In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

import yfinance as yf
from prophet import Prophet
```

```
/Users/manikshakya/anaconda3/envs/hgp/lib/python3.10/site-packages/requests/
__init__.py:109: RequestsDependencyWarning: urllib3 (1.26.9) or chardet (5.
1.0)/charset_normalizer (2.0.12) doesn't match a supported version!
  warnings.warn(
```

In [2]:
```
# Load the dataset
data = pd.read_csv('PG.csv')
```

In [3]:
```
# Extract the date and closing prices
dates = pd.to_datetime(data['Date'])
closing_prices = data['Close']
```

In [4]:
```
# Convert closing prices to a pandas Series
closing_prices = pd.Series(closing_prices)
closing_prices
```

Out[4]:
```
0      123.410004
1      122.580002
2      122.750000
3      121.989998
4      122.510002
          ...
751    152.619995
752    153.949997
753    151.960007
754    152.589996
755    151.559998
Name: Close, Length: 756, dtype: float64
```

Technical Analysis & Monte Carlo Simulation

In [5]:
```
# Calculate the 20-day moving average
moving_average = closing_prices.rolling(window=20).mean()
moving_average
```

Out[5]:
```
0             NaN
1             NaN
2             NaN
3             NaN
4             NaN
          ...
751    150.428001
752    150.795500
753    151.119501
754    151.291000
755    151.406500
Name: Close, Length: 756, dtype: float64
```

In [6]:
```
# Calculate the standard deviation of the closing prices
std_deviation = closing_prices.rolling(window=20).std()
std_deviation
```

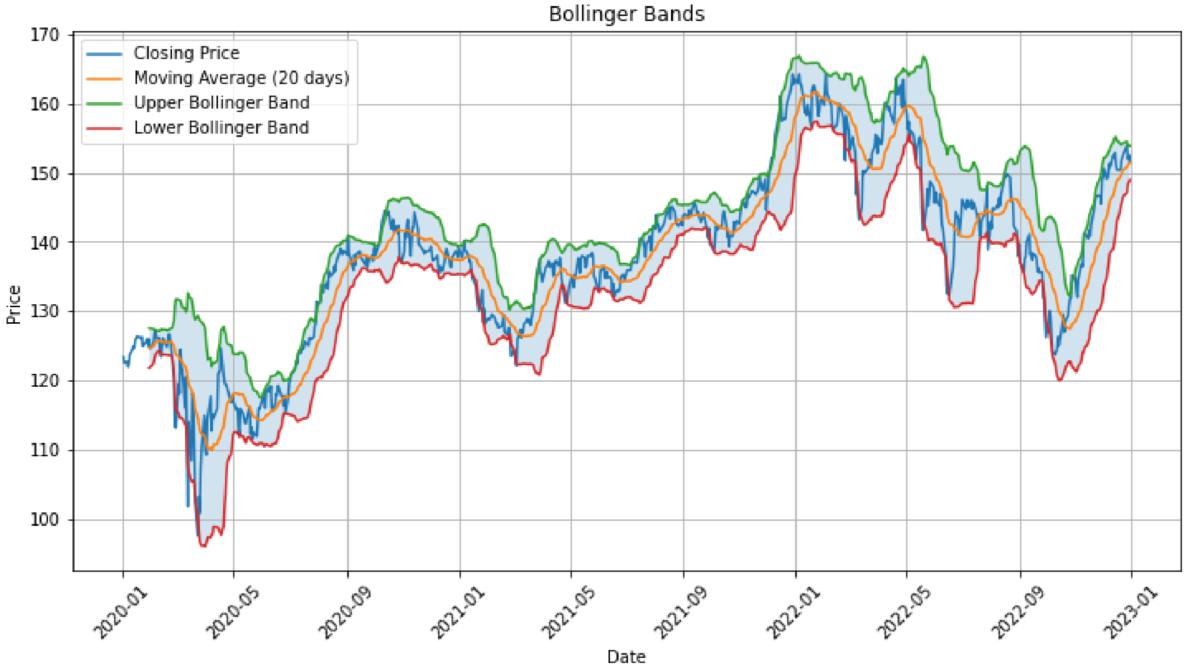
Out[6]:
```
0            NaN
1            NaN
2            NaN
3            NaN
4            NaN
          ...   
751     1.919256
752     1.850137
753     1.377241
754     1.333250
755     1.244217
Name: Close, Length: 756, dtype: float64
```

In [7]:
```
# Calculate the upper and lower Bollinger Bands
upper_band = moving_average + (2 * std_deviation)
lower_band = moving_average - (2 * std_deviation)

print(upper_band)
print(lower_band)
```

```
0              NaN
1              NaN
2              NaN
3              NaN
4              NaN
          ...    
751     154.266512
752     154.495773
753     153.873983
754     153.957500
755     153.894934
Name: Close, Length: 756, dtype: float64
0              NaN
1              NaN
2              NaN
3              NaN
4              NaN
          ...    
751     146.589489
752     147.095227
753     148.365018
754     148.624500
755     148.918067
Name: Close, Length: 756, dtype: float64
```

In [8]:
```
# Plot the Bollinger Bands
plt.figure(figsize=(12, 6))
plt.plot(dates, closing_prices, label='Closing Price')
plt.plot(dates, moving_average, label='Moving Average (20 days)')
plt.plot(dates, upper_band, label='Upper Bollinger Band')
plt.plot(dates, lower_band, label='Lower Bollinger Band')
plt.fill_between(dates, lower_band, upper_band, alpha=0.2)
plt.title('Bollinger Bands')
plt.xlabel('Date')
plt.ylabel('Price')
plt.legend()
plt.xticks(rotation=45)
plt.grid(True)
plt.show()
```



In [9]:
```
# Perform Monte Carlo simulation
num_simulations = 10000
num_trading_days = len(closing_prices)
```

In [10]:
```
# Calculate daily returns
daily_returns = closing_prices.pct_change().dropna()
daily_returns
```

Out[10]:
```
1      -0.006726
2       0.001387
3      -0.006191
4       0.004263
5       0.010938
          ...
751     0.002825
752     0.008714
753    -0.012926
754     0.004146
755    -0.006750
Name: Close, Length: 755, dtype: float64
```

In [11]:
```
# Calculate average daily return and standard deviation
avg_return = daily_returns.mean()
std_return = daily_returns.std()

print(avg_return)
print(std_return)
```

```
0.00038777679872341303
0.015222003733285064
```

In [12]:
```
np.random.seed(42)
```

In [13]:
```
# Perform Monte Carlo simulation
simulation_results = np.zeros((num_simulations, num_trading_days))
simulation_results
```

Out[13]:
```
array([[0., 0., 0., ..., 0., 0., 0.],
       [0., 0., 0., ..., 0., 0., 0.],
       [0., 0., 0., ..., 0., 0., 0.],
       ...,
       [0., 0., 0., ..., 0., 0., 0.],
       [0., 0., 0., ..., 0., 0., 0.],
       [0., 0., 0., ..., 0., 0., 0.]])
```

In [14]:
```
for i in range(num_simulations):
    # Set the initial price as the last closing price of 2022
    simulated_prices = np.zeros(num_trading_days)
    simulated_prices[0] = closing_prices.iloc[-1]

    for j in range(1, num_trading_days):
        # Generate a random daily return based on the average and standard c
        daily_return = np.random.normal(avg_return, std_return)

        # Calculate the simulated price for the next trading day
        simulated_prices[j] = simulated_prices[j - 1] * (1 + daily_return)

    # Store the simulated prices for each simulation
    simulation_results[i] = simulated_prices
```

In [15]:
```
simulation_results
```

Out[15]:
```
array([[151.559998  , 152.76471228, 152.50243315, ..., 144.74208991,
        147.11966924, 145.05058165],
       [151.559998  , 157.69179822, 158.9371004 , ..., 738.79246175,
        740.07316348, 757.00510882],
       [151.559998  , 148.98483917, 148.60342186, ..., 195.14667793,
        192.0407612 , 194.10366861],
       ...,
       [151.559998  , 147.85503193, 147.2608956 , ..., 236.10958076,
        241.6119289 , 245.09743354],
       [151.559998  , 148.93696836, 149.33772685, ..., 161.88204088,
        163.09339235, 164.42256387],
       [151.559998  , 147.41477692, 151.4344293 , ..., 190.67614145,
        188.4976631 , 189.01140172]])
```

In [16]:
```
# Calculate the average and standard deviation of the simulated returns
simulated_returns = (simulation_results[:, -1] / closing_prices.iloc[-1]) -
avg_simulated_return = np.mean(simulated_returns)
std_simulated_return = np.std(simulated_returns)

print(avg_simulated_return)
print(std_simulated_return)
```

```
0.3362081091697624
0.575999633684304
```

In [17]:
```
# Print the results
print("Monte Carlo Simulation Results:")
print("-------------------------------")
print("Average Return: {:.4f}".format(avg_simulated_return))
print("Standard Deviation of Return: {:.4f}".format(std_simulated_return))
```

```
Monte Carlo Simulation Results:
-------------------------------
Average Return: 0.3362
Standard Deviation of Return: 0.5760
```

Stock Signals

In [18]:
```
# Extract the date and closing prices
dates = pd.to_datetime(data['Date'])
closing_prices = data['Close']
```

In [19]:
```
# Calculate the short-term moving average (SMA)
sma_short = closing_prices.rolling(window=30).mean()
sma_short
```

Out[19]:
```
0             NaN
1             NaN
2             NaN
3             NaN
4             NaN
          ...
751    147.978334
752    148.411000
753    148.777001
754    149.180334
755    149.507667
Name: Close, Length: 756, dtype: float64
```

In [20]:
```
# Calculate the long-term moving average (SMA)
sma_long = closing_prices.rolling(window=90).mean()
sma_long
```

Out[20]:
```
0             NaN
1             NaN
2             NaN
3             NaN
4             NaN
          ...
751    139.217445
752    139.263889
753    139.288667
754    139.324889
755    139.381667
Name: Close, Length: 756, dtype: float64
```

In [21]:
```
# Calculate the short-term moving average (EMA)
ema_short = closing_prices.ewm(span=30, adjust=False).mean()
ema_short
```

Out[21]:
```
0      123.410004
1      123.356455
2      123.317329
3      123.231695
4      123.185134
          ...
751    147.575910
752    147.987142
753    148.243456
754    148.523878
755    148.719756
Name: Close, Length: 756, dtype: float64
```

In [22]:
```
# Calculate the long-term moving average (EMA)
ema_long = closing_prices.ewm(span=90, adjust=False).mean()
ema_long
```

Out[22]:
```
0      123.410004
1      123.391762
2      123.377658
3      123.347160
4      123.328760
          ...
751    142.722692
752    142.969446
753    143.167040
754    143.374138
755    143.554047
Name: Close, Length: 756, dtype: float64
```

In [23]:
```
# Generate buy and sell signals based on SMA
buy_sma = (sma_short > sma_long) & (sma_short.shift() < sma_long.shift())
sell_sma = (sma_short < sma_long) & (sma_short.shift() > sma_long.shift())

print(buy_sma)
print(sell_sma)
```

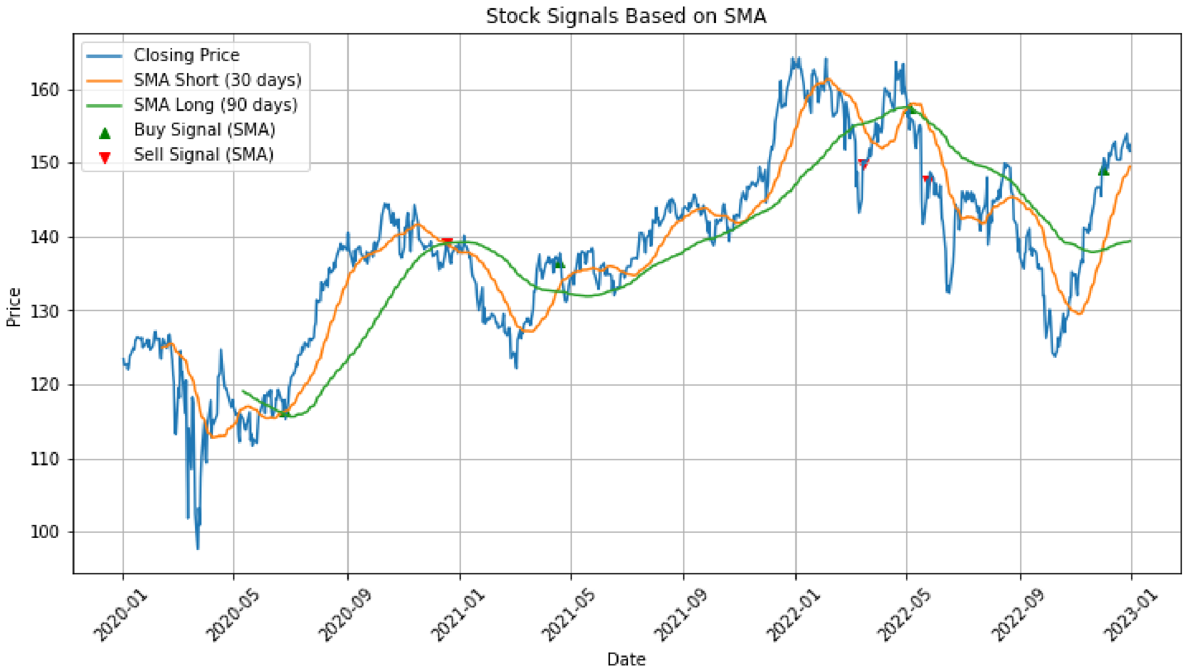
```
0      False
1      False
2      False
3      False
4      False
       ...
751    False
752    False
753    False
754    False
755    False
Name: Close, Length: 756, dtype: bool
0      False
1      False
2      False
3      False
4      False
       ...
751    False
752    False
753    False
754    False
755    False
Name: Close, Length: 756, dtype: bool
```

In [24]:
```
# Generate buy and sell signals based on EMA
buy_ema = (ema_short > ema_long) & (ema_short.shift() < ema_long.shift())
sell_ema = (ema_short < ema_long) & (ema_short.shift() > ema_long.shift())

print(buy_ema)
print(sell_ema)
```

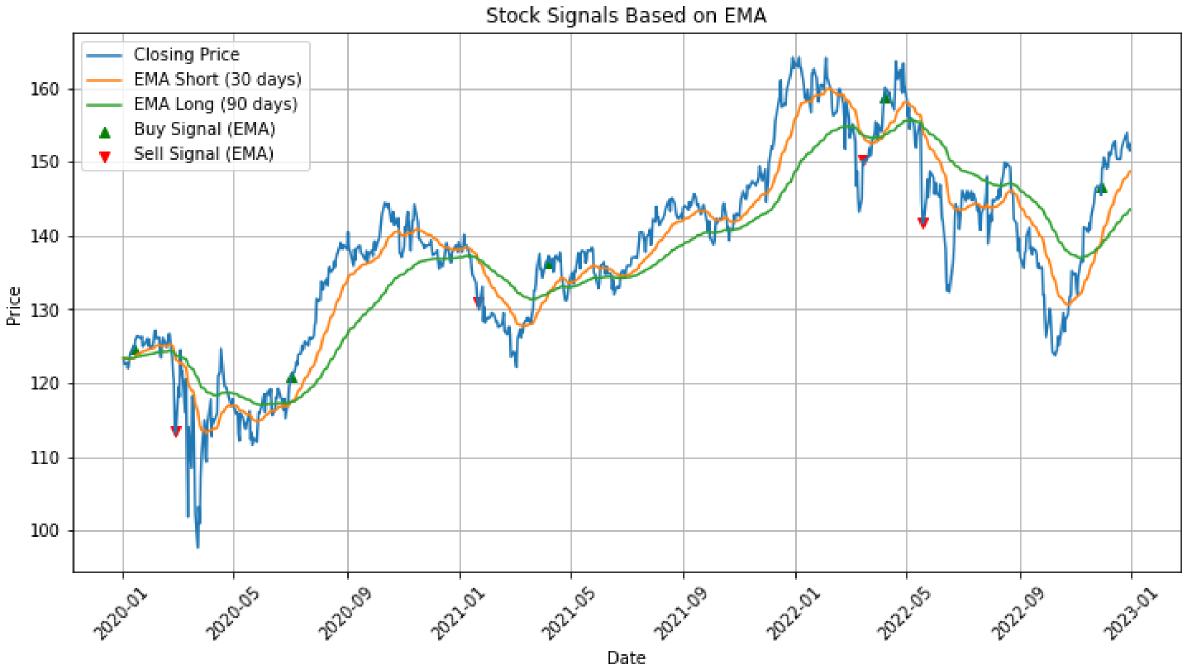
```
0      False
1      False
2      False
3      False
4      False
       ...
751    False
752    False
753    False
754    False
755    False
Name: Close, Length: 756, dtype: bool
0      False
1      False
2      False
3      False
4      False
       ...
751    False
752    False
753    False
754    False
755    False
Name: Close, Length: 756, dtype: bool
```

In [25]:
```
# Plot the closing prices with buy and sell signals based on SMA
plt.figure(figsize=(12, 6))
plt.plot(dates, closing_prices, label='Closing Price')
plt.plot(dates, sma_short, label='SMA Short (30 days)')
plt.plot(dates, sma_long, label='SMA Long (90 days)')
plt.scatter(dates[buy_sma], closing_prices[buy_sma], marker='^', color='g',
plt.scatter(dates[sell_sma], closing_prices[sell_sma], marker='v', color='r'
plt.title('Stock Signals Based on SMA')
plt.xlabel('Date')
plt.ylabel('Price')
plt.legend()
plt.xticks(rotation=45)
plt.grid(True)
plt.show()
```



In [26]:
```
# Plot the closing prices with buy and sell signals based on EMA
plt.figure(figsize=(12, 6))
```

```
plt.plot(dates, closing_prices, label='Closing Price')
plt.plot(dates, ema_short, label='EMA Short (30 days)')
plt.plot(dates, ema_long, label='EMA Long (90 days)')
plt.scatter(dates[buy_ema], closing_prices[buy_ema], marker='^', color='g',
plt.scatter(dates[sell_ema], closing_prices[sell_ema], marker='v', color='r'
plt.title('Stock Signals Based on EMA')
plt.xlabel('Date')
plt.ylabel('Price')
plt.legend()
plt.xticks(rotation=45)
plt.grid(True)
plt.show()
```



Forecasting

In [27]:
```
# Extract the date and closing prices
df = data[['Date', 'Close']]
df.columns = ['ds', 'y']
```

In [28]:
```
# Convert the 'ds' column to datetime type
df['ds'] = pd.to_datetime(df['ds'])
```

```
/var/folders/3_/4zcfm8q95td3zxq1xkmtz8kr0000gn/T/ipykernel_31203/854574570.p
y:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/
stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df['ds'] = pd.to_datetime(df['ds'])
```

In [29]:
```
# Create a new Prophet instance
model = Prophet()
```

In [30]:
```
# Fit the model to the data
model.fit(df)
```

```
11:43:36 - cmdstanpy - INFO - Chain [1] start processing
11:43:37 - cmdstanpy - INFO - Chain [1] done processing
```

Out[30]: <prophet.forecaster.Prophet at 0x11b68dba0>

In [31]:
```
# Generate future dates for the prediction
future_dates = model.make_future_dataframe(periods=365)
future_dates
```

Out[31]:

	ds
0	2020-01-02
1	2020-01-03
2	2020-01-06
3	2020-01-07
4	2020-01-08
...	...
1116	2023-12-26
1117	2023-12-27
1118	2023-12-28
1119	2023-12-29
1120	2023-12-30

1121 rows × 1 columns

In [32]:
```
# Make the prediction
forecast = model.predict(future_dates)
forecast
```

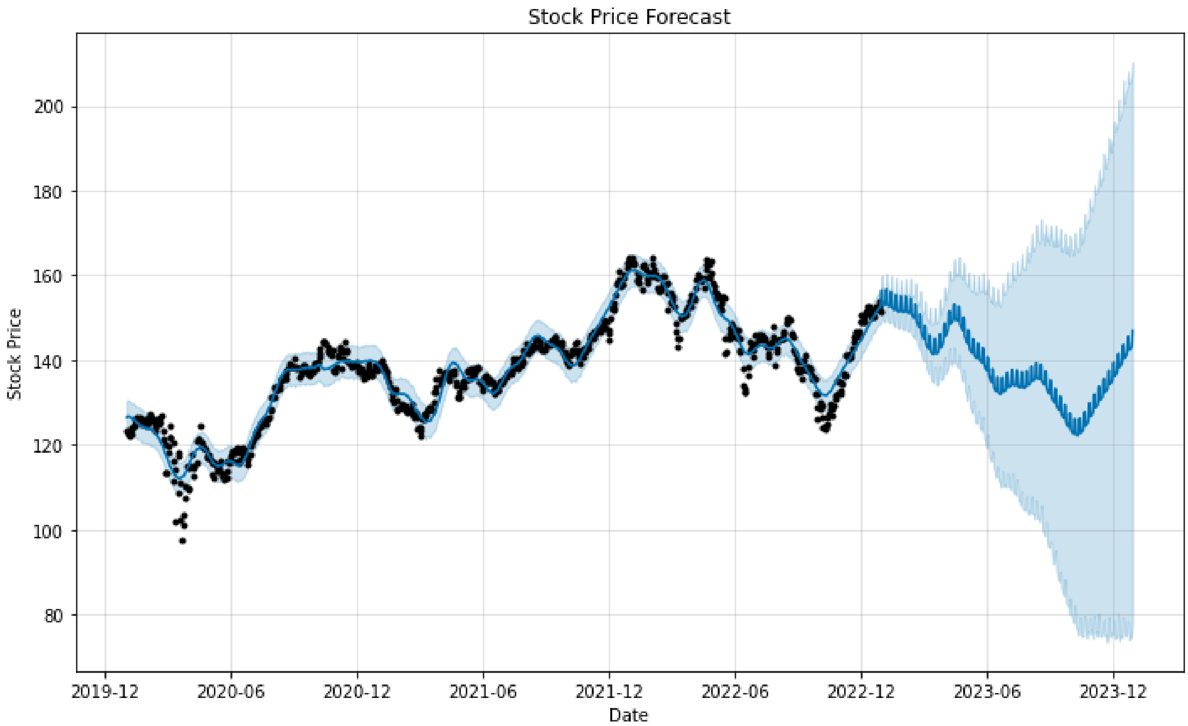
Out[32]:

	ds	trend	yhat_lower	yhat_upper	trend_lower	trend_upper	additive_terms
0	2020-01-02	117.444639	122.563391	130.246900	117.444639	117.444639	9.008726
1	2020-01-03	117.380025	123.016956	130.689160	117.380025	117.380025	9.319297
2	2020-01-06	117.186184	122.824746	130.321389	117.186184	117.186184	9.503477
3	2020-01-07	117.121571	122.748313	130.082104	117.121571	117.121571	9.349960
4	2020-01-08	117.056957	122.650998	129.896017	117.056957	117.056957	9.336561
...	...	...	...	...	...	...	...
1116	2023-12-26	134.668066	74.467046	205.772032	66.967912	197.647181	7.816477
1117	2023-12-27	134.642520	75.075702	205.673270	66.466378	197.715430	8.058521
1118	2023-12-28	134.616973	74.389268	206.730750	66.066545	197.789235	8.195892
1119	2023-12-29	134.591427	75.768587	207.114306	65.755081	197.863039	8.617817
1120	2023-12-30	134.565881	77.640914	210.323283	65.443618	197.936844	12.333322

1121 rows × 19 columns

In [33]:

```
# Plot the forecast
model.plot(forecast, xlabel='Date', ylabel='Stock Price')
plt.title('Stock Price Forecast')
plt.show()
```



In [ ]:

In [ ]: