

Time Series Forecasting

Tesla Stock Price Analysis and Forecast

Team #02

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Agenda

Overview &
Objectives

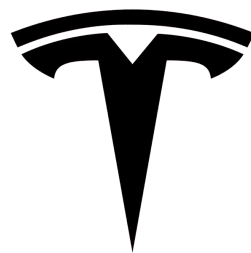
Data &
Analysis

Conclusions



Company Overview

- ❏ Produces electric vehicles, energy storage units, and solar panels
- ❏ Deliveries (FY22): 1.3mn
- ❏ Revenue (FY22): \$81.5bn
- ❏ EPS (FY22): \$3.62



TESLA



Objectives

#1

Explore the impact of COVID-19 and the global chip shortage on Tesla stock prices.

#2

Train forecasting models to predict Tesla's stock price for the next **12** weeks and **3** months of 2023.

Objective #1

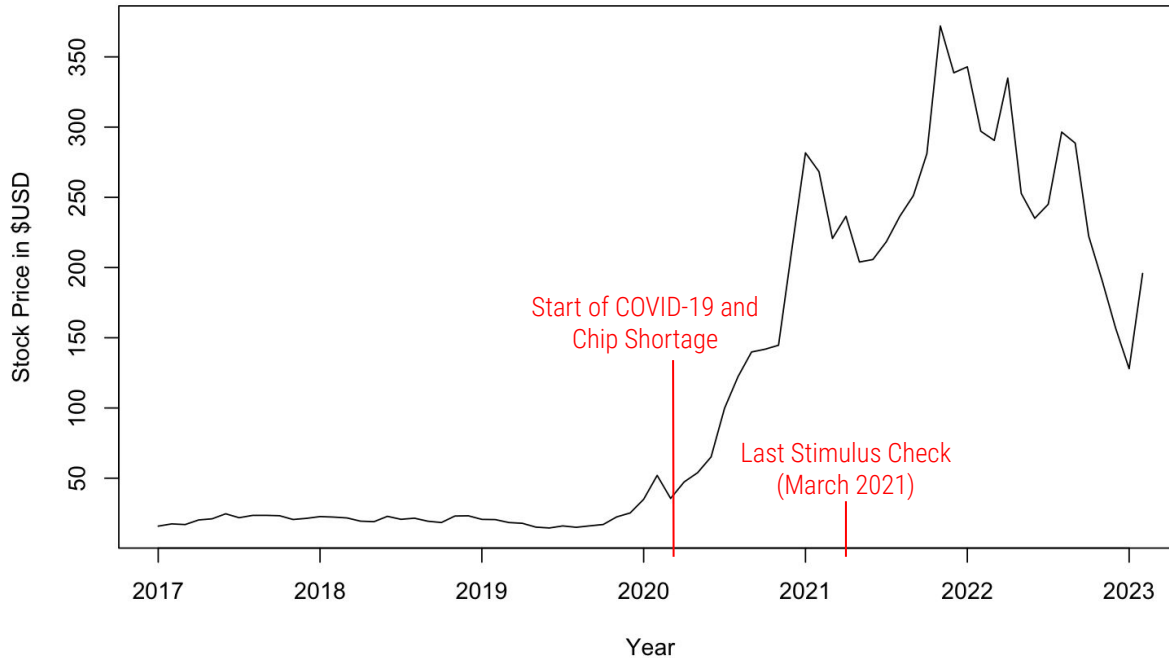


Explore the impact of COVID-19 and the global chip shortage on Tesla stock prices.



Tesla Stock Prices Over the Years

Monthly Tesla Stock Price vs. Year (2017-2023)



Objective #2



Train forecasting models to predict Tesla's stock price for the next **12** weeks and **3** months of 2023.



Forecast Methods

**Regression
Based Model**

**Smoothing
Methods**

ARIMA Model

**Neural
Networks**

Regression Based Model - Weekly

Linear Regression for Weekly Data



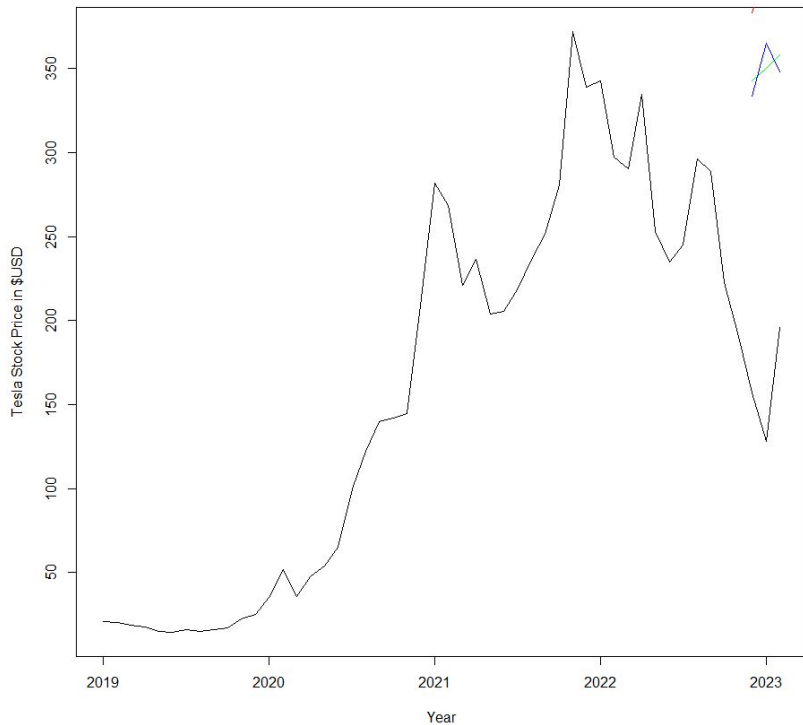
Green = Trend
Red = Trend + Season
Blue = Exp. Trend + Season

Weekly Linear Model MAPE:

- Trend = 58.8
- ✓ • Trend + Season = 55.7
- Exp. Trend + Season = 85.9

Regression Based Model - Monthly

Linear Regression (Trend and Season) for Monthly Data



Green = Trend
Red = Trend + Season
Blue = Exp. Trend + Season

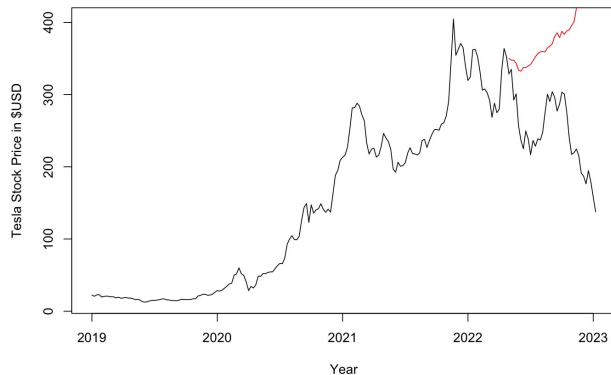
Weekly Linear Model MAPE:



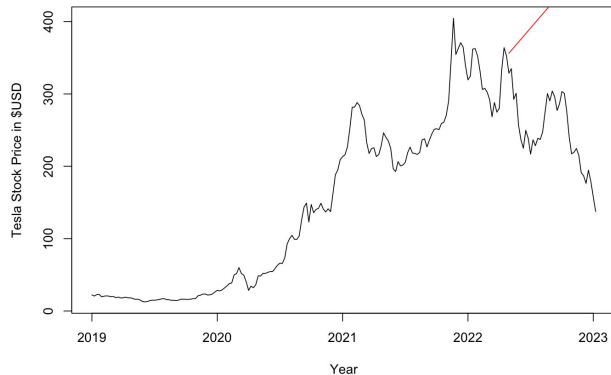
- Trend = 124.9
- Trend + Season = 155.6
- Exp. Trend + Season = 125.2

Smoothing Methods - SES vs. ETS - Weekly

SES Model for Weekly Data



ETS Model for Weekly Data



SES Weekly:



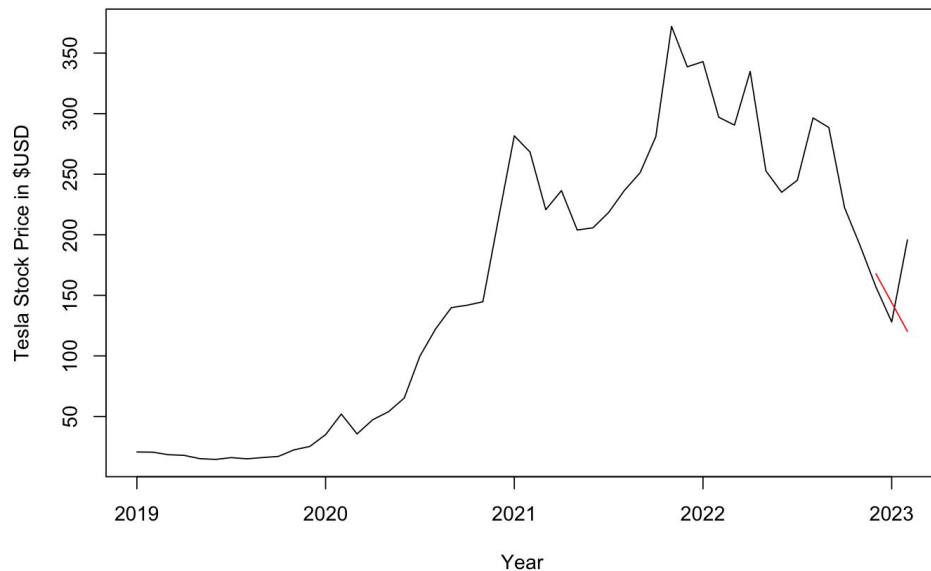
- MAE: 133.7566
- MAPE: 63.23887

ETS "MAN" Weekly:

- MAE: 179.5398
- MAPE: 82.86146

Smoothing Methods - SES vs. ETS - Monthly

SES Model for Monthly Data



SES Monthly:

- MAE: 34.1464
- MAPE: 19.34789

ETS "MAN" Monthly:

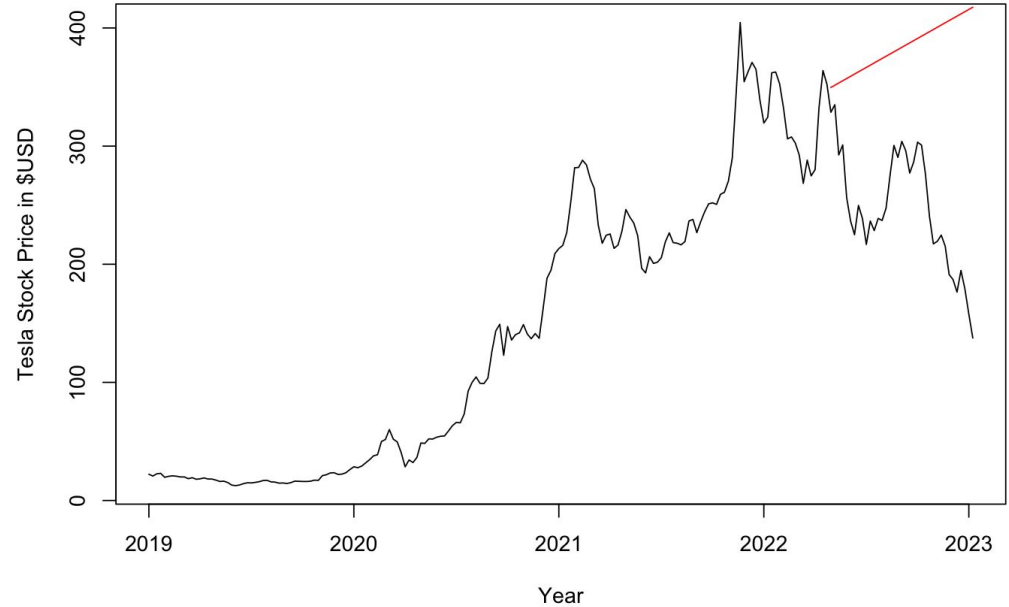
- MAE: 34.1464
- MAPE: 19.34789

ARIMA Model - Weekly

ARIMA Weekly:

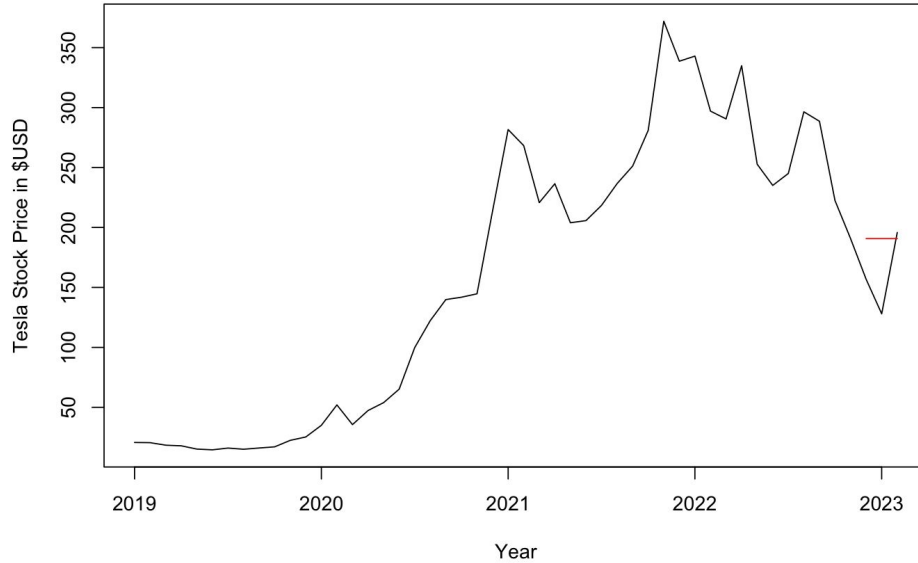
- ARIMA(0,1,1)
- MAE: 137.1278
- MAPE: 63.60255

ARIMA Model for Weekly Data



ARIMA Model - Monthly

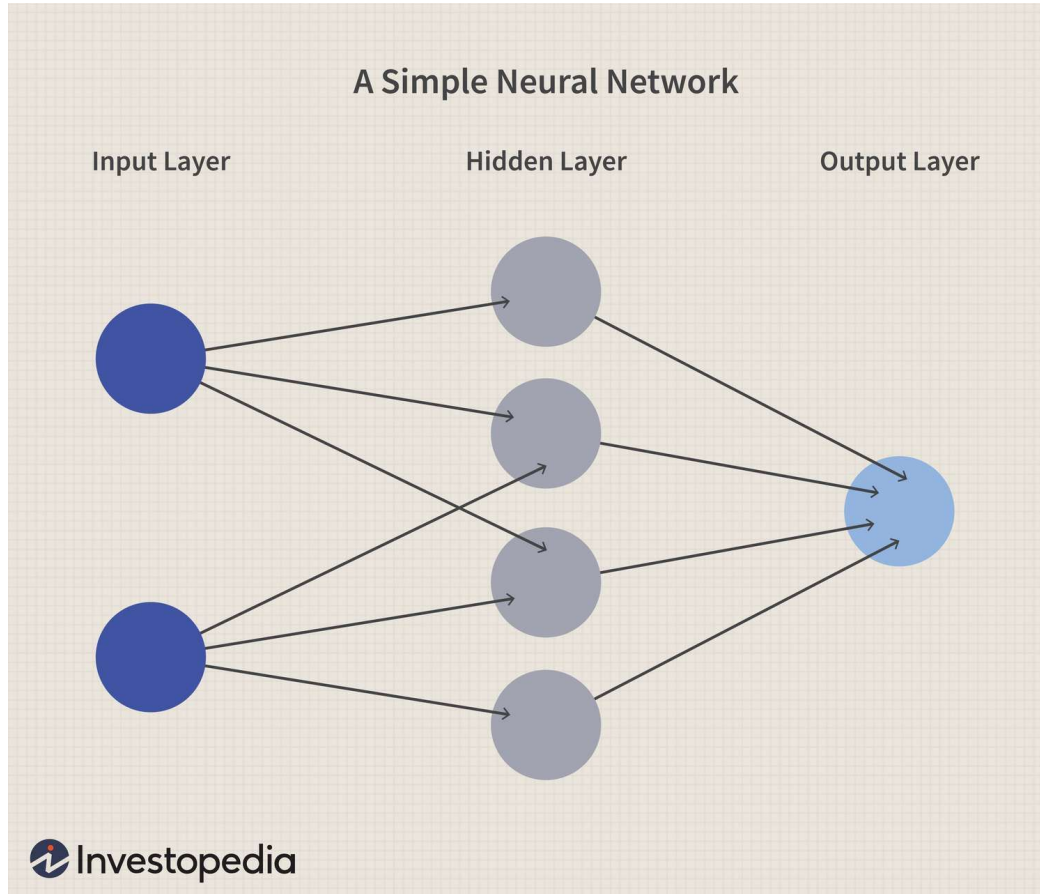
ARIMA Model for Monthly Data



ARIMA Monthly:

- ARIMA(0,1,0)
- MAE: 33.91
- MAPE: 24.41626

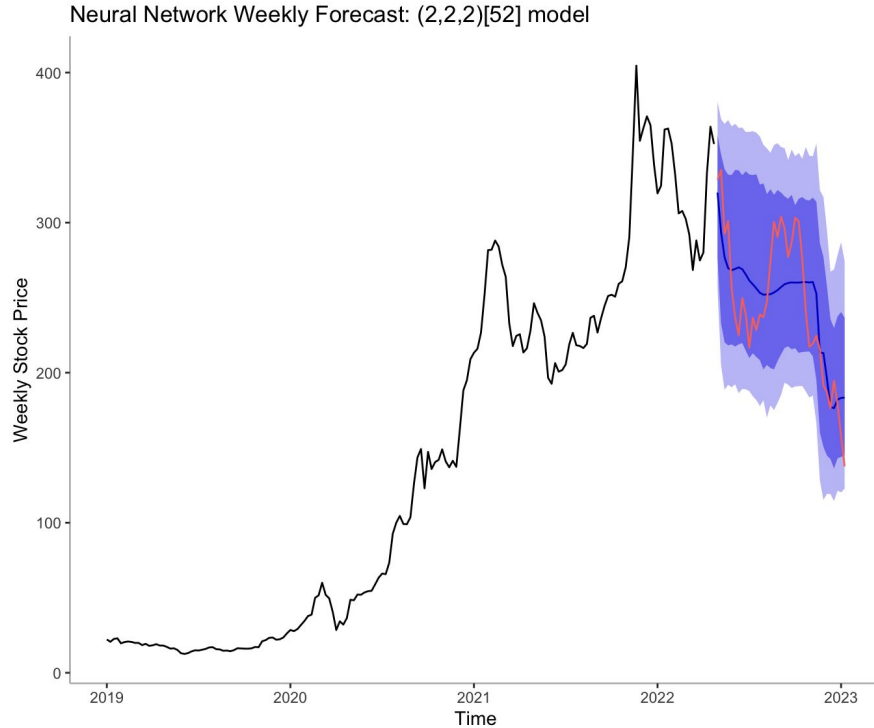
Neural Networks



Complex nature of stock price → Neural Networks + Time Series

- *nnetar*: Feed-forward neural networks with a single hidden layer and lagged inputs for forecasting univariate time series.

Neural Networks – Weekly

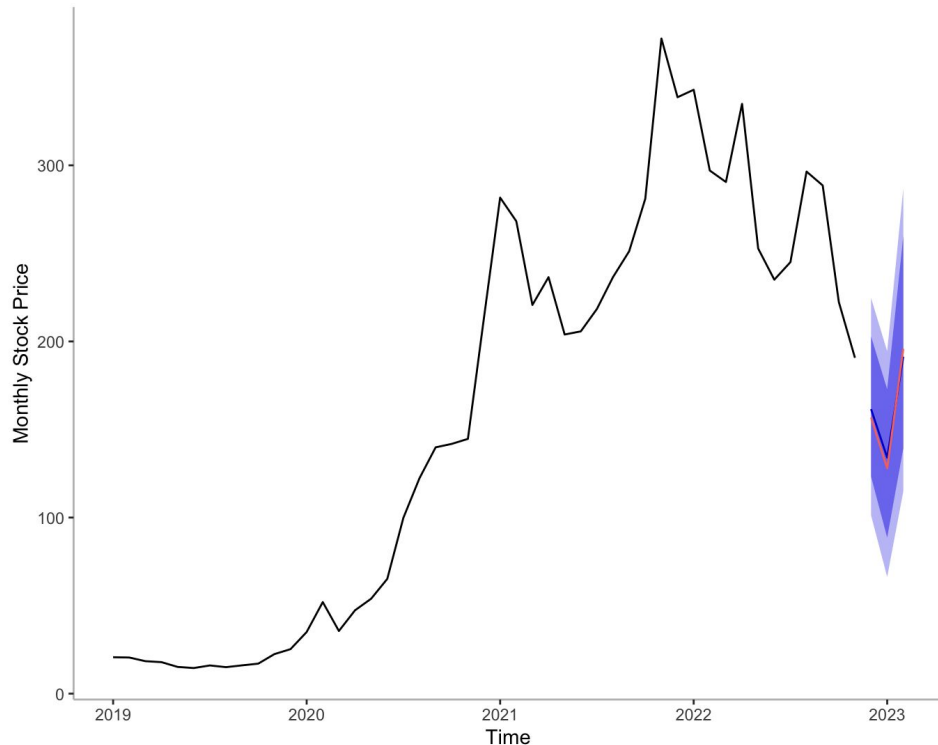


Weekly:

- Seed at 80
- 2 periods of seasonal lag and lambda at 1
- NNAR(2,2,2)[52] model
- MAE: 25.70614
- MAPE: 10.66192

Neural Networks – Monthly

Neural Network Monthly Forecast: (1,2,2)[12] model



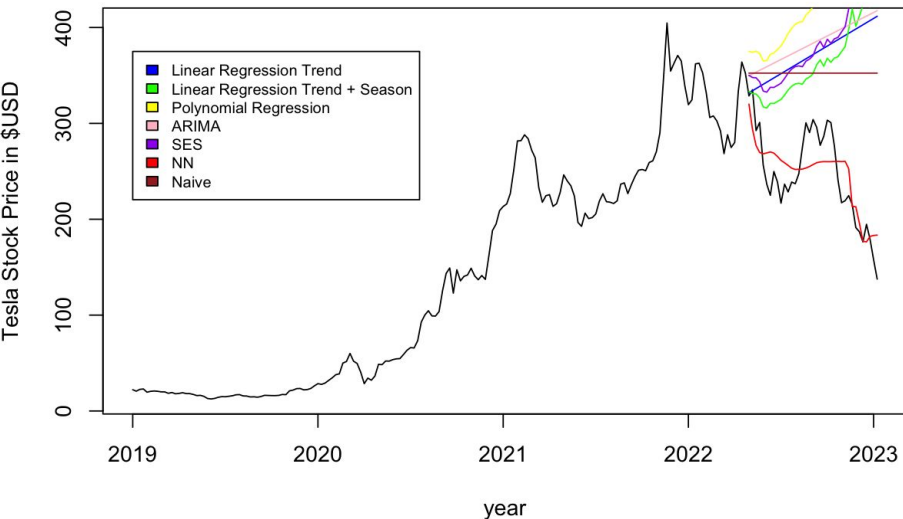
Monthly:

- Seed at 2678
- 2 periods of seasonal lag and lambda at 1
- NNAR(1,2,2)[12] model
- MAE: 5.09701
- MAPE: 3.35368

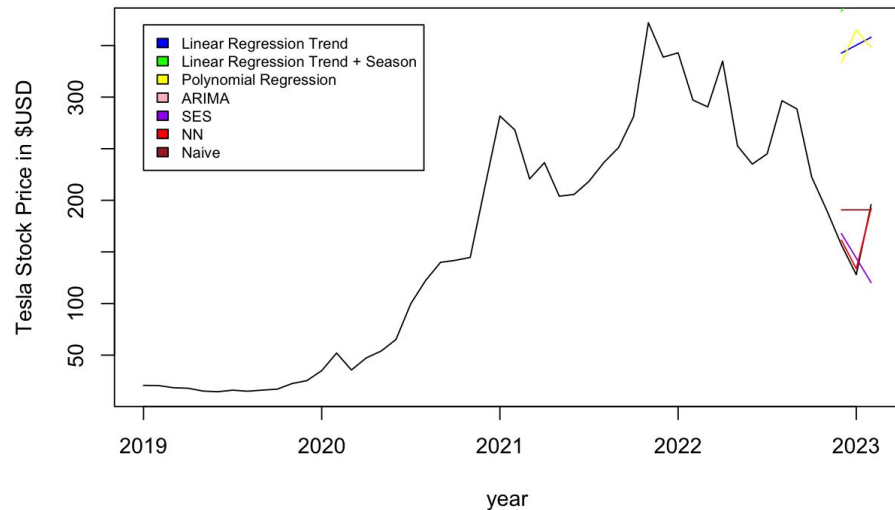
Neural Networks

Neural Networks model is the best performing.

All Models for Weekly Data



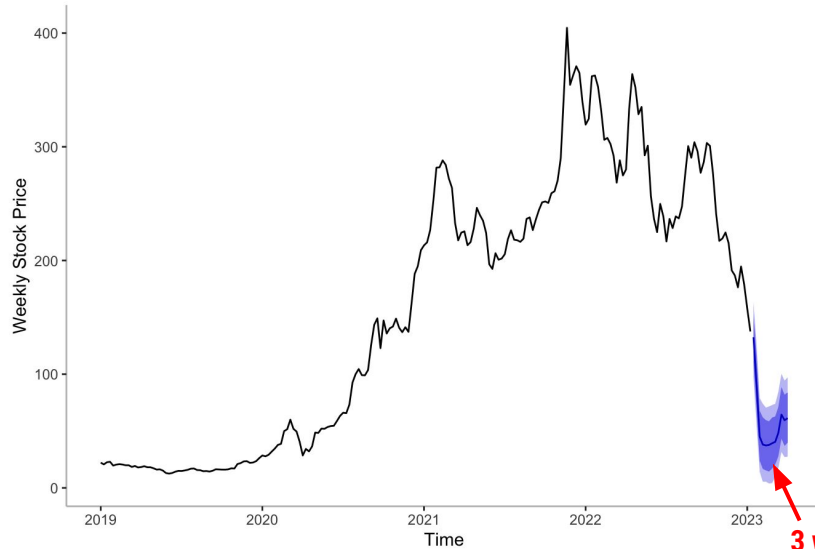
All Models for Monthly Data



Model Implementation on Full Data + Forecast

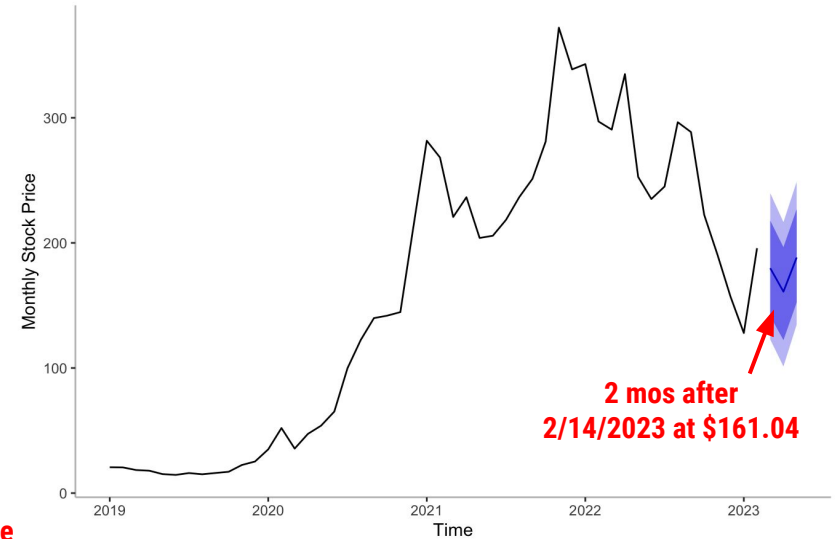
Forecast the real future for **3 months** and **12 weeks**

Neural Network Future Weekly Forecast: (2,2,2)[52] model



**3 weeks after
2/14/2023 at \$37.33**

Neural Network Future Monthly Forecast: (1,2,2)[12] model



**2 mos after
2/14/2023 at \$161.04**



Conclusion

- Neural Networks have highest predictive power
- As per our previous model, investors should buy in at 3 weeks to 2 months from now