



RUTGERS

Course: Risk Practice
Professor : Dr. Elliot Noma, PhD

Quantifying Investment Risk: A Multi-Method VaR Framework for Personalized Portfolios

“What if your portfolio could warn you before a crisis? What if it even adapted to your risk personality—like being conservative or aggressive—just like a Netflix recommendation system?”

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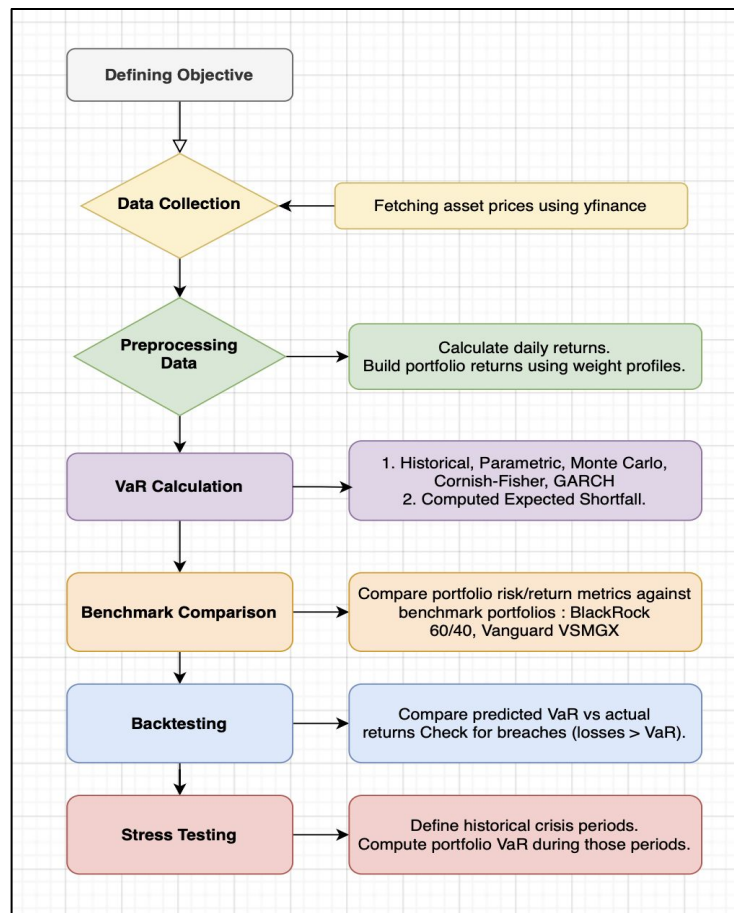
Workflow & Methodology

```
# === 2. Portfolio Configuration (Constants) ===
tickers = [
    'SPY',      # SPDR S&P 500 ETF - U.S. Large Cap Equities
    'AGG',      # iShares Core U.S. Aggregate Bond ETF - Broad Bond Exposure
    'QQQ',      # Invesco QQQ ETF - Nasdaq 100 (Tech-heavy Equities)
    'GLD',      # SPDR Gold Shares - Exposure to Gold (Commodities)
    'BTC-USD',  # Bitcoin (USD) - Leading Cryptocurrency
    'ETH-USD',  # Ethereum (USD) - Smart Contracts & Altcoins
    'IVV',      # iShares S&P 500 ETF - U.S. Large Cap Equities (BlackRock Portfolio)
    'IEFA',     # iShares MSCI EAFE ETF - International Equities (BlackRock Portfolio)
    'VTI',      # Vanguard Total Stock Market ETF (Vanguard Portfolio)
    'VXUS',     # Vanguard Total International Stock ETF (Vanguard Portfolio)
    'BND',      # Vanguard Total Bond Market ETF (Vanguard Portfolio)
    'VWO',      # Vanguard Emerging Market Bond ETF (Vanguard Portfolio)
]

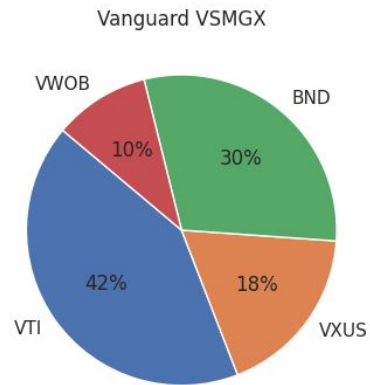
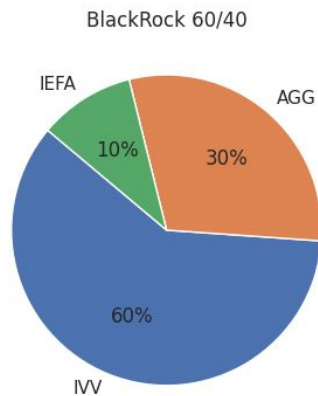
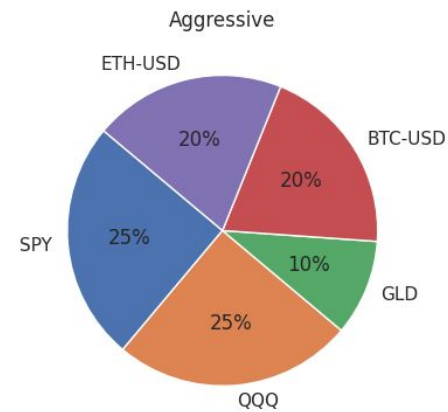
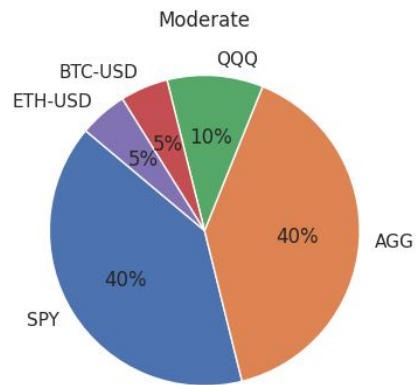
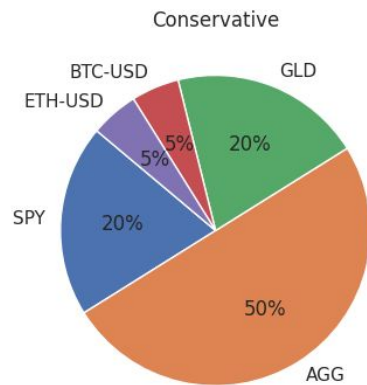
start_date = '2015-01-01'
end_date = '2024-12-31'
confidence_level = 0.95
rolling_window = 60 # Days for rolling VaR calculation
```

```
# === 2.1 Behavioral Risk Profiles ===
risk_profiles = {
    "Conservative": {'SPY': 0.2, 'AGG': 0.5, 'GLD': 0.2, 'BTC-USD': 0.05, 'ETH-USD': 0.05},
    "Moderate":     {'SPY': 0.4, 'AGG': 0.4, 'QQQ': 0.1, 'BTC-USD': 0.05, 'ETH-USD': 0.05},
    "Aggressive":   {'SPY': 0.25, 'QQQ': 0.25, 'GLD': 0.1, 'BTC-USD': 0.2, 'ETH-USD': 0.2},
}

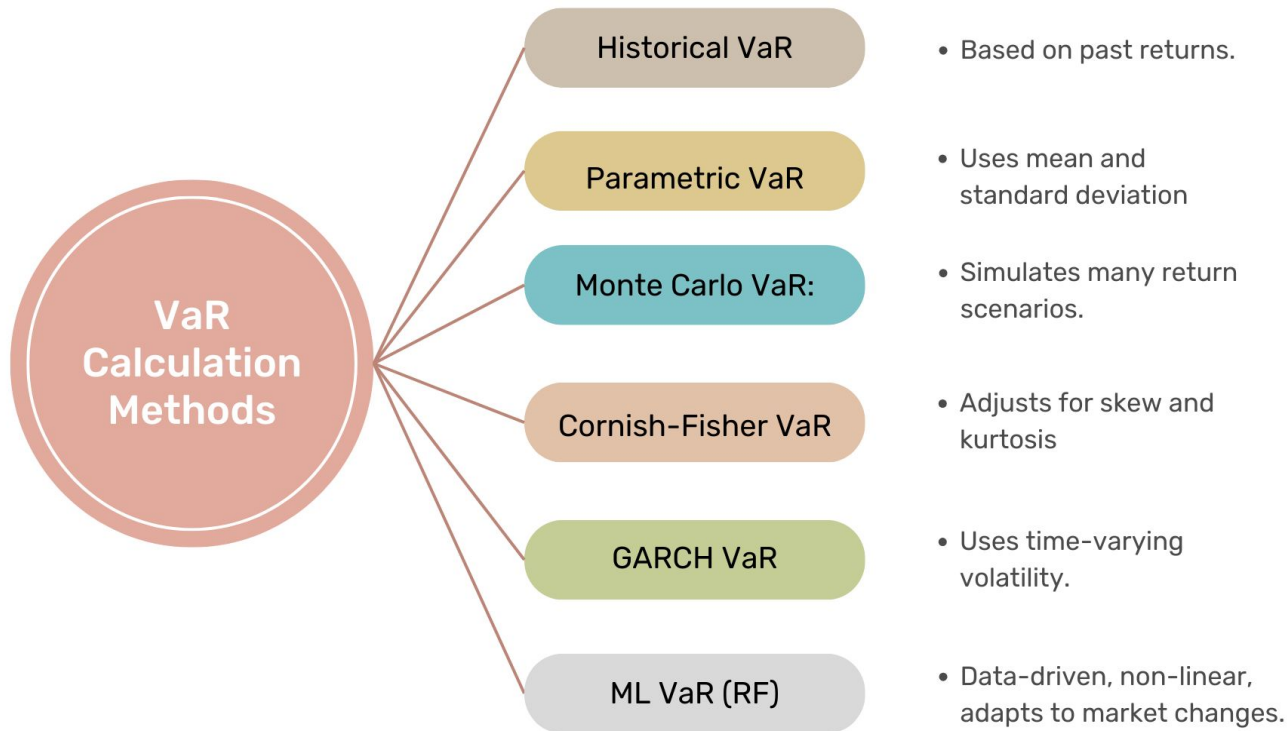
benchmark_profiles = {
    "BlackRock 60/40": {'IVV': 0.60, 'AGG': 0.30, 'IEFA': 0.10},
    "Vanguard VSMGX": {'VTI': 0.42, 'VXUS': 0.18, 'BND': 0.30, 'VWO': 0.10}
}
```

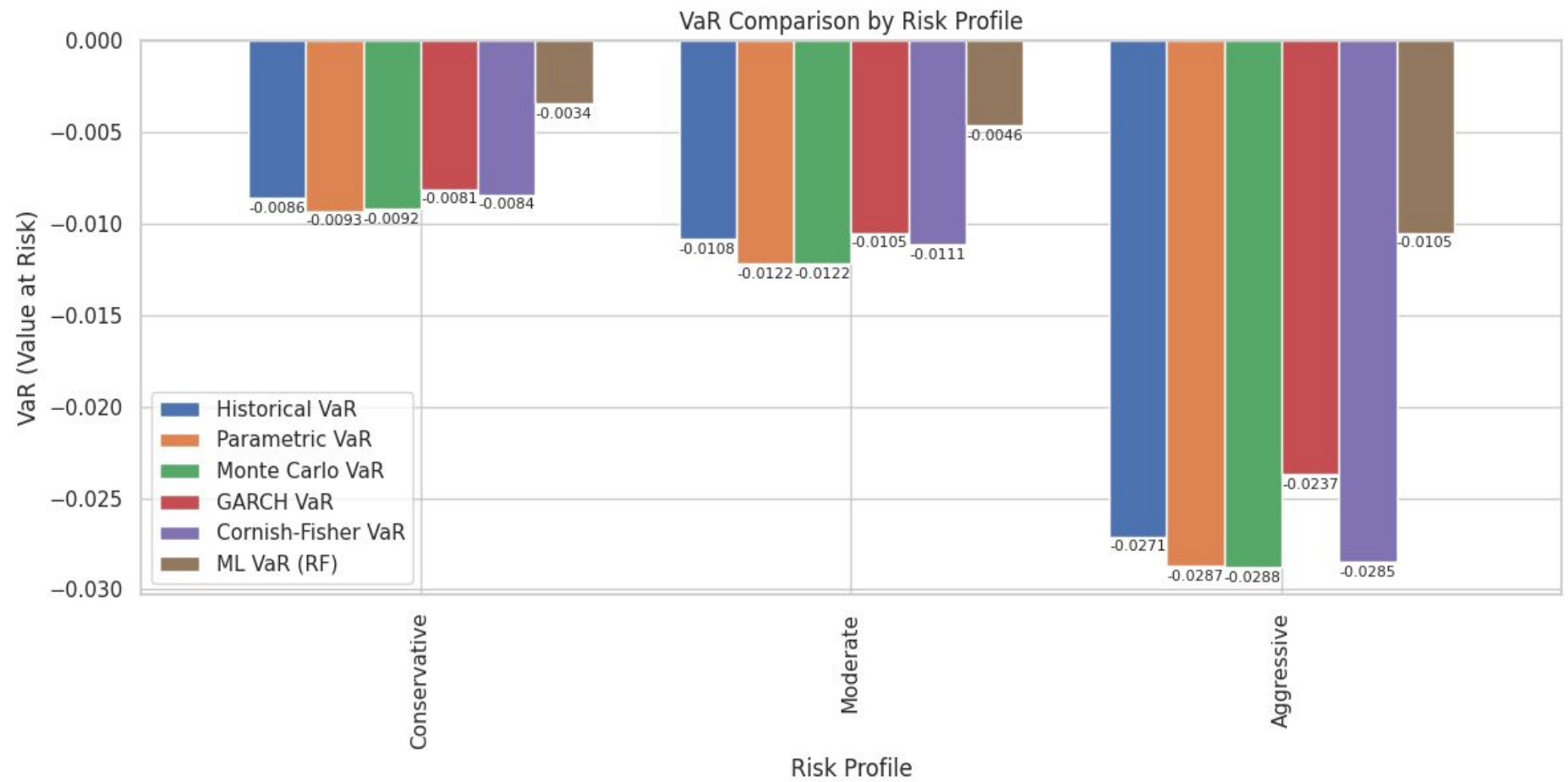


Asset Allocations: Behavioral & Benchmark Portfolios



VaR Methods - Traditional & Enhanced

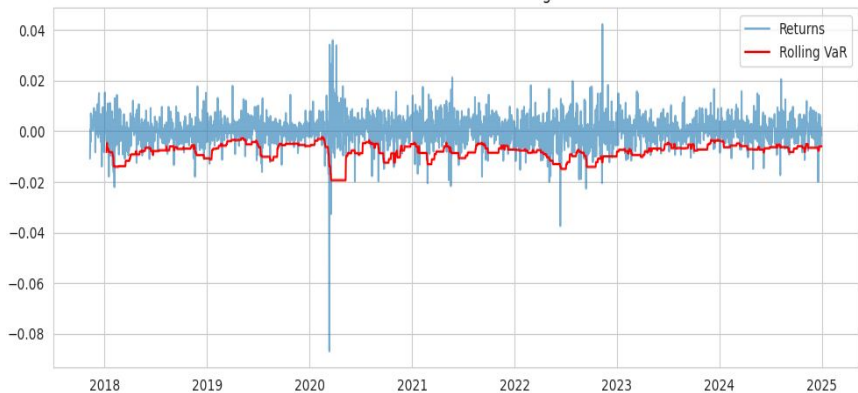




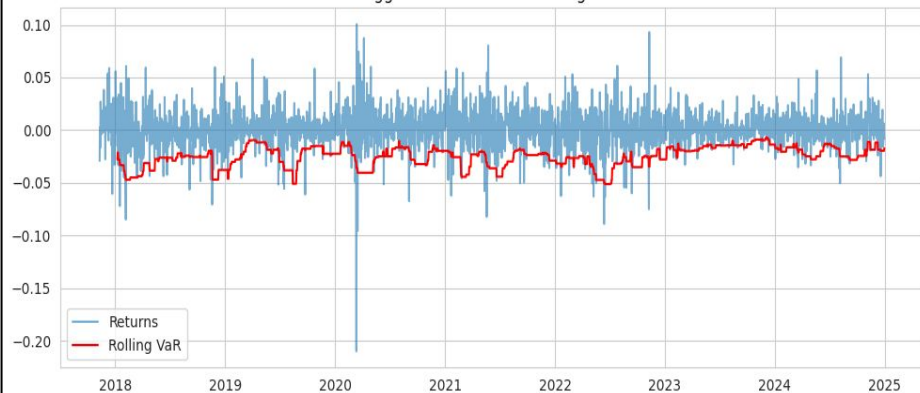


Rolling VaR across the Behavioral Portfolios

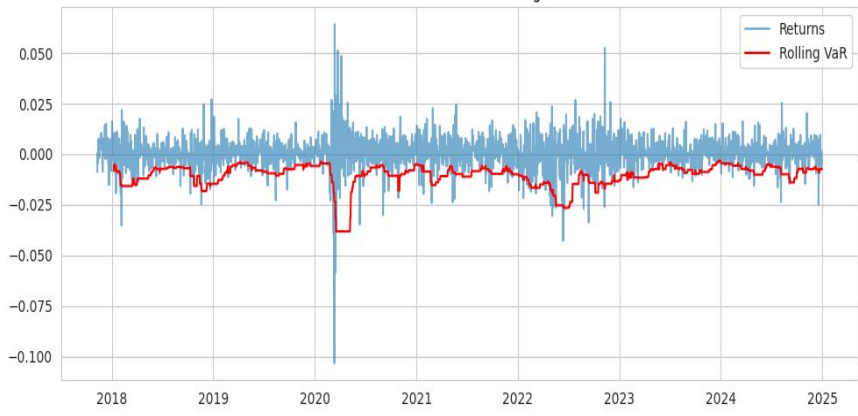
Conservative Portfolio - Rolling VaR



Aggressive Portfolio - Rolling VaR



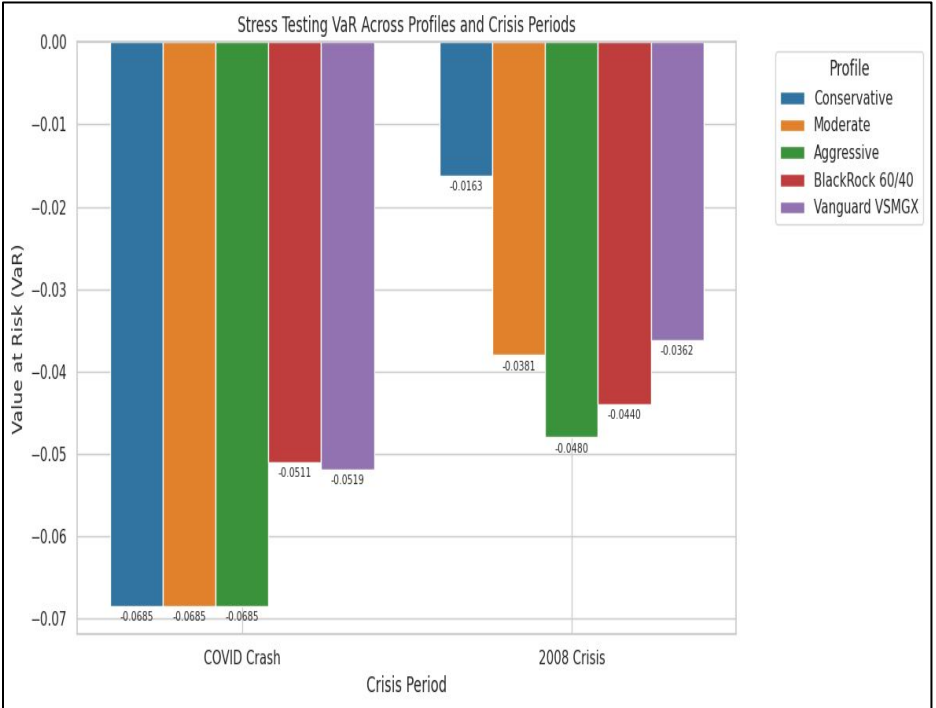
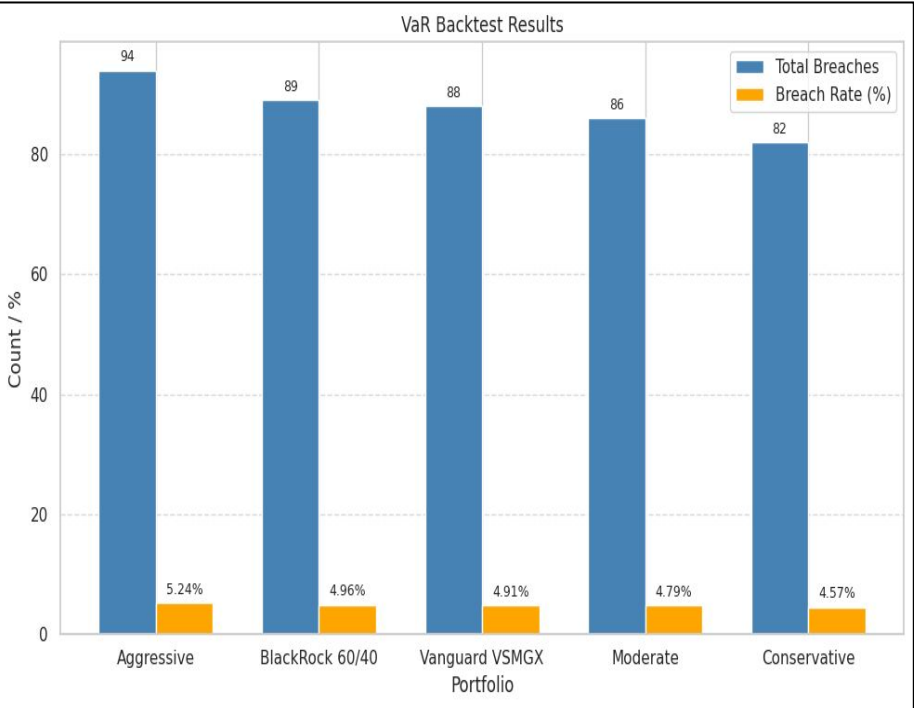
Moderate Portfolio - Rolling VaR



Cumulative Return Comparison by Risk Profile (2015-2024)



Backtesting & Stress Testing

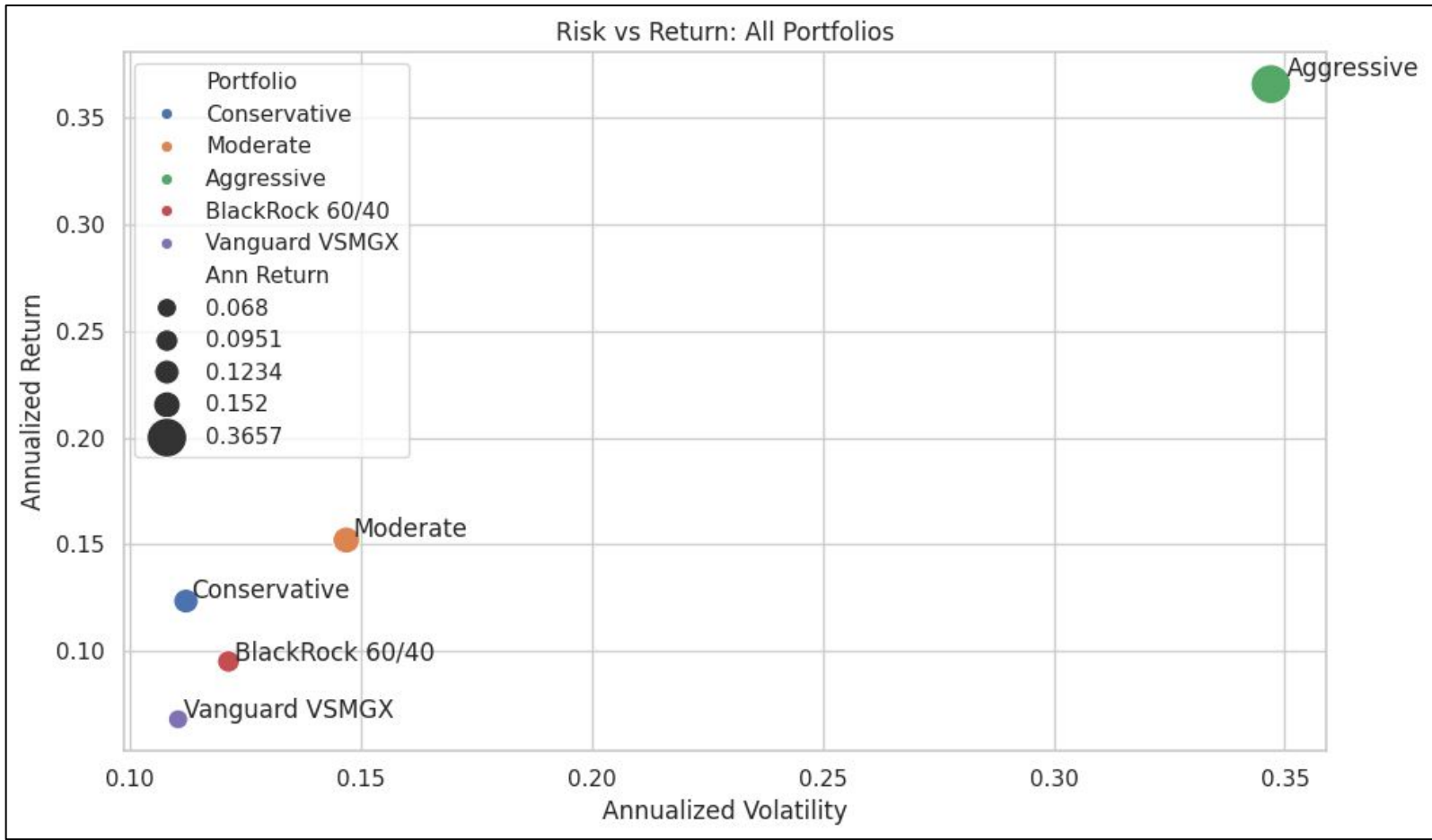


Portfolio Risk & Performance Summary

- **Aggressive:** Highest return (36.6%) but also highest risk and breach rate.
- **Conservative:** Lowest risk with stable return (12.4%) and lowest breaches.
- **Moderate:** Best balance of return and risk.
- **VaR Methods:** Consistent across models — reliable results.
- **Backtesting:** Breach rates ~5% → models are well-calibrated.
- **Expected Shortfall:** Always higher than VaR — correct tail-risk capture.

	Ann Return	Ann Vol	VaR 95%	Param VaR	MC VaR	CF VaR	ML VaR	GARCH VaR	ES	Breaches	Breach Rate	Sharpe Ratio
Portfolio												
Conservative	0.1234	0.1122	0.0101	0.0111	0.0112	0.0110	0.0039	0.0103	0.0159	82	0.0457	1.0997
Moderate	0.1520	0.1469	0.0136	0.0146	0.0146	0.0145	0.0054	0.0132	0.0218	85	0.0474	1.0346
Aggressive	0.3657	0.3470	0.0320	0.0345	0.0344	0.0353	0.0129	0.0294	0.0511	94	0.0524	1.0541
BlackRock 60/40	0.0951	0.1214	0.0111	0.0122	0.0122	0.0114	0.0034	0.0112	0.0184	87	0.0485	0.7834
Vanguard VSMGX	0.0680	0.1105	0.0100	0.0112	0.0111	0.0108	0.0032	0.0093	0.0165	85	0.0474	0.6158

Risk vs Return: Behavioral vs Benchmark



Thank you

