# Model

## RNN

### LSTM

Diagram

Description automatically generated

### Bidirectional LSTM

Diagram

Description automatically generated

## XGBoost

## Prophet

## LightGBM

# Loss Functions

## Mean Squared Error

Mean squared error (MSE) measures the amount of error in statistical models. It assesses the average squared difference between the observed and predicted values. When a model has no error, the MSE equals zero. As model error increases, its value increases. The mean squared error is also known as the mean squared deviation (MSD).

Where:

= number of data points

= observed values

= predicted values

## Mean Absolute Error

The simplest measure of forecast accuracy is called Mean Absolute Error (MAE). Mean Absolute Error is simply, as the name suggests, the mean of the absolute errors. The absolute error is the absolute value of the difference between the forecasted value and the actual value. Mean Absolute Error measures accuracy for continuous variables. Mean Absolute Error tells us how big of an error we can expect from the forecast on average. The Mean Absolute Error measures the average magnitude of the errors in a set of predictions, without considering their direction. The Mean Absolute Error is the average over the test sample of the absolute differences between prediction and actual observation where all individual differences have equal weight. Both Mean Absolute Error and Root Mean Square Error express average model prediction error in units of the variable of interest. The Mean Absolute Error and the Root Mean Square Error can range from 0 to ∞ and are indifferent to the direction of errors.

Where:

= prediction

= true value

= total number of data points

## Root Mean Squared Error

**Root Mean Square Error**(RMSE) is the standard deviation of the residuals (prediction errors). Residuals are a measure of how far from the regression line data points are; RMSE is a measure of how spread out these residuals are. In other words, it tells you how concentrated the data is around the line of best fit. Root mean square error is commonly used in climatology, forecasting, and regression analysis to verify experimental results. When standardized observations and forecasts are used as RMSE inputs, there is a direct relationship with the correlation coefficient. For example, if the correlation coefficient is 1, the RMSE will be 0, because all the points lie on the regression line (and therefore there are no errors).

Where:

= variable i

= number of non-missing data points

= actual observations

= predicted observations

## R-squared

The *coefficient of determination*, or , is a measure that provides information about the goodness of fit of a model. In the context of regression, it is a statistical measure of how well the regression line approximates the actual data. It is therefore important when a statistical model is used either to predict future outcomes or in the testing of hypotheses. The *sum squared regression* is the sum of the residuals squared, and the *total sum of squares* is the sum of the distance the data is away from the mean all squared. As it is a percentage it will take values between  and .