

Quantitative Finance - Option Pricing models

Winter in Data Science

Uid-29

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ENGINEERING PHYSICS

Libraries Used

- **Pandas:** Used for data manipulation and analysis, providing a flexible and efficient DataFrame structure.
- **NumPy:** Used for numerical operations I did, facilitating array manipulation and mathematical functions.
- **Matplotlib:** Used matplotlib.pyplot for data visualization, enabling the creation of informative plots and charts.
- **Scikit-learn:** Used for train-test splitting and standard scaling, streamlining the preprocessing of data.
- **Keras** (part of **TensorFlow**): Used in the construction and training of Neural Networks, allowing for easy implementation of models, Sequential and Dense layers.
- **Seaborn:** The best library I discovered was Seaborn. It's basically statistical data visualization library based on Matplotlib. Seaborn simplifies the creation of informative and attractive statistical graphics, and it includes various plots.
- **Torch (PyTorch):** It's an machine learning library, providing a dynamic computational graph, particularly for deep learning and neural networks.

Data Exploration and Preprocessing

- The dataset, sourced from "ASIANPAINT_Dataset.xlsx," undergoes thorough exploration using Pandas. Missing values are addressed, and a new feature, 'sigma_20,' is introduced to capture varying **volatility**.
- The dataset is then **split into training and testing sets**, with features scaled using StandardScaler.

Neural Network Architecture

- The main model, `call_model`, is structured using **Keras Sequential**.
- It consists of densely connected layers with **ReLU activation**, concluding with a linear activation output layer.
- The model is compiled using the mean squared error loss function and the **Adam** optimizer.

Model Training and Evaluation

- The model undergoes training with specified **hyperparameters**, batch size, epochs, and learning rate.
- Training history is visualized, and the model is saved. Evaluation on the test set reveals the model's performance.

Results and Analysis

- The **actual vs. predicted values** are depicted using Matplotlib, offering a visual insight into the model's predictive capabilities.
- A linear fit line further emphasizes the alignment between actual and predicted values.

Conclusion

- Mastered the development and implementation of advanced financial models for options pricing, skilfully applying **deep learning** and **neural networks** to overcome **Black-Scholes equation** limitations
- Hands-on experience in engineering and refining Multilayer Perceptron (**MLP**) models (**MLP1, MLP2**) and Long Short-Term Memory (**LSTM**) models, honing accuracy and flexibility in options pricing
- Utilized **20-day** historical volatility as input for MLP models and incorporated the latest **20-days** of underlying price for the LSTM model, enabling it to dynamically learn and adapt to changing market conditions

Submissions

[Week 1 Assignment Submission](#)

[Week 2 Assignment Submission](#)

No Assignment in Week 3

[Week 4 Assignment \(Project\) Submission](#)

[GitHub Repo](#)