THE LAAL STREET

Wells Fargo Quantitative AI Hackathon

Shaastra 2022

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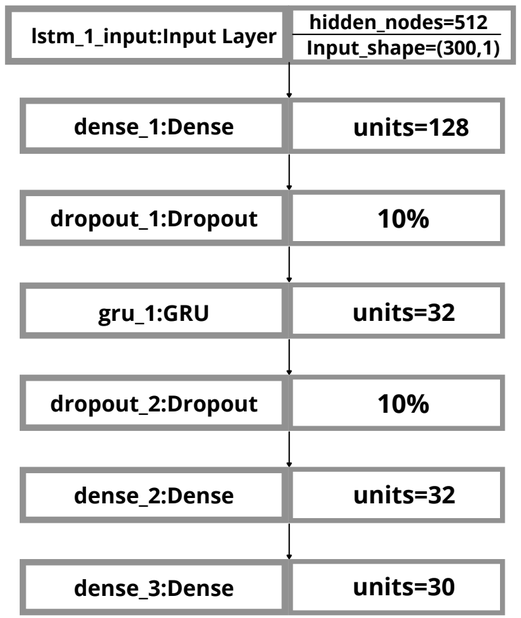
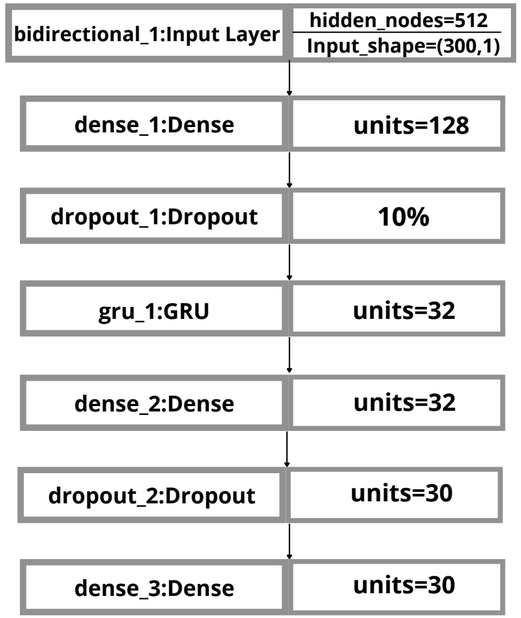
Description of Model

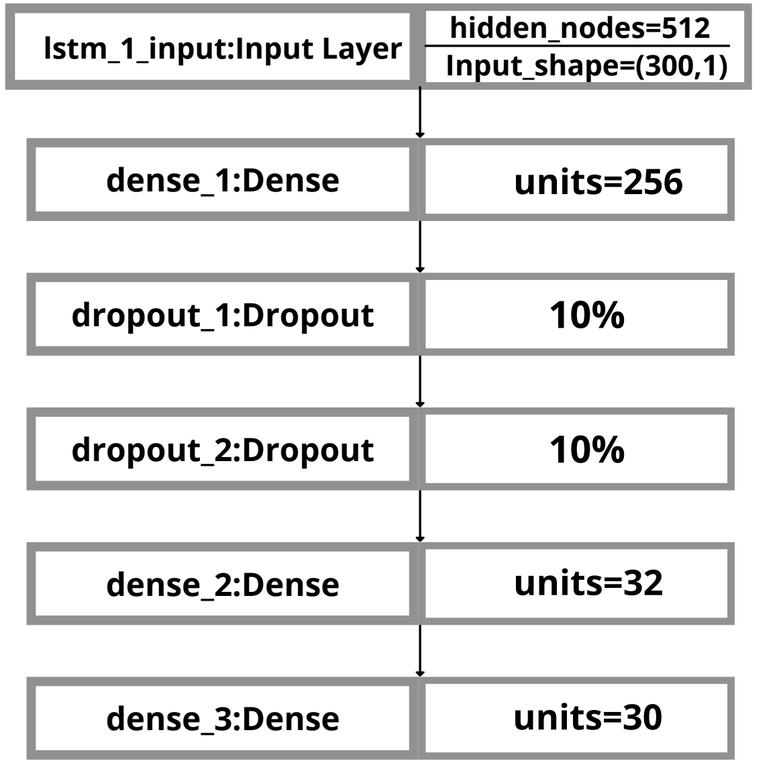




Use LSTM layer in order to learn the cyclic trends in implied volatility fluctuations

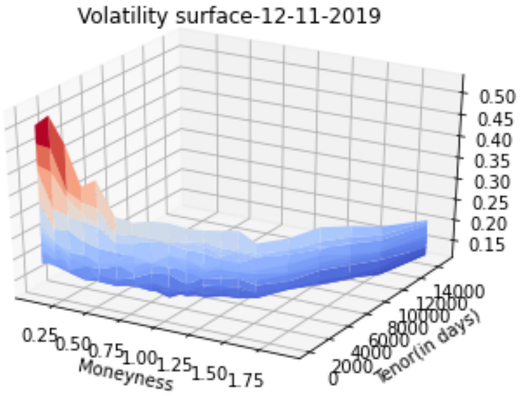
We use a dropout layer to avoid overfitting in the model as that would lead to worse results in stock related predictions

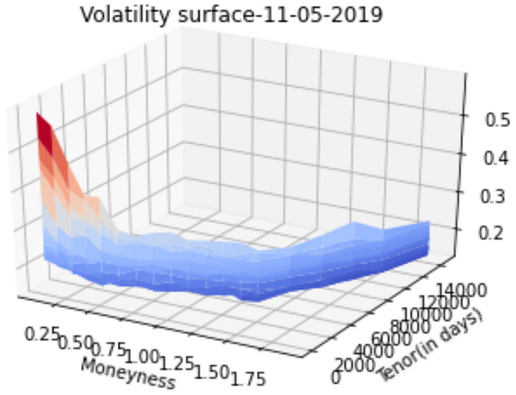
Use the GRU layer in order to avoid the vanishing gradient problems while maintaining functionality similar to LSTM with less computation



Among the models tested the given 3 models gave us the best test set results based on the training data among which the best accuracy was given

Data Analysis





Formula

$$C = \Phi(d1)S - \Phi(d2)Ke^{(-rT)}$$

$$d1 = \ln(S/K) + (r + \sigma^2/2)T / \sigma\sqrt{T} \qquad d2 = d1 - \sigma\sqrt{T}$$

Φ = cumulative density function of a standard normal distribution

C = premium for call option K = strike price

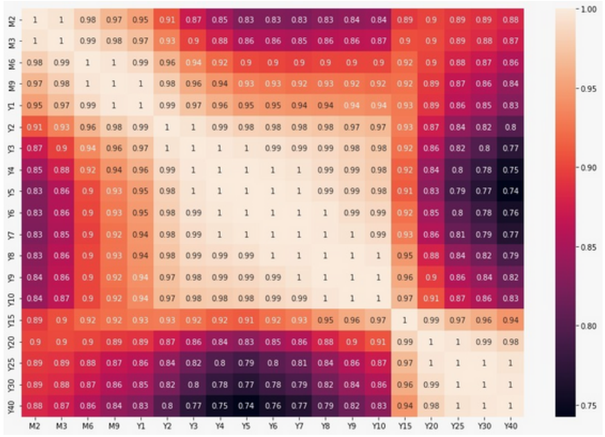
T = expiration date r = risk-free interest rate

S = stock price at time t0 σ = volatility

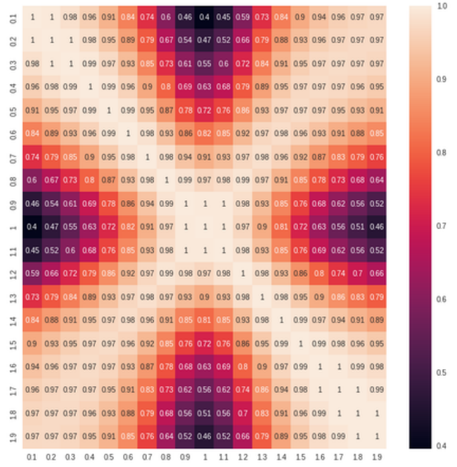
Based on the above formula and the plot shown, we can see that the values of implied volatility for a given tenor decreases till moneyness=1 and then increases again till 1.9 making moneyness=1 as the minima

The values of implied volatiity as the tenor increases i.e. implied volatility on a given date is maximum for 2M tenor and minimum for 40Y tenor

Model Selection



Tenor correlation plot



Moneyness correlation plot

Using the correlation among different tenors on a given date as well different moneyness of options we ran models by making sets of 3 moneyness at a time and 5 tenors at a time

To get the final prediction we averaged the predicted value given by the 3 sets of moneyness it is a part of as well as the 5 tenor sets it is a part of.

On comparing the results from the two models we tried to optimize the RMSE score by choosing the best ratio to add these models predictions in

As shown in the given figure, the greater the mooneyness based model prediction ratio, the better is the accuracy of the model, thus we finalised the model with only tenor-wise correlation

Link to implied volatility surface plots of 60 days