Appendix

Appendix A: Relevant diagrams and charts

```python
# Stock price dynamics with jump diffusion and market sentiment impact
def simulate_stock_price(S_t, v_t_new, lambda_t, jump_mean, jump_vol, market_state, dt,impact_str):
    dB = np.random.normal(0, np.sqrt(dt))
    jump = np.random.normal(jump_mean, jump_vol) if np.random.rand() < lambda_t * dt else 0
    #jump = np.random.normal(jump_mean, jump_vol) if np.random.rand() < jump_intensity * dt else 0

    # Adjust drift term based on market sentiment
    if market_state == 0:  # Bullish
        drift = r + 2 + impact_str  # Adding positive sentiment
    elif market_state == 2:  # Bearish
        drift = r - 2 - impact_str  # Adding negative sentiment
    else:
        drift = r

    S_t_new = S_t * (1 + drift * dt + np.sqrt(v_t_new) * dB + jump)   #Important
    return S_t_new
```

Figure 1: Stock price dynamics implementation

```python
# Heston process for variance with jumps
def simulate_variance(v_t, kappa, theta, eta, jump_intensity, vol_jump_mean, vol_jump_vol, dt):
    dW = np.random.normal(0, np.sqrt(dt))
    jump = np.random.normal(vol_jump_mean, vol_jump_vol) if np.random.rand() < jump_intensity * dt else 0
    v_t_new = max(v_t + kappa * (theta - v_t) * dt + eta * np.sqrt(v_t) * dW + jump, 0)
    return v_t_new
```

Figure 2: Heston Variance implementation

```python
def simulate_jump_intensity(lambda_t, alpha, beta, delta, dt):
    dZ = np.random.normal(0, np.sqrt(dt))
    return max(lambda_t + alpha * (beta - lambda_t) * dt + delta * np.sqrt(lambda_t) * dZ, 0)
```

Figure 3: Jump intensity(CIR process) implementation

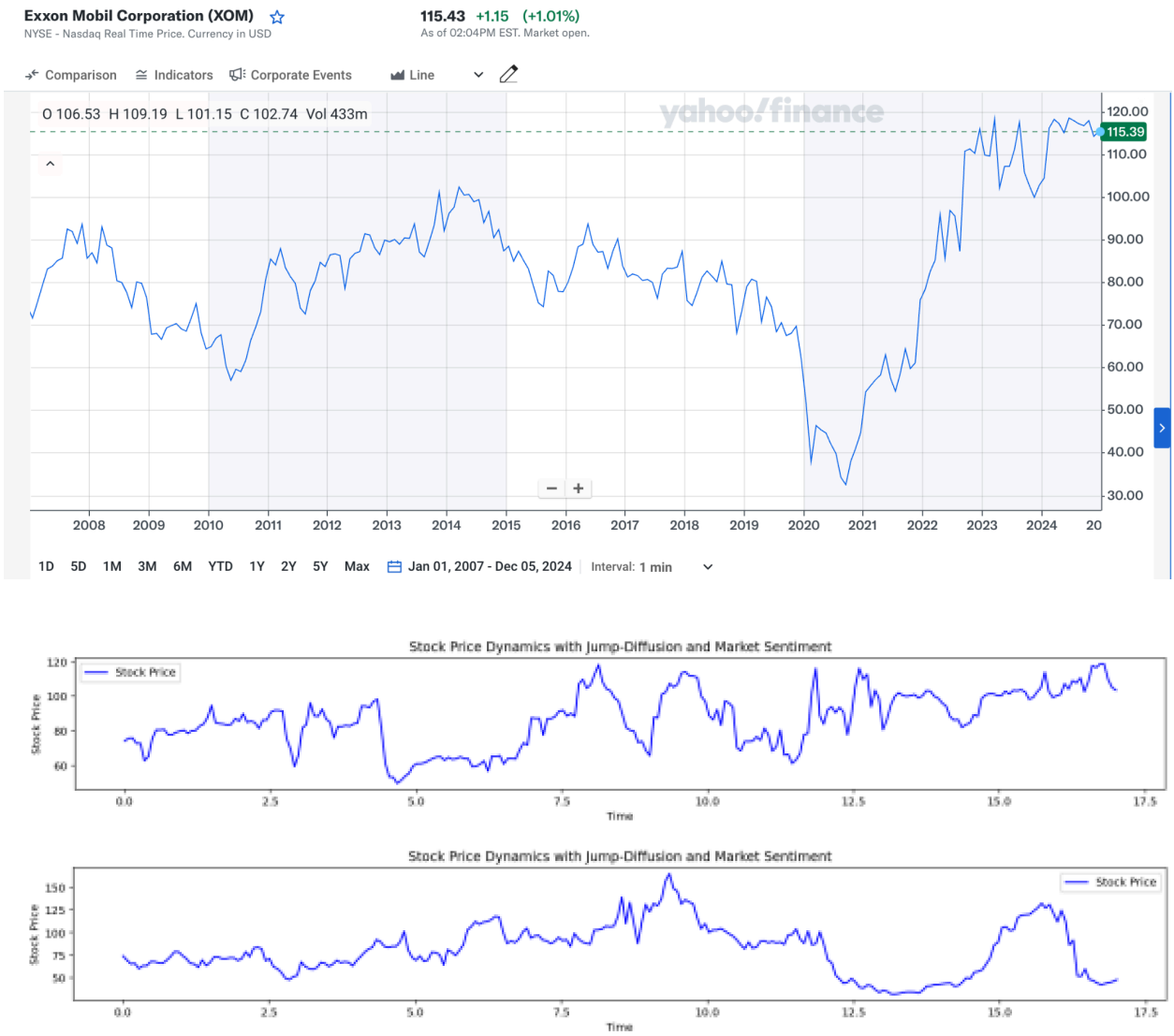

Figure 4: Exxon Mobil Simulation vs Real life comparison

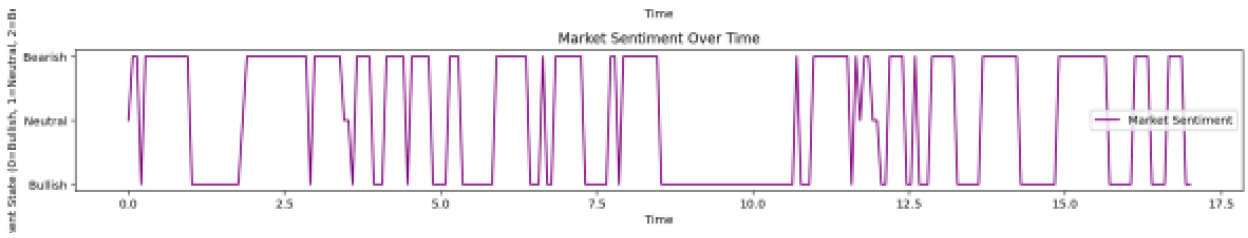

Figure 5: Market sentiment chart

Appendix B: Research Papers and Methodology References

- Heston Model Simulation in Python
- Stochastic Volatility and Jump Diffusion Models (MDPI)
- Stochastic Volatility Calibration to Option Prices
- Heston Model Overview (Univ. Evry)
- Andersen Stochastic Volatility
- Option Pricing with Heston's Stochastic Volatility Model

Appendix C: Financial Data Platforms and Databases

- Yahoo Finance - Nvidia Stock
- AlphaQuery - Nvidia Volatility
- Yahoo Finance - Pfizer Stock
- YCharts - 10-Year Treasury Rate
- Portfolio Lab - Nvidia
- Market Chameleon - Nvidia Options

Appendix D: Baum-Welch Algorithm

- A Tutorial on Hidden Markov Models and Selected Applications in Speech Recognition by L. R. Rabiner (1989). This paper explains the Baum-Welch algorithm, a key expectation-maximization technique used to estimate the parameters of a Hidden Markov Model (HMM). The algorithm is applied to optimize the transition probabilities in our model by iterating through observed data of market sentiment, thus refining the parameters over time.
    - Link to the paper

- Additional Resources:
    - HMM Baum-Welch Algorithm (GitHub)
    - Baum-Welch Algorithm for Training a Hidden Markov Model (Medium)

Appendix E: News Articles and Event Data

Nvidia:

- Nvidia Q3 Earnings & AI Chip Demand
- Nvidia and SoftBank Group Terminate Acquisition of ARM
- Nvidia's Last 3 Earnings

Pfizer:

- Pfizer's 2024 Revenue Guidance Amid Declining Demand for COVID Products
- Pfizer and BioNTech Win Pause in COVID-19 Vaccine Patent Infringement Trial
- Pfizer Invests $43 Billion to Battle Cancer
- Study on Vaccine Research (PMC)

Exxon Mobil:

- ExxonMobil Q4 Earnings Report
- Exxon Mobil Earnings Overview

Appendix F: Simulation and Computational Tools

- NumPy Documentation
- Matplotlib Documentation
- Random Module Documentation

Appendix G: Calibration and Validation References

- Quantifying Uncertainty (Washington University)
- Option Pricing with the Heston Model
- Financial Modelling Research Papers (EFMA)
- Stochastic Volatility Models: A Review (MDPI)

Appendix H: Tools for Calibration and Sector-Specific Insights

Nvidia:

- GPU Market Health Report (Tom's Hardware)
- Nvidia Stock Market Cap Rise (Business Insider)

Pfizer:

- Pfizer's Strategic Overview and Market Outlook (Investors Hangout)
- Pfizer's Year in Review (Insights Pfizer)

Exxon Mobil:

- Exxon Mobil's Investor Relations

Appendix I : Link to google drive

https://drive.google.com/file/d/1qzdgGsRZn7ppLoAti4MFBAaYIgOjCUxP/view?usp=drive_link