Fama-French Factor Model

Factor Definitions

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FAMA-FRENCH THREE-FACTOR MODEL (1993)

1. MKT (Market)
   - Market return minus risk-free rate
   - Rm - Rf
   - Captures broad market exposure

2. SMB (Small Minus Big)
   - Small cap return minus large cap return
   - Size effect: small stocks outperform
   - Based on market capitalization

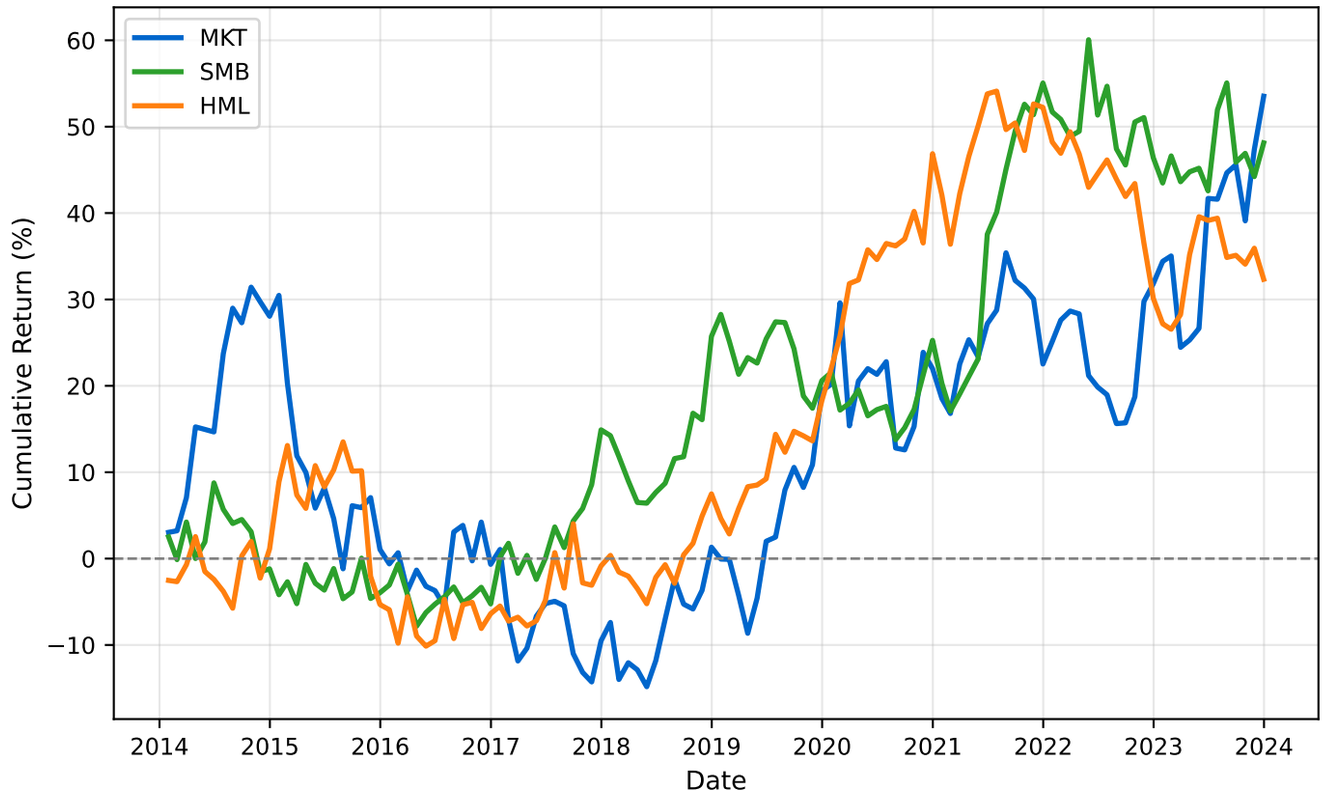
3. HML (High Minus Low)
   - Value stocks minus growth stocks
   - Value effect: high B/M outperform
   - Based on Book-to-Market ratio

FAMA-FRENCH FIVE-FACTOR MODEL (2015)

4. RMW (Robust Minus Weak)
   - Profitable firms minus unprofitable
   - Profitability effect

5. CMA (Conservative Minus Aggressive)
   - Low investment minus high investment
   - Investment effect
```

Cumulative Factor Returns (10 Years)



Factor Statistics

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FACTOR STATISTICS (Monthly)

Factor    Mean      Std       Sharpe (Ann.)
-----------------------------------------------
MKT         0.44%    4.15%    0.37
SMB         0.37%    3.02%    0.43
HML         0.28%    3.17%    0.31

CORRELATION MATRIX

          MKT     SMB     HML
MKT     1.00   0.10   -0.11
SMB     0.10   1.00   0.13
HML     -0.11   0.13   1.00

Key: Low correlations = good diversification
```

Python Implementation

```
Loading Fama-French Data with pandas

import pandas as pd
import numpy as np
from sklearn.linear_model import LinearRegression

# Load Fama-French factors (from Ken French website)
# Format: Date, Mkt-RF, SMB, HML, RF (in %)
ff_data = pd.read_csv('F-F_Research_Data_Factors.csv',
                      skiprows=3)
ff_data['Date'] = pd.to_datetime(ff_data['Date'],
                                 format='%Y%m')

# Load stock returns
stock_returns = pd.read_csv('stock_returns.csv')

# Merge and prepare for regression
merged = pd.merge(stock_returns, ff_data, on='Date')
merged['excess_return'] = merged['return'] - merged['RF']

# Fit FF3 model
X = merged[['Mkt-RF', 'SMB', 'HML']]
y = merged['excess_return']

model = LinearRegression()
model.fit(X, y)

print(f"Alpha: {model.intercept_:.4f}")
print(f"MKT beta: {model.coef_[0]:.3f}")
print(f"SMB beta: {model.coef_[1]:.3f}")
print(f"HML beta: {model.coef_[2]:.3f}")
```