

# Inflation rate prediction using LSTM

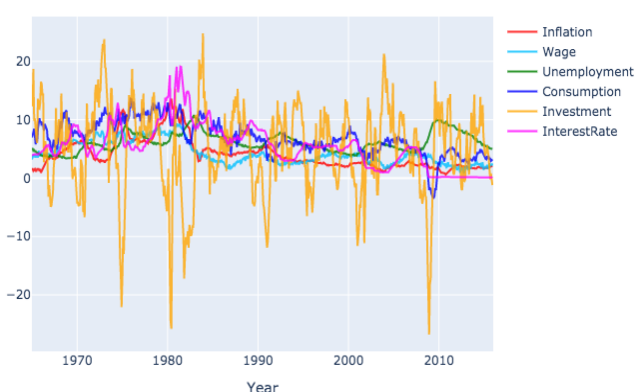
## Introduction

In this study, we built the Deep learning model to forecast the macro economy variable 'Inflation' using other macroeconomic variables such as wage, unemployment, consumptions, investment, and interest rate. The US economy data was collected by Federal Reserve Bank of St. Louis and we consider the data from year 1965 to 2015 for our analysis.

## DATA Exploration

We have given monthly aggregated macro economy data for inflation, wage, unemployment, consumptions, investment, and interest rate. For exploration, we looked missing values, distributions, correlation and historical values of the macroeconomic variables. We observed from the historical data plot that interest rate is almost got flat since 2008 and overall investment in economy non stationary and highly varies. Also, inflation has some correlation with wage and interest rate.

USA macroeconomy variables over time



	Inflation	Wage	Unemployment	Consumption	Investment	InterestRate
Inflation	1	0.778155	0.191886	0.61782	-0.341421	0.773616
Wage	0.778155	1	-0.0685292	0.703745	-0.125412	0.647482
Unemployment	0.191886	-0.0685292	1	-0.097183	-0.0382862	-0.0278087
Consumption	0.61782	0.703745	-0.097183	1	0.203165	0.655305
Investment	-0.341421	-0.125412	-0.0382862	0.203165	1	-0.234573
InterestRate	0.773616	0.647482	-0.0278087	0.655305	-0.234573	1

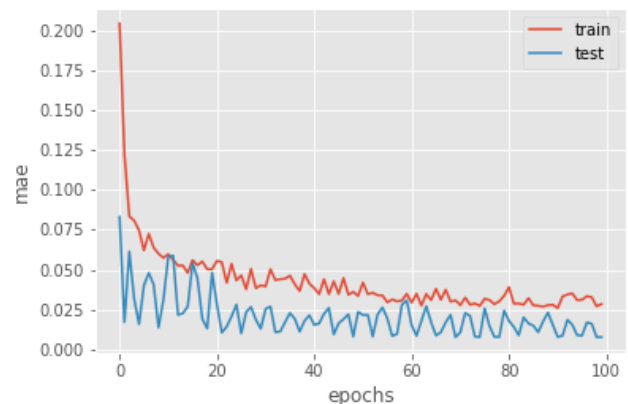
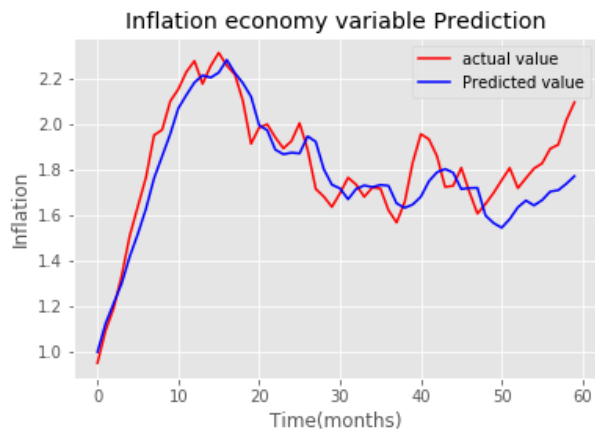
## Data preparation and model building

### Data preparation for deep learning

The time series prediction using deep learning require to convert time series data to supervised learning form (input and target variables). The data is converted using moving window concept, where 12 historical months' event use to predict current months' event. In our case, the inflation at current month as a target and other economy variables (including inflation) in past 12 months as an input features. The best window size can we found by more experiments if time permits. The entire data set is converted in this form using step forward method. The data is divided in train set (46 years) and test set (5 years).

## Model building and prediction

The time series forecast can be model using RNN - LSTM. There are many type of LSTM such as vanilla LSTM, stacked LSTM, Bidirectional LSTM or CNN-LSTM which can handle multivariate time series problem. In this study, we use the simple vanilla LSTM because of simplicity and time constrain. Vanilla LSTM expects each input data in terms of historical time steps and number of features used for prediction. Our case, we considered past 12 months as a historical time steps and 6 economic variables as number of feature. The shape of the input data pass in LSTM is 3 dimensional (sample size, historical time steps, number of future). We defined a model with 50 neurons (memory unit or block) in first hidden layer and 1 neuron in the output layer for prediction. The dropout layer is added with 20% dropout rate which help to reduce the overfitting. We use mean absolute error(MAE) loss function for error calculation and ADAM stochastic gradient descentes for updates the network weights iteratively during model fitting process. The model was trained using 100 epochs with full data batch size and saved in h5 file format. The training and test loss during training process was tracked by using validation data as argument in the fit function. The plot shows that after 50 epochs error get stationary and not varies much. The validation of the model on last 5 years (from 2010 to 2015) shows that our simple LSTM model is capturing trend. Model can be improved with parameters tunings if time permits.



## Forecasting for future months

Using trained LSTM Model, Inflation is forecasted for next 12 months (year 2016). We use one step moving forward approach to predict inflation month after month. First, we create 6 individual LSTM models to predict inflation, wage, unemployment, consumptions, investment, and interest rate for January 2016 using previous 12 months of historical data (2015). Now using January 2016 predicted values of economic variables and moving forward method, we predict inflation for February 2016 and so on.

