Private Market Forecasting Dashboard: Simulating Investment Decision-Making for Early-Stage Valuation

May 2025

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1. Introduction: Why This Matters

In private markets, data is sparse, outcomes are uncertain, and investment decisions often rely on imperfect but interpretable models.

This project simulates how an analyst might evaluate a private company's potential using:

- Revenue forecasts (via ML)
- Valuation heuristics (multiples and DCF)
- Quantified risk (VaR, Monte Carlo)
- Momentum trends (MACD, EMA)

Objective: Equip users with a tool that blends predictive modeling, risk simulation, and pattern recognition to support smarter decision-making.

2. Tech Stack Overview

- **Languages:** Python 3
- **Libraries:** Streamlit, Scikit-learn, NumPy, Pandas, Matplotlib
- **Model:** Linear Regression, joblib export

3. How Each Module Connects (End-to-End Use Flow)

1. Inputs → ML Forecast

User provides:

- Revenue
- Profit Margin
- Debt-to-Equity Ratio
- Cash Flow

These are passed into a trained regression model that outputs **projected revenue** — the core metric that powers everything downstream.

2. Revenue → Valuation

- **5× multiple:** Common in early-stage VC and PE
- **DCF method:** Five years of projected cash flows, discounted at 12%

3. Revenue → Risk Metrics

- **Monte Carlo:** 1000 simulations of revenue → valuation
- **Value-at-Risk (95%):** Shows downside risk in valuation

4. Revenue Trend → Momentum (Public Market Logic)

- **EMA-20 vs EMA-200:** Simulates trend strength
- **MACD Histogram:** Identifies acceleration or fading of revenue momentum

4. Understanding the Indicators and Metrics

1. EMA (Exponential Moving Average)

EMA assigns higher weights to recent values, capturing short-term momentum more responsively than a simple average.

- **EMA-20:** Short-term trend
- **EMA-200:** Long-term trend
- *Interpretation:* When EMA-20 ¿ EMA-200, momentum is positive.

2. MACD (Moving Average Convergence Divergence)

Derived by subtracting EMA-26 from EMA-12, MACD helps visualize trend shifts.

- **MACD Histogram:** Plots difference between MACD and its 9-day EMA (signal line)
- *Interpretation:* When histogram turns negative, momentum may be fading.

3. Monte Carlo Simulation

Random sampling of possible revenue outcomes, assuming a normal distribution.

- 1000 iterations are run to simulate various revenue paths.
- *Purpose:* Explore valuation ranges, downside risks, and volatility.

4. Value at Risk (VaR)

Estimates the worst-case loss with a certain confidence level (95% here).

$$\text{VaR} = \mu - 1.65 \cdot \sigma$$

- μ: Predicted valuation
- σ: Standard deviation from simulated samples
- *Meaning:* There's a 5% chance the actual value could fall below this.

5. Discounted Cash Flow (DCF)

Projects future cash flows over 5 years using a growth rate (e.g., 10%) and discounts them using a rate (e.g., 12%).

$$\text{DCF} = \sum_{t=1}^{5} \frac{CF_t}{(1+r)^t}$$

Used to reflect intrinsic value of a company.

6. Revenue Multiples

Applies a constant multiple (e.g., 5×) to current/future revenue. *Used when cash flow data is limited — common in early-stage valuations.*

5. Use Case Diagram (System Flow)

```
+-------------+       +------------------+       +------------------+
|    User     | ----> |  Input Dashboard | --->  | Forecast & Model |
+-------------+       +------------------+       +------------------+
                                                |
```

```
      v
+-------------+
| Valuation & |
| Risk Engine |
+-------------+
      |
      v
+----------------+
| Export Results |
+----------------+
```

Figure: Flow of actions from user input to valuation and final report.

6. Architecture Overview

```
[ dashboard.py ] --> Collects input from user
       |
       v
[ financial_forecast_model.joblib ] --> Predicts revenue
       |
       v
[ Valuation Engine ] --> Applies DCF and Multiples
       |
       v
[ Monte Carlo + VaR ] --> Assesses downside risk
       |
       v
[ MACD / EMA Analysis ] --> Evaluates momentum
       |
       v
[ Export to PDF ] --> Report generation and visualization
```

Figure: Text-based architecture pipeline of the system.

7. Investor-Led Interpretation Examples

- **VaR high?** Flag risk, reconsider investment assumptions.
- **MACD turning bearish?** Pause investment, monitor trend stability.
- **DCF > Valuation multiple?** Potential to justify higher offer.
- **Momentum strong, risk low?** Favorable conditions for go/no-go.

8. Human Touch in Decision-Making

This app doesn't just run numbers — it guides decision logic:

- Built-in heuristics mimic how real analysts interpret data
- Encourages "what-if" testing of metrics
- Delivers a downloadable report (simulating pitch documents)

9. Supporting Files

1. **generate_financial_data.py**

- Generates synthetic financial data (CSV format) used for model training

2. **train_model.py**

- Trains Linear Regression model on the generated data and saves the model as a Joblib file

3. **financial_forecast_model.joblib**

- Pre-trained model used for live revenue forecasting in the dashboard

4. **financial_data.csv**

- Example dataset used for model input/output display

5. **dashboard.py**

- Front-end Streamlit application to simulate financial decision-making workflow

10. Future Features (Roadmap)

- Compare multiple companies on the same dashboard
- Integrate real data (e.g., Crunchbase, Preqin)
- ESG rating sliders and sustainability metrics
- API for founder scoring and sector classification
- Industry-based DCF templates with built-in risk profiles

11. Conclusion

This project was designed as a hands-on exercise in developing a lightweight financial forecasting and valuation toolkit.

- It demonstrates how machine learning, simulation, and financial logic can be integrated into an interactive application.
- The system supports exploratory "what-if" analysis, giving users dynamic insight into valuation and risk.
- A modular structure allows for easy extension into more complex investment workflows.

What this project demonstrates:

- Ability to apply core financial modeling concepts using Python
- Practical use of simulation and risk assessment tools
- Development of a user-facing dashboard for scenario-based decision support

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Updated JULY 8