Project 1 - META Platforms Inc Class A

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Meta Description

Meta is a social technology company that owns and operates many popular social media platforms, including Facebook, Instagram, WhatsApp, Oculus, Messenger, and Workplace.

Loading Data

```
!pip install yfinance plotly
```

Show hidden output

```
#Importing libraries
import yfinance as yf
import plotly.express as px
import numpy as np
import pandas as pd


def clean_stock_data(df):
    df.reset_index(inplace=True)
    df.columns = df.columns.to_flat_index()
    df.columns = ["_".join(col) for col in df.columns]
    df.rename(columns={"Date_": "Date"}, inplace=True)
    return df


#Load Meta data and clean the data
meta_data = yf.download('Meta', start='2000-01-01', end='2025-03-01')
meta_data = clean_stock_data(meta_data)
meta_data.head()
```

Show hidden output

```
#Load Meta data for one year
meta_one_year = yf.download('Meta', start='2024-03-01', end='2025-03-01')
meta_one_year = clean_stock_data(meta_one_year)
meta_one_year.head()
```

Show hidden output

```
#Loading competitor data
#Competitor 1: Google
google_data = yf.download('GOOG', start='2020-01-01', end='2025-03-01')
google_data = clean_stock_data(google_data)
google_data.head()
```

Show hidden output

```
#Loading competitor data
#Competitor 2: Microsoft
microsoft_data = yf.download('MSFT', start='2000-01-01', end='2025-03-01')
microsoft_data = clean_stock_data(microsoft_data)
microsoft_data.head()
```

Show hidden output

```
#Import data for the S&P 500 for one year
sp500_one_year = yf.download('^GSPC', start='2024-03-01', end='2025-03-01')
sp500_one_year = clean_stock_data(sp500_one_year)
sp500_one_year.rename(columns={"Close_^GSPC": "Close_GSPC", 'High_^GSPC':'High_GSPC', 'Low_^GSPC': 'Low_GSPC', 'Open_^GSPC':'Open_GSPC', 'Volume_^GSPC': 'Volume_GSPC'
sp500_one_year.head()
```

Show hidden output

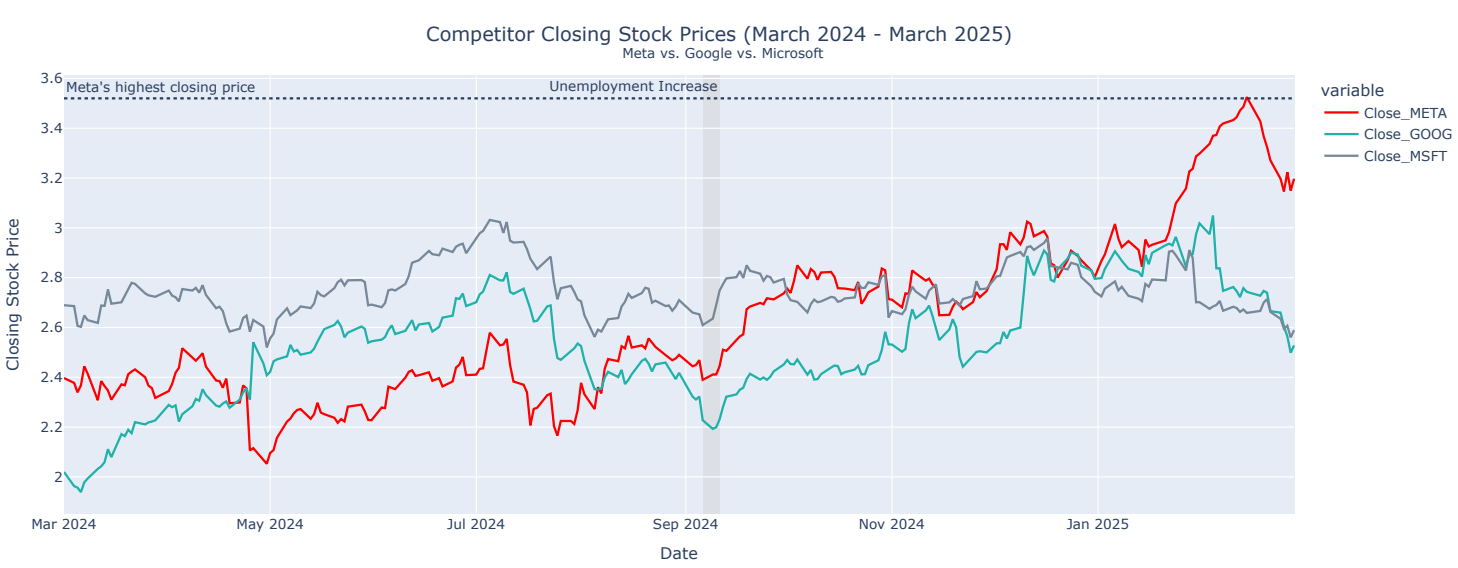
Q1: Time Series Chart

```
#Merge Meta data with competitors data
competitor_data = meta_data.merge (google_data, on="Date", how='inner').merge(microsoft_data, on="Date", how='inner')
competitor_data.head()
```

Show hidden output

```
#Normalize the data for better comparison
competitor_data['Close_META'] = competitor_data['Close_META']/competitor_data['Close_META'].iloc[0]
```

```
competitor_data['Close_GOOG'] = competitor_data['Close_GOOG']/competitor_data['Close_GOOG'].iloc[0]
competitor_data['Close_MSFT'] = competitor_data['Close_MSFT']/competitor_data['Close_MSFT'].iloc[0]


# Filter competitor_data for the desired date range
filtered_data = competitor_data[
    (competitor_data['Date'] >= '2024-03-01') & (competitor_data['Date'] <= '2025-03-01')]

#Creating the time series chart
fig1 = px.line(filtered_data, x='Date', y=['Close_META', 'Close_GOOG', 'Close_MSFT'],
              labels={"value": "Closing Stock Price", "Date": "Date"})

#Adding title
fig1.update_layout(
    title={
        'text': "Competitor Closing Stock Prices (March 2024 - March 2025) <br><sup>Meta vs. Google vs. Microsoft</sup>",
        'x': 0.5,
        'xanchor': 'center'
    }
)

#Changing the line color
fig1.update_traces(selector=dict(name='Close_META'), line=dict(color='red'))
fig1.update_traces(selector=dict(name='Close_GOOG'), line=dict(color='lightseagreen'))
fig1.update_traces(selector=dict(name='Close_MSFT'), line=dict(color='lightslategray'))

#Adding annotation
fig1.add_hline(y=3.52, line_dash="dot",
               annotation_text="Meta's highest closing price ",
               annotation_position="top left"
)

fig1.add_vrect(x0="2024-09-06", x1="2024-09-11",
            fillcolor="lightgray", opacity=0.5,
            layer="below", line_width=0,
            annotation_text='Unemployment Increase')

fig1.show()
```



The purpose of the chart is to compare Meta's closing stock price to two competitor companies Google and Microsoft over a period from March 2024 to March 2025. It also aims to illustrate how these stock prices might relate to external events, such as an increase in unemployment. This chart is normalized for accurate comparison.

Key Takeaways

Prompt: What are the key takaeways from this chart? What conclusion can you draw specifically related to Meta?

LLM Response:

Key Takeaways from the Chart:

1. Meta's Outperformance – Meta (red line) shows strong upward momentum, significantly outperforming both Google (GOOG) and Microsoft (MSFT) by early 2025, reaching its highest closing price in the observed period.
2. Market Volatility and Recovery – Meta experienced dips, especially around mid-2024, but rebounded strongly, indicating resilience despite market fluctuations.
3. Economic Impact – The unemployment increase marked in the chart may have influenced stock movements, but Meta recovered and surged, showing strong investor confidence.
4. Competitor Comparison – While Meta gained value, Google and Microsoft saw stagnation or declines toward early 2025, suggesting Meta is benefiting from unique growth drivers.

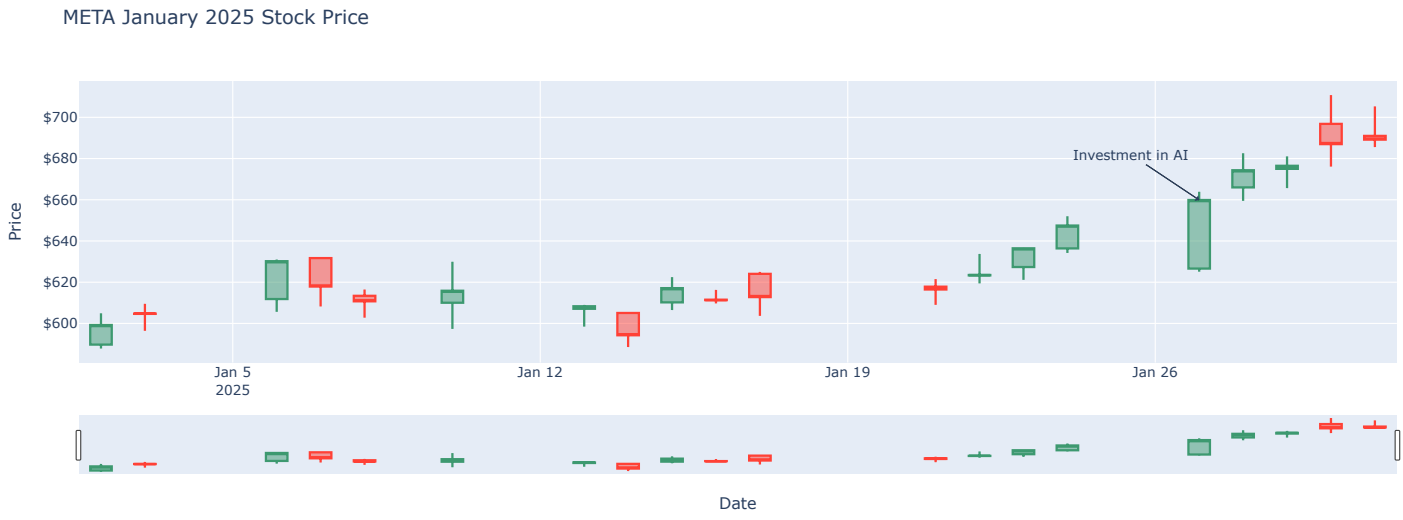
Conclusion Related to Meta: Meta's ability to recover from downturns and reach new highs suggests strong market confidence and growth potential. Compared to competitors, Meta is demonstrating greater resilience and momentum, making it a potentially strong investment choice, especially if its expansion in AI, digital advertising, or the metaverse continues to drive value.

Improvements:

I would add that the reason Meta's price was gradually increasing from Janruary 21, 2025 up until February 14, 2025 was due to the aggressive investment into AI infrastructure – $65 billion in 2025 alone, to be exact. The highlighted section in the middle shows a drop amongst all three companies which was a result of the February 2025 employment report which showed an increase in umemployment rates. Overall all three companies move in the same directions. We can see from May 2024 to July 2024, all three companies increasing in price and then from July 2024 to September 2024 they all expereince a decrease for the most part. Towards the end of the chart we see Meta's price surpass both competitors as a result of optimistic views on the companies decesions before the start of the decline on February 18, 2025. This decrease at the end of February was due to recession fears resurfacing. This chart shows Meta to be a competitive company by surpassing Microsoft and Google.

Q2: Candlestick Chart

```
import plotly.graph_objects as go

# Filter data for January 2025
meta_data_jan = meta_data[(meta_data['Date'] >= '2025-01-01') & (meta_data['Date'] <= '2025-02-01')]

# Create the candlestick chart
fig2 = go.Figure(data=[go.Candlestick(x=meta_data_jan['Date'],
                open=meta_data_jan['Open_META'],
                high=meta_data_jan['High_META'],
                low=meta_data_jan['Low_META'],
                close=meta_data_jan['Close_META'])])

# Customize the chart layout
fig2.update_layout(title='META January 2025 Stock Price',
                   xaxis_title='Date',
                   yaxis_title='Price',
                   yaxis_tickprefix='$')

#Add an annotation to the chart to emphasize the largest increase in price
fig2.add_annotation(
    x='2025-01-27',
    y=meta_data_jan[meta_data_jan['Date'] == '2025-01-27']['Close_META'].values[0],
    text="Investment in AI",
    showarrow=True,
    arrowhead=1,
    ax=-60,
    ay=-40
)

# Display the chart
fig2.show()
```



The purpose of this chart is to show the daily stock price fluctuations of Meta specifically during January 2025. It shows the open, closing, low, and high prices.

Key Takeaways

Prompt: What are the key takeaway's from this chart?

LLM Response:

Key Takeaways from the META January 2025 Stock Price Chart: Overall Upward Trend in Stock Price

1. The chart shows a general increase in Meta's stock price throughout January 2025, moving from around $600 to over $700. Most candlesticks are green, indicating that the stock closed higher than it opened on many days. Significant Spike Following AI Investment Announcement
2. Around January 26, 2025, there is a large green candlestick, suggesting a major jump in stock price. This coincides with the "Investment in AI" annotation, indicating that Meta's decision to invest in AI triggered a strong positive market reaction. Increased Volatility Toward the End of January
3. Larger candlesticks and wicks in the final days of January suggest greater price fluctuations. Higher trading volumes (shown in the bottom subplot) indicate increased investor interest and market activity.
4. Profit-Taking and Resistance Near $700. As the stock approaches $700+, red candlesticks appear, signaling possible profit-taking by investors. This suggests that the stock may have encountered resistance at this level.

Conclusion

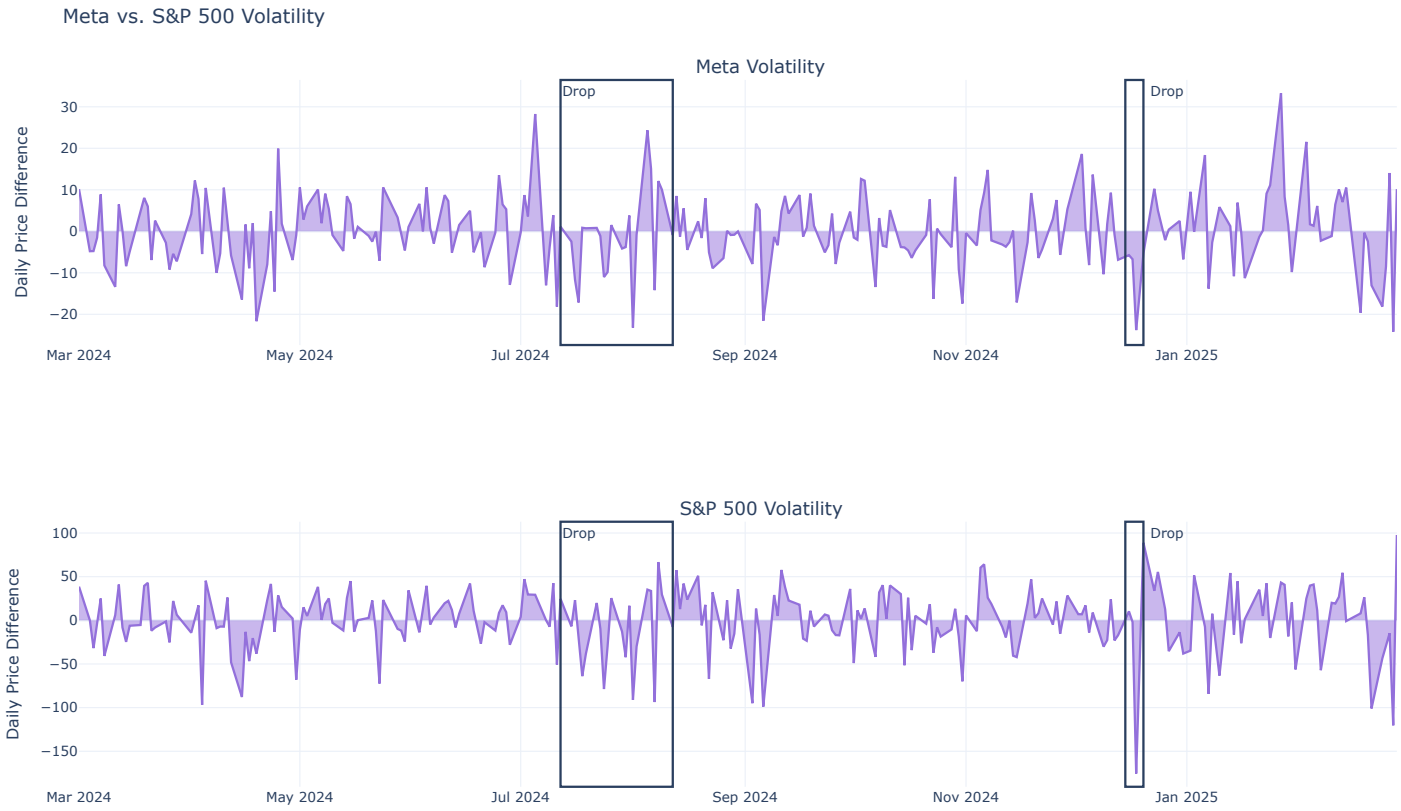
Meta's stock had a strong bullish trend in January 2025, fueled by positive sentiment around AI investments. Short-term volatility increased, especially after the AI announcement, attracting more trading activity. Potential resistance near $700 suggests that investors are cautious at higher price levels, leading to some sell-offs.

Improvements:

I would add that there is a positive correlation between the change in price and trading volumes, they move in the same directions. Meta's stock is pretty stable and increases over time. We see a significant increase in price on January 27, 2025 due to investors optimist views on Metas high investment into AI. CEO Mark Zuckerberg described this as a "defining year for AI," emphasizing that the investment would "unlock historic innovation and extend American technology leadership." The overall stock market got off to a strong start in 2025 with positive performances in January. The Dow Jones Industrial Average rose 4.8%, and S&P 500 advanced 2.8%. Meta moved in the same direction, maintaing a steady increase.

Q3: Chose your own

```
# Calculating daily differences between the closing and opening price
meta_data['Daily_Diff'] = meta_data['Close_META'] - meta_data['Open_META']


from plotly.subplots import make_subplots

# Calculate Daily Difference for both dataframes
meta_one_year['Daily_Diff'] = meta_one_year['Close_META'] - meta_one_year['Open_META']
sp500_one_year['Daily_Diff'] = sp500_one_year['Close_GSPC'] - sp500_one_year['Open_GSPC']

# Create subplots with 2 rows and 1 column
fig = make_subplots(rows=2, cols=1, subplot_titles=("Meta Volatility", "S&P 500 Volatility"))

# Meta Volatility Plot
fig.add_trace(
    px.area(meta_one_year, x='Date', y='Daily_Diff', color_discrete_sequence=['mediumpurple']).data[0],
    row=1, col=1
)

# S&P 500 Volatility Plot
fig.add_trace(
    px.area(sp500_one_year, x='Date', y='Daily_Diff', color_discrete_sequence=['mediumpurple']).data[0],
    row=2, col=1
)

# Update layout for better appearance
fig.update_layout(
    title_text="Meta vs. S&P 500 Volatility",
    height=800,
    template="plotly_white",
    showlegend=False,
)

# Update y-axis labels
fig.update_yaxes(title_text="Daily Price Difference", row=1, col=1)
fig.update_yaxes(title_text="Daily Price Difference", row=2, col=1)

fig.add_vrect(x0 = "2024-12-15",
              x1= "2024-12-20",
              annotation_text = "Drop",
              annotation_position = "top left")
fig.update_annotations(dict(xshift=20))

fig.add_vrect(x0 = "2024-07-12",
              x1= "2024-8-12",
              annotation_text = "Drop",
              annotation_position = "top left")

fig.show()
```



The purpose of this chart is to compare the volatility of Meta's stock against the volatility of the S&P 500 index over time, from March 2024 to January 2025. It displays the daily price difference for both Meta and the S&P 500, highlighting periods of increased or decreased volatility for each. This type of comparison helps us understand how Meta's stock performance relates to the broader market.

Key Takeaways

Prompt: What are the key takeaways from this chart?

LLM Response: Here are the key takeaways from the chart comparing Meta's volatility vs. S&P 500 volatility:

1. Volatility Trends Both Meta and the S&P 500 exhibit daily price fluctuations, but the magnitude of volatility differs. Meta's price movements appear more frequent but within a smaller range, whereas the S&P 500 shows larger price swings.
2. Significant Drops in Price Both charts highlight two major drops: one around July–August 2024 and another in January 2025. The S&P 500's drop in July 2024 is more pronounced, indicating that broader market conditions likely affected Meta's stock as well. The January 2025 drop appears in both charts, suggesting it was a systemic event impacting the overall market.
3. Meta-Specific vs. Market-Wide Volatility While Meta follows market trends, its price changes appear less extreme than the S&P 500 during major market drops. This suggests that while Meta is influenced by broader economic events, its volatility is somewhat independent of the S&P 500's movements.
4. Potential Causes of Volatility The July 2024 drop could be linked to the unemployment increase event seen in the previous chart, affecting both Meta and the broader market. The January 2025 drop might be due to macroeconomic factors like earnings reports, Fed rate changes, or economic slowdowns.

Conclusion Meta's volatility is significant but follows broader market trends with some degree of independence. The S&P 500 exhibits larger swings, suggesting that broader market events have a bigger impact than firm-specific factors. Investors should monitor macroeconomic trends and industry-specific factors when evaluating Meta's risk exposure.

Improvements:

Addding on to ChatGPT's response the drops that the stock market experienced in July 204 - August 2024 was seen as the S&P 500's biggest percentage decline in six weeks. The decline in U.S. stock values during July 2024 can be attributed to various factors. These include initial optimism stemming from encouraging inflation data, followed by a correction within the technology sector, indications of a softening labor market suggesting potential future rate adjustments, and market response to the Federal Open Market Committee (FOMC) deliberations. December 18, 2024 was then seen as one of the worse days in the market which declined significantly due to the Federal Reserve outlook for fewer rate cuts in the year ahead. This caused a $175.49 decrease in the S&P 500, and a $23.81 decrease in Meta's stock price. Overall the Meta moves in correlation to the S&P 500 which makes it a good company to invest in.

Q4: Regression Plot

```
import plotly.express as px
```

```
import plotly.graph_objects as go
import pandas as pd
import statsmodels.formula.api as sm

# Merge the dataframes
merged_data = pd.merge(meta_data[['Date', 'Close_META']], microsoft_data[['Date', 'Close_MSFT']], on='Date', how='inner')

# Add a 'Year' column for animation
merged_data['Year'] = merged_data['Date'].dt.year

# Create the animated scatter plot with regression line
fig = px.scatter(
    merged_data,
    title="Meta vs Microsoft Stock Prices Over Time",
    x="Close_MSFT",
    y="Close_META",
    animation_frame="Year",
    trendline="ols",
    trendline_color_override="grey",
    color_discrete_sequence=['darkcyan'], #orchid, darkgreen
    labels={'Close_MSFT': 'Microsoft Close Price', 'Close_META': 'Meta Close Price'},
    range_x=[merged_data['Close_MSFT'].min(), merged_data['Close_MSFT'].max()],
    range_y=[merged_data['Close_META'].min(), merged_data['Close_META'].max()],
    opacity=0.7
)

# Create custom frames to keep all data visible and include regression line
frames = []
for year in sorted(merged_data['Year'].unique()):
    frame_data = merged_data[merged_data['Year'] <= year]

    # Calculate regression line for current frame data
    model = sm.ols(formula="Close_META ~ Close_MSFT", data=frame_data).fit()
    x_range = frame_data['Close_MSFT']
    y_range = model.predict(frame_data[['Close_MSFT']])

    frame = go.Frame(
        data=[
            go.Scatter(x=frame_data["Close_MSFT"], y=frame_data["Close_META"], mode='markers'),
            go.Scatter(x=x_range, y=y_range, mode='lines', name='Regression Line')
        ],
        name=str(year)
    )
    frames.append(frame)

fig.frames = frames

fig.update_layout(
    title="Meta vs Microsoft Correlations (2012-2025)",
    xaxis_title="Close Meta price ",
    yaxis_title="Close Miscrosoft price",
    yaxis_tickprefix="$",
    xaxis_tickprefix="$"
)
fig.show()
```

The purpose of this chart is to show the correlation between Meta's stock price and Microsoft's stock price from 2012 to 2025. The scatter plot displays each company's closing price on a given day, and the trend line helps visualize the overall relationship between the two stocks. By observing how closely the points cluster around the line, one can assess the strength and direction of the correlation (positive or negative).

Key Takeaways

Prompt: What are the key takeaways from this regression plot?

LLM Response:

The key takeaways from this regression plot analyzing Meta vs. Microsoft closing prices (2012-2025) are:

1. Strong Positive Correlation: The scatter plot shows a clear upward trend, indicating that as Meta's stock price increases, Microsoft's stock price also tends to rise. The regression line confirms a strong linear relationship.
2. Long-Term Growth Trend: Over time, both Meta and Microsoft have experienced significant price appreciation. The data points show a clustering at higher price levels in recent years (2023-2025), suggesting strong growth in stock prices.
3. Increased Volatility in Recent Years: The spread of data points widens at higher price levels, especially from 2022 onward. This suggests higher volatility in stock prices, which may be due to macroeconomic factors, earnings surprises, or sector-wide changes.
4. Periods of Divergence: While the correlation is strong, there are instances where Meta's price moves without a proportional increase in Microsoft's price, and vice versa. This could indicate temporary divergences due to company-specific events.
5. Investment Implications: If the historical correlation continues, investors might use one stock's movement as an indicator for the other. The regression line suggests a predictive relationship, though it does not guarantee future price movements.

Overall, the chart highlights a historically strong correlation between Meta and Microsoft stock prices, showing shared growth trends with periods of divergence and volatility.

Improvements:

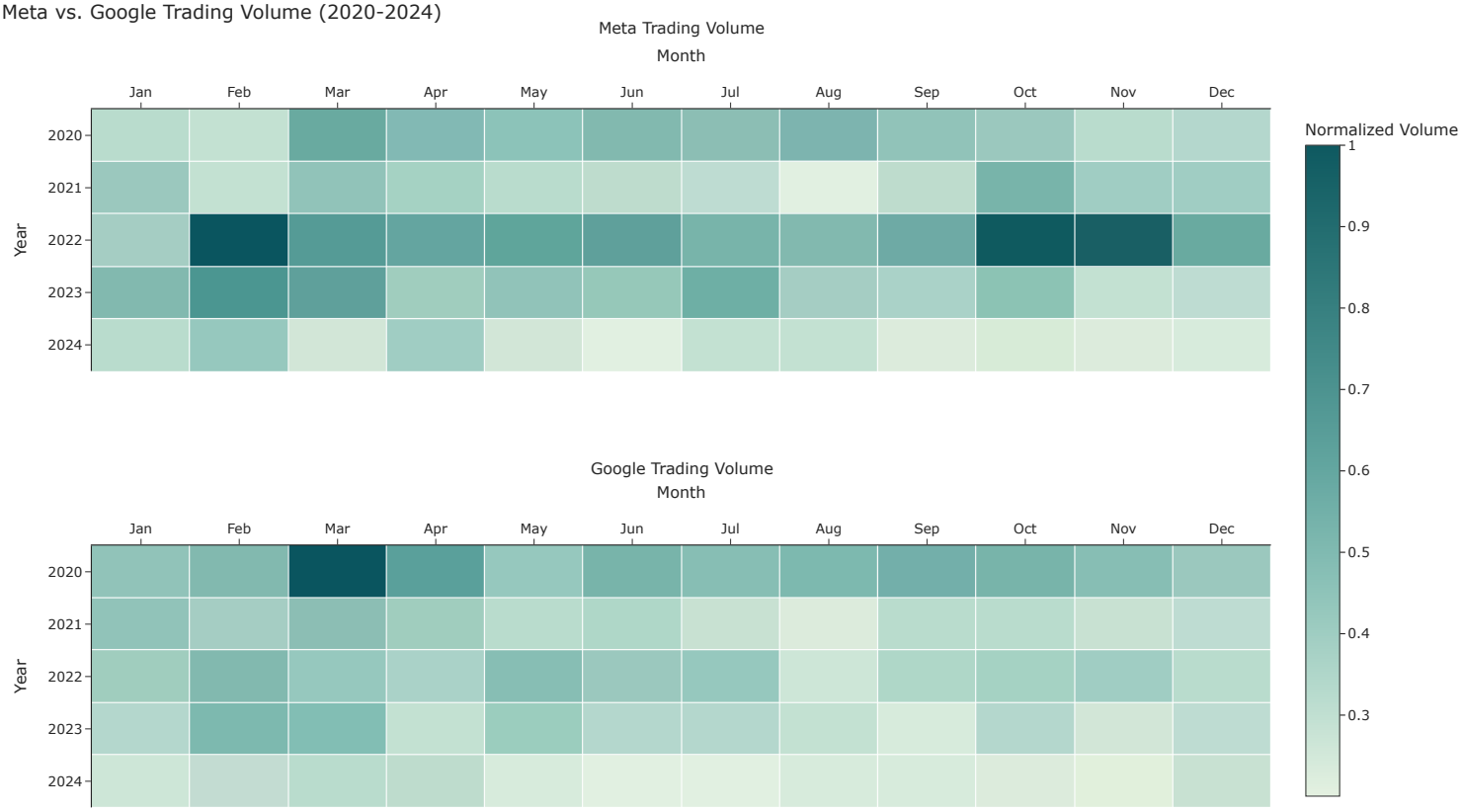
From 2012 to 2016 we can see a strong linear relationship since all the data points are close to the regression line. But then from 2018 to 2021, Microsoft's stock price was relatively higher than Meta's, causing the dots to fall below the regression line. This was due to Microsoft's strong growth in cloud computing (Azure) and favorable market opinions, while Meta faced challenges such as regulatory scrutiny and declining ad revenue. In contrast, from 2024 to 2025, Meta appears to be outperforming Microsoft, pushing the dots above the line. This could be due to Meta's recovery in ad revenue, success in AI investments, and increase in financial reports. Overall, these deviations reflect periods where one stock outperformed the other due to changing business performance and market dynamics.

Q5 Heatmap

```
from plotly.subplots import make_subplots
import plotly.graph_objects as go
import pandas as pd

# Group and pivot the data for Volume_GOOG and Volume_META
google_heatmap_data = google_filtered.groupby(['Year', 'Month'])[['Volume_GOOG']].sum().reset_index()
google_heatmap_data = google_heatmap_data.pivot(index='Year', columns='Month', values='Volume_GOOG')

meta_heatmap_data = meta_data_filtered.groupby(['Year', 'Month'])[['Volume_META']].sum().reset_index()
meta_heatmap_data = meta_heatmap_data.pivot(index='Year', columns='Month', values='Volume_META')

# Normalize the data
google_heatmap_data = google_heatmap_data / google_heatmap_data.max().max()
meta_heatmap_data = meta_heatmap_data / meta_heatmap_data.max().max()

# Create a figure with subplots (2 rows, 1 column)
fig = make_subplots(rows=2, cols=1, subplot_titles=("Meta Trading Volume", "Google Trading Volume"))

# Add the heatmap trace for Meta
fig.add_trace(
    go.Heatmap(
        z=meta_heatmap_data.values,
        x=meta_heatmap_data.columns,
        y=meta_heatmap_data.index,
        colorscale='mint',
        xgap=1,
        ygap=1,
        colorbar=dict(
            title='Normalized Volume',
            tickmode='array',
            tickvals=[0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1],
            ticktext=['0', '0.1', '0.2', '0.3', '0.4', '0.5', '0.6', '0.7', '0.8', '0.9', '1']
        ),
    ),
    row=1, col=1
)

# Add the heatmap trace for Google
fig.add_trace(
    go.Heatmap(
        z=google_heatmap_data.values,
        x=google_heatmap_data.columns,
        y=google_heatmap_data.index,
        colorscale='mint',
        showscale=False,
        xgap=1,
        ygap=1
    ),
    row=2, col=1
)
```

```
# Update layout
fig.update_layout(
    height=800,
    showlegend=True,
    title_text="Meta vs. Google Trading Volume (2020-2024)",
    title_x=0,
    title_y=.99,
    title_subtitle_font_size=14,
    title_subtitle_font_color="black",
    template='simple_white',

    # Move annotations to the main layout
    annotations=[
        dict(text="Meta Trading Volume", x=0.5, y=1.1, xref="paper", yref="paper", showarrow=False, font=dict(size=14)),
        dict(text="Google Trading Volume", x=0.5, y=0.47, xref="paper", yref="paper", showarrow=False, font=dict(size=14))
    ],
    coloraxis_colorbar=dict(
        x=0.5,
        y=0.5,
        title='Normalized Volume',
        tickmode='array',
        tickvals=[0, 0.25, 0.5, 0.75, 1],
        ticktext=['0', '0.25', '0.5', '0.75', '1']
    )
)

# Update axes for both subplots
for i in range(1, 3):
    fig.update_yaxes(title_text="Year", autorange="reversed", row=i, col=1,

                     tickvals=list(range(2020, 2025)))
    fig.update_xaxes(title_text="Month",
                     title_standoff=15,
                    side='top',
                    tickmode='array',
                    tickvals=list(range(1, 13)),
                    ticktext=["Jan", "Feb", "Mar", "Apr", "May", "Jun", "Jul", "Aug", "Sep", "Oct", "Nov", "Dec"],
                    row=i, col=1)



fig.show()
```

Meta vs. Google Trading Volume (2020-2024)



The main purpose of the chart is to compare the normalized trading volume of Meta and Google on a monthly basis from 2020 to 2024. It visualizes trends and seasonality in trading volume for both companies over this period.

Key Takeaways

Prompt: What are the key takeaways from this chart?

LLM Response:

The key takeaways from this chart comparing Meta and Google's trading volumes from 2020 to 2024:

1. Trading Volume Peaks: Meta experienced notable peaks in trading volume in March 2022 and October 2022. Google saw a strong peak in trading volume in March 2020, likely due to market reactions to the COVID-19 pandemic.
2. Overall Trends: Both Meta and Google show fluctuations in trading volume, but Google's trading activity appears more stable across the years. Meta's volume has more pronounced spikes compared to Google, which suggests periods of heightened interest in the stock.
3. Recent Trends (2023-2024): Trading volume for both companies appears to have declined or stabilized in recent years. Lower overall activity in 2024 might indicate reduced market volatility or less trading interest compared to prior years.
4. Comparison Between Meta and Google: Meta's trading volume seems more event-driven with significant peaks. Google's trading volume distribution is more even, without sharp spikes.
5. Possible Explanations: Meta's volume spikes could correspond to earnings reports, major product announcements, or controversies. Google's steadier volume suggests it might be less affected by short-term speculation.

This analysis suggests that while both stocks are actively traded, Meta experiences more dramatic shifts in volume, whereas Google maintains a relatively steady pattern

Improvements:

In 2022 we see high trading volumes for Meta especially in February, October, and November. In February 2022, Meta's stock experienced high trading volumes primarily due to a significant drop in its share price following a disappointing earnings report, where the company revealed a decline in daily active users for the first time ever, causing a large number of investors to sell their shares rapidly, leading to high trading activity. In October and November Meta experienced high trading volumes due to a worry amongst investors about Meta's plans to spend a large amount of money on new technology trends. Additionally there was growing artificial intelligence costs that could hit their earnings. Aside from Meta's unusual trading volume in 2022, the chart reveals some alignment between Meta and Google's trading patterns. Specifically, both companies displayed stronger trading volume in 2020 than in subsequent years, and both showed weaker volume towards the end of 2024.

Concluding Statement

Based on the data, Meta seems like a good investment. It has steady trading volume, strong ties to major tech stocks like Microsoft, and has recently been outperforming in price trends. While it has faced volatility in the past, its resilience—especially in 2024-2025—shows that investor confidence is bouncing back. The spikes in trading volume suggest strong market interest, and its correlation with Microsoft reinforces its standing as a key player in tech. With promising growth in AI and digital advertising, Meta has potential to be a strong long-term investment.