

Mini-Project 4:
Stock Price Prediction using Neural Network, LSTM, and CNN
Due Date: 4 pm, Monday, November 5, 2018

Team Members:

Name: Zainiya Manjiyani

Student ID: 219216284

Problem Statement:

Task 1: Use the daily [Open, High, Low, Volume] to predict [Close] on that day using a **fully-connected neural network**. Use the first 70% of the records for training and the remaining 30% of the records for test. Report the RMSE of the model. Show the “regression lift chart” of your test data.

Task 2: Predict [Close] of a day based on the last 7 days’ data [Open, High, Low, Volume, Close] using a **LSTM model**. In other words, we want to predict the price in the green cell using all the numbers in the red cell. Use the first 70% of the available records for training and the remaining 30% of the available records for test. Report the RMSE of the model. Show the “regression lift chart” of your test data.

Hint: Each record in X can be viewed as a sequence of 7 vectors, each vector with 5 dimensions.

Task 3: Do the same as Task 2 but use a **CNN model**. Report the RMSE of the model. Show the “regression lift chart” of your test data.

Task Division:

- Completed Task 1, 2 and 3.
- Generated Refression lift chart as well as RMSE score for each model
- In addition: Used two other companies data from different domain to comapre the models

Models used for comparision:

- Fully-Connected Neural Networks
- LSTM
- Convolutional Neural Networks (CNN)

Methodology:

- Data Preprocessing
- Made changes in to _sequence model to generate appropriate training and testing data.
- Used different models for comparing RMSE score
- Printed and plotted Regression lift chart
- Did tuning of hyper-parameters to see performance using:

Activation: relu, sigmoid, tanh

Layers and neuron counts

Optimizer: adam, sgd, rmsprop

Kernel number and kernel size (for CNN only)

LSTM neuron count (for LSTM only)

- Added dropout layers to observe changes in the RMSE Score.

Experimental Results and Analysis:

Experiments and results on Neural Network:

Activation and Optimizer used: relu and rmsprop

Hidden Layer 1	Hidden Layer 2	Hidden Layer 3	Hidden Layer 4	Hidden Layer 5	RMSE	r2
135	127	198	60		0.6805	0.999
400	300	57	60		0.5852	0.9995
400	300	225	57	60	0.62109	0.99949
120	64	128			0.5276	0.9996
73	108	45	37		0.4981	0.9998

Using the best result given from relu and rmsprop applied to the other activation functions and optimizers for testing the change in RMSE score. so from the observations above using the layers with nuerons: 73, 108, 45, 37 are as follows:

Activation	Optimizer	RMSE Score	r2 Score
relu	adam	0.4519	0.99973
relu	sgd	1.055	0.9985
relu	rmsprop	0.4981	0.9998
sigmoid	adam	32.3313	-0.3588
sigmoid	sgd	30.024	-0.1718
sigmoid	rmsprop	33.458	-0.455257
tanh	adam	33.83	-0.48851
tanh	sgd	50.10	-2.263
tanh	rmsprop	35.053	-0.597

From the table above I observed that relu in particular gives better results in comparision to others and the best result I got of the combination of relu and adam.

By using above I choose the best result and added dropout layers to observe change in RMSE score:

Dropout Layer 1	RMSE Score
0.1	0.6905
0.2	0.78256
0.5	1.031
0.7	1.8724

Experiments and result on RNN:

Activation and Optimizer used: relu and adam

LSTM	Layer 2	Layer 3	Layer 4	RMSE Score	r2 Score

130	64	128		14.071	0.7413
120	64	128	55	17.266	0.613
100	73	120		15.847	0.67
300	225	150		12.3588	0.8018

Using the best result given from relu and adam applied to the other activation functions and optimizers for testing the change in RMSE score. so from the observations above using the layers with values: 300, 225, 150 and also used the dropout in all the observation below as 0.1 are as follows:

Activation	Optimizer	RMSE Score	r2 Score
relu	adam	12.3588	0.8018
relu	sgd	30.874	-0.2366
relu	rmsprop	7.9668	0.9176
sigmoid	adam	34.616	-0.55449
sigmoid	sgd	30.7924	-0.2300
sigmoid	rmsprop	72.894	-5.893
tanh	adam	35.663	-0.7070
tanh	sgd	34.911	
tanh	rmsprop	35.5341	-0.6379

The combination of activation and optimizer from the above observation table is relu and rmsprop.

Dropout Layer 1	Dropout Layer 2	RMSE Score
0.1		14.665
0.1	0.1	10.09
0.2	0.5	36.644
0.5		20.6446
0.7		24.698

Experiments and results on CNN (cov2d):

Input shape used: (1,7,5)

kernel_size on layers 1: (1,4)

kernel_size on layers 2: (1,2)

Activation and Optimizer used: relu and rmsprop

Layer1	Layer 2	Layer 3	RMSE Score	r2 Score
130	64	128	5.565	0.9598
125	52	129	2.85	0.9894
200	167	92	2.843	0.9895

Using the best result given from relu and rmsprop applied to the other activation functions and optimizers for testing the change in RMSE score. so from the observations above using the layers with values: 200,167, 92 are as follows:

Activation	Optimizer	RMSE Score	r2 Score
relu	adam	4.2040	0.97707
relu	sgd	7.3212	0.9304
relu	rmsprop	2.843	0.9895
sigmoid	adam	35.52	-0.6373
sigmoid	sgd	29.73	-0.1469
sigmoid	rmsprop	35.6431	-0.64806
tanh	adam	35.808	-0.6633
tanh	sgd	37.7272	-0.8464
tanh	rmsprop	36.0618	-0.6870

Best combination observed of relu and rmsprop with RMSE Score of 2.843.

I also did some experiment with the input shape to be (7,5,1) but the result were almost same. so didn't find any distinguish between them.

Dropout Layer 1	RMSE Score
0.1	4.1876
0.2	3.4878
0.5	3.4954
0.7	3.5649

Additional Features:

I have applied same models on **two other data sets from different domain companies** for observing the RMSE Scores.

Company: Alphabet Inc. (GOOG)

Link to the data set:

<https://finance.yahoo.com/quote/GOOG/history?p=GOOG&.tsrc=fin-srch>

Data set used: **8/19/2004 - 11/3/2018**

Total Number of records: **3580**

Experimental Results and Analysis:

Experiments and results on Neural Network:

Activation and Optimizer used: relu and adam

Hidden Layer 1	Hidden Layer 2	Hidden Layer 3	Hidden Layer 4	RMSE
135	127	198	60	7.07883
135	198	60		6.56
467	200	82		4.3248
467	363	82		4.3258
467	363	627	82	4.31104
467	363	627	82	7.0725(with dropout layer of 0.5)

Using the best result given from relu and adam applied to the other activation functions and optimizers for testing the change in RMSE score. so from the observations above using the layers with nuerons: 467,363,627,82 are as follows:

Activation	Optimizer	RMSE Score
relu	adam	4.31104
relu	sgd	2.2684
relu	rmsprop	10.1119

From the table above I observed that relu in particular gives better results in comparision to others and the best result I got of the combination of relu and sgd. I tried to add dropout layer but it was geeting worse so i removed it and continue my experiment.

Experiments and result on RNN:

Activation and Optimizer used: relu and adam

LSTM	Layer 2	Layer 3	RMSE Score
200	150		73.1609
200	163	150	26.1101
328	400	83	59.0844
257	309	62	56.2411

Using the best result given from relu and adam applied to the other activation functions and optimizers for testing the change in RMSE score. so from the observations above using the layers with values: 200, 163, 150 and also used the dropout in all the observation below as 0.1 are as follows:

Activation	Optimizer	RMSE Score
relu	adam	26.1101
relu	rmsprop	43.7736
sigmoid	rmsprop	576.266

The combination of activation and optimizer from the above observation table is relu and adam.

Experiments and results on CNN (cov2d):

Input shape used: (1,7,5)

kernel_size on layers 1: (1,4)

kernel_size on layers 2: (1,2)

Activation and Optimizer used: relu and rmsprop

Layer1	Layer 2	Layer 3	Layer 4	RMSE Score
500	700	127	50	30.6117
67	43	28		13.245
150	200	25		22.1629
79	345	19		32.6559

Using the best result given from relu and rmsprop applied to the other activation functions and optimizers for testing the change in RMSE score. so from the observations above using the layers with values: 67,43,28 are as follows:

Activation	Optimizer	RMSE Score
relu	adam	22.4948
relu	sgd	837.345
relu	rmsprop	13.245

Company: Reliance Industries Limited

Link to the data set:

<https://finance.yahoo.com/quote/RELIANCE.NS/history?p=RELIANCE.NS&.tsrc=fin-srch>

Data set used: **12/31/1995 - 11/3/2018**

Total number of records: **5773**

Experimental Results and Analysis:

Experiments and results on Neural Network:

Activation and Optimizer used: relu and rmsprop

Hidden Layer 1	Hidden Layer 2	Hidden Layer 3	Hidden Layer 4	RMSE
135	127	198	60	0.994669
200	12	350	78	0.99958
250	67	430	86	0.9995

Using the best result given from relu and rmsprop applied to the other activation functions and optimizers for testing the change in RMSE score. so from the observations above using the layers with neurons: 135,127,198,60 are as follows:

Activation	Optimizer	RMSE Score
relu	adam	3.6309
relu	rmsprop	4.813
sigmoid	rmsprop	98.83

From the table above I observed that relu in particular gives better results in comparison to others and the best result I got of the combination of relu and adam.

Experiments and result on RNN:

Activation and Optimizer used: relu and rmsprop

LSTM	Layer 2	Layer 3	Layer 4	RMSE Score
300	225	150		47.275
125	160	43	25	35.527
200	135	250		41.37

Using the best result given from relu and rmsprop applied to the other activation functions and optimizers for testing the change in RMSE score. so from the observations above using the layers with values: 200, 135, 250 are as follows:

Activation	Optimizer	RMSE Score
relu	adam	59.3688
relu	rmsprop	33.72
sigmoid	rmsprop	426.034

The combination of activation and optimizer from the above observation table is relu and rmsprop.

Experiments and results on CNN (cov2d):

Input shape used: (1,7,5)

kernel_size on layers 1: (1,4)

kernel_size on layers 2: (1,2)

Activation and Optimizer used: relu and rmsprop

Layer1	Layer 2	Layer 3	RMSE Score
125	52		15.360
200	650	25	54.36
176	200	58	19.27

Using the best result given from relu and rmsprop applied to the other activation functions and optimizers for testing the change in RMSE score. so from the observations above using the layers with values: 125,52 are as follows:

Activation	Optimizer	RMSE Score
relu	adam	15.388
relu	rmsprop	15.360
sigmoid	rmsprop	112.828

The best result i got is from the combination of relu and rmsprop.

I have also applied with the input shape (7,5,1) but didn't saw much difference.