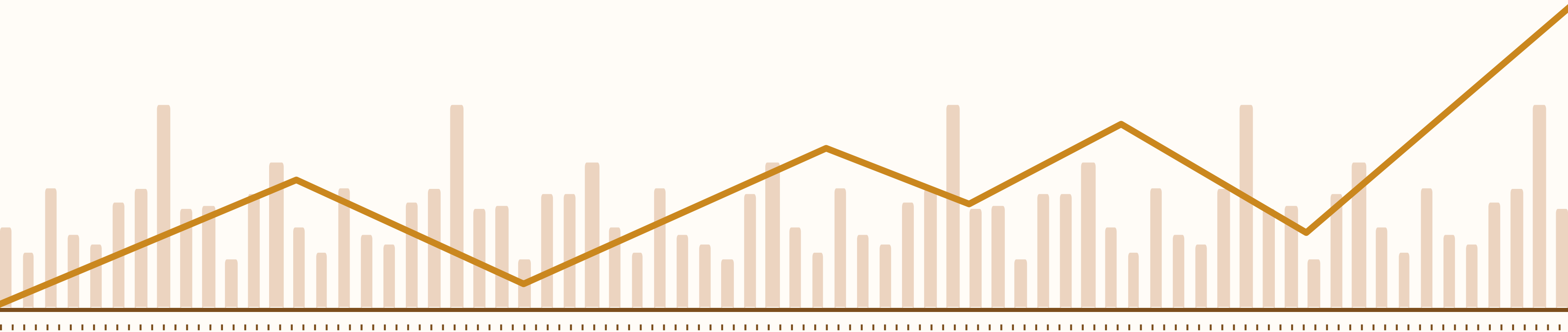
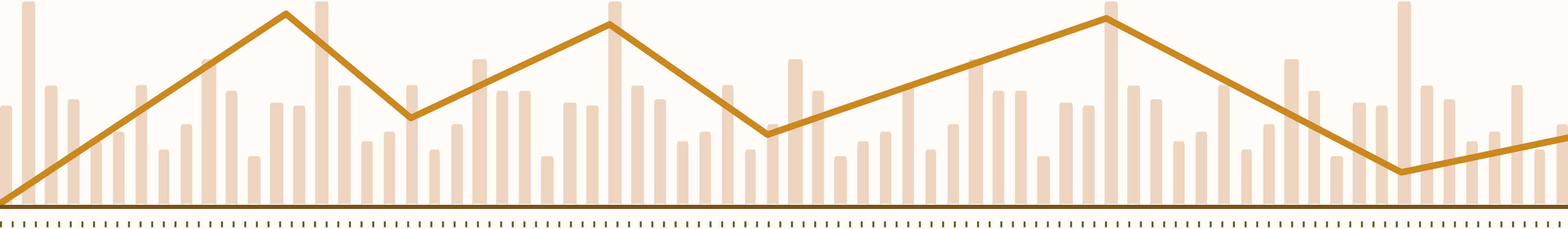


Time-Series Forecasting of NVDA Stock Using Naive and Prophet Models

By: Kourosh, Wendy, Alana

Contents of this template

Goals	
Background Info	Prophet, NVIDIA, Investing(buy low, sell high),...
Dataset	NVIDIA - where we got it, why we chose it
Pre-Processing	All the colors used in this presentation
Models	Introduction to prophet and how we used it, (holidays, seasonality), intro to Naive
Training Results	The graphs, what they mean, compared naive baseline, also the numbers(accuracy
Challenges	
Future Work	

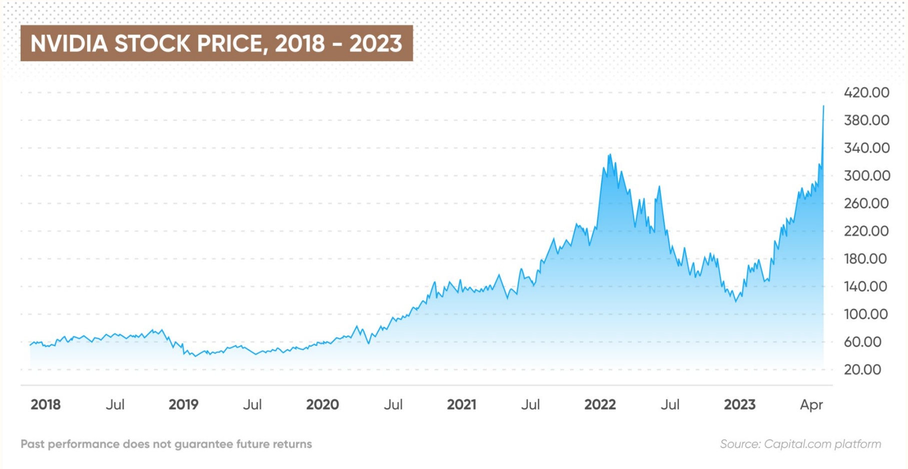


1 Introduction

Our Project

Our project explores stock forecasting methods, focusing primarily on Prophet and its ability to capture trend, seasonality, and holidays in time-series. Our case study is NVIDIA, a leader in the artificial intelligence field with its GPUs and data center demand.

In this project we compare a simple baseline model with a more advanced tool, Prophet.



Source: Capital.com platform

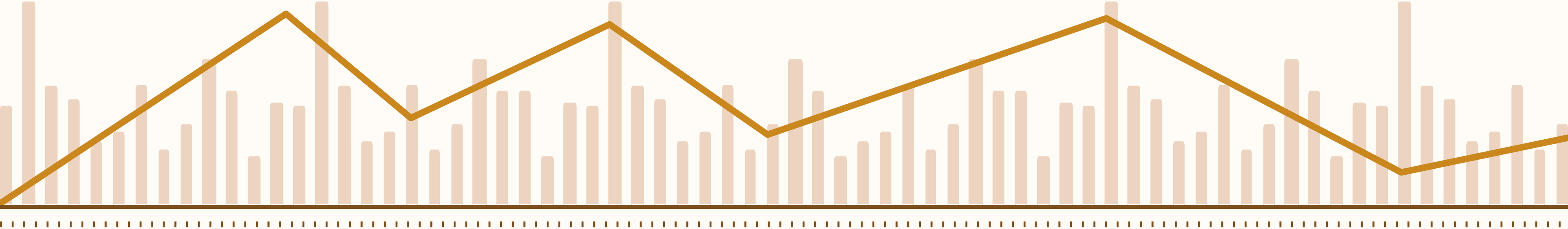
Stock Prediction

Why Stock Market Prediction Matters

- The stock market is a critical component of the global economy
- Helps individuals build wealth
- Predicting the market helps inform investment decisions and manage risks.

Why Predicting Stocks is Difficult

- External Influences
- Noisy Data
- Complex and nonlinear Relationships



2

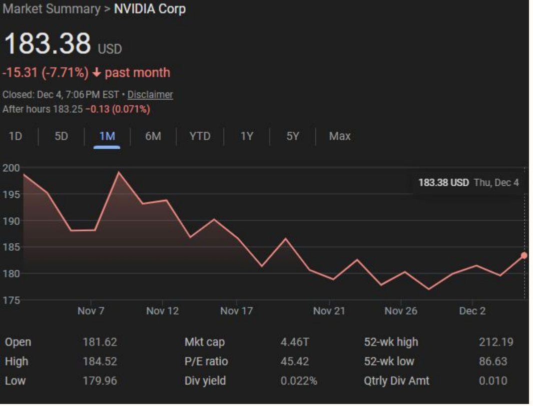
Project Goals

Goals

- Deepen our understanding of time-series forecasting
- Establish a baseline model with simple forecasting
- Apply Facebook's Prophet model to NVIDIA stock
- Evaluate and understand the two models strengths and limitations in real market conditions
- Develop a model using Prophet to predict stock prices as closely as possible

3

Data Set


Market Summary > NVIDIA Corp

183.38 USD

-15.31 (-7.71%) ↓ past month

Closed: Dec 4, 7:06 PM EST • Disclaimer

After hours 183.25 −0.13 (0.071%)

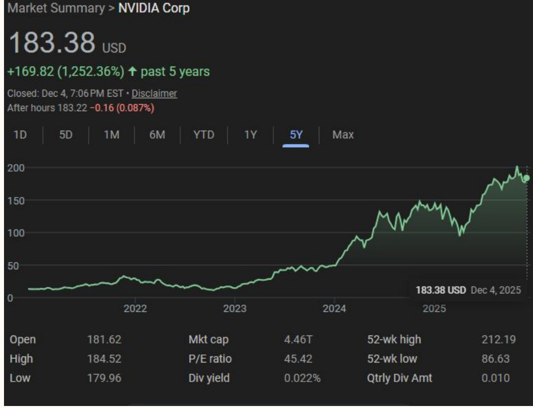
Open	181.62	Mkt cap	4.46T	52-wk high	212.19
High	184.52	P/E ratio	45.42	52-wk low	86.63
Low	179.96	Div yield	0.022%	Qtrly Div Amt	0.010

NVIDIA

NVIDIA was selected for this project as it represents a dynamic and influential company in today's market.

In additional, NVIDIA's price behavior offers a mix of short-term volatility and long-term growth. Over the past month, the stock has experiences sharp fluctuation, while the five-year chart shows an overall upward trend.

Finally, NVIDIA's central role in the rapid expansion of AI, data centers, and semiconductor technology contributes to increased investor attention and market sensitivity. Its prominence,volatility, and technological importance makes it an interesting choice for analysis


Market Summary > NVIDIA Corp

183.38 USD

+169.82 (1,252.36%) ↑ past 5 years

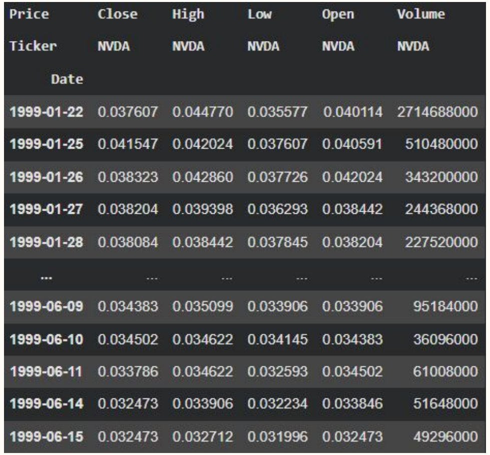
Closed: Dec 4, 7:06 PM EST • Disclaimer

After hours 183.22 −0.16 (0.087%)

Open	181.62	Mkt cap	4.46T	52-wk high	212.19
High	184.52	P/E ratio	45.42	52-wk low	86.63
Low	179.96	Div yield	0.022%	Qtrly Div Amt	0.010

NVIDIA Data Set

We used daily NVIDIA stock data from Yahoo Finance via the yfinance library. We used data ranging from January 1st, 1999 to today. This data includes the daily high, low, opening, and closing price as well as the volume traded, providing a comprehensive view of NVIDIA's long term market behavior.



Price	Close	High	Low	Open	Volume
Ticker	NVDA	NVDA	NVDA	NVDA	NVDA
Date					
1999-01-22	0.037607	0.044770	0.035577	0.040114	2714688000
1999-01-25	0.041547	0.042024	0.037607	0.040591	510480000
1999-01-26	0.038323	0.042860	0.037726	0.042024	343200000
1999-01-27	0.038204	0.039398	0.036293	0.038442	244368000
1999-01-28	0.038084	0.038442	0.037845	0.038204	227520000
...	...	...	...	...	...
1999-06-09	0.034383	0.035099	0.033906	0.033906	95184000
1999-06-10	0.034502	0.034622	0.034145	0.034383	36096000
1999-06-11	0.033786	0.034622	0.032593	0.034502	61008000
1999-06-14	0.032473	0.033906	0.032234	0.033846	51648000
1999-06-15	0.032473	0.032712	0.031996	0.032473	49296000

4

Models

Prophet

What is Prophet?

- A time-series forecasting model from Meta (Facebook).
- Designed to be robust, easy to use, and interpretable (separate trend/seasonality components)

Why did we chose prophet

- Widely used in industry

$$y(t) = \mathrm{trend}(t) + \mathrm{seasonality}(t) + \mathrm{holiday/events}(t) + \varepsilon_t$$

- Fits directly into class topics: forecasting, regressors, train–test splits.
- Easier and more interpretable than hand-building ARIMA or custom models.

What does prophet offer?

- Automatic trend modeling with changepoints. Built-in weekly/yearly seasonality.
- Ability to add holidays / event effects and extra regressors (market returns, volatility, etc.).
- Handles missing data and outliers reasonably well.
- In our implementation we fit Prophet on the log of the NVDA price and then convert predictions back to the original scale

When does Prophet work well / not well?

- Works well:
  - Time series with clear trend + seasonal patterns (e.g., sales, web traffic, energy load).
  - Moderately noisy data where events/holidays have consistent effects.
- Does not work well (for us):
  - Highly noisy, random-walk-like series such as short-horizon stock prices.
  - When overloaded with many noisy regressors → can overfit and become unstable.

Naive Model

What naive model are we using?

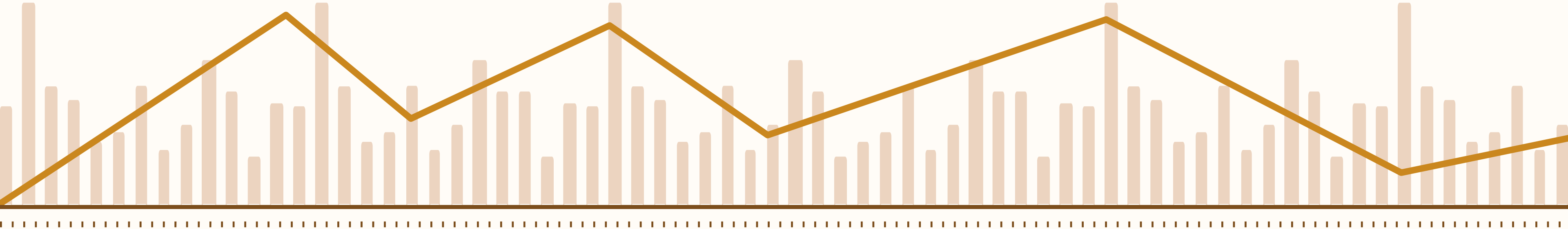
- Persistence model (random walk baseline)
- “Tomorrow’s close = today’s close.”
- Uses only yesterday’s NVDA closing price, no extra features.

When does it work well?

- Short horizons (30-day ahead) where prices are highly persistent.
- Periods without huge overnight gaps or major regime breaks.
- Stocks that behave roughly like a random walk from day to day (like NVDA in our test window)

When does it not work well?

- Around big news events (earnings surprises, major AI announcements, export bans) that cause large jumps
- Longer-horizon forecasts (multi-day or multi-week ahead) where trend/seasonality matter more.
- When the series has strong predictable structure that depends on external factors, not just yesterday’s price.



5

Preprocessing

Preprocessing Methods

Data cleaning & formatting

- Download NVDA + SPY/QQQ/SOXX/AMD/MSFT from Yahoo Finance
- Keep adjusted Close as target y, timestamps as ds (Prophet format)
- Enforce numeric types; drop rows with any NaNs
- Apply log transform to Close for Prophet; convert predictions back to the original scale for evaluation

Time-series feature engineering

- RSI(14) capturing short term momentum
- ret_nvda for daily returns vol_20 20-day rolling volatility of returns, high_vol flag binary for high volatility days
- Regime flags: is_ai_hype (AI boom) form 2023 post gpt ai boom and is_export_regime (export-control window)
- Daily returns of similar semiconductor and technology companies (s&p amd msft)

Train–test split

- Chronological split: last 500 trading days as test; earlier data as train.

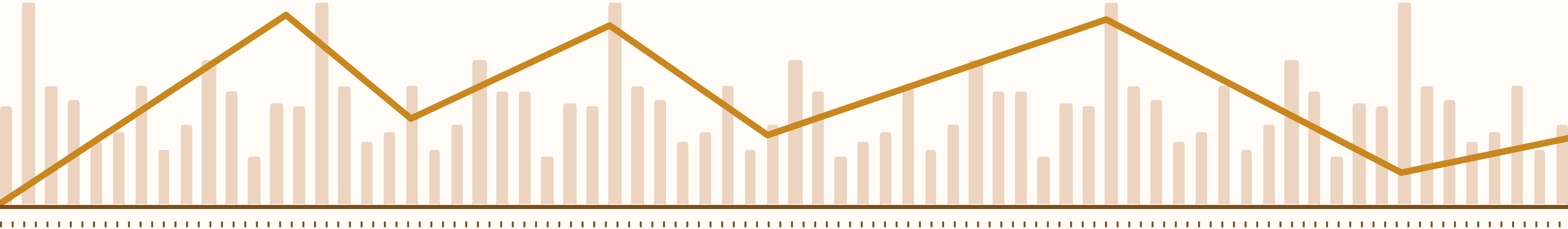
Preprocessing Methods

What works well?

- Chronological split realistic evaluation with no look ahead leakage
- Simple features like returns volatility and RSI plus market returns
- Useful for analysis even if they don’t always improve forecasting.

What does not work well?

- Many regressors at once. Useful for analysis even if they don’t always improve forecasting. The prophet model overfits and becomes unstable and perform worse than the naive baseline
- Some of The regime flags like ai hype are useful conceptually but may not translate into stable short term predictions



6

Training Results

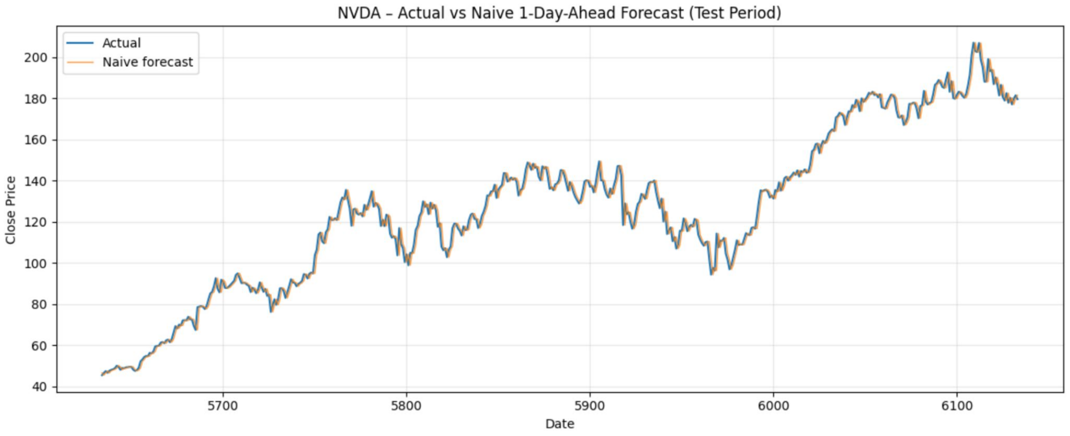
Naive Model Performance

MAE: ≈ 2.82 dollars

RMSE: ≈ 3.87 dollars

R²: ≈ 0.99

Interpretation: On average, we're off by less than $3, and the model explains almost all of the variance in recent NVDA prices.



Prophet Performance

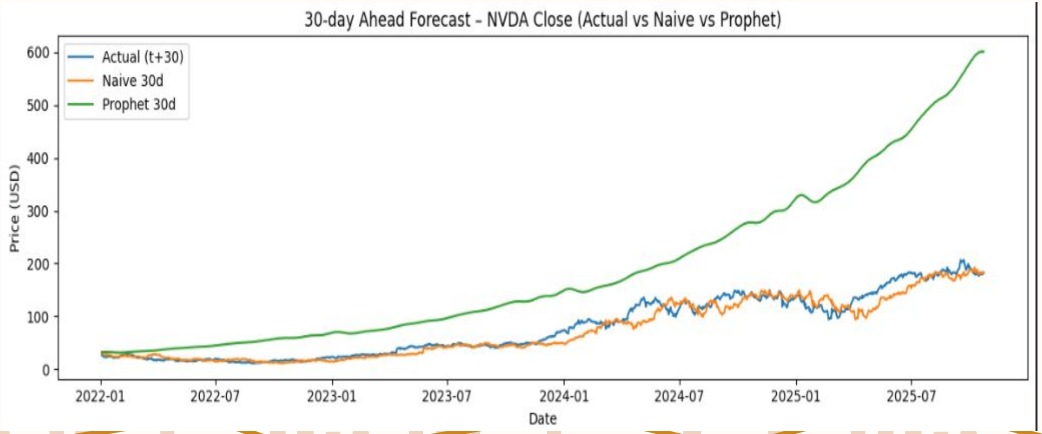
Evaluated Prophet on 30-day ahead log-price forecasting to reduce noise and highlight medium-term trends

Trained on NVDA data from 2010–2021, tested on 2022–2025

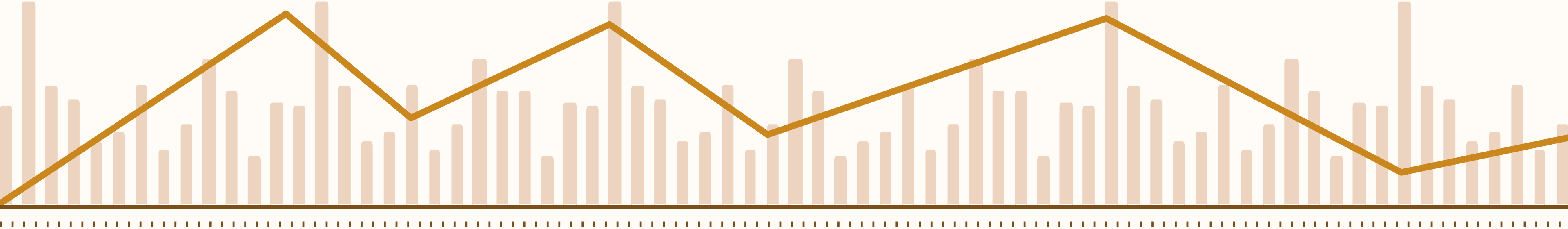
Inputs: log-price + smooth regressors (MA30, MA90) only

Prophet generates stable, trend-respecting forecasts but struggles on sharp jumps and high-volatility segments

Compared against a 30-day naive baseline (future price = today’s price)



Comparison (30-day horizon): Naive RMSE (log)=0.1928, RMSE(price)=14.2047 USD
Prophet RMSE (log)=0.9108, RMSE(price)=147.8430 USD



7

Challenges

What went wrong with Prophet?!

Stock data is extremely noisy and non-stationary, making it difficult for models like Prophet that assume smoother patterns. Prophet is would work better with more stable and periodic stock or smooth business time-series but NAVIDIA's stock that's highly affects by unpredictable events and AI news are challenging for Prophet to incorporate. The holiday parameters does provide a short term correction but not long term.

Prophet's additive, piece-wise linear structure cannot represent jump dynamics or volatility clustering common in financial time series.

What did Prophet do well

Successfully captured smooth long-term growth trends using its piece-wise linear trend model. Produced stable, interpretable forecasts rather than reacting to short-term noise

Log-transformation + Prophet produced reasonable medium-term trend shape, even if magnitude diverged

Demonstrated strong decomposition capabilities (trend vs. seasonal vs. regressor effects)

Allowed us to easily add and experiment with external regressors such as MA30/MA90. Automatically placed changepoints near major structural shifts in NVDA’s price history.

8

Future Work

Next Steps

Acknowledge Prophet’s structural limitations for highly volatile assets like NVDA; consider testing Prophet on more stable stocks (e.g., KO, PG, JNJ, VOO) where seasonality and trend assumptions hold more reliably.

Constrain Prophet’s trend flexibility using smaller changepoint priors and fewer trend breakpoints to avoid runaway extrapolation.

Incorporate informative features commonly used in LSTM or other modern forecasting models—such as volatility indicators, volume trends, macroeconomic factors, or news sentiment—as structured regressors in Prophet to enhance its ability to capture meaningful market drivers.

Thank You!