triangle	
Permeability	1 – 15000 mD Most likely 2605.7 mD	Triangle	
Net pay thickness per block	0.66667 – 20 ft Most likely 4 ft	Triangle	
Initial oil saturation	0.35 – 0.9 Most likely 0.66	Triangle	
Oil density	54.67 – 63.29 lbm/ft³ Most likely 60.48 lbm/ft	Triangle	

Heat rock capacity	31-38 BTU/(°F ft³)	Normal	
Injection rate	200 – 2500 bbl/d	Normal	
Injector BHP	500 – 2500 psi	Normal	
Steam quality	0.4 – 1	Normal	
Injection temperature	200 – 500 °F	Normal	
Injection pressure	200 – 2000 psi	Normal	

Injection duration	5, 10, 15, 20, 25, 30 years	Discrete Uniform	-

Appendix A. Full Dataset

The full dataset is presented in the table below.

ID	Type	Reservoir Depth	Injector BHP	Injection Pressure	Steam Quality	Injection Rate	Injection Temp.	Oil Density	Net Pay Thickness	Permea-bility	Rock Heat Capacity	Oil Saturation	Injection Duration	Recovery Factor
		(ft)	(psi)	(psi)		(bbl/d)	(°F)	(lbm/ft3)	(ft/block)	(mD)	(Btu/ft3.F)		(years)	(%)
1	Train	2626.8	1770.1	1498.5	0.515	1586.5	372.4	59.75	1.72	6178.5	31.5	0.654	20	35.80
2	Train	1126.4	1523.0	842.0	0.610	654.4	351.8	60.86	6.63	10214.1	34.2	0.754	30	24.81
3	Train	2679.0	1649.0	238.3	0.802	1856.4	361.1	59.41	4.95	7101.2	31.2	0.812	10	37.56
4	Train	2202.6	1600.3	1360.5	0.773	1209.8	403.3	58.66	11.07	7378.5	34.4	0.695	5	9.83
5	Train	5373.0	1496.2	1305.3	0.713	1408.5	430.6	56.99	4.33	9735.1	37.1	0.582	15	23.45
6	Train	3744.9	1525.5	1378.8	0.653	1103.0	295.7	58.54	14.09	4842.8	34.7	0.485	25	16.82
7	Test	2064.4	987.1	240.9	0.575	1005.7	312.7	60.22	16.19	7872.9	35.7	0.571	10	8.96
8	Train	7026.5	1325.0	1402.3	0.637	1642.4	325.0	57.76	10.27	747.1	34.5	0.635	10	28.77
9	Train	1100.7	582.0	1598.5	0.790	1110.0	303.3	57.21	12.22	6503.8	34.2	0.738	20	4.72
10	Train	5017.6	1605.4	1528.8	0.598	1812.0	493.9	58.22	4.02	11270.9	33.7	0.843	10	19.87
11	Train	5706.9	1280.9	1266.7	0.702	1510.8	371.2	61.05	8.02	7853.0	33.9	0.395	20	17.98
12	Train	1967.5	877.4	943.2	0.773	938.0	403.1	57.30	12.32	3318.2	35.4	0.822	20	8.48
13	Test	4369.6	2001.9	1175.6	0.934	1427.2	461.2	60.73	4.85	2514.1	35.4	0.683	25	35.85
14	Test	1617.3	1373.8	1243.5	0.580	1777.1	290.6	56.89	4.66	9429.3	35.0	0.405	25	13.78
15	Val	1237.3	1247.8	672.3	0.738	1292.7	388.3	58.38	2.29	6942.2	32.8	0.741	25	42.84
16	Train	4527.0	1228.8	1010.8	0.709	1537.8	359.8	60.72	7.36	7408.3	33.6	0.731	20	18.32
17	Val	5580.1	1431.2	1520.3	0.671	2410.8	279.1	59.45	12.32	3206.7	35.4	0.506	25	24.58
18	Test	4160.9	1535.3	838.6	0.733	1207.9	315.2	58.39	7.13	10260.9	35.8	0.629	10	17.75
19	Train	5208.2	1246.2	1693.4	0.926	1674.0	443.6	62.00	4.82	9120.5	32.7	0.763	30	18.51
20	Test	3257.3	1751.8	1665.4	0.644	1924.1	372.3	58.27	8.00	8728.5	34.7	0.577	30	15.01
21	Train	1200.7	1532.5	932.0	0.760	1367.8	326.6	61.70	2.72	8894.8	32.1	0.784	5	0.71
22	Val	8682.2	1299.3	1921.9	0.836	1153.6	367.6	57.92	5.03	3276.6	35.2	0.674	25	31.46
23	Test	7256.8	1609.8	1057.0	0.657	1050.7	325.7	60.92	8.01	5421.3	35.4	0.770	30	28.26
24	Train	3372.9	755.9	1725.4	0.838	1810.6	403.7	55.31	2.43	1599.3	31.4	0.446	25	15.63
25	Test	5646.8	1072.1	1662.6	0.634	1041.3	398.9	60.66	7.11	8417.0	36.2	0.713	15	22.88
26	Train	1130.5	2223.5	1337.3	0.722	1459.5	303.0	55.21	8.85	8588.4	31.7	0.608	5	4.83
27	Train	6522.8	974.9	986.6	0.807	240.4	406.6	58.79	4.58	7470.5	37.5	0.586	20	27.57
28	Val	866.0	2077.4	1165.4	0.758	1712.5	391.0	61.71	6.03	5550.9	37.0	0.807	20	5.92
29	Test	2394.8	1717.2	1162.0	0.622	1066.2	302.0	61.91	3.31	8473.9	34.5	0.829	15	9.89
30	Val	1752.7	1183.6	1662.1	0.597	1669.2	317.3	58.30	4.38	3230.0	33.6	0.513	10	36.87
31	Train	4474.6	1226.8	1621.8	0.549	1747.6	421.3	58.90	5.13	9031.5	35.1	0.400	30	18.75
32	Train	1626.4	1325.2	1406.6	0.622	1447.5	320.8	56.21	6.19	301.8	33.4	0.587	30	22.01
33	Train	367.0	871.7	877.5	0.495	1575.8	400.8	60.54	8.78	4304.5	35.3	0.833	5	2.84
34	Test	1562.8	1387.8	1622.5	0.711	692.4	464.2	57.21	9.68	6632.4	34.8	0.435	15	7.44
35	Train	5880.0	1622.6	236.3	0.549	1736.9	254.1	61.13	3.37	13088.0	34.4	0.573	5	23.79
36	Val	3202.3	1660.7	928.9	0.657	2062.4	350.2	61.87	6.00	12721.9	36.2	0.438	10	20.15
37	Train	2012.1	1135.1	1301.1	0.716	1693.7	345.7	62.22	2.88	2965.3	33.5	0.619	25	1.80
38	Train	1586.9	1547.3	861.3	0.665	1934.6	343.5	58.43	4.48	3396.2	34.3	0.592	20	42.73
39	Train	2507.4	1443.7	1437.6	0.552	1363.8	276.3	62.20	1.67	8057.7	36.1	0.468	5	3.73
40	Test	5095.7	1656.2	882.4	0.994	1463.2	433.1	60.60	12.96	11471.3	36.6	0.540	5	22.18
41	Test	5188.5	1129.3	1806.1	0.905	1178.1	333.7	58.46	17.28	9610.6	34.5	0.659	5	21.44
42	Val	2707.4	1070.9	1417.1	0.885	1368.0	285.8	61.37	7.93	5334.7	34.8	0.437	20	8.85
43	Train	7011.2	968.1	1270.7	0.789	1394.0	417.7	60.17	14.50	4151.5	38.0	0.510	20	30.19
44	Train	2655.6	1779.2	998.5	0.476	1889.1	273.3	60.65	3.08	8315.1	33.5	0.679	20	34.96
45	Train	3178.7	1058.9	865.8	0.639	2170.9	401.2	60.88	5.91	2447.8	32.2	0.737	25	8.23
46	Train	1039.1	2306.2	664.5	0.476	1232.8	376.0	62.23	8.40	3406.7	33.4	0.850	30	2.49
47	Train	604.7	980.2	1354.6	0.619	975.7	372.8	60.94	4.18	7434.6	33.7	0.643	15	6.62
48	Test	1881.2	1679.0	1125.6	0.567	2108.7	376.8	58.01	8.72	9824.1	33.7	0.749	15	30.53
49	Test	6561.3	1502.1	663.5	0.756	1590.9	212.0	57.47	11.56	5434.4	33.6	0.724	5	26.17
50	Train	1499.2	1640.6	1579.3	0.805	785.8	280.8	59.23	5.51	6765.3	33.8	0.604	30	26.16
51	Val	3467.4	1469.6	1327.0	0.824	1257.1	309.6	59.83	5.56	2064.2	35.6	0.592	15	14.86
52	Test	1149.6	596.4	1755.0	0.991	1484.8	366.4	58.35	9.96	10638.9	34.5	0.443	20	5.33
53	Val	2776.0	1254.2	1489.6	0.864	1227.1	459.0	59.63	17.01	1940.2	33.1	0.760	5	10.52
54	Train	1220.6	1230.7	728.0	0.770	1261.5	464.7	60.82	11.20	6855.1	34.4	0.621	15	16.41
55	Train	1769.1	2143.1	1104.6	0.706	1545.0	330.8	56.85	4.85	4710.8	35.3	0.687	30	36.28
56	Train	1108.1	1181.9	1150.5	0.869	1706.0	273.5	59.40	12.15	4766.8	31.7	0.508	15	33.54
57	Train	1672.7	1622.0	1057.6	0.723	1140.8	340.1	60.67	6.97	12326.5	36.1	0.771	10	30.57
58	Train	4578.4	1254.2	1199.9	0.803	1540.8	433.5	60.52	4.15	11615.1	35.9	0.865	5	18.04
59	Val	1725.1	1573.4	748.9	0.556	1956.1	395.3	58.57	19.36	11001.4	35.7	0.623	20	7.31
60	Test	659.3	1747.8	1469.9	0.502	935.3	381.8	60.05	12.32	7483.4	34.5	0.525	25	24.53
61	Train	1858.1	1765.4	226.1	0.540	944.1	281.2	57.51	3.03	7222.3	32.8	0.516	5	23.63
62	Train	5425.6	928.7	1244.3	0.687	920.7	248.9	57.06	13.81	6187.7	34.9	0.687	10	22.21
63	Test	8606.4	928.9	704.3	0.690	1751.4	388.5	60.30	6.52	6803.0	36.5	0.810	25	30.03
64	Train	6299.5	1247.3	1337.0	0.523	1041.5	318.1	59.58	3.28	4625.6	34.5	0.665	15	25.94
65	Train	2626.0	2126.6	441.5	0.579	1697.9	394.4	55.23	3.33	5214.5	35.1	0.565	5	14.17
66	Train	3938.6	1234.0	1353.9	0.583	1419.0	374.8	60.30	8.70	2421.2	35.1	0.676	20	16.26
67	Train	5566.1	1107.1	805.1	0.680	1577.5	260.8	62.82	14.03	2725.5	33.8	0.654	20	9.21
68	Train	4610.5	1087.1	1380.3	0.605	1411.6	390.7	57.86	3.88	8554.9	36.2	0.679	15	19.21
69	Train	4719.7	931.5	1125.4	0.756	1258.8	277.4	60.12	6.32	8726.8	34.6	0.638	20	19.83
70	Train	3650.1	1873.8	940.3	0.824	840.8	292.5	61.36	13.14	3406.6	33.4	0.556	15	14.45
71	Train	6470.7	992.4	868.6	0.577	1976.7	344.2	60.99	2.38	5125.4	33.4	0.582	25	27.17
72	Train	1761.7	2002.7	1502.9	0.539	1424.4	328.1	61.76	6.12	9255.1	33.4	0.770	15	11.77
73	Train	2145.1	1328.9	991.1	0.759	2065.5	290.4	59.23	9.36	2330.0	35.2	0.615	25	42.85

ID	Type	Reservoir Depth (ft)	Injector BHP (psi)	Injection Pressure (psi)	Steam Quality	Injection Rate (bbl/d)	Injection Temp. (°F)	Oil Density (lbm/ft3)	Net Pay Thickness (ft/block)	Permea-bility (mD)	Rock Heat Capacity (Btu/ft3.F)	Oil Saturation	Injection Duration (years)	Recovery Factor (%)
74	Train	1532.1	934.3	1537.4	0.880	1508.3	310.0	60.00	12.83	4990.2	34.1	0.693	30	35.49
75	Train	4784.9	1297.6	1341.1	0.814	1053.9	342.7	57.38	4.93	3367.4	35.7	0.634	10	20.10
76	Test	2944.5	1333.1	1304.0	0.789	1137.4	347.3	61.14	15.74	4560.9	35.1	0.688	25	15.25
77	Train	1131.8	971.6	1426.1	0.847	740.7	406.0	61.59	2.22	6036.0	35.9	0.680	15	1.19
78	Train	3303.0	786.2	1696.6	0.592	1973.7	343.2	55.20	12.29	2713.3	33.3	0.721	20	13.54
79	Train	2396.3	1544.0	1704.8	0.852	1450.0	382.2	62.19	3.91	3779.6	36.9	0.578	30	4.36
80	Train	1285.2	1812.3	857.5	0.756	1160.2	318.7	59.85	8.69	3841.1	33.6	0.388	5	17.21
81	Train	2903.7	1816.7	1278.9	0.751	1409.3	289.5	58.96	1.87	11373.0	34.9	0.408	30	18.86
82	Train	1759.8	1339.1	1418.5	0.513	1314.8	373.3	59.67	3.75	7103.5	32.4	0.630	20	31.67
83	Train	7965.1	1724.3	983.7	0.703	1655.3	321.6	60.40	2.71	9949.2	31.7	0.692	10	29.50
84	Train	6244.0	1100.5	528.3	0.758	388.6	355.1	58.04	8.14	2776.8	32.3	0.785	10	24.58
85	Train	4553.0	1901.3	1503.5	0.720	380.1	375.1	58.91	13.08	12439.9	34.5	0.589	10	19.55
86	Train	3503.5	1540.2	1208.1	0.672	1557.8	391.6	59.93	2.82	6391.1	33.6	0.634	10	18.62
87	Train	1759.2	1012.7	1259.8	0.716	828.9	377.5	60.73	10.81	2729.3	36.6	0.685	30	9.00
88	Train	4678.9	1940.0	984.8	0.663	1449.6	316.4	58.40	4.79	3478.9	35.1	0.683	20	19.26
89	Train	1574.4	1297.5	991.2	0.653	1287.2	264.9	61.23	10.34	14349.1	35.6	0.765	5	5.77
90	Train	1641.9	1606.7	1088.3	0.759	1406.9	426.0	56.28	8.02	7112.2	33.6	0.669	10	8.40
91	Train	5608.8	1548.0	956.5	0.813	1886.6	293.1	62.96	15.59	7091.3	32.6	0.534	30	17.79
92	Train	2004.8	1546.8	735.2	0.784	798.2	329.8	57.52	12.38	3769.3	36.0	0.454	15	9.59
93	Val	2345.0	1492.5	1056.8	0.891	1583.8	239.9	55.88	15.12	10482.0	35.9	0.689	25	9.81
94	Train	3835.3	1853.5	926.5	0.678	936.1	372.3	60.47	5.26	1143.1	33.6	0.464	15	28.53
95	Train	1781.6	1674.7	713.4	0.595	991.2	313.4	59.85	2.11	1857.2	33.2	0.775	30	35.69
96	Train	5633.8	1182.4	643.7	0.700	1265.9	350.4	61.71	11.59	13160.5	34.4	0.598	15	23.39
97	Train	7490.1	1075.3	1333.7	0.677	1273.5	292.9	56.12	4.29	11373.7	37.5	0.620	10	30.09
98	Train	2103.9	1455.6	1444.6	0.590	1126.5	323.2	57.65	10.84	3515.1	33.3	0.700	15	10.91
99	Val	1880.6	1889.2	1253.9	0.434	2427.5	243.9	61.18	9.47	1421.2	36.0	0.642	20	3.68
100	Train	3107.5	1920.6	1532.2	0.800	1872.2	344.9	57.83	15.72	1173.0	35.5	0.573	30	42.12
101	Test	571.0	1854.8	767.5	0.860	1861.9	396.7	58.25	2.68	10500.8	34.9	0.575	10	46.41
102	Val	6723.9	1439.8	261.1	0.665	802.2	260.1	60.89	7.42	2523.6	34.6	0.656	5	17.45
103	Train	3601.8	1064.5	998.6	0.620	1813.4	330.1	58.94	8.88	3015.0	34.3	0.713	15	14.77
104	Test	4333.4	1948.2	1335.6	0.627	645.4	333.4	56.40	17.48	4310.8	36.3	0.758	5	17.61
105	Train	1737.5	1114.8	1208.6	0.712	1483.4	359.2	60.43	2.53	8457.9	34.6	0.835	25	40.60
106	Train	2349.6	1710.9	827.0	0.600	1160.9	261.3	60.00	7.98	2078.0	33.9	0.697	20	39.16
107	Val	1786.9	1326.3	1122.9	0.896	1106.1	356.5	57.43	3.35	3812.7	37.0	0.709	5	33.54
108	Train	1567.3	1112.6	1240.3	0.764	1597.1	324.6	57.31	4.32	8230.7	34.8	0.563	5	27.54
109	Train	1824.8	1354.9	1571.9	0.716	666.9	426.2	59.57	8.67	6625.5	34.6	0.750	30	8.46
110	Train	2519.7	1550.1	1177.0	0.836	1478.1	378.0	59.86	4.03	2996.9	35.3	0.528	15	35.59
111	Test	5763.5	1941.1	863.3	0.664	955.1	302.0	59.57	9.76	4979.6	33.8	0.399	10	22.54
112	Train	8448.7	1498.8	898.6	0.826	1229.1	414.3	57.15	2.19	9663.8	32.6	0.689	15	30.66
113	Train	1550.9	1423.1	1207.0	0.632	1660.9	366.4	60.11	5.02	10452.2	35.0	0.711	20	33.31
114	Test	1063.8	1351.3	941.0	0.514	2194.5	394.7	58.79	4.52	8164.4	34.6	0.514	5	32.27
115	Test	4491.0	1624.6	1195.6	0.724	1569.5	395.8	59.04	13.77	3757.1	37.0	0.670	5	18.59
116	Train	4430.3	1294.4	740.9	0.743	2072.7	375.3	59.84	9.04	1064.8	36.7	0.571	15	19.07
117	Test	4007.4	1406.5	1152.9	0.708	1124.5	435.3	57.28	6.55	11594.1	33.0	0.673	25	16.83
118	Train	1487.0	1801.1	272.4	0.509	1302.3	380.3	61.42	10.57	3276.0	33.5	0.692	5	0.61
119	Train	3817.6	1272.4	824.6	0.736	1462.0	278.5	61.23	7.96	9559.4	36.4	0.666	25	14.96
120	Train	4217.5	1104.1	1099.5	0.885	1217.6	253.2	57.74	17.60	6252.4	33.1	0.505	15	18.93
121	Val	5706.0	1717.9	947.4	0.534	1464.6	375.7	58.90	8.49	4125.6	33.0	0.719	10	22.99
122	Test	2608.2	1308.6	879.2	0.633	1709.7	367.8	59.15	16.01	1681.7	34.6	0.849	30	42.32
123	Train	3249.5	1483.3	1829.0	0.725	1733.8	349.2	57.71	9.73	7844.3	34.5	0.409	15	15.39
124	Train	4894.2	1560.0	1164.6	0.699	1564.4	354.9	59.22	12.32	2429.6	32.5	0.647	30	20.55
125	Val	1586.7	936.4	1264.7	0.501	1816.3	309.6	61.25	10.24	1308.1	35.5	0.520	20	1.31
126	Val	5113.3	2130.3	1166.6	0.681	1313.5	412.2	58.23	6.82	6386.3	34.5	0.492	10	22.96
127	Train	5848.5	1686.8	323.9	0.724	1844.3	310.9	62.34	5.08	1711.8	32.4	0.737	20	8.17
128	Train	2414.8	1930.5	1201.3	0.559	2060.8	427.0	58.87	6.06	7026.4	34.3	0.556	25	28.06
129	Test	8409.8	1402.2	989.2	0.641	901.6	278.0	59.04	7.20	10250.7	32.5	0.766	30	29.80
130	Test	3080.5	1727.0	868.8	0.814	1895.2	262.0	58.83	5.48	4229.8	36.0	0.430	25	18.62
131	Train	1006.3	1838.4	1988.3	0.590	200.2	375.9	60.98	2.92	746.3	36.4	0.699	10	0.19
132	Train	7522.2	1521.2	1527.5	0.642	1566.4	271.1	59.56	5.62	4328.9	36.2	0.668	10	29.61
133	Train	6743.6	1215.9	1541.4	0.652	1257.5	398.3	60.46	11.23	8089.8	33.9	0.777	15	26.27
134	Train	4802.3	1251.0	817.2	0.641	1427.4	414.6	59.80	18.70	1567.1	33.7	0.395	20	18.71
135	Train	753.9	1428.8	949.1	0.858	593.0	378.3	60.37	2.34	5753.8	34.3	0.662	10	29.45
136	Train	7764.4	1603.0	1099.8	0.707	1796.0	260.2	56.24	5.43	3142.3	35.5	0.693	10	29.16
137	Train	7343.3	1870.7	1532.3	0.684	1027.4	349.0	60.51	7.07	5553.5	35.2	0.697	5	29.01
138	Train	1638.2	1552.8	1087.3	0.802	1618.5	277.8	60.46	18.76	1642.3	35.0	0.607	10	24.16
139	Val	2840.5	1965.2	1087.4	0.669	1908.9	285.7	60.81	4.93	11202.2	33.8	0.635	25	33.27
140	Train	4672.1	2383.6	1470.3	0.790	1047.8	326.5	61.33	17.60	8191.6	34.7	0.589	10	19.07
141	Train	5611.1	1839.1	689.6	0.787	1476.1	302.4	56.87	3.88	5718.0	36.8	0.666	25	23.20
142	Train	3663.2	1243.3	497.8	0.678	1415.6	363.9	55.83	12.68	4947.0	36.4	0.457	25	16.93
143	Train	1769.0	2062.4	1171.8	0.637	1864.6	361.0	61.16	7.05	7916.4	32.9	0.753	30	25.62
144	Train	1516.8	2194.2	1057.5	0.555	1918.4	332.6	58.47	5.98	4853.0	34.5	0.545	30	34.88
145	Train	4259.3	1438.9	1555.2	0.614	1599.4	484.8	59.56	4.46	1184.8	35.8	0.508	25	19.02
146	Train	5877.7	875.6	1134.8	0.679	1254.5	393.5	61.09	2.71	5082.2	33.2	0.787	10	20.38
147	Train	2370.4	1630.7	1570.3	0.703	1761.1	279.2	60.06	14.55	6781.9	33.7	0.663	10	11.04
148	Val	2431.8	1585.2	937.5	0.773	1155.8	354.3	58.34	6.21	2749.7	34.9	0.636	25	34.96
149	Test	1516.9	1305.2	1607.0	0.451	1251.9	311.2	56.66	6.93	9107.2	34.8	0.672	10	7.69
150	Train	3736.4	1724.0	1887.3	0.773	1466.6	332.0	60.29	13.19	3163.1	33.4	0.496	5	17.71
151	Train	2509.9	1799.7	1339.2	0.561	1907.9	271.0	62.05	2.84	8446.5	34.0	0.534	25	15.88
152	Val	3710.9	1869.8	1053.7	0.521	2071.2	379.6	61.33	13.22	2952.3	34.2	0.588	25	15.83
153	Val	1717.3	1806.9	938.7	0.670	1968.2	327.5	56.85	5.27	9206.2	35.1	0.563	25	26.09
154	Train	2462.7	1664.4	1572.4	0.761	1222.4	329.4	58.76	11.94	4676.4	35.3	0.690	15	11.56
155	Train	1160.3	1743.2	604.9	0.536	1598.2	407.9	60.26	4.31	3565.9	32.7	0.785	30	43.86
156	Train	913.9	2005.8	555.1	0.894	2003.5	281.3	57.74	4.25	1956.1	35.0	0.582	5	19.67

ID	Type	Reservoir Depth	Injector BHP	Injection Pressure	Steam Quality	Injection Rate	Injection Temp.	Oil Density	Net Pay Thickness	Permea-bility	Rock Heat Capacity	Oil Saturation	Injection Duration	Recovery Factor
		(ft)	(psi)	(psi)		(bbl/d)	(°F)	(lbm/ft3)	(ft/block)	(mD)	(Btu/ft3.F)		(years)	(%)
157	Train	1882.8	1388.7	1362.5	0.829	993.9	390.6	57.86	18.29	5455.2	34.3	0.665	25	7.88
158	Train	3917.0	1682.8	954.0	0.629	1179.7	337.7	58.50	9.51	6007.6	34.8	0.483	20	17.73
159	Train	2409.4	2087.2	966.8	0.668	1849.9	415.6	60.81	1.13	9702.0	31.8	0.567	10	31.49
160	Train	1621.7	993.0	919.5	0.511	1369.0	281.6	60.91	14.38	1928.1	33.4	0.878	10	1.18
161	Train	904.7	1723.5	1190.6	0.592	1291.4	423.1	60.42	13.81	1495.3	34.1	0.420	20	32.99
162	Train	5437.4	1758.4	1345.7	0.846	555.8	407.8	60.40	2.89	2350.7	34.6	0.547	10	23.73
163	Val	1147.1	1067.6	417.1	0.459	1168.1	332.4	60.27	18.14	6598.0	36.4	0.737	25	27.94
164	Test	5402.7	2049.3	916.4	0.816	1122.9	400.7	61.79	8.22	1304.2	32.9	0.545	5	2.96
165	Train	781.0	1367.1	1319.1	0.659	1605.9	312.9	57.43	2.71	8061.5	36.8	0.643	5	34.65
166	Train	1109.8	1246.3	276.6	0.683	1293.6	385.7	60.85	9.00	11973.7	37.4	0.692	20	28.20
167	Train	2679.5	1731.5	910.3	0.762	1562.2	377.3	59.71	12.85	1098.9	32.7	0.524	5	18.92
168	Test	3576.3	1898.3	792.0	0.773	781.5	301.2	57.01	7.26	5800.9	34.1	0.749	20	15.16
169	Train	7109.6	1859.4	905.3	0.704	1590.1	299.2	59.86	5.43	5946.9	36.0	0.582	10	29.70
170	Test	1793.5	868.8	910.3	0.745	975.8	315.5	60.63	7.71	2995.2	33.7	0.614	20	15.24
171	Test	4262.9	1822.3	1456.2	0.757	1613.8	391.5	59.91	8.48	6040.6	33.3	0.710	30	17.41
172	Train	1430.4	1854.2	1047.4	0.922	1673.9	345.0	56.76	13.41	4874.2	35.5	0.451	25	7.50
173	Train	6266.3	2076.4	1193.9	0.566	762.5	335.9	57.05	5.65	8197.8	34.2	0.602	5	26.99
174	Train	2316.6	1480.2	483.4	0.687	1330.5	314.6	61.46	3.16	7120.9	35.1	0.495	20	16.91
175	Train	4938.1	1654.6	857.6	0.555	511.0	359.4	57.49	8.99	6163.6	33.8	0.586	30	21.26
176	Train	2051.7	1877.0	984.0	0.613	1907.7	427.2	62.67	17.90	4064.9	34.0	0.627	15	3.28
177	Train	2460.0	1443.1	1179.5	0.624	1151.2	336.3	60.42	5.06	11418.9	35.2	0.646	30	12.23
178	Train	1320.2	1826.1	594.0	0.869	1296.2	318.8	59.49	10.54	6625.5	35.1	0.588	10	29.70
179	Train	2820.3	1333.0	1671.9	0.516	1016.1	306.1	60.94	2.53	4112.5	36.6	0.439	5	7.87
180	Train	6239.2	726.9	601.1	0.830	1807.1	351.3	57.58	4.13	5580.9	35.0	0.630	10	25.98
181	Test	4306.2	2219.5	1138.8	0.640	945.5	390.7	58.09	1.59	7212.0	36.1	0.854	10	20.11
182	Train	3073.8	2107.2	1052.5	0.663	2107.8	374.7	60.08	5.29	4410.7	36.0	0.829	25	41.58
183	Train	4407.0	1341.2	1251.5	0.836	1009.2	321.1	56.83	11.72	7825.7	35.7	0.565	20	19.18
184	Train	1315.0	933.9	1330.4	0.551	832.0	309.1	58.99	13.29	5893.8	32.6	0.461	5	6.05
185	Test	6583.7	1743.5	1077.0	0.712	1302.0	294.4	58.26	3.50	3524.2	33.7	0.614	5	27.41
186	Val	8548.0	971.3	1261.9	0.616	920.5	396.1	58.50	12.06	8950.7	35.3	0.447	10	32.39
187	Train	2332.5	2299.5	1231.7	0.874	1100.3	383.8	59.12	6.06	5081.6	34.8	0.640	5	30.31
188	Train	3923.3	1484.3	1114.7	0.629	633.6	380.9	56.14	3.21	3633.6	34.0	0.536	25	17.42
189	Val	3223.6	1936.5	1646.1	0.820	1101.0	418.9	58.00	4.37	6526.2	31.9	0.599	10	15.52
190	Train	1899.7	1793.1	1066.3	0.745	1232.5	491.7	58.81	7.70	5896.4	36.4	0.640	25	29.59
191	Train	2579.8	1609.3	923.9	0.791	1411.0	404.5	58.06	13.97	11193.4	32.8	0.483	10	11.85
192	Val	7145.6	792.1	1298.4	0.751	1010.2	280.5	57.50	6.87	5763.9	33.5	0.727	30	28.55
193	Train	3818.9	1902.7	998.5	0.695	1046.2	342.1	60.22	4.61	2193.2	33.6	0.607	30	34.16
194	Val	1867.9	1922.5	796.7	0.823	1481.5	364.2	58.96	4.90	2983.4	33.0	0.652	20	43.81
195	Train	1680.6	2088.9	1316.6	0.536	969.1	370.3	60.51	11.65	2096.0	34.5	0.491	20	30.27
196	Train	5155.2	1147.3	851.3	0.803	1723.5	349.5	60.66	6.35	4405.7	34.5	0.650	20	21.47
197	Train	1971.6	1996.8	1167.2	0.641	1424.5	234.4	59.01	6.84	4555.9	35.0	0.607	15	31.55
198	Val	1285.9	1228.4	1176.4	0.793	1793.3	349.1	59.07	2.47	9175.6	35.9	0.771	30	43.99
199	Val	5430.8	1668.8	1213.3	0.468	1116.1	383.9	61.43	7.89	1927.2	34.8	0.562	5	5.40
200	Train	3236.0	1818.2	1076.6	0.569	530.4	344.4	60.19	4.04	7718.9	33.5	0.561	25	15.14
201	Train	3753.5	1124.8	1674.5	0.689	1128.6	343.9	59.06	11.24	4806.4	33.8	0.605	25	16.04
202	Train	4134.7	1251.1	1395.4	0.861	2277.4	215.1	55.18	10.52	5621.2	34.9	0.712	20	17.29
203	Train	5372.1	1695.0	1077.0	0.761	2334.1	268.7	58.63	8.23	8374.9	35.1	0.594	15	22.80
204	Train	6836.8	1906.9	1005.9	0.745	1429.6	320.5	59.95	1.53	3466.6	35.5	0.608	10	28.48
205	Train	1909.6	1295.2	451.1	0.646	1656.4	390.1	59.11	5.25	6071.2	35.3	0.551	30	29.13
206	Train	2939.9	1776.0	1362.0	0.576	1795.2	331.9	62.41	11.04	941.7	34.2	0.476	30	1.63
207	Train	3103.1	1063.6	1325.9	0.692	1464.2	331.3	59.69	2.21	2098.6	35.4	0.577	5	12.48
208	Train	1670.6	1788.8	1682.7	0.765	799.0	323.1	60.97	3.26	2208.3	35.1	0.616	10	2.93
209	Train	1910.6	1443.0	1310.6	0.621	2264.4	413.5	58.06	6.06	6685.4	32.6	0.677	15	36.13
210	Train	840.2	1966.6	1144.8	0.811	434.1	293.5	60.95	14.05	1272.7	34.2	0.663	5	0.14
211	Test	322.7	2008.4	1753.3	0.743	2030.2	396.6	59.08	3.72	10225.9	35.6	0.502	30	47.08
212	Test	789.8	1420.4	1008.4	0.705	1261.8	310.8	59.04	11.33	9661.7	37.4	0.881	5	27.12
213	Train	5342.4	1849.1	1536.2	0.412	561.8	336.7	55.38	6.45	8299.3	32.8	0.484	30	24.52
214	Test	1413.0	587.3	608.0	0.663	1164.3	230.2	59.45	11.81	12409.4	34.7	0.541	10	5.40
215	Train	4955.6	1326.6	940.1	0.802	1761.8	344.2	61.70	8.69	2695.3	35.6	0.531	15	10.45
216	Train	4003.0	2014.0	476.0	0.890	1460.0	342.7	59.23	8.39	1366.8	35.1	0.816	10	43.13
217	Train	2159.1	1194.0	1306.5	0.678	1051.6	250.2	60.98	7.40	4581.2	35.5	0.500	5	4.50
218	Train	1685.1	1975.0	857.0	0.486	1108.4	308.8	59.14	5.68	9170.9	33.1	0.541	10	22.26
219	Train	2889.6	1941.6	837.0	0.778	1675.9	393.4	59.69	9.50	8699.9	34.5	0.599	5	13.48
220	Train	8111.3	1827.1	573.7	0.631	1345.2	358.4	56.84	1.32	1184.6	36.6	0.545	25	31.92
221	Train	3174.8	1542.1	911.3	0.839	1322.4	340.3	59.63	8.88	5059.1	36.5	0.556	30	15.05
222	Test	7058.1	711.7	891.9	0.775	1643.5	411.3	59.45	18.75	7242.4	33.6	0.644	5	28.64
223	Train	4893.8	721.3	1009.6	0.666	871.0	333.4	61.26	3.95	388.0	32.8	0.515	5	1.26
224	Train	2218.9	1400.7	1279.2	0.471	1751.9	439.1	57.77	12.83	2921.5	32.4	0.756	5	32.75
225	Train	5030.1	1139.8	1283.8	0.770	1455.5	369.9	59.18	13.71	7171.3	35.5	0.715	25	20.51
226	Test	3759.4	738.4	1326.8	0.822	961.0	386.2	57.07	8.99	2542.5	33.5	0.693	10	15.64
227	Train	1656.3	1966.5	595.7	0.730	2341.7	277.1	57.54	8.64	2119.8	32.0	0.778	30	46.73
228	Train	7456.0	2305.4	538.7	0.699	1447.4	374.7	60.84	6.06	6002.2	35.0	0.574	15	30.80
229	Train	4746.4	920.6	782.3	0.762	1875.8	250.3	60.49	1.34	3066.2	36.7	0.590	10	20.47
230	Val	1559.2	1393.2	446.3	0.594	1019.5	421.4	61.09	5.13	3117.4	33.8	0.636	5	0.92
231	Test	6735.0	1127.8	813.1	0.712	1760.6	257.8	58.90	12.25	4005.4	34.5	0.597	10	28.07
232	Train	2916.5	930.7	897.8	0.512	1247.2	278.2	58.16	9.20	7788.4	34.0	0.451	15	13.29
233	Train	4393.2	1871.2	1001.4	0.687	1888.4	325.0	59.92	5.93	12289.1	33.0	0.649	25	18.54
234	Train	1907.9	1614.7	1684.9	0.721	1694.4	384.1	56.32	15.06	3075.7	35.7	0.743	30	9.73
235	Val	5433.0	1212.1	1393.9	0.759	992.2	263.7	60.54	13.23	7304.8	34.5	0.634	10	22.46
236	Train	5016.7	983.9	1045.6	0.644	1917.3	364.8	62.23	5.35	4597.2	35.6	0.798	25	12.03
237	Train	6040.7	1557.8	1645.7	0.654	1609.8	355.1	60.53	2.99	9452.2	35.9	0.716	30	24.36
238	Train	2059.8	1330.3	1330.4	0.655	916.7	461.6	57.51	9.55	10588.6	37.3	0.437	30	9.68
239	Test	6884.3	1808.0	1255.9	0.748	1645.9	355.5	62.42	5.88	8082.0	34.2	0.562	15	25.88

ID	Type	Reservoir Depth (ft)	Injector BHP (psi)	Injection Pressure (psi)	Steam Quality	Injection Rate (bbl/d)	Injection Temp. (°F)	Oil Density (lbm/ft3)	Net Pay Thickness (ft/block)	Permea-bility (mD)	Rock Heat Capacity (Btu/ft3.F)	Oil Saturation	Injection Duration (years)	Recovery Factor (%)
240	Train	2218.0	2358.2	1371.4	0.724	1271.3	323.1	58.79	11.41	2419.3	34.2	0.829	10	38.45
241	Train	4388.2	1604.9	1497.9	0.470	1668.2	391.9	61.32	10.14	3416.5	34.3	0.652	15	11.22
242	Train	2276.0	1766.8	1151.5	0.971	1370.5	260.1	62.35	13.63	2006.4	33.9	0.607	25	1.74
243	Train	5952.5	1895.8	974.3	0.728	1398.9	319.5	59.25	5.64	7535.5	36.8	0.596	30	25.14
244	Train	5140.1	1741.9	1244.2	0.732	1360.3	371.4	58.79	5.65	5316.3	33.4	0.516	25	22.92
245	Train	3776.3	1163.8	1813.4	0.674	1607.7	356.0	61.56	16.80	3350.6	31.1	0.570	30	9.35
246	Train	2670.5	2482.9	1078.1	0.669	2426.1	367.0	58.23	3.72	1957.3	35.6	0.646	5	34.04
247	Train	2681.8	1836.3	1042.0	0.841	1163.4	452.7	62.67	11.89	10640.1	36.7	0.665	20	15.05
248	Train	3055.9	2163.1	1742.0	0.754	1234.1	322.6	60.83	5.42	4110.6	34.0	0.814	25	31.49
249	Val	4803.4	844.8	750.1	0.901	2212.2	304.8	59.33	12.05	3667.8	33.8	0.744	30	19.30
250	Train	5841.2	783.5	959.2	0.416	1300.1	362.5	59.73	8.26	3695.6	31.4	0.507	15	25.73
251	Train	424.3	714.0	1163.0	0.804	1637.7	225.4	61.74	3.37	10886.1	35.2	0.546	30	2.33
252	Test	2098.2	1328.2	1333.9	0.764	912.9	289.8	58.44	12.47	4945.0	34.3	0.609	30	9.51
253	Test	1992.9	2119.3	929.2	0.622	2036.6	386.6	56.42	6.77	4636.4	32.6	0.595	20	31.65
254	Train	3048.3	1309.4	1097.0	0.598	1540.5	412.9	60.48	10.74	6253.5	34.5	0.748	15	12.23
255	Train	2693.4	1794.3	1361.1	0.601	418.0	382.3	57.28	6.89	5339.0	34.7	0.601	30	11.95
256	Train	2855.6	1360.4	1372.2	0.860	531.3	409.2	60.48	15.28	4269.5	35.2	0.455	5	13.20
257	Train	2677.1	1980.5	1179.3	0.773	1303.9	318.9	59.98	8.78	3213.9	33.5	0.603	25	32.60
258	Test	1636.5	1507.6	829.5	0.588	2261.8	399.6	60.35	9.48	8870.2	33.8	0.509	20	25.83
259	Train	1628.9	1223.5	1720.1	0.780	1244.5	444.0	61.27	7.54	8263.9	34.7	0.546	25	15.56
260	Train	6057.0	1146.7	1274.2	0.686	1153.7	273.7	56.98	4.55	7479.5	33.4	0.630	5	25.67
261	Train	1047.9	1732.5	1431.2	0.717	985.6	379.0	61.06	7.69	5181.2	34.6	0.661	20	11.56
262	Train	1581.2	1471.9	873.1	0.712	1654.6	244.1	60.81	5.83	3610.9	33.8	0.770	15	9.85
263	Val	1270.2	1720.3	1583.4	0.725	975.6	332.1	59.72	11.05	4436.7	33.3	0.488	10	24.43
264	Test	5366.4	1116.9	1851.4	0.904	1300.9	349.4	57.50	3.52	4797.6	34.4	0.476	15	24.17
265	Train	5888.6	1301.4	1112.3	0.776	627.4	333.5	59.19	9.58	2767.9	34.9	0.746	10	23.37
266	Val	2828.4	1235.7	566.9	0.503	2118.0	360.4	61.43	9.25	6387.4	33.2	0.669	5	3.62
267	Val	6048.7	1161.8	955.3	0.706	558.8	238.6	57.47	5.03	2310.4	37.6	0.688	10	24.60
268	Train	5105.5	1279.6	1184.8	0.701	1857.8	310.4	57.40	5.26	2512.4	35.0	0.616	25	21.44
269	Train	3951.7	1281.6	968.3	0.741	976.8	252.9	59.37	5.04	2626.5	32.8	0.615	20	16.83
270	Val	7653.0	1006.0	839.3	0.655	923.2	407.3	60.81	4.54	9442.3	34.7	0.432	15	26.42
271	Test	1723.1	1823.2	1180.8	0.529	1232.7	362.8	58.28	12.50	11075.3	34.9	0.460	10	8.03
272	Val	2452.7	1553.2	1123.6	0.735	1209.4	271.5	60.67	14.79	2481.0	35.8	0.753	20	21.18
273	Train	7039.7	2291.4	1186.7	0.829	1547.2	328.3	57.88	6.22	3115.6	33.3	0.586	10	29.34
274	Train	2432.4	886.1	1590.8	0.809	1034.5	389.4	60.27	15.53	974.9	34.7	0.540	15	9.22
275	Train	4051.0	1091.6	548.5	0.706	1615.7	395.4	59.96	10.43	5116.0	34.8	0.646	15	16.99
276	Train	4771.5	2275.3	1979.9	0.664	721.5	340.4	61.34	12.55	3807.2	32.8	0.581	25	25.69
277	Train	3752.4	1093.9	1423.2	0.643	2053.3	434.3	59.21	11.35	1444.3	36.8	0.739	30	15.34
278	Val	7445.0	1969.9	1436.3	0.563	1836.8	361.6	58.43	9.59	3770.9	33.3	0.468	15	31.22
279	Train	3593.3	712.6	1278.3	0.530	1514.4	393.2	62.71	7.75	9156.0	34.4	0.463	5	5.43
280	Train	2757.0	676.3	1564.6	0.807	1207.3	394.0	59.34	11.89	5973.2	32.8	0.549	30	11.97
281	Train	6486.1	1337.4	1362.5	0.676	1633.8	316.1	60.43	3.50	5538.3	34.6	0.620	10	26.89
282	Test	4623.2	1413.3	1265.5	0.661	1806.8	420.2	59.30	5.80	11347.6	34.2	0.700	10	19.02
283	Train	2508.1	2133.9	1220.1	0.504	1231.1	292.5	57.19	4.85	7851.1	33.5	0.625	15	12.61
284	Val	5101.0	1625.1	480.2	0.784	1773.8	344.3	55.90	4.67	9556.5	33.2	0.738	25	21.26
285	Train	4767.9	1672.4	1276.9	0.860	795.6	341.9	58.76	7.62	3822.9	35.3	0.727	25	19.32
286	Train	5308.5	1051.6	1350.3	0.631	1091.1	359.5	58.23	13.39	453.2	34.8	0.539	30	22.90
287	Train	2474.2	1063.4	1500.3	0.682	855.4	266.9	59.86	15.65	11641.0	34.7	0.582	20	10.47
288	Train	7153.8	1366.3	1754.1	0.727	1479.6	441.9	58.01	3.85	1183.4	34.5	0.497	30	30.95
289	Train	2805.6	1143.6	878.3	0.728	1070.0	498.2	60.83	8.58	14630.1	31.9	0.633	5	10.29
290	Train	2060.9	1387.7	1033.3	0.668	1956.9	408.8	58.33	6.56	6527.9	34.9	0.839	20	37.61
291	Test	5630.5	1572.1	1047.6	0.754	1473.1	357.0	59.19	3.96	13852.5	36.2	0.745	25	22.77
292	Train	1310.4	1354.2	843.7	0.771	1906.9	222.5	60.72	5.00	1864.0	36.8	0.636	5	0.85
293	Train	1822.4	1391.6	652.7	0.867	1028.5	261.8	59.86	8.48	6573.5	34.5	0.564	25	9.61
294	Train	3788.3	1586.9	929.5	0.692	1697.0	481.5	57.12	3.56	13062.9	35.6	0.428	20	17.61
295	Val	2648.7	1795.0	1803.6	0.708	629.5	355.9	60.24	4.46	9125.3	35.5	0.693	5	12.44
296	Train	3976.8	588.7	1226.0	0.496	1693.1	269.6	61.03	10.13	12429.0	34.2	0.543	20	17.39
297	Val	1570.5	1751.5	1206.3	0.599	870.9	328.6	58.65	6.86	3833.6	34.3	0.726	10	33.75
298	Train	3038.6	2012.6	886.4	0.710	2091.1	339.3	57.65	4.28	2973.9	31.9	0.543	30	35.25
299	Train	4904.4	1165.2	978.5	0.644	1375.8	348.3	60.25	6.88	13792.5	34.0	0.658	30	20.40
300	Train	5110.8	1256.1	1037.8	0.840	2056.9	334.0	57.46	8.42	1397.4	33.9	0.483	10	23.05
301	Val	6505.4	1219.3	674.0	0.883	1620.2	455.7	61.72	15.00	4453.0	33.6	0.664	10	17.42
302	Val	3450.8	1874.4	1415.4	0.726	994.9	274.0	62.14	12.87	2830.4	34.0	0.461	20	8.69
303	Train	1455.2	1200.7	1095.0	0.698	1145.3	276.7	60.83	10.00	1276.0	33.6	0.471	5	0.77
304	Train	7715.5	982.5	1532.2	0.578	1488.8	288.8	59.62	8.63	4607.5	33.8	0.774	20	28.71
305	Train	1135.8	1927.9	828.9	0.943	1693.2	303.9	55.58	3.45	2103.8	33.9	0.368	25	46.63
306	Train	3448.6	1882.8	449.8	0.955	879.1	330.3	57.42	8.51	9191.0	33.8	0.872	30	14.10
307	Train	3069.4	1762.8	1046.4	0.488	1450.8	325.8	58.85	13.28	4090.4	35.6	0.701	5	13.73
308	Train	1668.7	1042.8	1000.7	0.676	209.1	441.0	59.35	4.71	3502.4	32.8	0.620	30	8.05
309	Val	5458.4	789.6	970.1	0.773	1237.5	452.8	60.25	4.25	5323.8	34.7	0.519	25	24.13
310	Train	3324.3	1574.1	429.6	0.713	784.6	297.5	59.03	9.65	1851.6	33.6	0.618	20	15.64
311	Train	2090.1	1698.3	1210.0	0.660	1094.8	369.2	60.17	5.37	1385.5	36.3	0.600	10	24.27
312	Test	1982.3	1987.1	742.0	0.769	210.3	442.6	61.04	1.30	11264.8	37.7	0.776	20	27.93
313	Train	1737.4	1863.9	381.2	0.726	668.5	409.2	56.41	8.45	5604.0	34.1	0.537	5	7.97
314	Train	1991.6	2111.2	1382.2	0.604	2070.8	232.6	61.75	13.12	10171.4	34.1	0.498	10	17.36
315	Train	3041.6	1145.6	1265.6	0.856	1039.9	353.6	57.76	4.45	1243.8	35.0	0.654	20	12.72
316	Train	2153.5	1014.7	1399.7	0.759	1099.7	319.8	61.30	16.79	7481.3	36.3	0.640	15	9.73
317	Val	2671.1	1191.3	1291.5	0.704	1763.0	399.6	59.00	16.97	3567.7	36.8	0.568	10	12.39
318	Train	5192.6	1374.0	974.0	0.832	1199.4	262.5	60.79	2.25	9151.2	36.1	0.729	5	19.92
319	Train	1614.7	1310.4	1346.4	0.912	1292.8	325.6	61.53	4.91	5896.1	35.6	0.730	15	3.53
320	Val	8127.0	1576.2	1293.6	0.551	1379.2	479.8	61.67	13.87	2705.8	34.8	0.799	5	12.32
321	Test	2444.0	1185.1	990.8	0.720	1689.7	407.2	59.11	8.33	9076.3	33.9	0.591	30	11.54
322	Test	6088.9	862.3	978.5	0.666	983.0	323.7	59.52	6.76	4703.4	32.3	0.750	20	24.28

ID	Type	Reservoir Depth (ft)	Injector BHP (psi)	Injection Pressure (psi)	Steam Quality	Injection Rate (bbl/d)	Injection Temp. (°F)	Oil Density (lbm/ft3)	Net Pay Thickness (ft/block)	Permea-bility (mD)	Rock Heat Capacity (Btu/ft3.F)	Oil Saturation	Injection Duration (years)	Recovery Factor (%)
323	Val	2205.1	1788.4	1872.5	0.622	628.9	365.7	61.66	13.39	8098.1	36.9	0.403	15	10.24
324	Train	3997.4	1883.7	1985.4	0.488	1111.2	250.9	60.50	12.48	3049.5	35.1	0.567	5	17.77
325	Train	1382.7	1314.7	1854.6	0.682	1039.1	331.4	62.14	5.44	9082.7	35.1	0.734	10	1.68
326	Train	3563.0	1369.3	1253.1	0.455	590.8	472.3	61.78	2.18	2746.7	34.7	0.602	15	5.30
327	Train	6657.2	954.5	606.2	0.614	1840.4	373.2	61.64	4.59	12148.6	34.2	0.523	5	24.08
328	Train	5038.7	1265.6	1211.4	0.601	1634.2	310.0	57.38	10.71	4727.3	33.5	0.677	25	20.95
329	Train	7279.7	681.8	533.9	0.588	771.0	352.5	56.43	6.32	1055.8	34.8	0.626	10	29.86
330	Val	5604.6	1353.3	1621.2	0.571	330.1	371.1	57.73	7.81	3981.7	33.0	0.656	10	23.29
331	Test	5806.3	1522.4	490.6	0.499	1120.1	335.4	58.19	6.85	7429.5	34.6	0.373	15	21.20
332	Val	3742.0	1145.7	1202.6	0.615	783.9	362.4	59.89	14.10	5179.8	33.3	0.559	5	16.31
333	Test	5416.8	844.2	895.6	0.943	1501.8	328.6	57.87	5.14	903.5	33.8	0.514	15	24.12
334	Train	3602.2	1691.2	1002.3	0.626	899.2	263.3	60.39	3.60	1755.6	32.5	0.763	20	39.40
335	Test	2907.5	1153.5	953.5	0.943	336.7	336.1	55.46	7.55	13595.8	35.7	0.701	10	12.05
336	Train	1212.3	1808.4	1301.0	0.494	922.3	363.0	61.33	4.34	8633.8	31.9	0.485	20	18.29
337	Train	6920.0	2188.9	1331.0	0.659	1498.2	316.7	57.10	13.86	7516.1	31.7	0.655	30	28.59
338	Train	1716.2	2189.2	1378.2	0.775	1172.0	364.8	59.24	17.09	2934.3	34.6	0.782	25	35.84
339	Test	3938.7	1252.9	1116.4	0.612	1449.4	305.1	57.50	16.95	9115.4	35.0	0.690	30	16.38
340	Val	2135.7	1351.6	1100.6	0.814	1173.2	364.4	58.68	11.84	1780.9	31.5	0.677	20	40.44
341	Val	827.2	1994.2	320.2	0.823	552.2	308.9	57.84	16.30	3714.2	36.2	0.877	25	29.54
342	Train	3992.2	1193.2	1447.8	0.855	1307.0	365.1	60.65	14.72	4609.0	35.6	0.665	10	15.90
343	Test	3679.6	2047.0	329.1	0.926	1009.0	474.1	56.56	11.91	4436.1	33.4	0.558	20	16.53
344	Val	1537.8	1677.9	1317.4	0.515	628.1	299.3	58.54	5.82	4610.6	33.1	0.804	10	31.19
345	Train	1530.5	2105.5	1615.1	0.672	2384.6	315.8	57.32	8.35	330.2	36.0	0.701	25	20.05
346	Train	6514.6	1653.5	1467.7	0.823	1280.1	297.5	60.06	5.05	6127.5	37.7	0.707	5	26.01
347	Val	1389.3	1155.5	767.5	0.798	1948.2	339.5	59.47	1.94	11146.0	35.2	0.631	10	40.71
348	Train	1565.2	1100.5	1073.0	0.687	885.2	425.9	59.15	10.67	1372.8	37.4	0.602	25	29.02
349	Train	1817.5	2186.3	634.1	0.718	1630.2	282.2	57.98	6.08	4552.3	34.9	0.635	30	35.49
350	Test	8643.0	1501.1	997.0	0.781	1566.8	436.6	61.53	9.66	3358.6	33.4	0.407	20	22.55
351	Train	3305.8	2280.3	1275.3	0.693	1364.9	389.3	58.97	4.24	2685.7	36.1	0.684	15	38.86
352	Train	2421.6	1273.9	682.8	0.848	897.5	301.3	61.20	6.89	2858.3	36.8	0.524	20	8.53
353	Train	4394.3	1039.7	1174.1	0.579	1475.0	223.3	63.14	9.78	2001.1	34.7	0.529	10	2.69
354	Train	277.7	1645.7	1048.3	0.749	1189.6	308.4	58.43	11.84	14010.0	34.5	0.698	10	29.41
355	Train	4038.7	660.5	1182.3	0.830	1543.4	374.1	61.52	11.90	8493.2	34.3	0.692	5	7.88
356	Test	1262.2	1467.0	1144.8	0.905	2101.2	237.3	61.08	3.07	8692.1	33.8	0.776	30	15.57
357	Train	4326.9	1422.0	1861.4	0.702	1335.3	329.8	60.36	7.68	13893.1	36.5	0.666	15	18.12
358	Val	3752.2	1054.8	1184.1	0.852	1301.7	394.5	59.32	2.92	4295.9	36.2	0.546	30	16.43
359	Test	8137.3	1894.5	1426.6	0.720	1231.9	368.3	58.39	4.29	8189.7	32.9	0.450	30	31.67
360	Train	8424.9	1014.7	606.0	0.851	1566.9	258.5	58.21	12.07	11136.0	36.4	0.452	30	32.42
361	Train	1607.5	933.7	1138.0	0.724	1513.1	381.5	62.32	12.81	2298.5	33.4	0.397	25	1.31
362	Train	1521.6	1770.6	559.3	0.664	1771.1	229.2	61.30	11.71	4685.1	35.4	0.676	25	10.29
363	Train	2790.6	967.5	614.0	0.706	1618.5	344.2	58.86	13.02	5356.3	32.9	0.584	25	11.91
364	Train	4148.2	1112.3	1476.8	0.576	1319.9	290.0	60.23	8.10	11947.3	34.6	0.703	25	17.04
365	Val	2272.7	512.7	1844.5	0.824	1880.1	370.8	59.15	3.85	7842.4	34.6	0.535	5	9.70
366	Val	3492.0	801.5	1080.7	0.726	1424.3	327.5	61.00	4.35	1148.7	35.2	0.593	25	5.99
367	Train	2124.3	1768.6	1025.9	0.831	898.1	429.7	59.14	4.74	6563.6	33.4	0.711	15	30.58
368	Train	6089.9	1553.7	729.9	0.695	1234.8	346.6	60.86	18.48	3454.7	33.9	0.748	25	23.97
369	Train	3271.3	1342.5	908.4	0.848	951.1	268.0	58.88	3.55	4375.6	35.4	0.794	15	13.15
370	Train	3149.6	2078.0	770.5	0.671	1525.9	456.9	59.83	9.43	5249.3	35.4	0.625	25	15.27
371	Train	3549.9	1911.2	693.9	0.677	1991.7	379.5	55.65	5.45	10848.0	32.9	0.716	10	15.44
372	Train	7941.5	1976.2	1184.0	0.657	1446.7	372.4	59.73	3.87	2299.8	33.7	0.699	5	29.39
373	Train	2911.7	932.7	1041.3	0.623	2106.4	439.3	63.11	8.67	1177.8	33.5	0.448	25	1.55
374	Val	3708.5	1949.1	1502.7	0.663	558.5	303.8	61.62	4.89	6977.6	36.1	0.510	25	21.35
375	Train	2291.6	1186.3	1057.6	0.702	709.5	372.1	63.01	8.55	4786.8	34.9	0.861	30	2.05
376	Test	7242.0	1837.3	1286.6	0.881	1967.4	322.3	59.47	8.57	3956.8	34.8	0.674	20	28.93
377	Train	6326.0	1930.0	728.5	0.651	587.3	327.3	58.53	3.68	8840.6	34.3	0.688	15	25.87
378	Train	3170.5	1124.8	585.8	0.708	1790.5	360.6	60.46	17.20	8238.1	35.1	0.600	25	13.44
379	Train	1965.8	1259.5	1110.4	0.716	607.5	379.8	60.28	8.56	4486.0	33.9	0.732	10	9.52
380	Train	2891.3	1035.1	714.9	0.576	2301.8	285.8	61.88	5.87	8143.7	35.2	0.761	10	4.92
381	Train	5278.4	1841.7	1152.5	0.951	2044.2	325.3	60.67	6.22	802.3	34.4	0.558	15	14.71
382	Train	3962.1	1836.0	1036.5	0.622	1346.1	339.2	58.83	10.39	7064.1	34.4	0.422	15	18.26
383	Val	6719.9	1049.1	1322.3	0.704	1333.4	250.5	61.27	6.90	5903.8	34.6	0.863	20	25.54
384	Val	5716.0	1688.5	1408.4	0.800	1115.5	350.2	61.07	10.93	4622.4	35.0	0.743	20	21.88
385	Train	2951.0	1650.1	1381.9	0.712	2363.2	410.2	59.65	2.08	8090.2	34.6	0.677	5	36.73
386	Train	2189.1	1184.2	1402.2	0.825	1824.7	309.0	60.53	6.23	3282.4	32.1	0.694	20	36.91
387	Test	8353.0	1897.8	1067.0	0.953	1518.4	276.9	56.01	14.04	11110.1	34.6	0.833	20	29.24
388	Test	1611.4	1808.4	782.3	0.552	1537.5	403.5	57.63	3.45	9318.1	32.8	0.404	15	17.18
389	Train	2467.2	1234.1	1250.9	0.693	1590.2	241.7	56.53	11.45	2498.2	33.5	0.703	20	11.90
390	Val	4391.5	1908.9	1174.2	0.721	760.5	320.3	56.23	6.60	2213.8	34.1	0.717	30	18.65
391	Train	7263.2	1340.9	1367.7	0.842	442.1	323.5	59.69	10.83	4846.7	34.4	0.643	30	29.35
392	Train	3403.6	1254.5	1144.1	0.703	457.8	349.1	63.16	1.09	10299.3	35.5	0.550	30	9.43
393	Train	1913.8	2398.4	1427.8	0.647	1087.1	340.2	59.11	6.88	9647.4	34.5	0.508	5	9.96
394	Test	4993.8	1491.1	1196.5	0.533	1415.7	375.3	60.80	8.29	4705.8	35.7	0.478	25	21.66
395	Train	3304.1	1365.3	1510.2	0.754	440.0	391.3	58.62	16.52	5176.8	33.6	0.787	5	13.31
396	Train	3424.6	1419.4	1041.0	0.477	1181.0	402.8	59.11	15.29	7775.8	35.9	0.692	10	14.08
397	Train	2423.3	1585.4	1427.4	0.713	877.7	393.0	58.55	12.36	3787.8	35.6	0.469	25	11.78
398	Test	3833.6	1505.2	1567.7	0.753	1709.5	281.9	58.27	10.94	841.5	35.1	0.678	15	15.63
399	Val	2447.6	1325.2	1077.6	0.796	1515.8	357.0	60.00	4.97	4836.2	33.4	0.853	10	39.50
400	Train	1429.2	765.6	974.4	0.734	1220.2	359.4	60.12	4.55	11975.3	33.0	0.588	20	25.01
401	Train	2140.9	1595.1	1138.7	0.834	887.8	385.8	60.43	6.31	1876.9	32.4	0.785	30	40.85
402	Train	2542.3	1650.5	1461.4	0.582	2064.6	339.1	59.61	10.35	2626.7	35.9	0.860	30	43.17
403	Train	3322.8	1539.0	1145.2	0.709	1104.7	348.5	58.79	6.35	9507.0	33.3	0.610	15	14.84
404	Val	4621.0	1574.3	847.3	0.416	1320.9	247.2	57.08	14.82	13483.7	36.4	0.598	20	20.01
405	Val	4967.3	1563.1	1444.3	0.802	1006.1	367.7	57.86	13.08	11247.5	35.7	0.519	10	22.20

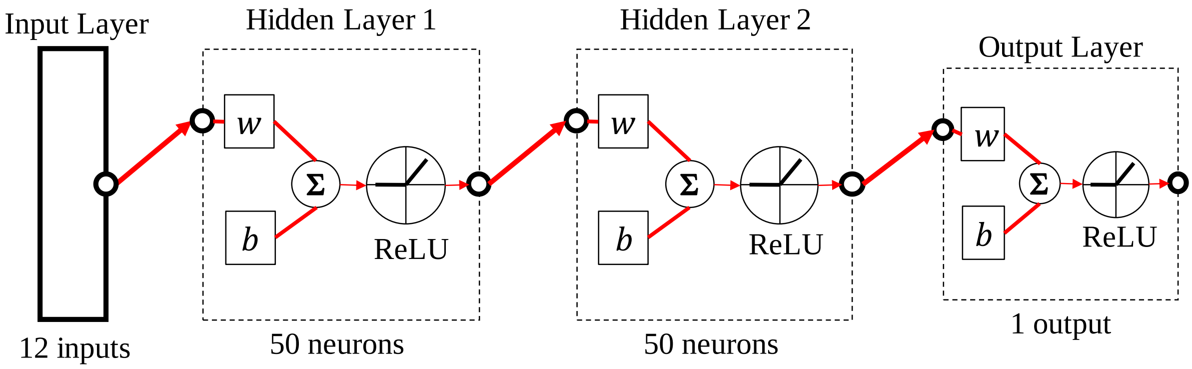
ID	Type	Reservoir Depth (ft)	Injector BHP (psi)	Injection Pressure (psi)	Steam Quality	Injection Rate (bbl/d)	Injection Temp. (°F)	Oil Density (lbm/ft3)	Net Pay Thickness (ft/block)	Permea-bility (mD)	Rock Heat Capacity (Btu/ft3.F)	Oil Saturation	Injection Duration (years)	Recovery Factor (%)
406	Train	4539.2	1751.1	1155.0	0.855	874.4	269.0	59.03	8.52	6757.8	31.4	0.515	5	20.23
407	Test	2820.3	1548.9	1346.1	0.843	653.4	281.6	58.44	8.99	9073.6	37.6	0.707	20	12.05
408	Train	4648.8	2229.8	947.8	0.773	639.3	389.8	61.26	12.82	4388.2	32.3	0.554	30	26.06
409	Train	3572.0	1127.7	857.3	0.641	1961.3	357.5	61.52	9.26	7878.5	33.5	0.634	5	6.38
410	Train	1425.7	1378.4	1191.8	0.577	1622.8	338.9	56.30	16.36	8258.8	34.7	0.688	20	5.74
411	Train	3066.2	1282.3	819.3	0.729	1747.2	434.0	61.06	10.45	6548.8	35.9	0.371	10	7.46
412	Val	3239.6	1124.2	581.2	0.791	1357.6	302.8	60.53	6.25	2888.3	36.3	0.394	15	12.79
413	Train	6256.9	867.0	977.8	0.662	1451.6	344.9	56.27	5.18	1921.2	34.0	0.471	25	27.87
414	Train	5584.7	2138.7	980.0	0.806	1305.8	422.3	58.00	9.82	4959.4	36.3	0.821	20	22.02
415	Train	5760.2	1568.8	927.7	0.714	1584.1	435.1	62.53	9.58	9088.2	34.2	0.619	5	11.34
416	Train	6317.0	2391.3	947.7	0.745	1091.1	233.7	61.18	2.73	9767.8	36.6	0.624	25	26.17
417	Train	2193.2	1429.5	469.0	0.851	773.4	489.3	61.62	3.78	6982.0	36.6	0.832	15	6.16
418	Train	1738.2	1666.2	1649.5	0.563	978.4	335.0	61.31	5.79	8141.9	35.0	0.555	30	19.10
419	Train	3838.6	995.1	1386.9	0.804	1206.8	400.2	55.94	7.53	6830.5	35.2	0.488	20	17.52
420	Test	2438.9	1711.0	1124.3	0.846	632.2	388.7	62.07	3.52	3488.5	34.5	0.678	25	3.67
421	Train	7751.5	1488.1	615.8	0.614	522.5	237.8	59.35	8.74	1265.9	34.7	0.700	15	29.31
422	Train	2485.5	1392.5	1196.5	0.892	463.5	360.1	59.80	15.00	3102.9	35.1	0.679	20	10.52
423	Train	3389.1	1037.4	458.3	0.865	1092.0	278.8	58.75	5.78	12657.8	34.3	0.627	25	14.33
424	Train	4254.4	1314.3	1507.1	0.681	1137.9	358.2	57.32	9.09	8375.7	33.0	0.732	10	17.36
425	Train	4613.1	1711.5	997.4	0.594	1358.4	369.7	57.01	13.42	7529.8	33.9	0.644	10	19.41
426	Train	4382.8	1691.2	1834.4	0.587	1386.7	301.4	61.02	12.82	1742.9	34.7	0.544	5	5.08
427	Train	4938.4	2015.1	1092.8	0.602	861.4	325.7	56.43	16.62	5798.0	35.2	0.706	5	20.22
428	Val	8490.1	1603.9	971.5	0.767	1153.5	298.0	62.11	15.83	5174.5	34.7	0.570	25	30.66
429	Train	1798.6	1181.9	1416.5	0.710	1287.1	401.6	57.33	3.14	3247.8	36.6	0.806	30	45.07
430	Test	3637.6	2088.4	1362.1	0.671	801.9	366.6	57.31	10.47	409.1	34.8	0.760	15	35.70
431	Train	6633.5	2165.5	1262.6	0.838	1551.1	413.2	60.50	5.40	5334.5	36.8	0.685	15	26.86
432	Test	1533.2	1564.9	1432.8	0.643	1755.3	423.8	60.98	15.43	8654.3	36.0	0.847	30	25.58
433	Train	2379.3	1631.3	1366.4	0.499	1450.0	338.4	61.23	6.24	8264.2	32.9	0.814	30	21.79
434	Test	2309.4	1243.8	1287.1	0.771	1672.1	333.6	58.94	12.73	579.7	32.9	0.528	15	20.43
435	Train	4436.5	2076.3	946.7	0.491	1868.2	348.7	58.69	10.84	3837.3	34.8	0.720	10	19.07
436	Val	3376.9	1527.1	1094.8	0.467	2105.2	455.5	58.68	3.34	8371.9	35.6	0.451	25	18.16
437	Test	1068.6	1625.5	755.8	0.710	1146.0	378.7	56.73	8.17	9915.9	32.3	0.565	20	5.46
438	Val	3839.5	1983.2	1054.8	0.819	2066.6	404.2	61.60	3.16	3465.2	35.4	0.619	20	14.32
439	Test	5864.6	977.4	1126.2	0.825	1368.6	401.6	57.54	6.98	3301.1	35.9	0.609	5	24.84
440	Train	5435.9	650.0	1493.1	0.683	1900.6	336.9	59.48	11.69	2698.8	31.1	0.471	15	24.20
441	Train	6469.7	527.1	823.7	0.510	1410.5	307.9	60.79	8.11	3021.4	32.7	0.388	5	15.34
442	Train	4113.3	1232.4	870.0	0.872	1160.7	419.6	57.04	13.02	6192.3	34.1	0.424	25	18.75
443	Train	5432.0	1877.0	1781.5	0.672	594.7	325.4	57.64	10.98	9853.1	33.9	0.748	30	21.97
444	Train	1677.5	1155.8	584.1	0.782	988.5	299.0	62.38	1.38	12631.3	34.8	0.564	20	9.40
445	Test	2473.4	1332.7	1223.7	0.736	2142.3	228.6	60.87	3.14	1195.0	35.6	0.538	5	1.63
446	Test	3909.3	1632.2	951.6	0.810	1521.7	319.3	58.46	15.77	6308.2	34.3	0.646	5	16.27
447	Train	2454.3	1938.0	1128.7	0.647	1335.9	381.7	56.99	13.28	7180.1	33.9	0.636	5	10.62
448	Train	1025.4	1695.6	1580.6	0.569	1842.6	319.3	55.85	5.73	10393.5	32.8	0.851	25	32.55
449	Train	2003.4	1010.8	1697.2	0.695	1992.6	385.5	56.58	4.59	3069.6	35.3	0.557	15	35.89
450	Train	1217.7	595.2	657.2	0.718	869.0	459.9	57.78	6.18	3738.6	33.5	0.666	15	33.63
451	Train	4145.2	1562.5	707.6	0.613	1731.9	316.1	59.40	10.13	8744.9	35.8	0.773	5	16.66
452	Test	2331.6	1445.0	751.7	0.514	1719.1	276.9	56.80	2.35	5299.3	33.3	0.782	15	38.18
453	Train	1613.4	1549.3	963.0	0.670	421.3	386.8	59.60	4.09	7973.8	31.9	0.582	30	8.91
454	Test	2996.9	1566.1	729.4	0.454	729.8	384.1	58.60	7.38	9878.2	34.6	0.597	5	13.28
455	Train	1993.4	1642.7	1992.8	0.847	1581.3	385.4	60.25	4.79	5053.9	35.7	0.428	25	23.46
456	Train	6863.8	2358.2	1023.5	0.807	1834.1	332.8	59.76	10.44	1207.3	35.0	0.560	25	29.10
457	Train	3848.2	1737.9	568.0	0.529	1562.5	458.8	57.72	4.54	2894.0	33.7	0.516	10	19.73
458	Train	4715.1	1186.8	1207.3	0.781	1427.4	237.9	56.16	5.87	1659.3	36.4	0.557	25	20.53
459	Test	2606.1	786.2	1487.5	0.603	775.6	318.1	58.22	8.56	11664.8	35.9	0.596	30	10.94
460	Train	1947.6	1182.6	1237.6	0.670	1516.7	344.8	58.92	8.31	14572.8	31.6	0.652	5	8.85
461	Train	6849.5	1418.4	1441.0	0.516	1086.9	344.6	62.15	7.84	2880.1	34.8	0.733	30	17.73
462	Val	2781.3	2435.5	678.1	0.757	1535.6	341.8	57.41	17.41	3326.9	34.3	0.737	30	11.97
463	Train	1162.8	2067.6	1127.3	0.822	1676.3	302.8	57.83	3.78	7012.6	32.3	0.598	10	39.36
464	Train	6939.5	688.9	1116.0	0.751	1141.7	364.1	58.41	7.60	3787.7	33.7	0.679	25	27.79
465	Val	7266.7	1401.7	1030.5	0.883	2216.7	450.1	55.53	1.04	1537.9	37.4	0.812	25	28.21
466	Train	7669.8	1343.7	908.3	0.580	2192.7	435.5	57.86	14.68	2388.7	35.9	0.851	10	28.42
467	Train	1983.0	1007.5	999.5	0.767	1052.6	355.7	60.01	5.02	2942.7	36.5	0.510	15	29.31
468	Train	4246.5	2122.5	1554.9	0.724	1774.7	328.0	56.02	7.05	7560.7	35.4	0.549	5	19.34
469	Test	2888.1	1814.5	1642.1	0.531	2063.1	244.8	58.81	6.46	4533.1	35.1	0.689	30	35.39
470	Train	2459.1	609.2	1628.8	0.687	1458.9	396.4	58.04	8.61	9551.3	35.3	0.656	15	10.11
471	Train	6576.5	1074.3	1038.1	0.520	731.7	359.0	57.83	15.75	8035.3	35.8	0.783	25	26.11
472	Val	6619.2	1712.4	768.8	0.738	1075.9	401.6	62.32	5.82	1473.4	34.1	0.647	15	8.54
473	Val	1068.1	1150.5	1317.0	0.895	1741.8	362.4	59.70	16.84	3467.8	36.8	0.836	30	36.16
474	Train	1904.6	725.6	1054.8	0.679	1864.8	229.2	56.76	2.85	5948.4	35.2	0.672	30	7.57
475	Train	1189.7	2405.7	1420.6	0.911	838.1	366.7	59.62	10.03	2645.9	34.6	0.820	15	37.12
476	Val	1780.6	1314.6	1354.6	0.635	1082.6	270.0	62.37	4.03	9310.7	35.7	0.562	15	6.79
477	Train	5502.9	1043.6	1506.2	0.781	1432.6	439.9	61.30	1.75	9271.8	33.7	0.715	25	22.33
478	Val	3169.8	1641.5	847.5	0.604	1431.1	438.1	56.07	12.35	4732.4	35.3	0.662	5	13.74
479	Train	5397.1	1908.1	1186.2	0.840	1419.3	390.7	60.79	5.75	10837.7	33.9	0.616	10	22.81
480	Train	5247.3	1161.1	1286.4	0.496	1499.3	478.9	59.14	2.91	3092.6	35.3	0.622	20	22.07
481	Train	385.5	1463.7	1161.8	0.661	1168.6	420.7	59.18	14.35	6519.8	35.3	0.701	20	30.89
482	Train	3482.4	1657.5	1760.3	0.819	222.2	374.7	59.92	6.14	2119.8	31.9	0.780	15	14.76
483	Train	3909.1	1483.1	812.5	0.749	1499.7	318.3	61.39	11.05	1854.5	34.8	0.744	10	3.78
484	Train	5935.3	2355.4	1279.2	0.738	1192.4	301.7	62.75	4.04	5006.6	35.8	0.468	30	17.25
485	Val	956.4	1017.2	1573.9	0.732	1128.4	307.4	55.06	12.29	7098.4	35.4	0.650	10	3.62
486	Val	3085.1	1048.3	1103.1	0.495	1250.4	262.2	59.38	6.88	8171.9	35.6	0.594	30	13.13
487	Train	4436.4	1419.9	1590.7	0.574	1925.1	397.5	60.97	11.38	9696.7	33.7	0.704	25	18.26
488	Test	1577.1	1870.1	667.4	0.561	1520.4	297.6	60.45	6.88	8018.9	36.7	0.643	20	30.69

ID	Type	Reservoir Depth (ft)	Injector BHP (psi)	Injection Pressure (psi)	Steam Quality	Injection Rate (bbl/d)	Injection Temp. (°F)	Oil Density (lbm/ft3)	Net Pay Thickness (ft/block)	Permea-bility (mD)	Rock Heat Capacity (Btu/ft3.F)	Oil Saturation	Injection Duration (years)	Recovery Factor (%)
489	Val	4401.5	2172.8	987.6	0.741	1600.2	347.9	59.56	15.54	2457.3	34.5	0.645	15	19.59
490	Train	2379.2	1599.5	1498.4	0.790	832.2	367.1	59.57	5.83	7112.1	37.4	0.657	25	11.63
491	Train	6304.1	999.8	1266.2	0.734	948.8	295.4	58.70	9.66	5997.7	34.0	0.798	5	24.64
492	Train	2538.9	2049.8	1277.0	0.755	918.3	304.5	60.66	11.81	8227.7	34.7	0.612	5	21.35
493	Train	1819.6	1132.0	870.8	0.789	686.7	296.0	59.93	6.96	3051.6	36.6	0.761	15	34.09
494	Train	1867.3	1763.1	828.2	0.502	2204.4	345.1	61.59	15.35	1155.5	34.9	0.654	20	1.07
495	Train	3613.1	829.2	793.2	0.720	2419.6	327.1	59.51	16.03	2327.9	36.4	0.730	10	14.56
496	Train	1249.0	1848.3	1139.9	0.759	1441.3	309.4	56.81	10.88	4682.9	32.8	0.799	15	36.78
497	Train	1239.2	1792.6	1415.5	0.758	1170.0	304.7	59.30	5.71	10901.3	37.0	0.739	5	30.77
498	Train	7450.3	1431.9	1456.7	0.645	1201.3	340.1	57.42	3.25	5882.8	34.3	0.763	5	29.25
499	Val	2782.1	2283.7	1058.1	0.725	998.2	323.0	61.49	6.62	6938.6	33.8	0.598	15	20.28
500	Test	3488.5	1515.2	622.8	0.609	303.5	467.5	61.10	2.34	8428.6	34.1	0.595	15	23.79
501	Train	6311.7	1395.4	1444.5	0.572	1883.6	269.8	59.96	18.69	1693.8	33.4	0.721	20	25.11
502	Train	1159.8	1748.7	787.9	0.542	990.4	412.0	60.86	4.39	8762.4	34.5	0.610	15	21.93
503	Train	3967.1	1959.4	1049.0	0.650	1906.3	274.4	58.89	1.37	7145.1	34.2	0.543	30	31.62
504	Test	2763.9	568.2	861.6	0.756	1090.7	279.3	57.08	9.95	7034.4	34.2	0.752	25	11.15
505	Test	3130.3	2442.3	1064.2	0.893	1592.3	426.5	57.48	3.84	6509.4	33.8	0.704	30	17.59
506	Train	3679.5	856.1	1113.1	0.740	609.6	289.6	58.84	12.78	7300.6	34.0	0.813	25	14.62
507	Train	5661.5	1944.5	1432.1	0.674	2034.2	241.9	61.05	7.66	1974.0	34.9	0.578	10	13.44
508	Test	4503.9	2226.5	1505.7	0.655	1018.7	345.6	57.06	3.16	5966.7	35.6	0.489	30	21.48
509	Val	3749.3	1026.7	835.0	0.865	1483.0	350.0	60.38	5.02	2262.0	36.4	0.496	15	16.84
510	Train	1274.7	1756.9	1800.9	0.795	460.8	487.9	61.17	12.52	8116.9	35.3	0.509	30	15.48
511	Train	3079.5	1304.8	1492.7	0.824	2421.8	382.0	59.39	10.46	1570.8	34.2	0.614	15	12.97
512	Train	5308.4	1646.6	1260.5	0.812	1396.0	309.4	60.90	2.97	4915.3	35.0	0.586	10	20.79
513	Train	3217.2	1738.5	563.8	0.616	475.0	222.7	61.26	3.00	6762.7	32.1	0.737	10	13.54
514	Train	1128.8	1726.0	1270.7	0.736	2160.9	380.1	59.48	2.81	2935.3	36.3	0.642	10	28.94
515	Train	1428.7	1353.5	1607.9	0.798	1008.3	290.5	58.84	8.82	5518.3	33.6	0.583	5	26.24
516	Train	3161.8	1548.1	667.4	0.685	1348.5	363.9	60.76	9.54	8396.2	31.6	0.746	5	20.19
517	Train	4600.4	1882.4	983.0	0.865	1505.3	351.8	61.85	3.64	3756.0	35.9	0.676	20	11.12
518	Train	4060.9	1798.9	1703.0	0.661	1012.4	386.9	60.81	15.45	11247.5	34.7	0.523	5	17.52
519	Train	2684.8	1244.9	681.5	0.585	1135.7	328.1	58.04	6.85	5791.6	34.0	0.768	25	11.98
520	Train	6680.1	1202.1	1014.5	0.535	2080.2	323.3	58.94	7.53	1262.5	32.4	0.604	30	27.68
521	Train	3338.7	1239.6	1108.7	0.909	1181.1	286.5	60.12	1.74	2374.1	35.4	0.621	5	13.32
522	Train	1314.1	2395.8	902.1	0.770	1193.5	326.7	55.07	12.15	6254.4	35.7	0.502	25	5.64
523	Train	3025.2	731.4	1480.7	0.479	821.2	422.0	58.25	5.87	3702.8	36.8	0.739	15	12.23
524	Train	3392.2	1525.5	1075.1	0.679	1238.3	410.1	59.56	5.82	2116.0	33.2	0.857	20	40.91
525	Train	1585.8	1075.3	1383.3	0.820	1594.9	401.3	59.87	10.77	10061.4	34.4	0.841	20	32.21
526	Train	7530.3	675.2	327.7	0.603	2019.6	411.7	56.12	11.06	5757.9	34.5	0.574	20	31.12
527	Test	3376.6	1895.0	1181.1	0.937	1289.4	317.8	60.82	4.32	4907.7	35.7	0.587	15	33.37
528	Val	1014.2	1249.1	855.8	0.513	399.9	317.8	62.00	5.09	4717.5	34.6	0.556	15	1.71
529	Train	1771.9	1340.3	1322.9	0.846	1176.0	320.8	59.38	6.55	700.0	34.7	0.575	15	17.28
530	Val	594.7	1468.3	1471.6	0.708	1330.5	423.1	58.86	5.66	9644.4	33.0	0.716	10	37.39
531	Train	1870.0	1700.0	1487.0	0.600	1176.9	303.6	61.63	5.04	3021.1	33.8	0.748	30	3.20
532	Val	3347.6	1686.7	1342.5	0.673	1393.0	460.1	60.05	13.37	5717.9	35.7	0.627	15	14.87
533	Train	4484.5	1012.7	598.5	0.637	1838.6	370.9	62.47	13.83	3741.5	35.4	0.794	10	4.85
534	Train	3311.6	1062.1	1290.4	0.404	801.3	260.5	58.70	15.45	8936.5	34.0	0.576	20	14.16
535	Train	6917.1	1873.0	653.2	0.421	2081.7	274.7	61.91	3.35	6487.5	32.9	0.764	10	21.72
536	Train	5927.2	1904.3	1412.9	0.767	1331.3	416.8	59.14	5.18	7903.0	33.7	0.668	20	24.25
537	Val	2690.0	1945.2	990.1	0.558	1410.2	435.3	57.23	16.57	3273.2	36.1	0.536	15	12.47
538	Train	3814.0	1871.4	983.1	0.532	1827.9	294.1	60.97	11.94	6128.5	33.4	0.695	20	33.72
539	Train	1496.3	1409.5	1314.3	0.775	1797.4	442.0	61.59	12.48	9280.9	32.0	0.502	20	17.59
540	Train	1509.2	1916.1	1027.0	0.685	1411.5	307.3	59.82	8.62	11506.2	33.9	0.600	5	24.16
541	Train	2726.5	1742.6	844.3	0.841	1184.4	316.7	61.87	1.92	8168.3	34.7	0.615	5	3.70
542	Train	3296.2	2263.7	1462.4	0.690	1320.7	339.9	62.59	3.97	10349.8	34.6	0.481	15	20.52
543	Train	5390.1	1304.2	945.2	0.705	1036.8	319.8	58.41	5.19	8683.9	33.0	0.711	25	21.88
544	Train	3713.8	1818.9	1115.0	0.826	1619.9	384.8	58.58	6.21	10229.4	34.5	0.748	15	15.96
545	Train	2592.3	1975.3	1502.2	0.765	625.2	351.6	56.20	5.73	411.9	36.8	0.848	30	39.30
546	Train	3499.9	1173.6	1817.5	0.841	1560.8	247.2	59.10	8.28	6435.0	35.8	0.724	15	14.28
547	Val	6532.8	1490.5	1982.3	0.642	1882.1	428.3	56.94	4.01	5330.9	35.0	0.689	15	26.71
548	Train	2573.1	925.3	996.0	0.724	1749.0	372.6	62.44	4.57	4467.8	34.3	0.639	5	1.25
549	Test	1745.0	1605.8	736.7	0.879	1296.8	356.0	59.67	8.26	2304.6	34.2	0.607	30	41.06
550	Train	2197.3	1934.7	910.6	0.579	1286.3	318.6	61.20	3.83	7088.0	36.8	0.466	15	20.95
551	Train	1845.1	840.4	1062.1	0.816	1461.7	429.1	58.90	4.06	6821.2	35.1	0.579	20	28.47
552	Train	2688.6	1728.6	1187.3	0.881	1353.3	252.8	59.08	8.15	5757.2	34.5	0.534	25	13.51
553	Train	5143.5	1177.3	1433.6	0.459	968.9	383.5	59.91	6.13	5376.4	33.1	0.784	20	20.47
554	Train	5459.8	1528.7	905.7	0.786	2002.4	471.3	60.38	3.04	5108.4	31.9	0.539	30	23.87
555	Val	2906.3	1831.1	994.5	0.519	641.2	407.3	58.20	7.09	5349.9	31.1	0.734	20	12.72
556	Train	4441.5	1454.6	416.2	0.888	888.5	348.2	60.08	3.35	9171.0	31.7	0.532	15	19.72
557	Train	749.4	1310.8	670.1	0.766	1888.9	387.1	61.38	3.20	1148.9	36.3	0.526	20	0.20
558	Test	7897.2	1516.5	1088.2	0.501	337.1	357.3	55.82	12.39	6593.7	35.7	0.619	20	30.19
559	Train	1774.8	1147.6	785.5	0.845	2263.0	394.5	58.96	12.82	3455.4	34.8	0.706	25	41.03
560	Train	1388.3	1403.6	1023.0	0.703	1415.7	419.9	56.53	12.95	3719.1	36.6	0.408	5	7.79
561	Train	1699.3	1791.2	1555.5	0.767	1569.7	242.7	57.24	3.20	7029.6	34.4	0.522	10	27.60
562	Val	5449.1	2272.1	1421.0	0.675	1107.4	404.7	59.51	9.39	1645.3	32.8	0.629	25	22.89
563	Train	2467.9	1718.0	1619.3	0.714	796.3	369.6	62.15	19.37	10245.4	31.0	0.785	20	15.94
564	Train	4347.1	1129.7	1531.1	0.649	2080.2	414.3	62.81	11.94	8562.9	34.8	0.584	25	12.84
565	Train	7615.0	1304.1	1017.5	0.556	1889.8	420.9	61.05	7.97	8251.9	34.8	0.720	30	28.84
566	Train	4373.6	1474.1	1018.8	0.777	1488.8	410.2	61.75	9.26	8868.6	33.9	0.733	20	15.15
567	Train	3168.5	1815.1	1032.3	0.603	1107.2	408.9	59.37	9.38	5257.4	35.9	0.491	30	15.19
568	Test	711.5	1889.9	1622.1	0.570	2086.6	379.1	59.81	1.67	910.2	34.7	0.797	10	8.28
569	Train	731.4	1668.2	1203.0	0.522	548.1	332.4	59.53	7.54	1133.9	37.4	0.675	20	19.72
570	Train	1199.6	1513.9	446.9	0.678	2270.7	247.2	60.70	15.35	10467.5	36.0	0.634	20	25.09
571	Test	1097.6	966.2	1639.5	0.898	1371.1	283.1	58.32	3.07	6048.5	34.2	0.661	30	43.57

ID	Type	Reservoir Depth (ft)	Injector BHP (psi)	Injection Pressure (psi)	Steam Quality	Injection Rate (bbl/d)	Injection Temp. (°F)	Oil Density (lbm/ft3)	Net Pay Thickness (ft/block)	Permea-bility (mD)	Rock Heat Capacity (Btu/ft3.F)	Oil Saturation	Injection Duration (years)	Recovery Factor (%)
572	Train	4247.0	882.7	817.2	0.806	1924.7	330.7	58.84	7.33	767.8	32.2	0.785	25	16.92
573	Train	5107.1	1280.8	1409.6	0.751	882.1	272.6	58.31	8.37	4811.6	34.9	0.675	20	21.08
574	Train	7187.5	2205.4	1012.4	0.760	1653.1	398.0	58.76	15.15	10286.7	33.8	0.617	20	29.94
575	Val	6631.3	1959.4	1164.6	0.836	1894.9	390.1	57.29	2.56	1831.6	34.1	0.719	25	26.55
576	Train	5753.7	1311.9	532.0	0.565	1196.4	358.8	56.54	6.57	3240.3	33.0	0.579	30	24.69
577	Train	3880.5	953.6	1068.6	0.814	1560.8	303.1	60.92	3.57	6814.5	32.4	0.599	10	14.65
578	Val	1892.4	1453.1	1504.2	0.880	1524.6	365.1	59.12	10.43	976.6	33.1	0.579	30	32.18
579	Test	1148.0	1485.8	1420.2	0.812	850.3	248.5	56.33	8.80	4787.9	37.1	0.609	10	6.18
580	Test	2844.6	1278.3	1503.5	0.426	1660.6	446.4	57.72	4.29	5452.9	32.0	0.818	25	14.22
581	Train	2554.8	1696.2	910.8	0.785	1061.0	358.8	60.63	17.49	8405.0	33.7	0.742	5	9.98
582	Test	5859.8	1232.7	1247.2	0.716	586.5	329.3	60.59	4.87	12815.7	36.9	0.678	20	23.90
583	Train	1478.3	1980.7	1085.5	0.740	1743.7	411.7	57.71	9.82	4336.7	33.5	0.677	5	33.76
584	Train	2120.5	1145.5	611.0	0.619	1206.5	290.4	61.77	12.08	3785.2	32.1	0.663	10	1.74
585	Val	2722.1	1607.5	1224.5	0.606	1363.8	353.4	57.59	2.93	7094.6	34.5	0.669	10	19.30
586	Val	7039.9	1745.8	744.5	0.554	745.3	405.3	56.61	6.50	9394.3	34.6	0.411	30	28.90
587	Train	1432.4	2018.3	1065.7	0.628	722.7	335.8	56.97	13.28	11688.3	33.9	0.743	30	5.43
588	Train	6307.2	1387.2	1190.2	0.702	508.7	344.5	59.77	9.12	5946.0	33.4	0.724	20	25.06
589	Train	1800.2	1146.3	746.3	0.680	1666.5	254.1	55.82	9.98	1385.8	33.7	0.668	30	45.10
590	Test	952.5	1194.5	661.0	0.716	1589.9	377.7	58.15	12.32	6311.8	34.7	0.642	20	33.52
591	Train	5221.4	1528.8	1392.3	0.603	1088.5	311.8	59.33	4.48	5069.8	33.5	0.588	30	22.30
592	Train	7229.2	971.8	827.1	0.598	1757.2	385.9	61.21	12.63	11177.2	33.8	0.595	30	30.03
593	Val	4185.6	2433.7	1192.1	0.562	1682.5	313.8	57.30	4.23	10426.5	34.7	0.464	30	20.22
594	Val	3557.5	1142.6	1048.7	0.706	1897.0	305.7	57.05	6.67	7569.3	33.4	0.685	10	14.78
595	Train	1352.4	1579.4	805.1	0.782	1844.1	348.8	60.16	11.62	12298.8	33.5	0.402	25	7.06
596	Train	3591.7	1342.5	1393.7	0.478	2185.7	306.4	56.43	11.46	7732.5	37.6	0.447	30	16.68
597	Test	3740.8	1659.7	749.0	0.640	663.7	400.0	62.23	4.30	3278.8	35.9	0.479	30	9.20
598	Val	5974.8	1446.7	1125.4	0.911	1301.8	322.5	62.12	7.77	3141.6	35.4	0.845	5	5.72
599	Val	2620.7	1102.7	1365.0	0.646	1826.7	269.7	60.47	13.74	5635.7	34.6	0.748	5	10.25
600	Train	5631.3	2250.5	1168.2	0.717	1607.3	402.6	60.58	15.06	1554.5	33.2	0.664	15	22.48
601	Train	8107.7	1575.3	897.6	0.891	1766.2	364.3	59.66	3.00	2201.7	34.2	0.712	15	29.57
602	Train	1365.4	1907.8	1604.7	0.790	1197.4	384.7	60.54	3.68	5593.6	33.2	0.695	30	40.00
603	Test	1727.5	1477.7	1225.7	0.613	1304.5	423.8	58.79	7.22	1285.5	34.1	0.542	10	23.90
604	Test	6838.9	1375.3	1218.6	0.858	1965.4	319.0	56.10	4.86	6991.3	36.4	0.583	25	29.18
605	Train	3305.1	1861.5	1658.7	0.737	1672.0	382.2	60.78	8.55	3313.2	35.5	0.687	15	24.94
606	Train	2945.1	2138.6	1276.1	0.650	1581.9	319.2	59.34	11.81	2445.1	34.1	0.397	30	17.91
607	Train	1754.6	1435.1	1772.4	0.622	1649.0	284.2	60.41	3.39	6784.6	32.7	0.538	25	31.46
608	Train	2617.3	922.3	433.6	0.841	1227.8	371.3	55.95	12.72	5627.2	35.3	0.672	15	10.68
609	Train	1586.2	779.0	1176.1	0.878	740.0	438.5	57.01	7.10	425.1	36.1	0.513	5	3.11
610	Train	1595.5	1798.3	867.3	0.671	1221.1	291.5	56.71	6.00	2496.7	32.1	0.729	30	42.57
611	Train	5017.8	1544.0	1566.3	0.719	1092.2	293.4	60.35	1.42	1554.8	35.6	0.738	15	20.32
612	Train	4136.9	1100.8	506.9	0.823	1771.4	372.9	57.88	7.26	6077.9	33.4	0.713	25	16.92
613	Train	5081.8	818.9	641.0	0.578	1308.1	301.1	61.90	4.53	4677.9	34.4	0.657	10	10.33
614	Test	1790.0	1457.5	762.3	0.631	851.8	330.3	59.08	9.61	5281.2	35.1	0.660	20	9.39
615	Train	2512.0	1792.1	941.5	0.806	938.9	299.7	59.67	8.75	2633.1	32.8	0.590	30	30.86
616	Train	4786.7	2370.7	1737.9	0.822	1573.2	391.6	56.92	4.88	11834.2	35.5	0.734	20	20.31
617	Train	2716.7	1032.4	828.1	0.667	1468.2	326.8	58.26	9.09	11112.8	33.1	0.734	5	10.90
618	Test	2539.4	2193.4	825.8	0.663	1984.6	313.8	60.96	12.84	11021.9	35.0	0.536	10	27.21
619	Train	3741.5	2362.8	1419.5	0.707	846.5	228.2	60.77	6.79	10234.3	33.4	0.691	5	27.11
620	Val	5487.5	711.4	646.0	0.677	1671.3	343.3	60.13	14.65	11569.2	32.1	0.533	30	23.94
621	Train	4102.6	1672.4	1079.4	0.605	1323.5	431.4	61.43	10.12	4899.7	34.9	0.878	25	11.66
622	Train	7785.7	1751.3	1131.0	0.607	1361.6	310.0	60.53	5.84	9656.5	34.2	0.458	15	30.32
623	Train	3859.4	1500.1	1038.8	0.400	768.5	215.6	55.54	8.23	7042.3	36.6	0.425	30	18.27
624	Train	5612.8	1582.8	1733.4	0.826	1921.7	450.3	59.34	16.69	7554.8	32.2	0.458	25	24.74
625	Train	4480.0	1090.7	1672.1	0.554	1701.3	282.3	61.26	3.63	14858.9	32.4	0.493	5	17.42
626	Train	8543.3	785.0	503.5	0.532	711.5	442.6	60.72	1.41	7382.9	34.0	0.831	30	29.95
627	Train	3831.4	831.7	1390.6	0.627	911.4	285.6	62.82	5.35	4544.8	36.5	0.633	30	6.60
628	Train	2261.4	2189.2	1529.5	0.517	268.1	495.2	61.97	8.72	4231.2	36.2	0.769	20	6.88
629	Train	6057.7	1143.9	1291.1	0.817	1286.6	247.6	56.30	1.72	6308.1	37.4	0.814	15	24.42
630	Val	5594.1	1271.9	1719.1	0.823	780.5	205.2	61.64	3.83	9432.5	32.5	0.892	15	20.43
631	Train	816.1	1512.7	215.8	0.705	1546.0	337.4	60.06	13.66	6052.8	31.4	0.742	30	32.21
632	Train	6177.5	1002.0	1585.4	0.487	1568.8	337.8	59.25	6.93	12.1	32.8	0.670	20	3.00
633	Val	1432.4	783.5	495.8	0.559	2343.1	379.6	63.09	9.34	5044.3	32.6	0.694	30	0.92

Appendix B. Model Parameters

Here are the DNN model, including the weights, and biases. The model consists of 2 hidden layers with 50 neurons each and ReLU activation function for all neurons. The inputs are reservoir depth (ft), Injector BHP (psi), Injection pressure (psi), Steam quality (fraction), Injection rate (bbl/d), Injection temperature (°F), Oil density (lbm/ft3), Net pay thickness (ft/block), permeability (mD), rock heat capacity (btu/ft3.°F), oil saturation (fraction), and injection duration (years), with recovery factor (%) as the target.



Each weight and bias is a matrix with size of $N_l \times N_{l-1}$ and $N_l \times 1$ respectively. For example, weight in hidden layer 1 has matrix size of 50×12, because it has 50 neurons, and its previous layer (input layer) has 12 neurons. Hence, the recovery factor is evaluated using feedforward algorithm as explained in 2.5.1. In detail, the calculation process is shown below

$$a_1 = \max(w_1 x + b_1, 0)$$

$$a_2 = \max(w_2 a_1 + b_2, 0)$$

$$RF = a_3 = \max(w_3 a_2 + b_3, 0)$$

where a is the ReLU activated output matrix, x is input vector, w is weight matrix, and b is bias vector. The weights and biases are presented as table instead of matrix for simplicity.

w_1											
-0.379810	0.481590	0.151210	-0.023330	0.141610	0.121340	-0.273130	-0.061355	0.071023	-0.186210	-0.006646	0.113860
0.029646	0.560720	0.083254	0.231330	0.432130	0.255180	-0.528110	0.204270	0.229940	-0.322590	-0.240290	0.018112
0.089988	-0.321120	-0.210920	-0.339720	0.263530	0.024607	-0.119560	-0.144760	0.471710	0.302270	-0.085107	0.009818
0.062736	0.084049	0.030071	0.078930	0.036587	0.040781	-0.067336	0.033127	-0.063244	0.059607	0.004507	0.146060
-0.019578	-0.031821	0.024642	0.039008	-0.008494	0.140730	-0.180370	0.074584	0.162120	-0.057632	-0.066091	0.035175
-0.000066	-0.041739	0.033824	0.037876	-0.017991	0.141890	-0.186770	0.073426	0.173830	-0.055072	-0.054852	0.044091
0.356110	0.133330	-0.263560	0.114660	0.030692	-0.034169	-0.142750	-0.251090	0.154080	0.199260	0.074107	0.096537
0.001906	0.110590	0.100690	0.002657	0.017622	0.061739	-0.041856	0.022458	0.071178	-0.138860	-0.005620	0.014347
-0.047512	0.272280	0.023312	0.236440	0.028994	-0.064562	-0.174970	0.014555	-0.245980	-0.145610	0.228290	0.413760
0.025894	-0.014838	0.004240	0.013891	-0.020236	0.044537	-0.029909	0.016896	0.050391	-0.004201	-0.004421	0.036523
0.187640	-0.031052	0.014027	-0.015706	0.027457	-0.010892	-0.055270	-0.072660	-0.048554	-0.021177	0.018968	0.035177
0.082326	0.003540	-0.059632	0.050510	-0.023200	0.018934	-0.050498	-0.067165	0.036230	0.062210	0.016163	0.033574
0.588880	0.067926	0.197700	0.031545	0.136390	-0.033312	0.034855	0.095261	-0.231790	-0.208690	-0.091073	0.046490
0.180650	-0.013800	-0.064012	0.029170	0.028153	0.064081	-0.027792	-0.072179	0.066015	0.026968	0.083947	0.049981
-0.334190	-0.056949	0.046957	0.086193	-0.065002	0.164990	-0.197800	0.040476	0.023190	-0.145670	-0.049356	0.077210
0.010165	0.006060	0.007030	0.023653	-0.002139	0.035785	-0.051711	0.031413	0.038081	0.005788	-0.020318	0.021438
-0.052942	-0.036083	-0.004348	0.020690	0.004878	0.071294	-0.104100	0.027560	0.060105	-0.017763	-0.046657	0.033174
0.536600	-0.261740	-0.331800	-0.113380	0.159220	0.119520	1.073300	0.039442	0.092095	0.127800	-0.070953	0.085392
-0.200200	0.380310	0.157790	0.067648	0.128960	0.115380	-0.261180	-0.120360	0.135790	-0.208270	-0.004255	0.061071
0.226700	0.072893	-0.010021	0.121510	-0.103060	-0.129400	0.094550	0.100160	-0.023307	-0.031280	-0.175420	0.006118
0.000103	0.004405	-0.028065	-0.009323	0.003288	-0.013986	0.051936	-0.036278	-0.032965	-0.012119	0.017439	0.000043
0.661150	-0.178040	0.040420	-0.019430	0.050565	0.021746	0.051831	0.118510	0.692360	-0.005237	-0.069188	-0.045963
-0.222460	-0.082368	-0.170350	0.158600	-0.271550	-0.056521	-0.064651	0.065206	0.364950	0.088231	-0.017917	-0.278470
0.196930	0.142110	-0.027988	0.102470	0.106860	-0.221610	0.254370	0.471340	0.187560	0.193810	0.229910	-0.104290
0.127700	-0.110580	-0.043922	0.074449	-0.002814	0.058853	-0.100890	-0.006826	-0.004867	-0.030236	0.071446	0.025889
-0.402280	-0.209470	0.240600	-0.046008	0.243290	0.044025	1.591100	-0.036777	-0.556350	-0.064623	0.127500	-0.514330
0.234980	-0.068781	-0.064605	0.026755	-0.074338	-0.089245	-0.165060	-0.239340	0.100040	-0.104690	0.094417	-0.016836
-0.530930	0.159530	0.303460	-0.093346	-0.525290	-0.065882	0.108020	0.126370	0.310890	-0.203360	-0.226230	0.234800
0.378590	0.026135	-0.019861	-0.068208	-0.082316	-0.127770	-0.175260	-0.238090	-0.019470	-0.071568	0.036298	0.019793
0.316260	-0.034239	0.135200	0.034529	0.054470	-0.190410	-0.043244	0.496200	0.073434	-0.406630	-0.390260	-0.044763
-0.028964	0.015746	-0.028556	0.004294	0.004395	-0.024449	0.031614	-0.042529	-0.035389	-0.012547	0.017746	-0.007338
0.210540	0.146980	-0.074893	-0.164690	-0.089667	0.052733	-0.274390	-0.216180	0.104520	0.094541	-0.147240	-0.039461
-0.644670	0.082472	0.020730	0.204350	0.136150	0.111200	-0.207920	-0.025490	0.014058	-0.021008	0.245100	0.032835
1.007800	-0.021819	0.093604	0.163300	-0.227450	0.062307	-0.467490	0.482600	0.179070	-0.050091	-0.178890	0.020364
-0.188850	-0.017302	0.147440	0.192390	-0.320700	-0.011114	-0.244690	0.185130	-0.116500	-0.044737	-0.093419	-0.016613
0.304640	-0.002322	-0.089999	0.009627	-0.109830	-0.064616	-0.248160	-0.359720	0.112890	-0.127660	0.078925	-0.087654
0.195460	-0.192070	-0.216690	-0.099437	0.011121	-0.070379	-0.158740	-0.074356	-0.140870	-0.179050	0.157440	0.174330
0.865180	-0.007139	-0.146610	-0.365790	-0.127640	-0.062559	0.069127	0.239240	-0.145640	0.345910	-0.216210	0.089637
0.216790	-0.199670	-0.114260	0.167820	0.083348	0.220160	0.129650	-0.003280	-0.107250	0.360700	0.140480	0.004081
-0.013272	0.040105	-0.074884	-0.007797	0.012578	-0.127360	0.137440	-0.096365	-0.147650	-0.048035	0.058112	-0.055053
-0.233540	-0.311000	-0.074864	0.123880	0.190440	0.237940	0.078120	0.269940	0.087747	-0.083758	0.164020	-0.032703
0.021451	-0.068893	0.047542	-0.092420	0.024943	-0.138750	0.093044	-0.066410	-0.016238	-0.021630	0.120800	0.224250
0.002581	-0.049505	0.060024	0.173640	-0.020699	0.383070	0.046434	-0.186310	0.176550	0.078677	-0.059390	-0.057492
-0.008073	0.133860	0.107310	-0.001922	-0.001401	0.073810	-0.067134	0.025982	0.106060	-0.188260	-0.012258	0.016404
0.015924	-0.015154	-0.017418	0.015976	-0.018636	0.012402	0.004189	-0.008769	0.012925	-0.013065	0.020812	0.018817
0.134290	0.332540	-0.317650	0.142340	0.501850	0.046454	0.071814	0.084385	0.434780	0.272440	0.067341	-0.041324
0.072029	-0.009931	-0.018625	0.085249	-0.024940	-0.051477	0.006443	-0.010331	0.056448	0.060857	0.034177	0.039772
0.445360	-0.025754	0.171340	-0.031382	0.032594	-0.021558	0.091049	0.131760	0.281500	0.198160	-0.051446	-0.119900
1.691900	-0.395720	0.168530	-0.150040	-0.373370	0.108590	-1.129200	0.435660	0.601560	-0.028431	-0.294410	0.084959
-0.811000	0.127570	-0.060591	-0.049220	0.283480	-0.011293	-0.043179	-0.126730	-0.270940	0.010350	0.231570	0.049571

w_2 column 1-12											
0.104920	-0.155390	0.158480	-0.043513	0.057541	0.060460	0.123920	0.034112	0.096126	0.016926	0.044362	0.033155
0.120550	-0.179630	0.182740	-0.052324	0.064464	0.069588	0.144460	0.036923	0.108970	0.019441	0.048618	0.036769
0.015368	-0.022976	0.027753	-0.006290	0.011328	0.012461	0.020789	0.008842	0.015871	0.003796	0.011109	0.008101
0.061292	-0.097633	0.108230	-0.026609	0.040912	0.042692	0.084277	0.025021	0.064234	0.016797	0.030621	0.020547
0.246150	-0.298830	0.252780	-0.052124	0.105990	0.098031	0.068266	0.048830	0.212310	0.012588	0.003749	0.015515
0.086004	-0.130330	0.137420	-0.037000	0.045519	0.047286	0.107020	0.026159	0.079697	0.016271	0.036746	0.025367
0.010765	-0.013637	0.021368	-0.003223	0.008614	0.011568	0.015796	0.008224	0.010655	0.006611	0.005320	0.006247
-0.098613	0.096162	-0.050880	0.025318	0.008089	0.008131	-0.054650	-0.016213	-0.124500	0.027730	-0.017889	-0.000197
0.083421	-0.116330	0.119700	-0.034917	0.044118	0.047472	0.095595	0.031197	0.075007	0.015119	0.033901	0.025415
0.105000	-0.159830	0.161060	-0.043388	0.053622	0.062759	0.126550	0.037477	0.095316	0.019341	0.041716	0.029919
-0.011464	0.027723	-0.022724	0.009691	-0.006336	-0.004847	-0.018243	-0.001094	-0.014051	0.001021	-0.000112	-0.003821
0.026711	-0.036003	0.044865	-0.010067	0.017008	0.017931	0.036151	0.013051	0.026447	0.010642	0.014674	0.010358
0.105080	-0.157190	0.157790	-0.044299	0.052679	0.060947	0.124480	0.034221	0.092757	0.015297	0.040012	0.032219
0.318800	-0.386180	0.247340	-0.041868	0.140370	0.132660	0.076096	0.091128	0.289140	0.037732	-0.005553	0.014066
0.119880	-0.178260	0.153810	-0.049082	0.061044	0.068678	0.135900	0.037331	0.109470	0.020035	0.050351	0.033746
0.063671	-0.097708	0.105180	-0.028729	0.036161	0.040555	0.078896	0.023964	0.060244	0.014073	0.029208	0.019839
0.030271	-0.037760	0.045261	-0.008007	0.015170	0.019684	0.033107	0.012432	0.026453	0.006251	0.012664	0.011627
0.115550	-0.174400	0.147430	-0.050543	0.057144	0.064496	0.135930	0.037283	0.102060	0.020238	0.048003	0.035096
0.045947	-0.068569	0.077870	-0.018719	0.027249	0.031527	0.062349	0.019889	0.046342	0.014709	0.022695	0.015491
-0.019298	0.040602	-0.036090	0.012779	-0.013773	-0.013820	-0.028710	-0.005143	-0.021659	-0.003823	-0.004783	-0.007461
-0.002071	0.011462	-0.003807	0.006776	-0.003347	-0.000181	-0.004201	0.000405	-0.002168	0.003176	0.000561	-0.000339
0.104450	-0.156870	0.163530	-0.044153	0.056933	0.059538	0.124620	0.034710	0.096772	0.020629	0.041829	0.033409
0.223170	-0.296690	0.218230	-0.041829	0.103810	0.094472	0.056373	0.047027	0.200910	0.018358	0.000722	0.016211
0.037862	-0.058076	0.065902	-0.013582	0.021865	0.028375	0.048737	0.016583	0.038238	0.010325	0.018030	0.014640
-0.030022	0.056553	-0.043749	0.016234	-0.010677	-0.014091	-0.046937	-0.005586	-0.031376	-0.001693	-0.005362	-0.010891
0.061680	-0.091479	0.102530	-0.028438	0.039019	0.039065	0.078351	0.023131	0.058015	0.017508	0.030394	0.020107
0.019983	-0.023322	0.031082	-0.005325	0.010844	0.013385	0.024046	0.007955	0.017851	0.005265	0.007943	0.008902
0.117230	-0.172930	0.145930	-0.047626	0.058858	0.063824	0.135110	0.034524	0.104330	0.020483	0.048917	0.035891
0.053125	-0.075754	0.083268	-0.023112	0.031811	0.034705	0.068322	0.022995	0.049009	0.014276	0.021459	0.015641
-0.070719	0.068720	-0.037739	0.022896	0.007237	0.005093	-0.037778	-0.014607	-0.091888	0.019508	-0.012451	0.002624
0.018548	-0.027286	0.032372	-0.003746	0.013866	0.015515	0.026926	0.011310	0.018560	0.009161	0.011657	0.010198
0.247000	-0.321260	0.224730	-0.037966	0.099729	0.097468	0.066658	0.049792	0.230410	0.022326	-0.001559	0.015091
0.037672	-0.057982	0.064741	-0.014740	0.024602	0.026773	0.048054	0.017534	0.039845	0.010906	0.017792	0.014553
0.118220	-0.176200	0.152900	-0.050264	0.060933	0.064876	0.136430	0.037396	0.106500	0.016111	0.047009	0.034199
0.155150	-0.194820	0.159880	-0.056274	0.049948	0.053239	0.150740	0.035363	0.121920	0.008271	0.052616	0.039961
0.084533	-0.134590	0.138060	-0.038130	0.049745	0.052831	0.110910	0.034033	0.085435	0.016969	0.040511	0.026300
-0.062523	0.059464	-0.043061	0.017991	-0.009702	-0.012144	-0.021701	-0.017697	-0.064669	0.005358	-0.012289	-0.001802
0.151920	-0.221280	0.163610	-0.039355	0.070782	0.065120	0.068020	0.041621	0.137780	0.014967	0.010774	0.019134
0.039061	-0.059056	0.062247	-0.017126	0.023231	0.024944	0.047852	0.018513	0.040272	0.011783	0.020538	0.015710
-0.048193	0.067998	-0.047179	0.021152	-0.005274	-0.006719	-0.063731	-0.011245	-0.056237	0.008876	-0.011314	-0.006914
0.143010	-0.212060	0.182930	-0.059888	0.071563	0.078901	0.165740	0.045076	0.125880	0.022226	0.055596	0.041074
0.039089	-0.058091	0.063931	-0.013336	0.025181	0.029127	0.050308	0.015460	0.038370	0.011793	0.017790	0.013395
0.003153	-0.003814	0.009934	0.002594	0.003371	0.005820	0.006297	0.002430	0.006069	0.003725	0.007119	0.005495
0.116970	-0.179810	0.186040	-0.053470	0.059596	0.066779	0.144500	0.039605	0.111000	0.020104	0.048583	0.038524
-0.046642	0.047716	-0.025723	0.012688	0.001960	0.001049	-0.022503	-0.007056	-0.058076	0.013148	-0.008282	-0.001231
0.028247	-0.037095	0.045303	-0.010270	0.015783	0.016961	0.032563	0.014196	0.026725	0.006633	0.015193	0.007702
0.044788	-0.059905	0.068034	-0.015943	0.025218	0.028694	0.053075	0.015761	0.042232	0.009818	0.018146	0.014173
0.153690	-0.230110	0.196790	-0.061621	0.072979	0.081346	0.177190	0.046245	0.138270	0.021927	0.062057	0.045467
0.038660	-0.058238	0.064972	-0.013996	0.026306	0.024791	0.048152	0.013848	0.037910	0.010949	0.016957	0.011663
0.001155	0.005291	0.002860	0.004967	0.003703	0.003759	0.000518	0.002437	0.000757	0.002166	0.003287	0.003985

w_2 column 13-24

0.132330	0.049913	0.041647	0.014971	0.019805	-0.147320	0.089887	0.054372	-0.015924	0.206790	-0.131110	0.128460
0.151680	0.054502	0.051620	0.016062	0.028027	-0.178610	0.103390	0.064149	-0.018462	0.233660	-0.155680	0.140570
0.023905	0.012301	0.007025	0.005992	0.006501	-0.010113	0.014431	0.009025	-0.000304	0.036391	-0.023541	0.021752
0.096249	0.036290	0.025682	0.008965	0.016342	-0.057210	0.056987	0.029681	-0.002202	0.137470	-0.088354	0.087575
0.060333	-0.017173	0.189060	0.024991	0.077545	-0.464270	0.193320	0.058338	-0.001001	0.147430	-0.065479	0.178420
0.113330	0.045179	0.037392	0.014193	0.017014	-0.119930	0.074339	0.044912	-0.010354	0.174740	-0.113170	0.106380
0.018439	0.006254	0.007434	0.003104	0.003773	-0.007246	0.012785	0.008960	0.002431	0.023955	-0.013109	0.019183
-0.122540	0.002082	0.031145	0.002433	0.015395	0.107200	-0.086839	0.006954	0.053127	-0.162020	0.126370	-0.068488
0.111680	0.039658	0.035092	0.008140	0.017212	-0.096783	0.069092	0.038140	-0.013358	0.160680	-0.107200	0.105850
0.138410	0.053782	0.041348	0.011668	0.019233	-0.142720	0.088269	0.055720	-0.018423	0.210560	-0.138480	0.132040
-0.017153	-0.003229	-0.003486	0.003023	0.002424	0.022246	-0.011981	-0.006061	0.010415	-0.036079	0.024615	-0.024967
0.039581	0.017663	0.010196	0.005239	0.008000	-0.017766	0.022925	0.012981	-0.001420	0.054035	-0.035245	0.035323
0.130710	0.052000	0.044279	0.011947	0.019135	-0.150600	0.087080	0.052643	-0.013787	0.206580	-0.135490	0.127750
0.154190	-0.016286	0.240030	0.048746	0.089230	-0.560370	0.252000	0.123660	0.011110	0.177170	-0.094376	0.250850
0.148070	0.052919	0.049577	0.019578	0.025206	-0.215050	0.103120	0.073176	-0.010829	0.204500	-0.152670	0.136540
0.092501	0.038643	0.027697	0.010628	0.017812	-0.055525	0.056476	0.027704	-0.002581	0.133440	-0.089021	0.084506
0.039230	0.017744	0.014186	0.007024	0.006077	-0.021226	0.023483	0.015248	-0.001541	0.055979	-0.037257	0.037073
0.144590	0.051604	0.051440	0.014850	0.025909	-0.208420	0.100100	0.071884	-0.012913	0.202510	-0.150100	0.136470
0.066704	0.027954	0.021427	0.007772	0.014634	-0.039202	0.040709	0.020777	-0.002675	0.096387	-0.065917	0.061675
-0.032625	-0.009686	-0.006810	-0.002102	-0.003577	0.026445	-0.015890	-0.009963	0.005526	-0.047381	0.034778	-0.030901
-0.008862	0.001883	0.001836	0.002474	0.003808	0.010298	-0.004108	0.000864	0.005014	-0.012970	0.011820	-0.004658
0.134700	0.049660	0.043951	0.015582	0.021128	-0.150300	0.090089	0.057414	-0.009675	0.205410	-0.132370	0.129730
0.072422	-0.013181	0.185190	0.030356	0.072443	-0.439500	0.176330	0.069490	0.010808	0.142970	-0.056055	0.183920
0.055947	0.025608	0.018460	0.008471	0.010183	-0.032855	0.035152	0.019097	0.000240	0.081720	-0.052153	0.051200
-0.046002	-0.009676	-0.009998	-0.001955	-0.000689	0.033483	-0.026610	-0.022385	0.015937	-0.083845	0.049495	-0.057123
0.091356	0.035865	0.026974	0.010316	0.013262	-0.053436	0.053751	0.028306	-0.002062	0.128830	-0.083824	0.084818
0.028755	0.011846	0.010175	0.002453	0.006566	-0.011258	0.017605	0.008491	0.001325	0.034226	-0.024138	0.026383
0.144430	0.050290	0.048805	0.017605	0.025091	-0.205510	0.096914	0.065571	-0.013230	0.197240	-0.149470	0.134380
0.077873	0.028477	0.020360	0.007069	0.012109	-0.050762	0.044130	0.022404	-0.007301	0.110040	-0.070690	0.069939
-0.086516	0.002805	0.024183	0.004081	0.017440	0.075168	-0.064850	0.002848	0.041078	-0.121080	0.094442	-0.050208
0.029326	0.010374	0.011276	0.005760	0.004681	-0.010945	0.017966	0.011190	0.001625	0.040174	-0.024615	0.024587
0.071990	-0.013751	0.193150	0.032413	0.073579	-0.493260	0.195130	0.066325	0.007455	0.136730	-0.056295	0.204550
0.055068	0.020968	0.017223	0.005228	0.008700	-0.030210	0.035400	0.020819	-0.001791	0.082778	-0.048975	0.050949
0.149720	0.054432	0.051605	0.013398	0.024404	-0.213820	0.103220	0.072254	-0.013222	0.204520	-0.154400	0.135350
0.172880	0.041436	0.065870	0.013992	0.028426	-0.304820	0.117650	0.093167	-0.004607	0.158770	-0.167280	0.100590
0.126480	0.049230	0.036977	0.013112	0.016639	-0.088687	0.077251	0.039071	-0.012489	0.179590	-0.122500	0.113850
-0.086569	-0.007279	0.001607	0.002827	0.003848	0.053049	-0.053898	-0.002129	0.022932	-0.090149	0.077096	-0.044648
0.098937	0.001278	0.116750	0.023323	0.043904	-0.302770	0.128250	0.071918	0.000462	0.112000	-0.074236	0.119670
0.058484	0.021899	0.019175	0.005513	0.010921	-0.043277	0.037543	0.021918	-0.003909	0.082150	-0.050640	0.055393
-0.075322	-0.009099	0.004223	0.001420	0.012134	0.048845	-0.051165	-0.019895	0.037412	-0.140310	0.076529	-0.065007
0.176580	0.063978	0.059541	0.020399	0.027595	-0.251650	0.122200	0.087208	-0.012845	0.244970	-0.184410	0.163350
0.059716	0.026245	0.019823	0.005419	0.011960	-0.032157	0.033052	0.019074	-0.001045	0.082191	-0.053314	0.054005
0.006458	0.002595	0.003036	0.003654	0.005112	-0.003094	0.007303	0.001318	0.001033	0.011822	-0.004576	0.005633
0.149550	0.055985	0.049163	0.016088	0.022034	-0.176740	0.102400	0.059502	-0.021435	0.237720	-0.155210	0.143390
-0.061238	-0.001227	0.013973	0.002028	0.010134	0.051765	-0.044528	0.000728	0.026296	-0.078326	0.060519	-0.032054
0.036893	0.017856	0.009567	0.007971	0.009533	-0.019793	0.021647	0.015810	0.000758	0.054467	-0.030409	0.033781
0.060125	0.027072	0.017878	0.008763	0.012565	-0.036418	0.035914	0.019843	0.001053	0.091799	-0.058433	0.057048
0.192710	0.069422	0.060869	0.022185	0.032868	-0.272390	0.132030	0.090569	-0.015176	0.264600	-0.199620	0.178400
0.060285	0.024918	0.017717	0.007146	0.008611	-0.034990	0.037115	0.021124	-0.000094	0.080648	-0.050005	0.054999
-0.000846	0.002686	0.003879	0.001549	0.003596	0.003863	0.000726	0.000016	0.003640	0.003086	0.001336	0.002043

w_2 column 25-36											
0.044591	-0.309060	0.087821	-0.132270	0.103240	0.142610	-0.019049	0.091328	0.087343	0.244360	0.097779	0.114310
0.045817	-0.361180	0.096841	-0.157360	0.117970	0.161740	-0.018559	0.104570	0.102010	0.284330	0.110060	0.129010
0.011798	-0.039195	0.016962	-0.024534	0.021503	0.026571	-0.000409	0.017062	0.015145	0.044325	0.013201	0.021224
0.031804	-0.170830	0.061187	-0.089804	0.068091	0.092518	-0.008019	0.054003	0.057988	0.158510	0.047312	0.078477
0.008676	-0.521920	0.065728	-0.313900	0.035875	0.179820	0.007550	0.095831	0.251940	0.149010	0.117800	0.101070
0.033904	-0.259000	0.074515	-0.114160	0.083873	0.119170	-0.015463	0.075024	0.073095	0.202690	0.078256	0.096405
0.008932	-0.031520	0.013082	-0.014545	0.016577	0.022463	-0.000038	0.010334	0.010616	0.033729	0.010874	0.015100
0.006236	0.230460	-0.016652	0.148450	-0.059288	-0.066096	0.045143	-0.019799	-0.124170	-0.196540	-0.064155	-0.022436
0.032981	-0.235710	0.070360	-0.111540	0.080827	0.116260	-0.018456	0.068572	0.066975	0.189470	0.068894	0.088336
0.044226	-0.316670	0.087062	-0.144280	0.105270	0.149830	-0.022228	0.093436	0.089527	0.252320	0.097288	0.119570
-0.001552	0.047870	-0.011866	0.026497	-0.010899	-0.024275	0.008146	-0.010275	-0.010782	-0.047856	-0.010201	-0.011432
0.013618	-0.069149	0.027388	-0.036919	0.026374	0.040430	-0.002236	0.024923	0.020001	0.063610	0.020464	0.036278
0.040630	-0.311280	0.086246	-0.135690	0.098205	0.137210	-0.020467	0.087531	0.088643	0.246990	0.092941	0.114850
-0.005997	-0.642160	0.038116	-0.335510	0.011973	0.296700	0.016133	0.098098	0.324000	0.218380	0.162410	0.078138
0.048157	-0.344660	0.101070	-0.152530	0.119800	0.165120	-0.008915	0.099298	0.104960	0.276210	0.120490	0.133710
0.029174	-0.171430	0.059425	-0.091432	0.066415	0.097735	-0.010765	0.052412	0.059249	0.156240	0.048529	0.076277
0.017107	-0.069372	0.027244	-0.038411	0.027201	0.041055	-0.001330	0.023244	0.024014	0.067580	0.019311	0.032727
0.045724	-0.349090	0.096689	-0.153670	0.116220	0.155260	-0.014834	0.097817	0.098854	0.271740	0.117280	0.130790
0.021941	-0.124280	0.043880	-0.067267	0.048099	0.067490	-0.005931	0.041649	0.040011	0.113650	0.033789	0.060082
-0.006166	0.067622	-0.017057	0.034920	-0.022418	-0.032536	0.007212	-0.016171	-0.018889	-0.057730	-0.012507	-0.022618
0.000719	0.019752	-0.000399	0.012795	-0.003275	-0.007857	0.004133	0.000080	-0.003366	-0.011706	-0.002657	-0.006575
0.042017	-0.307530	0.087489	-0.134840	0.100050	0.143240	-0.017489	0.092672	0.089272	0.246180	0.098682	0.112880
0.002261	-0.492080	0.062172	-0.312720	0.026365	0.180280	0.017311	0.094394	0.242100	0.137450	0.108850	0.097457
0.021146	-0.102670	0.041123	-0.055131	0.043453	0.058814	-0.003371	0.032174	0.035761	0.094311	0.031265	0.051286
-0.001160	0.099721	-0.023408	0.048594	-0.026027	-0.050517	0.013449	-0.026626	-0.029365	-0.099112	-0.018218	-0.029517
0.030071	-0.165570	0.060414	-0.089629	0.065941	0.092030	-0.008700	0.050904	0.055245	0.150780	0.043025	0.075707
0.010483	-0.042878	0.017183	-0.021746	0.020153	0.027530	0.000774	0.013486	0.014000	0.043041	0.012523	0.023546
0.048355	-0.348140	0.097590	-0.152040	0.113060	0.151910	-0.012478	0.095043	0.098408	0.269940	0.114200	0.125910
0.022352	-0.152890	0.048379	-0.073034	0.051997	0.075610	-0.007961	0.043308	0.047223	0.126790	0.036869	0.063113
0.002011	0.170150	-0.012050	0.109220	-0.043546	-0.048464	0.032768	-0.018297	-0.089098	-0.142270	-0.043187	-0.014866
0.009766	-0.046837	0.019004	-0.021325	0.020684	0.028460	-0.001805	0.016801	0.014419	0.049078	0.014464	0.024753
-0.001059	-0.540690	0.058027	-0.347600	0.025623	0.177390	0.020993	0.093742	0.267840	0.129070	0.113760	0.098815
0.021223	-0.100340	0.038921	-0.051436	0.039901	0.057697	-0.004904	0.030563	0.032634	0.092759	0.031148	0.050256
0.049095	-0.355660	0.099415	-0.155350	0.116230	0.159960	-0.014897	0.096679	0.100730	0.274910	0.118340	0.130960
0.045282	-0.380490	0.135040	-0.201460	0.142920	0.186210	0.000692	0.140650	0.126410	0.311360	0.119910	0.185220
0.042950	-0.258490	0.078989	-0.125850	0.086773	0.128720	-0.020659	0.074222	0.077567	0.214500	0.061932	0.104570
-0.002630	0.128520	-0.009270	0.070297	-0.034182	-0.051600	0.023399	-0.019631	-0.052660	-0.103810	-0.031863	-0.019257
0.013202	-0.340830	0.051162	-0.163440	0.037458	0.179260	0.006668	0.074198	0.151010	0.194410	0.099444	0.069172
0.018292	-0.110460	0.039015	-0.051396	0.042485	0.058577	-0.008132	0.034026	0.034554	0.096726	0.031905	0.049374
0.004930	0.150050	-0.017441	0.070781	-0.039966	-0.050485	0.033149	-0.037287	-0.068850	-0.165820	-0.012567	-0.024220
0.056837	-0.420260	0.119470	-0.184230	0.141490	0.194590	-0.013676	0.116970	0.125480	0.329050	0.143100	0.157630
0.018404	-0.101040	0.040538	-0.053070	0.038580	0.058810	-0.001694	0.035781	0.033769	0.095282	0.031485	0.051105
0.004248	-0.008702	0.007887	-0.005460	0.007056	0.006199	0.001314	0.006750	0.003753	0.010982	0.004410	0.005419
0.049017	-0.368110	0.098968	-0.161850	0.116690	0.159840	-0.024463	0.103490	0.104990	0.282460	0.109170	0.133650
0.005817	0.112560	-0.008318	0.068432	-0.028053	-0.031554	0.020732	-0.011969	-0.055567	-0.091127	-0.028320	-0.014947
0.015836	-0.065656	0.023575	-0.032664	0.026156	0.040603	-0.001351	0.020951	0.022357	0.064300	0.021742	0.033256
0.021164	-0.109700	0.043066	-0.056335	0.045238	0.060460	-0.007207	0.037953	0.039574	0.103140	0.033932	0.051476
0.059002	-0.461780	0.128160	-0.200030	0.152970	0.205900	-0.015579	0.124710	0.133280	0.358670	0.153710	0.170840
0.019601	-0.101180	0.039030	-0.055149	0.040413	0.057168	-0.002849	0.033317	0.034405	0.094888	0.030588	0.048845
0.003573	0.003094	0.002331	0.005236	0.003052	-0.000408	0.000512	0.004574	0.000439	0.002768	0.001319	0.001363

w2 column 37-48											
0.102540	0.204390	0.122200	-0.052794	0.101370	-0.063432	0.109860	0.049517	0.002036	-0.171510	0.026174	0.138350
0.116870	0.233790	0.145440	-0.062734	0.112430	-0.074911	0.132340	0.057113	0.005192	-0.203140	0.032559	0.153430
0.021902	0.036353	0.026029	-0.007203	0.018706	-0.008523	0.019350	0.009558	0.002911	-0.025473	0.007199	0.025270
0.069217	0.141050	0.085925	-0.033092	0.073890	-0.034305	0.080696	0.036191	0.007057	-0.103050	0.022503	0.100680
0.069056	0.217130	0.076479	-0.030377	0.199280	-0.097444	0.149520	0.074121	0.003335	-0.193830	0.002655	0.036394
0.085965	0.174460	0.103960	-0.044820	0.081210	-0.053180	0.091257	0.040092	0.001212	-0.144260	0.025227	0.118620
0.016344	0.029168	0.016788	-0.001107	0.012947	-0.005453	0.017648	0.006916	0.003449	-0.019071	0.005128	0.018867
-0.011764	-0.142490	-0.041782	0.077414	-0.024358	0.061330	-0.016630	-0.012792	0.045065	0.101460	-0.009059	-0.091795
0.082276	0.164190	0.093052	-0.047410	0.078885	-0.050076	0.082227	0.042546	0.000704	-0.129790	0.024479	0.115380
0.105860	0.214720	0.127260	-0.059067	0.102620	-0.066615	0.109290	0.048284	0.003509	-0.171260	0.032190	0.147390
-0.011796	-0.032968	-0.017732	0.016492	-0.015562	0.017671	-0.014390	-0.006548	0.007215	0.027081	-0.000572	-0.029702
0.030542	0.060675	0.036893	-0.012051	0.033727	-0.013412	0.032533	0.016426	0.006897	-0.042672	0.012199	0.042130
0.101990	0.202690	0.124200	-0.059984	0.100010	-0.066726	0.112480	0.047187	0.000568	-0.169660	0.029905	0.139250
0.067770	0.333050	0.049154	-0.032399	0.231130	-0.094747	0.189460	0.122610	0.018549	-0.284970	0.004259	0.057947
0.121860	0.219600	0.129880	-0.043662	0.113600	-0.071400	0.122390	0.052629	0.006257	-0.204010	0.032372	0.124550
0.071652	0.138700	0.089003	-0.035465	0.073230	-0.033174	0.075172	0.033823	0.005793	-0.106210	0.021977	0.099934
0.028954	0.058902	0.036620	-0.010570	0.031057	-0.011176	0.031750	0.015071	0.004569	-0.042530	0.011144	0.041943
0.123860	0.212570	0.128130	-0.049138	0.110350	-0.067587	0.116770	0.053899	0.008592	-0.198900	0.031823	0.124940
0.051990	0.100720	0.063494	-0.021313	0.057154	-0.023113	0.056383	0.023032	0.003534	-0.077034	0.017856	0.074155
-0.020937	-0.047168	-0.027599	0.014863	-0.024182	0.013895	-0.024234	-0.008750	0.001071	0.042360	-0.006096	-0.036474
-0.004213	-0.008993	-0.004483	0.004933	-0.005257	0.003899	-0.003014	-0.002022	-0.000032	0.012123	0.000264	-0.004537
0.103120	0.207330	0.127360	-0.052572	0.099340	-0.067757	0.110640	0.049263	0.006396	-0.175350	0.032361	0.138020
0.053897	0.230730	0.062613	-0.016700	0.186870	-0.076294	0.150750	0.071766	0.011064	-0.196470	0.002988	0.037568
0.041791	0.087613	0.054939	-0.018656	0.044363	-0.019228	0.048260	0.022194	0.003040	-0.062970	0.015375	0.063581
-0.022551	-0.082457	-0.035067	0.033789	-0.026190	0.028769	-0.032819	-0.013152	0.004842	0.055460	-0.013159	-0.065247
0.069285	0.136470	0.083175	-0.032564	0.072920	-0.030483	0.072169	0.030305	0.004823	-0.100300	0.022929	0.097346
0.021358	0.037398	0.025134	-0.006838	0.021497	-0.007007	0.022694	0.010740	0.003385	-0.025862	0.008512	0.026030
0.123140	0.209430	0.125550	-0.050297	0.106030	-0.070667	0.114320	0.049390	0.005134	-0.198370	0.031411	0.121690
0.058198	0.112990	0.069504	-0.032373	0.060350	-0.030951	0.062704	0.025988	0.003396	-0.085217	0.017483	0.080577
-0.012011	-0.103010	-0.032857	0.061153	-0.018572	0.042429	-0.013137	-0.010243	0.033649	0.081310	-0.008304	-0.062302
0.019305	0.043470	0.025914	-0.007370	0.025032	-0.008977	0.026388	0.009344	0.006301	-0.026944	0.010894	0.031650
0.060470	0.241870	0.057672	-0.020154	0.198200	-0.080086	0.149020	0.074381	0.011264	-0.199310	0.008891	0.030453
0.043083	0.081981	0.055284	-0.019858	0.047700	-0.017254	0.049108	0.022138	0.006456	-0.060649	0.014265	0.057582
0.122030	0.215890	0.132080	-0.051120	0.109270	-0.071790	0.119250	0.051917	0.006702	-0.205880	0.030708	0.126830
0.141600	0.240210	0.110330	-0.020316	0.089977	-0.081935	0.128740	0.054112	0.003766	-0.243490	0.021372	0.075965
0.094419	0.187390	0.110980	-0.056710	0.096921	-0.051487	0.097767	0.045867	0.006836	-0.144090	0.026418	0.128680
-0.023296	-0.080200	-0.025885	0.046582	-0.025774	0.027231	-0.015845	-0.017651	0.015111	0.067416	-0.002617	-0.052784
0.064112	0.169160	0.070890	-0.022816	0.136450	-0.074129	0.123120	0.054938	0.004589	-0.167940	0.006698	0.042279
0.043431	0.085795	0.053033	-0.023439	0.043889	-0.023920	0.048344	0.021916	0.005035	-0.063373	0.013238	0.062250
-0.013685	-0.111070	-0.035607	0.058502	-0.020965	0.038128	-0.024976	-0.009346	0.022602	0.075105	-0.013987	-0.097882
0.147410	0.260670	0.153490	-0.058752	0.132680	-0.086628	0.146390	0.061535	0.008453	-0.247500	0.034887	0.151300
0.041790	0.083558	0.052639	-0.020848	0.046304	-0.020669	0.048308	0.021281	0.007535	-0.059725	0.012647	0.063231
0.005870	0.008944	0.009772	0.002737	0.007951	0.000195	0.007493	0.004634	0.003272	-0.001823	0.002650	0.005495
0.119540	0.233480	0.141510	-0.070099	0.115960	-0.076101	0.125950	0.056896	0.003680	-0.201240	0.032674	0.158600
-0.012838	-0.064758	-0.018272	0.039653	-0.009974	0.027029	-0.006497	-0.007945	0.020883	0.054630	-0.003778	-0.044059
0.029475	0.054784	0.034353	-0.011533	0.033030	-0.010151	0.032183	0.015140	0.002660	-0.040515	0.013070	0.039797
0.049307	0.091881	0.059483	-0.018348	0.051890	-0.022269	0.053201	0.025312	0.003805	-0.066336	0.015527	0.064041
0.156500	0.280510	0.168470	-0.066857	0.141190	-0.091384	0.156590	0.068307	0.009428	-0.264050	0.040366	0.161550
0.043188	0.084223	0.056686	-0.018795	0.047519	-0.021156	0.048016	0.019769	0.005806	-0.064254	0.015582	0.060424
-0.000122	0.001995	0.001874	0.006187	0.000436	0.001769	0.003617	0.001545	0.001485	0.001685	0.004667	0.003167

w_2 column 49-50	
-0.283030	0.096417
-0.328550	0.119660
-0.042866	0.017582
-0.180190	0.052669
-0.856930	0.335800
-0.234440	0.075911
-0.031361	0.010879
0.305540	-0.157170
-0.216260	0.062370
-0.292170	0.089852
0.042548	-0.005148
-0.071285	0.019523
-0.283020	0.093357
-1.024100	0.406250
-0.326930	0.149590
-0.182380	0.053346
-0.073755	0.023030
-0.324410	0.140260
-0.128200	0.042366
0.073718	-0.019418
0.021671	-0.003497
-0.285880	0.098269
-0.787660	0.322170
-0.107790	0.032119
0.095575	-0.026036
-0.171020	0.049014
-0.048648	0.018174
-0.321940	0.134540
-0.144200	0.040287
0.224330	-0.112490
-0.046221	0.017942
-0.853380	0.345420
-0.103790	0.032572
-0.327360	0.143940
-0.409610	0.235960
-0.246100	0.068505
0.159810	-0.072072
-0.560940	0.234420
-0.108040	0.030990
0.136270	-0.076923
-0.394590	0.174920
-0.105810	0.034512
-0.006402	0.004673
-0.330100	0.108960
0.145790	-0.072553
-0.067852	0.019973
-0.119160	0.037995
-0.426260	0.185170
-0.108860	0.032642
0.002671	0.003161

$(w_3)^T$
0.845250
0.978240
0.140480
0.541440
1.472600
0.707970
0.103620
-0.670840
0.654460
0.866790
-0.135650
0.222650
0.844630
1.838700
0.957280
0.537600
0.225110
0.940780
0.391500
-0.193970
-0.044527
0.852060
1.400200
0.328850
-0.295650
0.518300
0.147000
0.929800
0.438330
-0.491170
0.157930
1.514000
0.320920
0.956110
1.097600
0.733500
-0.371700
1.021100
0.332560
-0.437670
1.145100
0.326740
0.036312
0.980640
-0.319810
0.214000
0.354530
1.237300
0.327830
0.002720

b_1
0.574890
-0.220280
0.577780
0.288280
0.945020
0.994160
0.609580
0.345990
-0.482590
0.667420
0.254660
0.183350
0.698300
0.374840
-0.142340
0.619050
0.671650
0.125190
0.495300
0.527430
0.856690
0.486450
0.460560
0.030943
0.393030
-0.951740
0.621670
0.038709
0.564530
0.742520
0.719800
0.775970
-0.381910
-0.115510
0.333080
0.739400
0.233470
0.776860
0.140390
0.806860
0.300740
0.307560
0.642390
0.416130
0.736390
0.710920
0.227580
0.663750
2.048000
-0.178900

b_2
0.181870
0.242060
0.192200
0.283900
0.295720
0.165480
0.399950
0.293280
0.175730
0.208260
0.078103
0.233660
0.230120
0.317060
0.104460
0.362580
0.094840
0.162410
0.287500
0.344310
0.216570
0.167550
0.176590
0.379950
0.258570
0.283730
0.350720
0.182400
0.164550
0.194900
0.179240
0.280040
0.224960
0.174930
0.142910
0.300720
0.241250
0.085363
0.051743
0.240200
0.173170
0.105190
0.290590
0.300100
0.138680
0.098497
0.156200
0.227020
0.214810
0.161290

b_3
1.759500