MODELLING FINANCIAL RISKS WITH R : *SUPERFUND SILVER (1068.N)*

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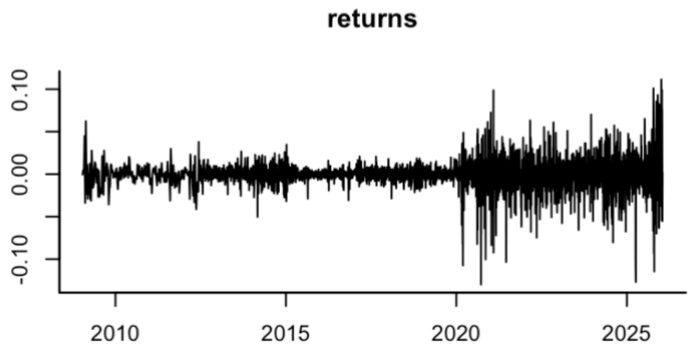
AGENDA

1. INTRODUCTION TO INVESTIGATED ASSET
2. HISTORICAL PRICES
3. RETURN DISTRIBUTIONS
4. VOLATILITY MODELS
5. FIT COMPARISON
6. VaR & ES
7. BACKTESTING AND EXEEDANCE PLOTS
8. CONCLUSION

ASSET INFORMATIONS

- Asset: Superfund Silver (1068.N)
- Data : daily prices → log returns, last 5 years
- Fees :
  - Entry fee: 4.0%
  - Management + running + transaction costs : 9.6%
  - Exit fee is 0% unless you redeem in first 12 month after the investment



HISTORICAL PRICES

Two callouts of the chart:

-Biggest fall: -12.7% of log-returns on 2025-04-07

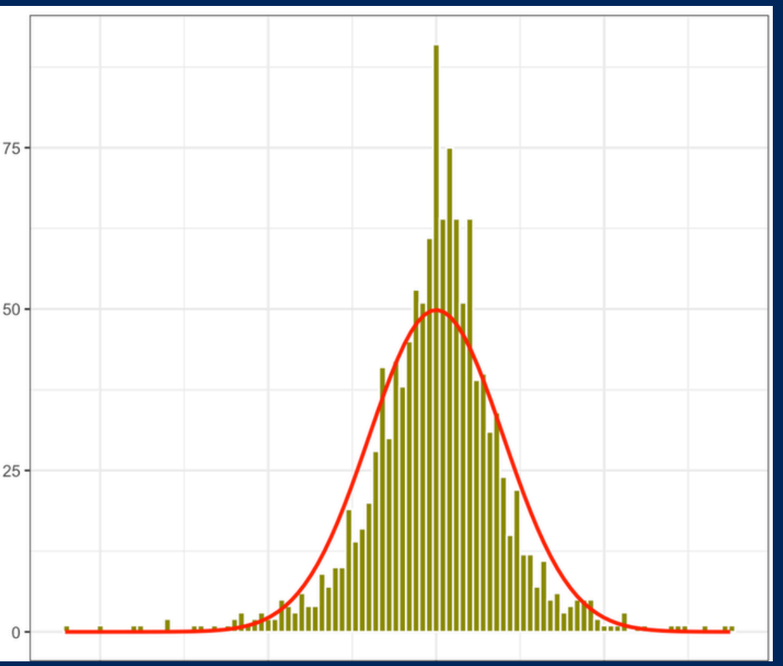
+ reason: US-China trade escalation

-Biggest rise: +10.11% of log-returns on 2025-10-13

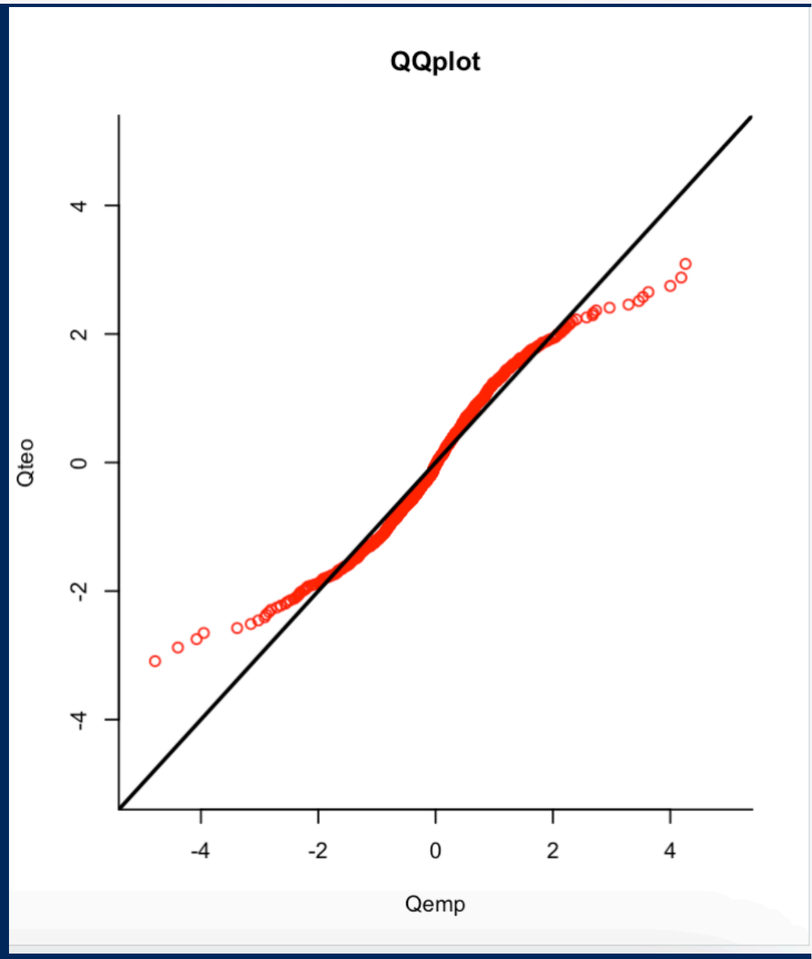
+ reason: silver rally (supply deficit + investment/ industrial demand)

RETURN PROPERTIES

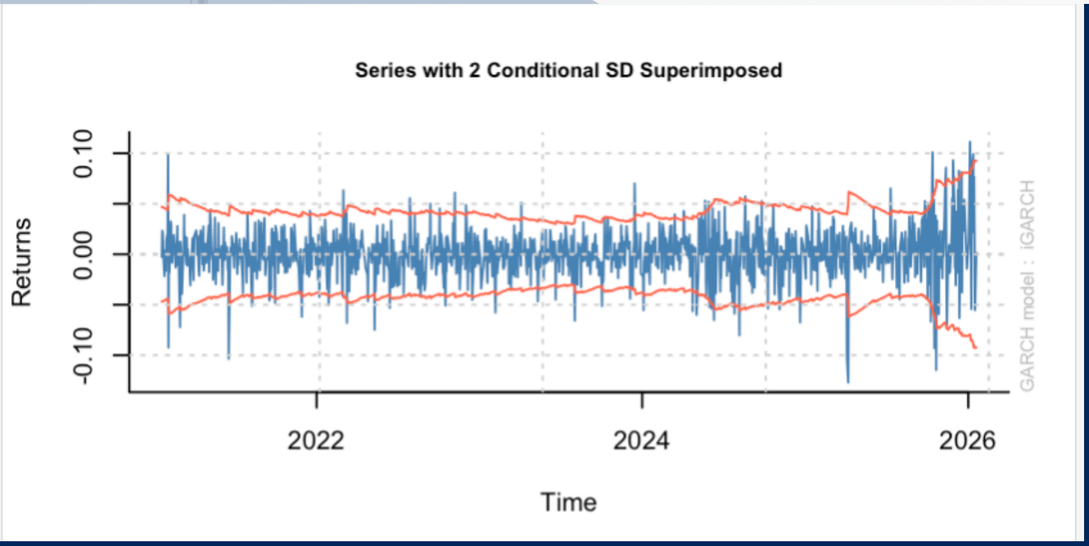
Mean annualised log return = 13.04%
Annualised sd ≈ 37.1% – very high volatility asset
Skewness ≈ –0.18 - slightly left skewed
Kurtosis ≈ 6.66 (very fat tails)



Historical data can hardly be fitter in normal distribution: too many observations are concentrated near the mean (high kurtosis proves this observation).

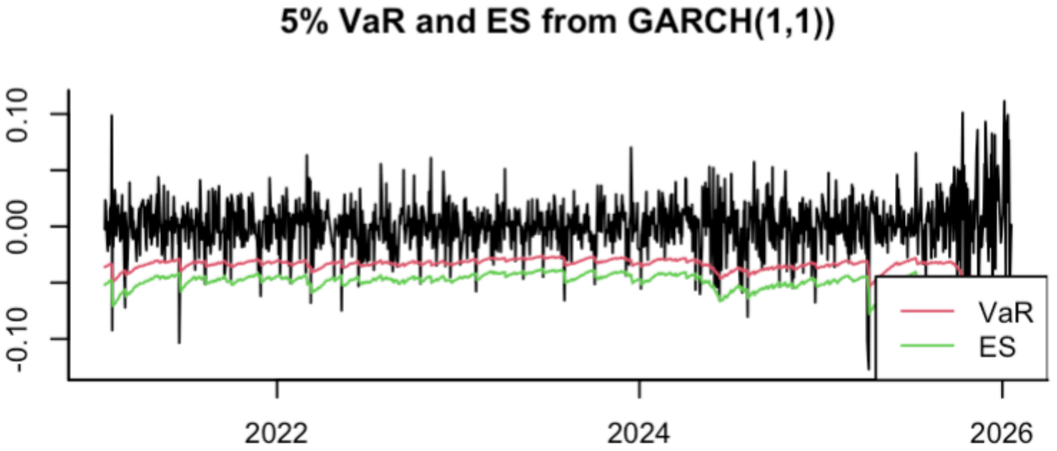


VOLATILITY CLUSTERING: IGARCH VS GARCH (1,1)



- **Very high persistence** : about 97.8% of today's variance come from yesterday's variance ($\lambda=\beta1=0.978$, with $\alpha1=0.022$)
- **Slow decay of shocks** : volatility remains elevated for many days after a big move (volatility clustering)
- ES is much more negative than VaR (-10,24% vs -7,14%) → **consistent with fat tail (ν =5)**

- $\mu=0.00053$: small positive average daily return
- $\alpha1=0.03146$ is the news impact
- $\beta1=0.95393$: volatility is highly persistent (clustering)
- $\nu = 5$: fat tails → more extreme moves than Normal
- $\alpha1 + \beta1 < 1$ → covariance-stationary and has a finite long-run variance.
- Long-run stardard deviation ≈ 0.0262

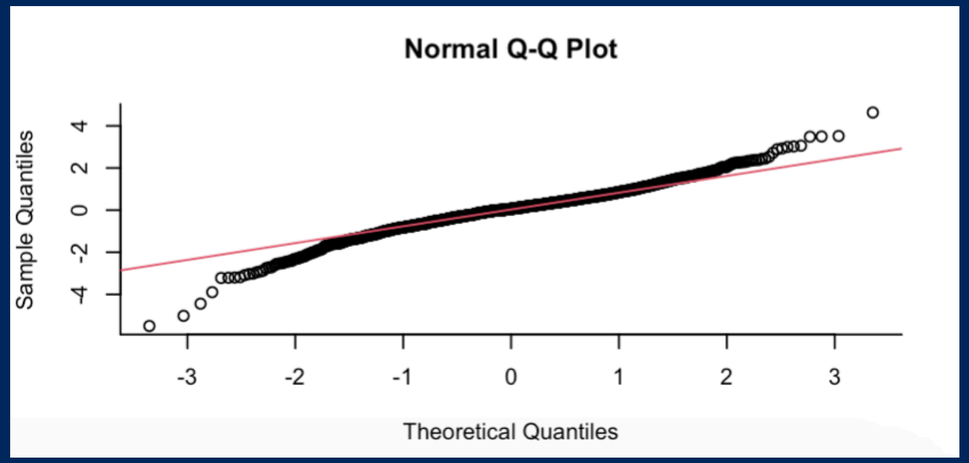


FIT COMPARISON

sGARCH with Normal vs Student-t

Criterion	**Student-t**	**Normal**	Better if..	**Winner**
LogLik / n	2.43	2.38	higher	t
AIC	-4.85	-4.76	lower	t
BIC	-4.83	-4.74	lower	t

- T explains observed returns better
- AIC/BIC → after penalizing complexity, t is still preferred



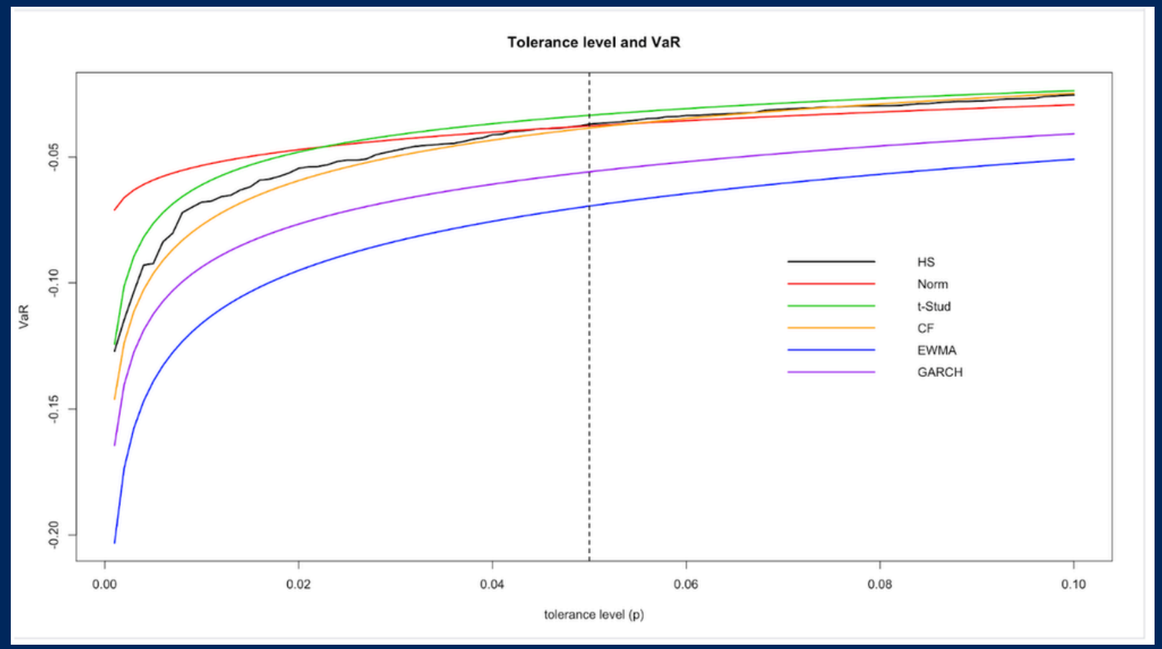
-Normal Q-Q plot shows strong tail deviation → strong tails → T innovation fit better

VAR & ES

VaR and ES values for 5 years-period horizon at 5% tolerance level

	HS	Norm	T-st	CF	EWMA	GARCH
VaR	-3.7	-3.76	-3.34	-3.85	-7.14	-6.88
ES	-5.69	-4.73	-5.2	-4.45	-10.24	-9.89

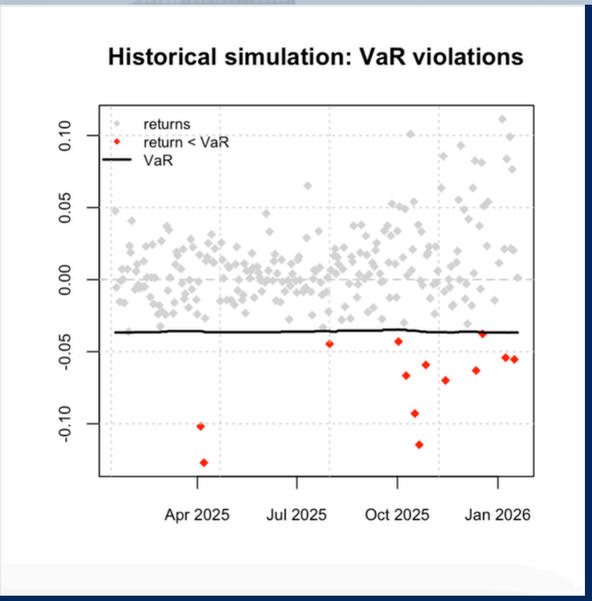
Plot VaR against tolerance level (from 0.1 to 10%)



BACKTESTING

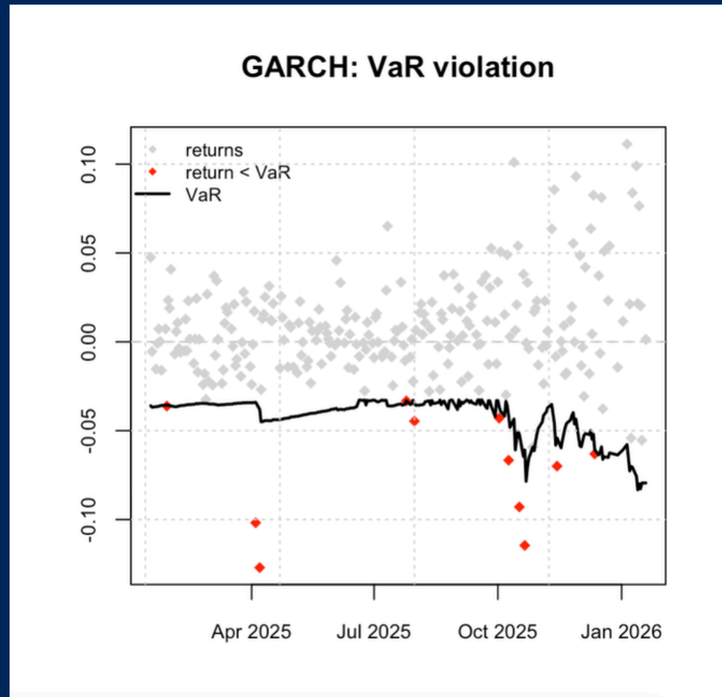
	Kupiec	Christ. 1	Chist. 2	Ch-p
Historical Simulation	✓	✓	✓	✓
Normal Distribution	✓	✓	✓	✓
t-Stud. Distribution	✓	✓	✓	✓
EWMA norm.	✓	✗	✓	✓
EWMA t-Stud.	✓	✗	✓	✓
GARCH norm.	✓	✓	✓	✓
GARCH t-Stud.	✓	✗	✓	✓

EXEEDANCE PLOTS : GARCH VS HS



- Produces an approximately correct number of violations, but exceedances are clustered during periods of increased volatility → the model reacts slowly to changing market conditions and tends to underestimate risk during stress episodes.

- GARCH adjust VaR downward when volatility rise, and most violations cluster in high-volatility period around late 2025



CONCLUSION

- **Superfund Silver returns** are high-risk: high annualized volatility and clear periods of volatility clustering.
- **Returns** are non-normal: QQ-plot and high kurtosis indicate fat tails, so Normal assumptions can underestimate tail risk.
- **IGARCH** shows very persistent volatility: $\lambda \approx 0.978 \rightarrow$ shocks decay slowly, risk stays elevated after big moves.
- **Standard GARCH(1,1)** is persistent but mean-reverting: $\alpha+\beta<1$, so long-run volatility exists (≈ 2.6% daily in our estimates).
- **Fit comparison** favors Student-t: sGARCH-t has higher LL/n and lower AIC/BIC than sGARCH-Normal → heavy tails are statistically supported.
- Risk measures: ES is always more conservative than VaR; methods with time-varying volatility (EWMA/GARCH) respond better during stress periods.
- **Backtesting** takeaway: prefer the model(s) that pass coverage and independence (Ch1/Ch2/Ch-P) and give stable exceedance behavior—typically GARCH with Student-t performs best.


THANK YOU