Multi-Factor Models: Comprehensive Risk Decomposition

The Factor Zoo

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THE FACTOR ZOO

Academic Factors (Well-Established)
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Market (MKT)    : Equity premium
Size (SMB)      : Small cap premium
Value (HML)     : Value vs growth
Momentum (MOM)  : Winners keep winning
Profitability   : Profitable > unprofitable
Investment      : Conservative > aggressive
Quality         : Low debt, stable earnings

Industry Factors (Practitioner)
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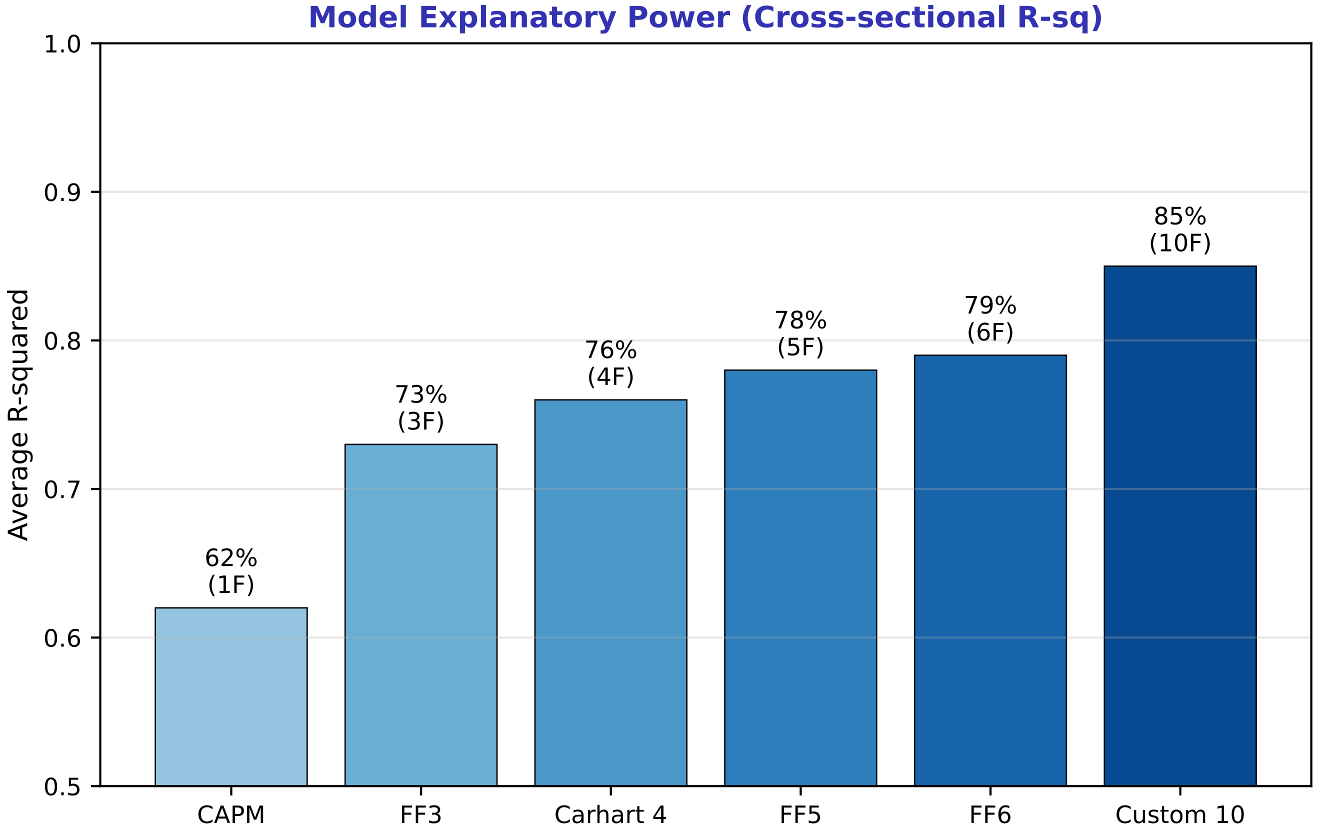
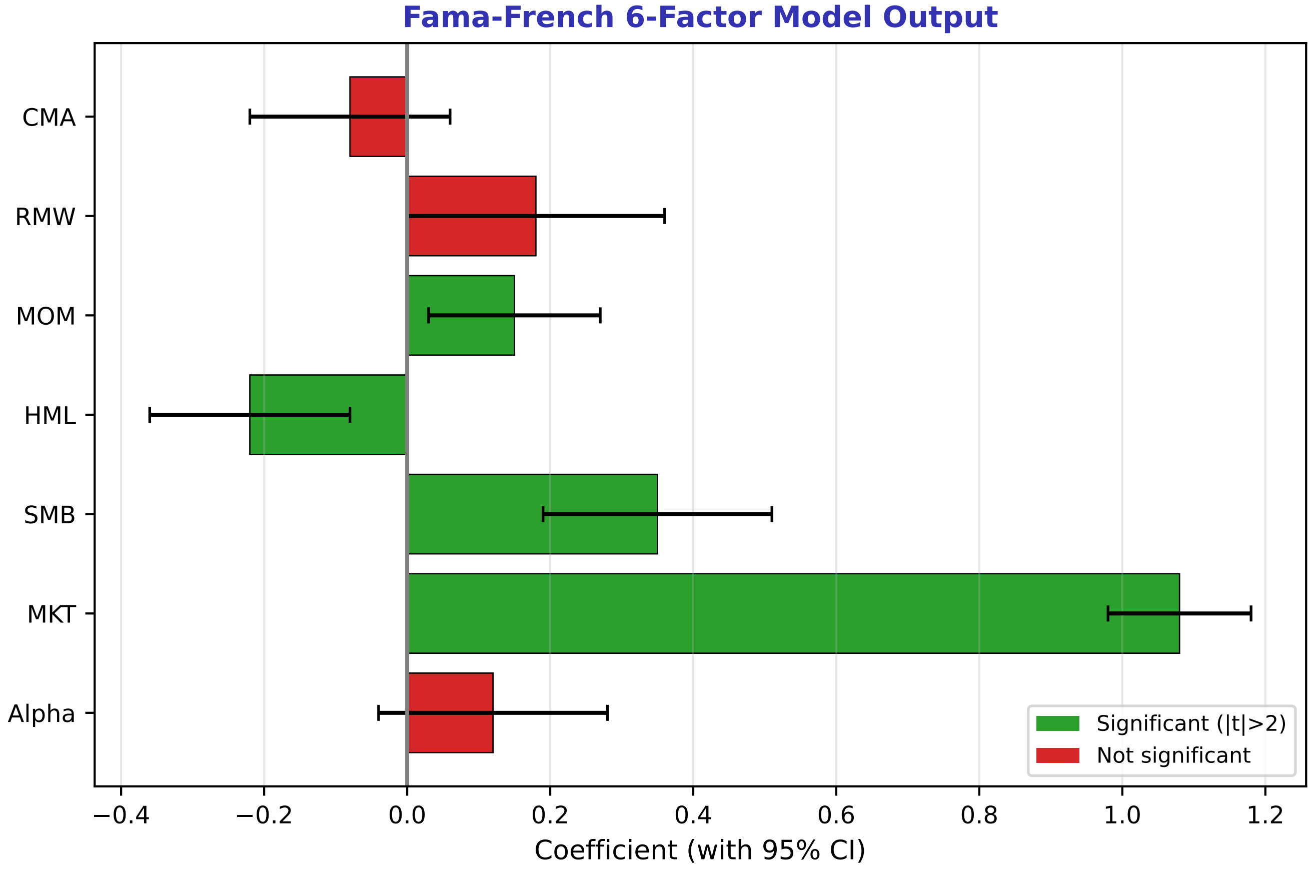
BAB             : Betting Against Beta
QMJ             : Quality Minus Junk
LIQ             : Liquidity risk premium
VOL             : Volatility factor
TERM            : Term structure
CREDIT          : Credit spread

THE PROBLEM: Factor proliferation
- 400+ published factors
- Many don't replicate
- Data mining concerns
- Use skeptically!
```



Model Explanatory Power (Cross-sectional R-sq)



Fama-French 6-Factor Model Output

Python Implementation

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Multi-Factor Model in sklearn

from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score
import statsmodels.api as sm

# Prepare factor data
factors = ['MKT', 'SMB', 'HML', 'MOM', 'RMW', 'CMA']
X = ff_data[factors]
y = stock_excess_returns

# Option 1: sklearn (simple)
model = LinearRegression()
model.fit(X, y)
print(f"Alpha: {model.intercept_:.4f}")
print(f"Betas: {dict(zip(factors, model.coef_))}")
print(f"R-squared: {r2_score(y, model.predict(X)):.4f}")

# Option 2: statsmodels (with t-stats)
X_sm = sm.add_constant(X)  # Add intercept
model_sm = sm.OLS(y, X_sm).fit()
print(model_sm.summary())

# Key outputs from statsmodels:
# - Coefficients with standard errors
# - t-statistics and p-values
# - R-squared and Adjusted R-squared
# - F-statistic for overall significance
```