

1. How the Model Works (High Level)

The system consists of four main stages:

1.1 Return Modeling (Mean Behavior)

The model converts prices into daily log returns

A lightweight ARIMA(1,0,0) model is used to capture short-term dependence

This models average market behavior, not long-term trends

This step ensures the model understands normal daily market movement.

1.2 Volatility Modeling (Risk Behavior)

Market risk is modeled using a rolling EGARCH model with Student-t distribution

Only the most recent 3–5 years of data are used (rolling window)

This allows the model to:

Adapt to new market regimes

Forget outdated crisis behavior

Capture volatility clustering and fat tails

This step is critical for detecting crash-like conditions.

1.3 Monte Carlo Simulation (Future Scenarios)

Thousands of possible future 10-day paths are simulated

Each path reflects:

Current volatility

Heavy-tailed shocks

The result is a distribution of possible outcomes, not a single forecast

This allows the system to estimate how likely extreme movements are.

1.4 Risk Threshold & Alert Logic

From the simulated outcomes, the model calculates probabilities for:

–5%, –10%, –20% downside moves

+5%, +10%, +20% upside moves

Alerts are generated using business-aligned rules:
Downside risk is treated more conservatively
Severe alerts (-10%, -20%) are only issued during high-volatility regimes

This reduces false alarms while preserving crash sensitivity

2. Alert Output (What the Model Produces)

Each daily run produces:
Probability of each risk level (e.g., -10% in next 10 days)
Current volatility regime (normal vs stressed)

Clear alert levels:

NO ALERT
WATCH
WARNING
CRITICAL

These results are stored in a PostgreSQL database and made available via FastAPI endpoints for frontend dashboards or downstream systems.

3. Why This Approach Is Reliable

Does not rely on fragile price point predictions
Uses probabilistic risk estimation
Adapts automatically to changing market conditions
Designed to minimize false alarms

Aligned with real-world financial risk management practices

4. How the Model Runs in Production

Executed once per day after market close
Automatically fetches the latest ASI data
Runs the full risk engine
Saves results for frontend and reporting use
No manual intervention required