Advanced Asset Pricing Models in Traditional and Digital Finance

Assignment: Fama-French 5-Factor Extensions and Behavioral Insights

September 25, 2025

1 Assignment Overview

This assignment focuses on the practical implementation and theoretical of Week's 3 material.

Due: Thursday 10-02-2025

2 Learning Objectives

Upon completion of this assignment, students will be able to:

- Identify and correct implementation errors in factor model specifications
- Design innovative factor constructions for emerging asset classes
- Apply behavioral finance theory to interpret factor model results
- Develop practical data analysis skills through experiential (i.e learning by doing) learning

3 Assignment Tasks

3.1 Task 1: Formula Correction and Code Implementation

Weight: 25%

Examine the Fama-French 5-factor model implementation in cells 4 and 4.1 of the provided notebook.

Requirements:

1. Identify any mathematical or computational errors in the current implementation
2. Provide corrected formulas with detailed explanations
3. Implement the corrections in Python code with proper commenting

4. Test the model on stocks, bonds, and/or indices as appropriate
5. Document your debugging process

3.2 Task 2: Cryptocurrency Factor Construction

Weight: 30%

Based on your understanding of client needs in the digital asset space, construct novel factors for cryptocurrency markets that extend the traditional Fama-French framework.

Requirements:

1. Design at least 3 cryptocurrency-specific factors (e.g., volatility, liquidity, network effects, regulatory sentiment)
2. Provide mathematical specifications for each factor:

$$\text{CryptoFactor}_t = f(\text{market variables}, \text{network metrics}, \text{sentiment data}) \quad (1)$$

3. Implement factor construction in Python with proper data handling
4. Provide detailed rationale for each factor based on:
   - Behavioral finance theory
   - Market microstructure considerations
   - DeFi-specific risk characteristics
   - Client portfolio optimization needs
5. Test factor validity through basic statistical analysis

Suggested Factor Categories:

- Network-based factors (hash rate, active addresses, transaction volume)
- Sentiment factors (social media, regulatory announcements)
- DeFi-specific factors (Total Value Locked, yield spreads, impermanent loss metrics)
- Cross-asset factors (correlation with traditional assets)

3.3 Task 3: Behavioral Finance Analysis of Jensen's Alpha

Weight: 25%

Analyze the managerial skill coefficient (Jensen's alpha) from a behavioral finance perspective, incorporating insights from your factor model results.

Requirements:

1. Define Jensen's alpha in the context of your extended factor model:

$$\alpha_i = E[R_{i,t} - R_{f,t}] - \sum_{k=1}^{n} \beta_{i,k} E[F_{k,t}] \quad (2)$$

2. Discuss behavioral biases that may affect alpha interpretation:

- Overconfidence bias in manager selection
- Attribution errors in performance evaluation
- Survivorship bias in fund analysis
- Herding behavior in factor exposure

3. Analyze how behavioral factors might manifest differently in:
   - Traditional equity markets
   - Fixed income markets
   - Cryptocurrency markets
4. Provide practical implications for:
   - Portfolio construction
   - Risk management
   - Client communication

3.4 Task 4: Professional Development Insights

Weight: 20%

Based on your experience working through this project, provide actionable advice for entry-level financial data analysts, particularly focusing on lessons learned from challenges and failures encountered.

Requirements:

1. Identify 5-7 key insights about working with financial data
2. For each insight, provide:
   - Specific example from your project experience
   - Why this issue caused problems or delays
   - Practical solution or prevention strategy
   - Tools or techniques that help address the issue
3. Focus areas should include (but not limited to):
   - Data quality and validation procedures
   - Version control and reproducibility
   - Error handling and debugging strategies
   - Performance optimization techniques
   - Documentation and code organization
   - Client communication and expectation management
4. Present insights in a format suitable for a junior analyst handbook

4 Submission Requirements

4.1 Technical Deliverables

- Jupyter notebook with corrected implementations and new factor constructions
- Python modules with well-commented functions for factor calculation
- Data validation and testing scripts
- Performance benchmarking results

4.2 Written Analysis

- Executive summary (1-2 pages)
- Technical appendix with mathematical derivations (if any)

4.3 Presentation

- 10-minute presentation covering key findings
- Focus on practical applications and client value proposition
- Include results of corrected model implementation

5 Evaluation Criteria

Criterion	Weight	Description
Technical Accuracy	30%	Correctness of formulas and implementations
Innovation	25%	Creativity and validity of new factor constructions
Theoretical Understanding	20%	Application of behavioral finance concepts
Professional Skills	15%	Quality of insights and practical advice
Communication	10%	Clarity of presentation and documentation

6 Resources and References

- Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. *Journal of Financial Economics*, 116(1), 1-22.
- Liu, W., & Tsyvinski, A. (2021). Risks and returns of cryptocurrency. *The Review of Financial Studies*, 34(6), 2689-2727.