In [1]:
```
import pandas as pd
import numpy as np
import yfinance as yf
from datetime import datetime
from datetime import timedelta
import plotly.graph_objects as go
from fbprophet import Prophet
from fbprophet.plot import plot_plotly, plot_components_plotly
import warnings
warnings.filterwarnings('ignore')
pd.options.display.float_format = '${:,.2f}'.format
```

In [2]:
```
today=datetime.today().strftime('%Y-%m-%d')
start_date = '2016-01-01'
df = yf.download('BTC-USD', start_date, today)
```

```
[**********100%%**********]  1 of 1 completed
```

In [3]:
```
df
```

Out[3]:

Date	Open	High	Low	Close	Adj Close	Volume
2016-01-01	$430.72	$436.25	$427.52	$434.33	$434.33	36278900
2016-01-02	$434.62	$436.06	$431.87	$433.44	$433.44	30096600
2016-01-03	$433.58	$433.74	$424.71	$430.01	$430.01	39633800
2016-01-04	$430.06	$434.52	$429.08	$433.09	$433.09	38477500
2016-01-05	$433.07	$434.18	$429.68	$431.96	$431.96	34522600
...	...	...	...	...	...	...
2023-11-05	$35,090.01	$35,340.34	$34,594.24	$35,049.36	$35,049.36	12412743996
2023-11-06	$35,044.79	$35,286.03	$34,765.36	$35,037.37	$35,037.37	12693436420
2023-11-07	$35,047.79	$35,892.42	$34,545.82	$35,443.56	$35,443.56	18834737789
2023-11-08	$35,419.48	$35,994.42	$35,147.80	$35,655.28	$35,655.28	17295394918
2023-11-09	$35,633.63	$37,926.26	$35,592.10	$36,693.12	$36,693.12	37762672382

2870 rows × 6 columns

In [4]:
```
df.columns
```

Out[4]:
```
Index(['Open', 'High', 'Low', 'Close', 'Adj Close', 'Volume'], dtype='object')
```

In [5]:
```
df.head()
```

Out[5]:

Date	Open	High	Low	Close	Adj Close	Volume
2016-01-01	$430.72	$436.25	$427.52	$434.33	$434.33	36278900
2016-01-02	$434.62	$436.06	$431.87	$433.44	$433.44	30096600
2016-01-03	$433.58	$433.74	$424.71	$430.01	$430.01	39633800
2016-01-04	$430.06	$434.52	$429.08	$433.09	$433.09	38477500
2016-01-05	$433.07	$434.18	$429.68	$431.96	$431.96	34522600

In [6]:
```
df.describe()
```

Out[6]:

	Open	High	Low	Close	Adj Close	Volume
count	$2,870.00	$2,870.00	$2,870.00	$2,870.00	$2,870.00	$2,870.00
mean	$16,450.12	$16,839.41	$16,029.14	$16,461.19	$16,461.19	$19,168,087,374.89
std	$16,145.30	$16,541.47	$15,696.21	$16,143.61	$16,143.61	$19,434,299,526.55
min	$365.07	$374.95	$354.91	$364.33	$364.33	$28,514,000.00
25%	$4,052.31	$4,115.34	$3,972.01	$4,066.18	$4,066.18	$3,674,422,500.00
50%	$9,518.59	$9,690.55	$9,305.47	$9,521.06	$9,521.06	$15,653,982,072.00
75%	$26,628.61	$27,053.17	$26,322.63	$26,705.61	$26,705.61	$29,906,093,638.50
max	$67,549.73	$68,789.62	$66,382.06	$67,566.83	$67,566.83	$350,967,941,479.00

In [7]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 2870 entries, 2016-01-01 to 2023-11-09
Data columns (total 6 columns):
 #   Column     Non-Null Count  Dtype  
---  ------     --------------  -----  
 0   Open       2870 non-null   float64
 1   High       2870 non-null   float64
 2   Low        2870 non-null   float64
 3   Close      2870 non-null   float64
 4   Adj Close  2870 non-null   float64
 5   Volume     2870 non-null   int64  
dtypes: float64(5), int64(1)
memory usage: 157.0 KB
```

In [8]:
```
df.isnull().any()
```

Out[8]:
```
Open          False
High          False
Low           False
Close         False
Adj Close     False
Volume        False
dtype: bool
```

In [9]:
```
df.isnull().sum()
```

Out[9]:
```
Open          0
High          0
Low           0
Close         0
Adj Close     0
Volume        0
dtype: int64
```

In [10]:
```
df.reset_index(inplace=True)
df.columns
```

Out[10]:
```
Index(['Date', 'Open', 'High', 'Low', 'Close', 'Adj Close', 'Volume'], dtype='object')
```

In [11]:
```
df.head()
```

Out[11]:

	Date	Open	High	Low	Close	Adj Close	Volume
0	2016-01-01	$430.72	$436.25	$427.52	$434.33	$434.33	36278900
1	2016-01-02	$434.62	$436.06	$431.87	$433.44	$433.44	30096600
2	2016-01-03	$433.58	$433.74	$424.71	$430.01	$430.01	39633800
3	2016-01-04	$430.06	$434.52	$429.08	$433.09	$433.09	38477500
4	2016-01-05	$433.07	$434.18	$429.68	$431.96	$431.96	34522600

In [12]:
```
df1=df[['Date','Open']]
df1.head()
```

Out[12]:

	Date	Open
0	2016-01-01	$430.72
1	2016-01-02	$434.62
2	2016-01-03	$433.58
3	2016-01-04	$430.06
4	2016-01-05	$433.07

In [13]:
```
newn={
    "Date":"ds",
```

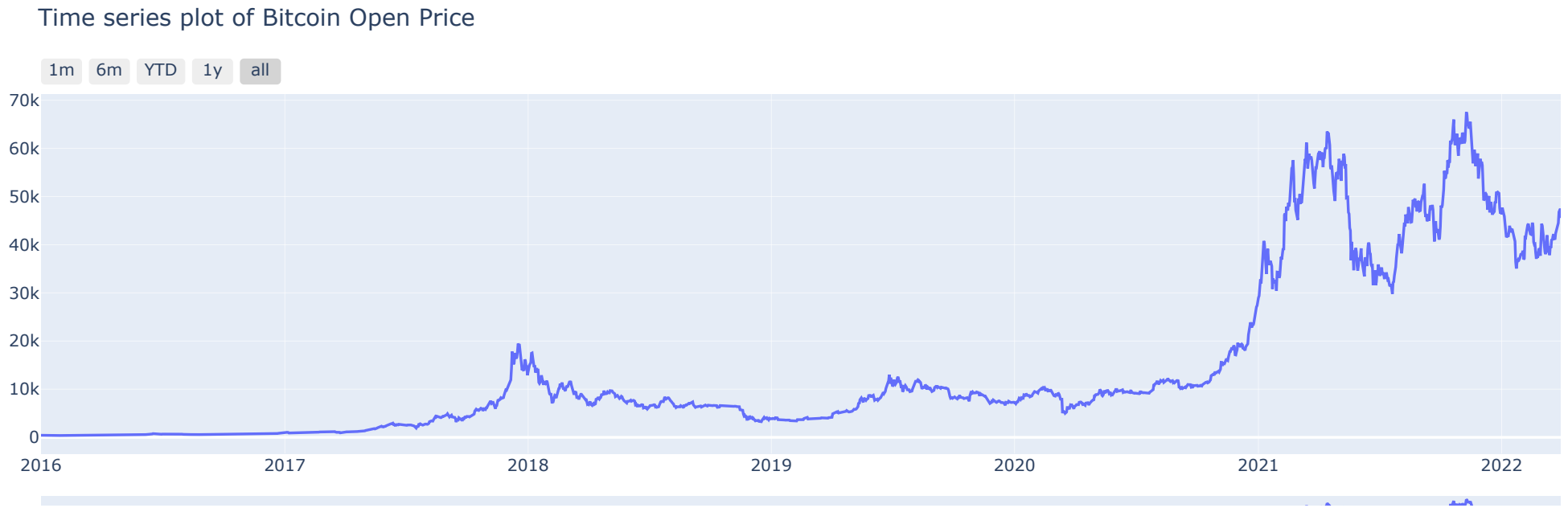
```
    "Open":"y",
}
df1.rename(columns=newn,inplace=True)
df1.head()
```

Out[13]:

	ds	y
0	2016-01-01	$430.72
1	2016-01-02	$434.62
2	2016-01-03	$433.58
3	2016-01-04	$430.06
4	2016-01-05	$433.07

In [14]:

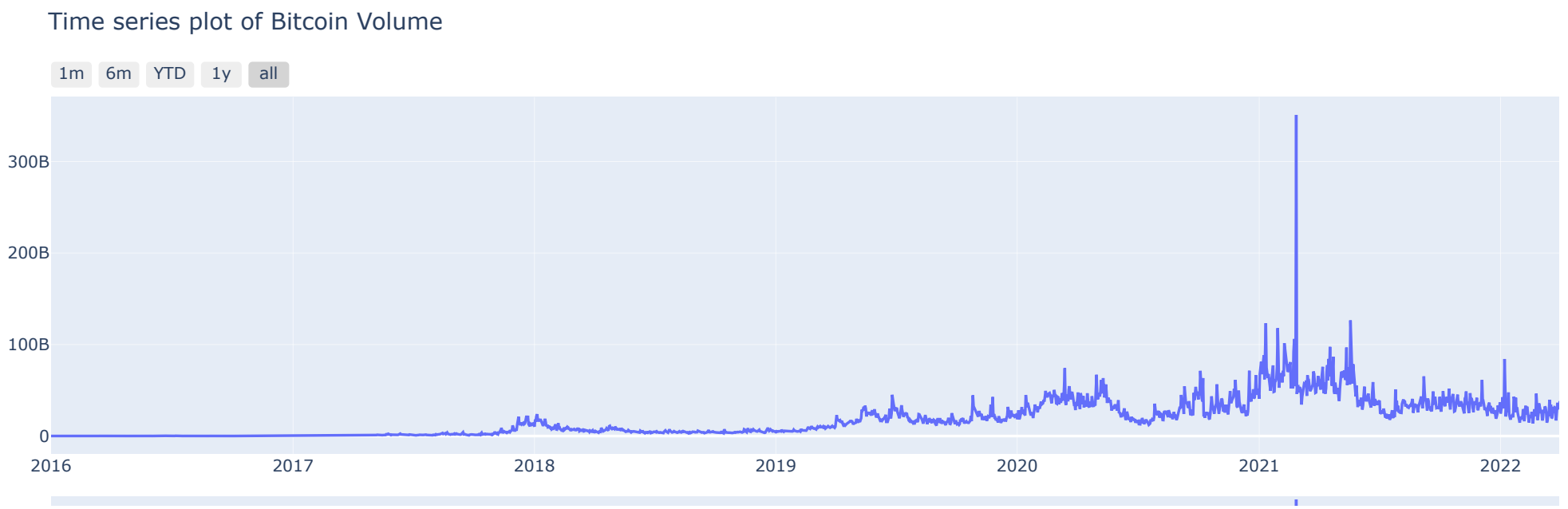
```
import plotly.graph_objects as go

x = df1["ds"]
y = df1["y"]

fig = go.Figure()
fig.add_trace(go.Scatter(x=x, y=y))

# Set title
fig.update_layout(
    title_text="Time series plot of Bitcoin Open Price"
)

fig.update_layout(
    xaxis=dict(
        rangeselector=dict(
            buttons=list(
                [
                    dict(count=1, label="1m", step="month", stepmode="backward"),
                    dict(count=6, label="6m", step="month", stepmode="backward"),
                    dict(count=1, label="YTD", step="year", stepmode="todate"),
                    dict(count=1, label="1y", step="year", stepmode="backward"),
                    dict(step="all"),
                ]
            ),
            visible=True
        ),
        rangeslider=dict(visible=True),
        type="date"
    )
)

# Show the plot
fig.show()
```



In [15]:

```
import plotly.graph_objects as go

x = df["Date"]
y = df["Volume"]

fig = go.Figure()
fig.add_trace(go.Scatter(x=x, y=y))

# Set title
fig.update_layout(
    title_text="Time series plot of Bitcoin Volume"
)

fig.update_layout(
    xaxis=dict(
        rangeselector=dict(
            buttons=list(
                [
                    dict(count=1, label="1m", step="month", stepmode="backward"),
                    dict(count=6, label="6m", step="month", stepmode="backward"),
                    dict(count=1, label="YTD", step="year", stepmode="todate"),
                    dict(count=1, label="1y", step="year", stepmode="backward"),
```

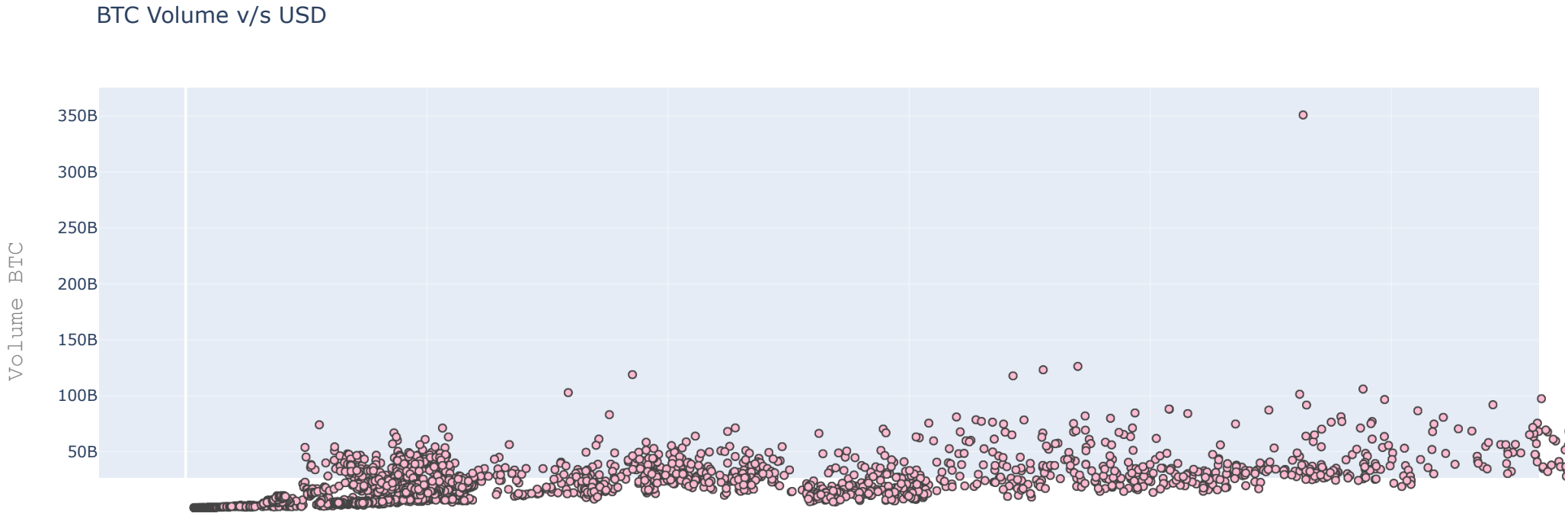
```
                    dict(step="all"),
                ]
            ),
            visible=True
        ),
        rangeslider=dict(visible=True),
        type="date"
    )
)

# Show the plot
fig.show()
```



In [16]:

```
import plotly.offline as pyo
pyo.init_notebook_mode(connected=True)


#BTC Volume vs USD visualization
trace = go.Scattergl(
    y = df['Volume'].astype(float),
    x = df['Close'].astype(float),
    mode = 'markers',
    marker = dict(
```

```
        color = '#FFBAD2',
        line = dict(width = 1)
    )
)
layout = go.Layout(
    title='BTC Volume v/s USD',
    xaxis=dict(
        title='Weighted Price',
        titlefont=dict(
            family='Courier New, monospace',
            size=18,
            color='#7f7f7f'
        )
    ),
    yaxis=dict(
        title='Volume BTC',
        titlefont=dict(
            family='Courier New, monospace',
            size=18,
            color='#7f7f7f'
        )))
data = [trace]
fig = go.Figure(data=data, layout=layout)
pyo.iplot(fig, filename='compare_webgl')
```



In [17]:
```
m = Prophet(
    seasonality_mode="multiplicative",
)

m.fit(df1)
```

```
INFO:fbprophet:Disabling daily seasonality. Run prophet with daily_seasonality=True to override this.
```

Out[17]:
```
<fbprophet.forecaster.Prophet at 0x1ee72fccc10>
```

In [18]:
```
future=m.make_future_dataframe(periods=365)
future.tail()
```

Out[18]:

	ds
3230	2024-11-04
3231	2024-11-05
3232	2024-11-06
3233	2024-11-07
3234	2024-11-08

In [19]:
```
forecast=m.predict(future)
forecast
```

Out[19]:

	ds	trend	yhat_lower	yhat_upper	trend_lower	trend_upper	multiplicative_terms	multiplicative_terms_lower	multiplicative_terms_upper	weekly	weekly_lower	weekly_u
0	2016-01-01	$6.26	$-4,735.94	$4,711.12	$6.26	$6.26	$-0.00	$-0.00	$-0.00	$-0.00	$-0.00	$
1	2016-01-02	$8.99	$-4,306.90	$4,650.01	$8.99	$8.99	$0.00	$0.00	$0.00	$-0.00	$-0.00	$
2	2016-01-03	$11.72	$-4,762.28	$4,826.99	$11.72	$11.72	$0.01	$0.01	$0.01	$-0.00	$-0.00	$
3	2016-01-04	$14.45	$-4,805.23	$4,474.76	$14.45	$14.45	$0.01	$0.01	$0.01	$0.00	$0.00	
4	2016-01-05	$17.18	$-5,040.90	$4,587.34	$17.18	$17.18	$0.02	$0.02	$0.02	$0.00	$0.00	
...	...	...	...	...	...	...	...	...	...	...	...	
3230	2024-11-04	$24,437.69	$6,069.07	$45,477.33	$6,159.27	$41,534.18	$0.09	$0.09	$0.09	$0.00	$0.00	
3231	2024-11-05	$24,435.23	$5,701.90	$44,746.41	$6,099.99	$41,612.01	$0.08	$0.08	$0.08	$0.00	$0.00	
3232	2024-11-06	$24,432.77	$6,677.38	$45,993.25	$6,012.79	$41,689.83	$0.08	$0.08	$0.08	$0.00	$0.00	
3233	2024-11-07	$24,430.31	$5,667.70	$46,753.96	$5,925.60	$41,754.17	$0.08	$0.08	$0.08	$0.00	$0.00	
3234	2024-11-08	$24,427.85	$6,166.71	$45,558.05	$5,838.41	$41,800.49	$0.07	$0.07	$0.07	$-0.00	$-0.00	$

3235 rows × 19 columns

In [20]:
```
forecast[['ds','yhat','yhat_lower','yhat_upper']].tail()
```

Out[20]:

	ds	yhat	yhat_lower	yhat_upper
3230	2024-11-04	$26,543.50	$6,069.07	$45,477.33
3231	2024-11-05	$26,478.18	$5,701.90	$44,746.41
3232	2024-11-06	$26,391.42	$6,677.38	$45,993.25
3233	2024-11-07	$26,361.85	$5,667.70	$46,753.96
3234	2024-11-08	$26,149.90	$6,166.71	$45,558.05

In [21]:
```
forecast[['ds','yhat','yhat_lower','yhat_upper']].head()
```

Out[21]:

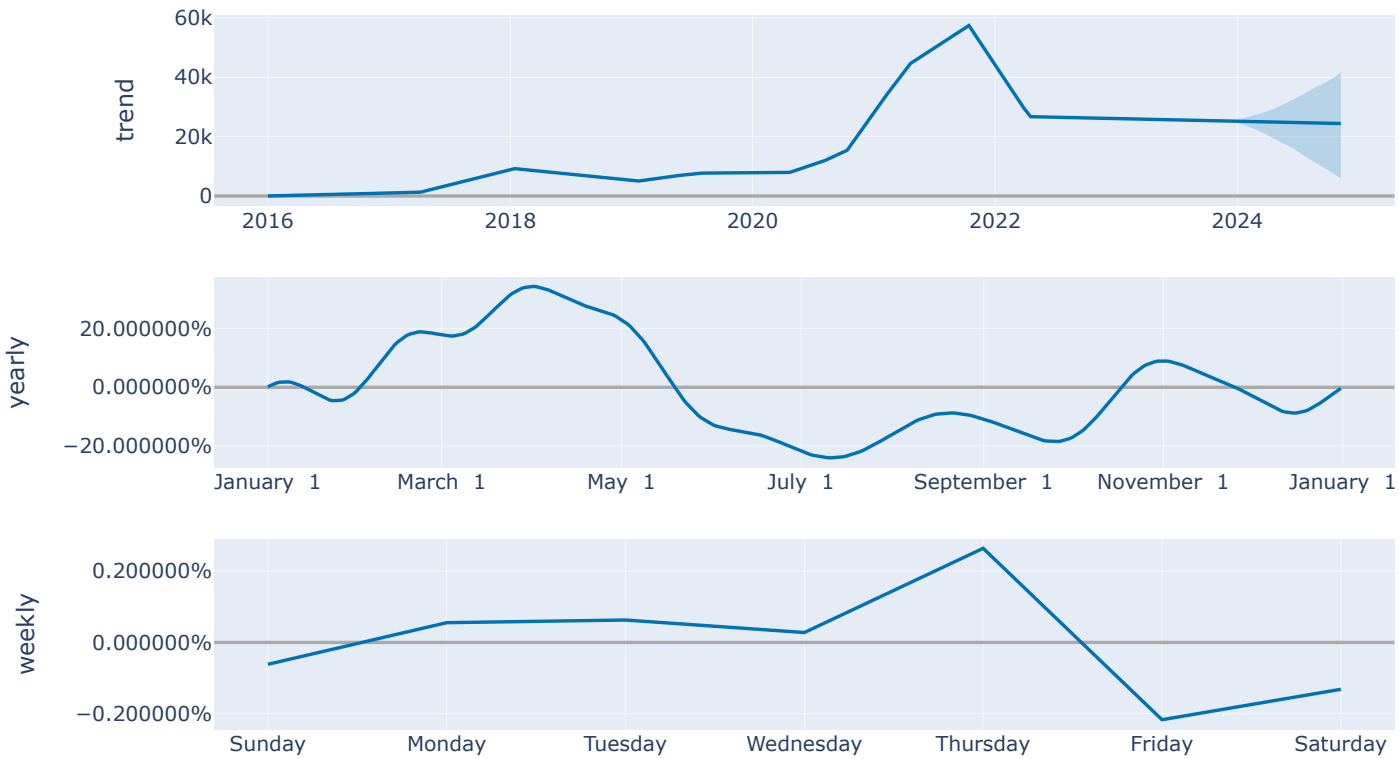
	ds	yhat	yhat_lower	yhat_upper
0	2016-01-01	$6.24	$-4,735.94	$4,711.12
1	2016-01-02	$9.01	$-4,306.90	$4,650.01
2	2016-01-03	$11.81	$-4,762.28	$4,826.99
3	2016-01-04	$14.64	$-4,805.23	$4,474.76
4	2016-01-05	$17.46	$-5,040.90	$4,587.34

In [22]:
```
next_day=(datetime.today()+timedelta(days=1)).strftime('%Y-%m-%d')
forecast[forecast['ds']==next_day]['yhat'].item()
```

Out[22]:
```
26894.970744877926
```

In [23]:
```
plot_plotly(m,forecast)
```

In [24]:
```
plot_components_plotly(m,forecast)
```

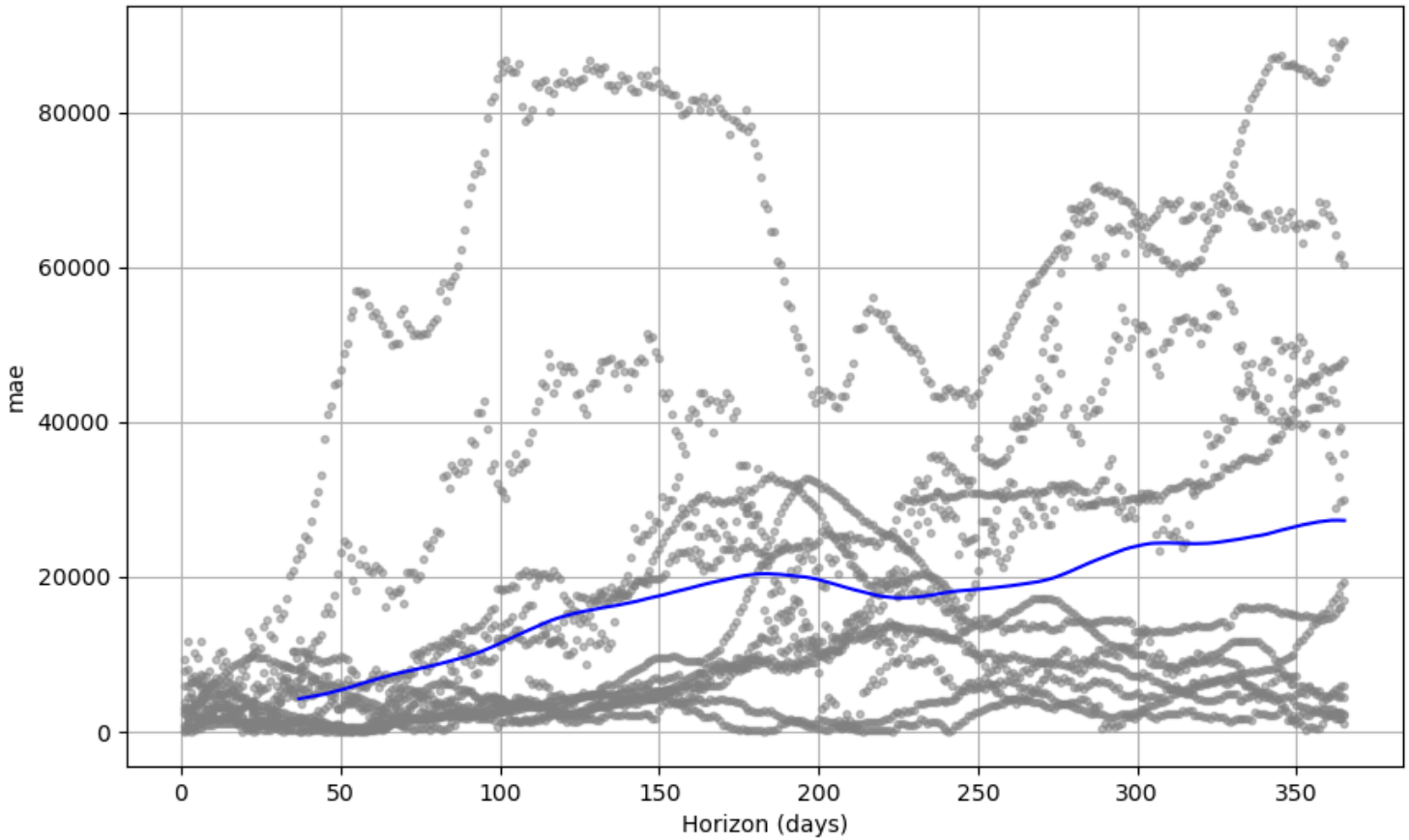


In [25]:
```
import pickle
pickle.dump(m,open('fbcrypto.pkl','wb'))
```

In [26]:
```
from fbprophet.diagnostics import performance_metrics
from fbprophet.plot import plot_cross_validation_metric
from fbprophet.diagnostics import cross_validation

# Assuming 'model' is your fitted Prophet model
df_cv = cross_validation(m, initial='365 days', period='180 days', horizon='365 days')

# Compute performance metrics
df_p = performance_metrics(df_cv)
print(df_p.head())

# Visualize performance metrics
fig = plot_cross_validation_metric(df_cv, metric='mae')
```

```
INFO:fbprophet:Making 12 forecasts with cutoffs between 2017-06-08 00:00:00 and 2022-11-09 00:00:00
WARNING:fbprophet:Seasonality has period of 365.25 days which is larger than initial window. Consider increasing initial.
  0%|          | 0/12 [00:00<?, ?it/s]
```

	horizon	mse	rmse	mae	mape	mdape	coverage
0	37 days	$30,460,837.99	$5,519.13	$4,190.97	$0.36	$0.24	$0.15
1	38 days	$31,859,113.54	$5,644.39	$4,259.57	$0.37	$0.25	$0.15
2	39 days	$33,694,115.73	$5,804.66	$4,340.80	$0.37	$0.25	$0.15
3	40 days	$35,482,365.48	$5,956.71	$4,417.51	$0.38	$0.26	$0.15
4	41 days	$37,429,333.02	$6,117.95	$4,489.15	$0.38	$0.27	$0.15



In [27]:
```python
from datetime import datetime
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
import numpy as np

# Assuming 'data_test' is your DataFrame containing true values and 'forecast' is the DataFrame with predicted values
y_true = df1['y']
forecast_before_nov_9 = forecast[forecast['ds'] <= datetime(2023, 11, 9)]

# Extract yhat column from the filtered DataFrame
y_pred = forecast_before_nov_9['yhat']

# Mean Squared Error (MSE)
mse = mean_squared_error(y_true=y_true, y_pred=y_pred)
```

```
print(f"Mean Squared Error (MSE): {mse}")

# Mean Absolute Error (MAE)
mae = mean_absolute_error(y_true=y_true, y_pred=y_pred)
print(f"Mean Absolute Error (MAE): {mae}")

# R-squared (R2)
r2 = r2_score(y_true=y_true, y_pred=y_pred)
print(f"R-squared (R2): {r2}")

# Root Mean Squared Error (RMSE)
rmse = np.sqrt(mse)
print(f"Root Mean Squared Error (RMSE): {rmse}")
```

```
Mean Squared Error (MSE): 14187191.901268193
Mean Absolute Error (MAE): 2605.9734316735935
R-squared (R2): 0.9455552766056716
Root Mean Squared Error (RMSE): 3766.588894645684
```

In [ ]:

In [ ]: