Fixed Income VaR Engine: Full Revaluation Model built from Scratch

- A hands-on implementation of market risk modelling for real portfolios
- Passed rigorous back testing
- Risk factors:

1. Treasury spot rates
2. Option adjusted spread
3. SOFR

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Backtesting Results:

Total Observations: 248
Number of Exceptions: 2
Expected Exceptions (1%): 2

Kupiec Unconditional Coverage Test:
Kupiec Test LR: 0.100
Kupiec Test p-value: 0.751
✅ Model Passed Kupiec Test (Good calibration)

Christoffersen Independence Test:
Christoffersen Test LR: 0.033
Christoffersen Test p-value: 0.857
✅ Exceptions are independent (Good)

Exception Summary:
Worst Exception (Max Loss): $-5,036.68
Average Exception Loss: $-4,475.04
Backtest results exported to combined_var_backtest_output.xlsx
Exception days exported to exceptions_only.xlsx
Skewness: 0.996
Kurtosis: 37.518
```

My Objective

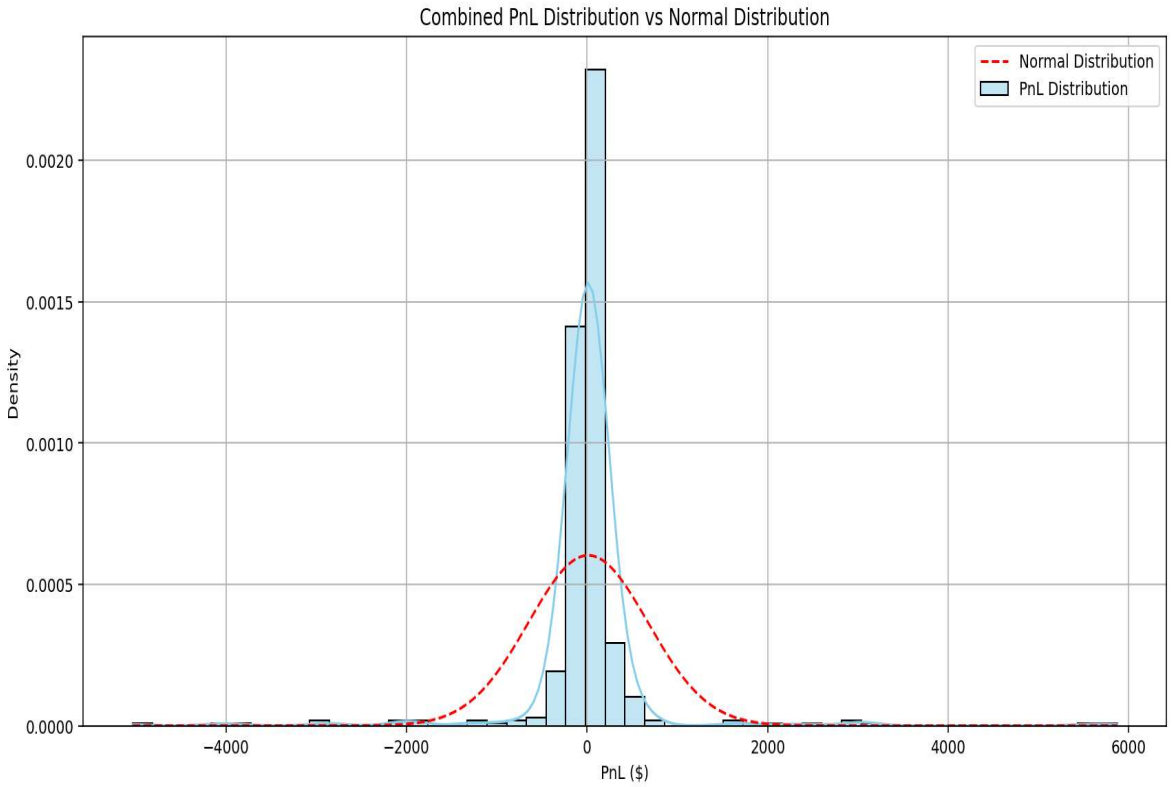
- To build a full revaluation VaR engine for fixed income portfolio combining:
  1. Corporate investment grade bonds
  2. Repo
  3. Bond Total return swap
- To price and revalue a multi-instrument fixed income portfolio
- To produce reliable risk metrics
- Conducted extensive backtesting

Instruments I Modelled

Instrument Type	My Valuation Approach
Bonds	Spot-rate + OAS discounting
Repos	Synthetic bond with fixed repo rate
TRS	Synthetic exposure: bond PV – financing leg

PnL Chart

- C**alculated PV daily** using tenor based zero coupon spot + rating-based OAS curves per instrument
- Avoided closed-form simplifications; **every day's PV is full reval**
- **Combined PnL chart**



VaR vs PnL chart

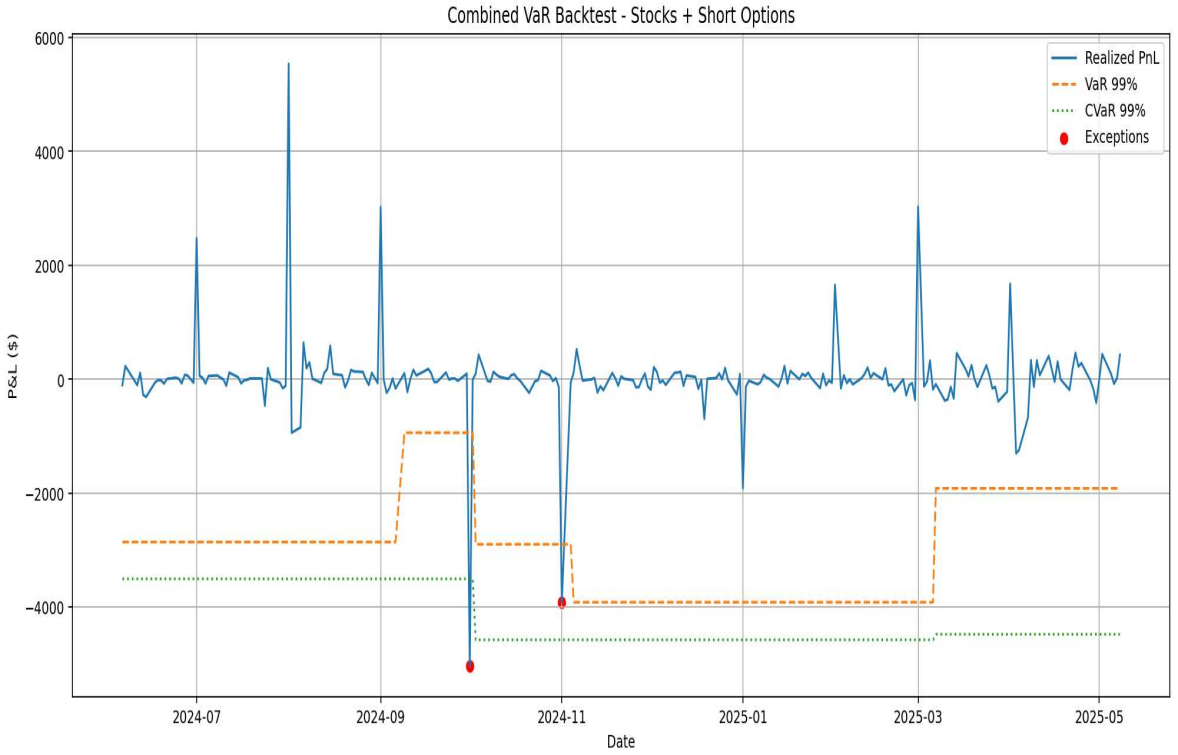
Historical Simulation VaR

250-day rolling window

99% confidence level

PnL = PV[today] - PV[yesterday]

No return scaling — **every shock is real**



Back testing I Implemented

- Tracked **VaR breaches**
- Built **Kupiec Test** to check exception count
- Built **Christoffersen Test** to check independence
- Plotted every result for clarity

✅ My code calculates true out-of-sample PnL shocks and aligns VaR windows correctly

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Key Learnings

- Full revaluation is **computationally expensive but exact**
- Repo and TRS require **realistic cash leg modeling**

My Data sources

- FRED (for Treasury spot rates and SOFR)
- ICE BofA (for OAS by rating)