Project: CAPM Beta & Fama–French Factor Models

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Objective

Estimate a stock's market beta under CAPM and extend to Fama–French three-factor loadings (market, size, value) using synthetic daily returns and factors.

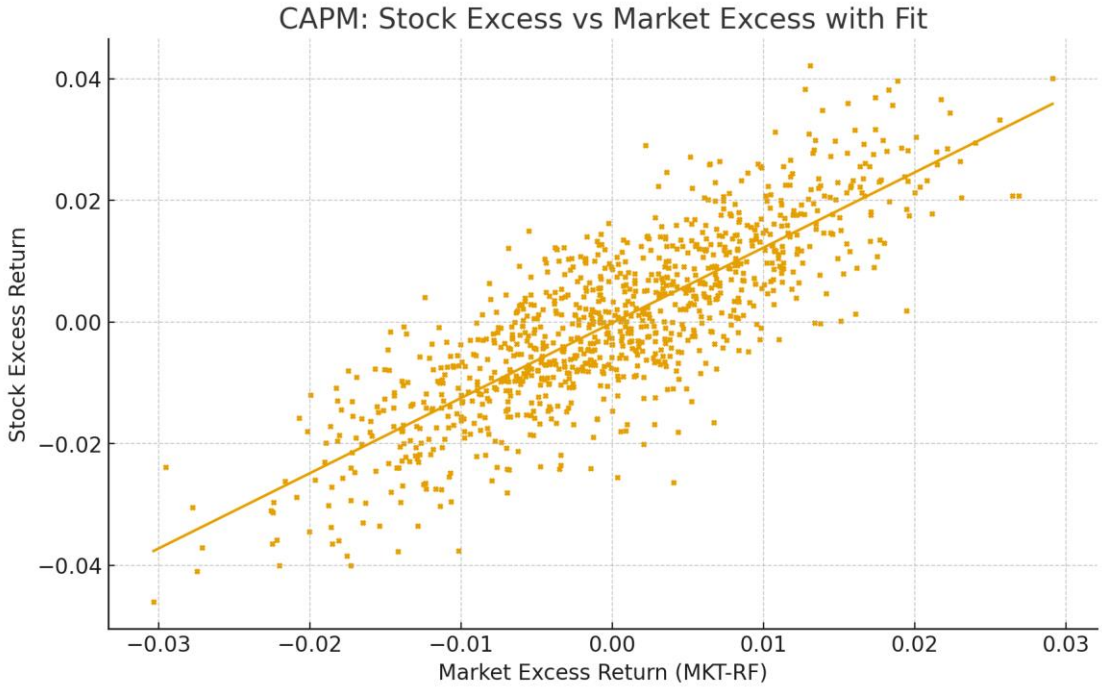
Methodology

• Construct synthetic daily series for market excess return (MKT–RF) and factors (SMB, HML), plus RF.
• Generate a synthetic stock's excess return with known true loadings and random noise.
• Run linear regressions: CAPM (STOCK_excess ~ MKT–RF) and FF3 (STOCK_excess ~ MKT–RF + SMB + HML).
• Evaluate fit quality via R^2 and inspect residual behavior.

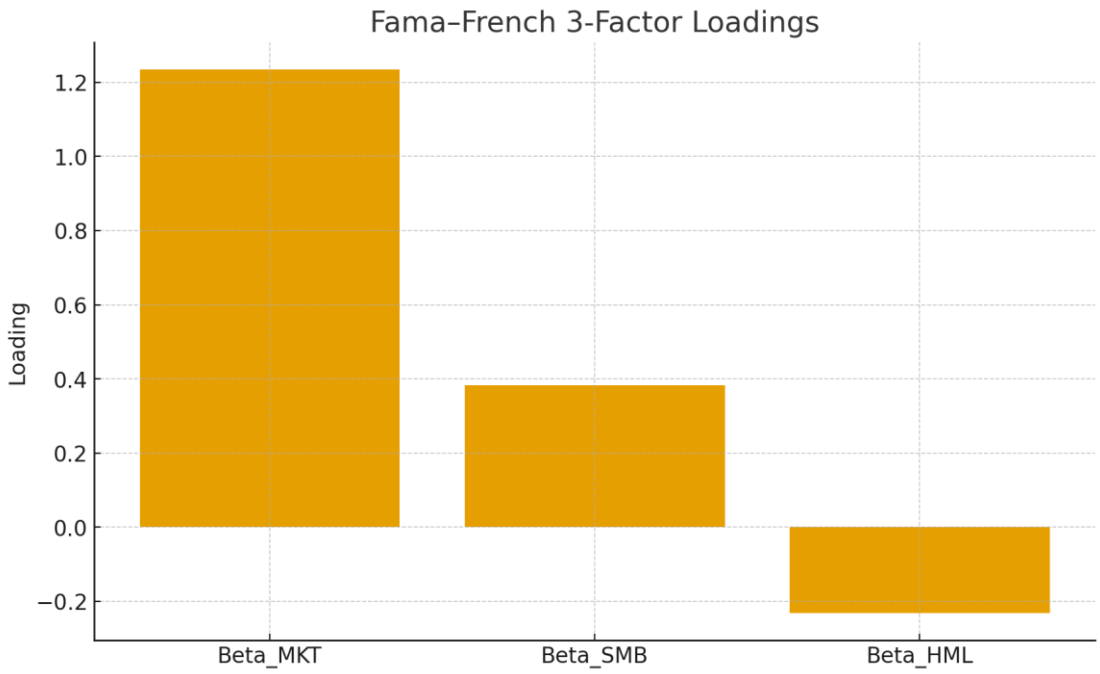
Results

CAPM fit: alpha=-0.000130/day, beta=1.237, R^2=0.674.
FF3 fit: alpha=-0.000024/day, betas=[MKT 1.234, SMB 0.382, HML -0.232], R^2=0.709.

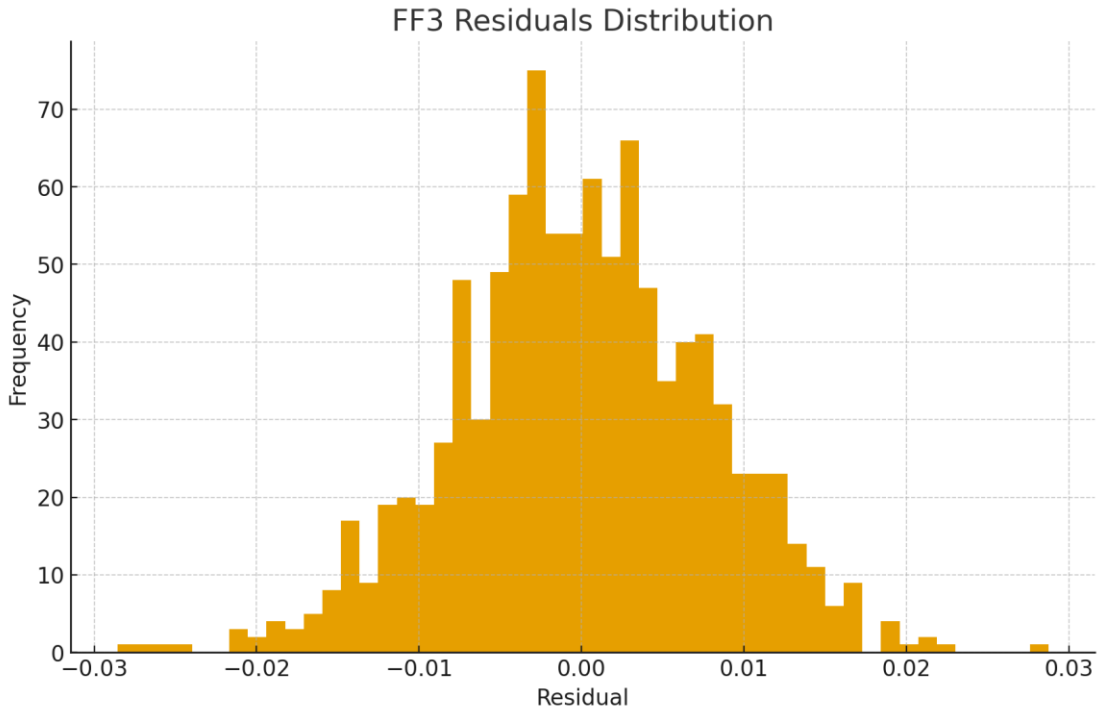
CAPM scatter with fitted regression line:



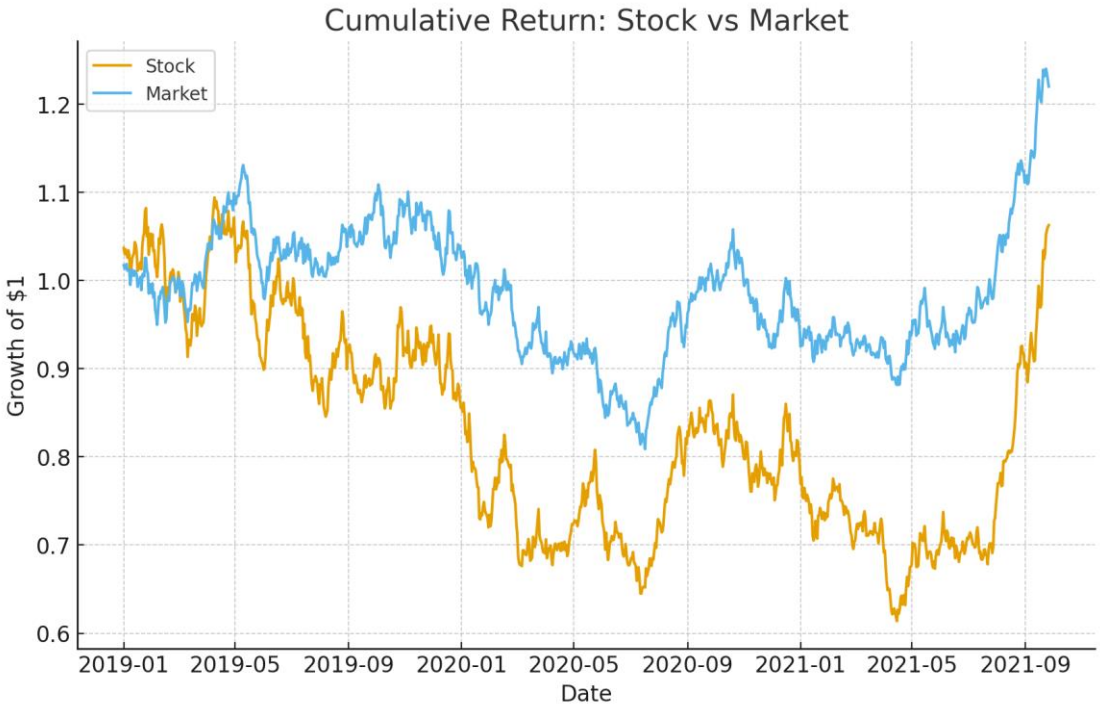
Fama–French factor loadings (betas):



Residual distribution of the FF3 regression:



Cumulative return of the stock vs market (growth of $1):



Discussion & Notes

The FF3 model typically explains more variation than CAPM alone, as reflected by higher R^2 here. Extensions: add momentum factor (UMD), run rolling regressions for time-varying betas, or test on real Fama–French data.