RUTGERS UNIVERSITY

School of Business - Camden

FINANCIAL DATA ANALYTICS

53:390:581 Online

Fall 2025

Tuesday to Monday Format

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Office Hours: By Appointment

Key Fall 2025 Dates:

- Classes begin: **Tuesday, September 2, 2025**
- Last day to withdraw with "W": **Monday, November 10, 2025**
- Classes end: **Wednesday, December 10, 2025**
- Reading Days: Thursday-Friday, December 11-12, 2025
- Final exam period: **Monday, December 15 - Saturday, December 20, 2025**

1 Course Description

This advanced graduate course in Financial Data Analytics equips students with cutting-edge quantitative skills for modern finance. Using R as our primary tool, students will master the complete workflow of financial data analysis: from data acquisition and cleaning to sophisticated portfolio optimization and algorithmic trading strategies. The course emphasizes practical application, with students building a professional-grade quantitative trading platform throughout the semester. Topics include market microstructure, risk analytics, factor modeling, portfolio optimization, alternative data, machine learning applications, and Monte Carlo simulations. By course completion, students will possess the technical skills demanded by quantitative funds, investment banks, and fintech firms.

2 Course Learning Objectives

Upon successful completion of this course, students will be able to:

1. **Data Acquisition & Management:** Extract, clean, and manage financial data from multiple sources using R APIs and web scraping techniques.
2. **Statistical Analysis:** Apply advanced statistical methods to analyze price patterns, return distributions, and market anomalies.
3. **Risk Modeling:** Implement comprehensive risk metrics including VaR, CVaR, and stress testing frameworks.
4. **Portfolio Theory:** Construct optimal portfolios using Markowitz optimization and modern factor models.
5. **Algorithmic Strategies:** Design, backtest, and evaluate quantitative trading strategies with proper performance attribution.
6. **Machine Learning:** Apply machine learning techniques to financial prediction and alternative data analysis.
7. **Monte Carlo Methods:** Develop simulation models for portfolio analysis and risk assessment.
8. **Professional Communication:** Present complex quantitative findings through professional visualizations and reports.

3 Prerequisites and Technical Requirements

3.1 Prerequisites

- Basic statistics and probability theory
- Foundational finance knowledge (time value of money, basic portfolio concepts)
- No prior R experience required (but helpful)

3.2 Technical Requirements

- **R and RStudio:** Latest versions (free download from r-project.org)
- **Computer:** Minimum 8GB RAM recommended for data processing
- **Internet:** Reliable connection for data downloads and API calls

4 Course Materials

4.1 Required Resources

- **Primary Text:** Course materials provided via Canvas (no textbook purchase required)
- **R Packages:** List provided in Module 1 (all free/open-source)
- **Data Sources:** Yahoo Finance, FRED, and other free APIs

4.2 Recommended Resources

- Ruppert, D. & Matteson, D. (2015). *Statistics and Data Analysis for Financial Engineering*
- Würtz, D. et al. (2009). *Portfolio Optimization with R/Rmetrics*
- **Online:** R-bloggers, QuantStart, Stack Overflow
- **Financial Press:** WSJ, Financial Times (student subscriptions available)

5 Grading Structure

Grade Distribution

Weekly Quizzes (14 total)	40%
Bi-Weekly Projects (7 total)	45%
Final Exam	15%
Total	**100%**

5.1 Weekly Quizzes (40%)

- Short assessments on readings and lecture content
- Focus on conceptual understanding and R syntax
- Open-book format but time-limited
- **No AI assistance permitted on quizzes**

5.2 Bi-Weekly Projects (45%): Personal Quant Trading Desk

You will build a comprehensive quantitative trading platform in R throughout the semester. Each project adds sophisticated functionality, culminating in a professional-grade analytical system.

Project Requirements:

- Submit R script/markdown file with clear documentation
- Post 2-3 professional visualizations to discussion board
- Include 150-word original analysis (no AI for this portion)
- Peer review: Provide feedback on 2 classmates' projects
- Maintain all code in single RStudio project
- AI strongly encouraged for debugging and code optimization

5.3 Final Exam (15%)

- Comprehensive assessment covering all modules
- Mix of conceptual questions and code interpretation
- No live coding required

6 Personal Quant Trading Desk - Project Progression - tentative and subject to change

Module 1: Foundation
Project: "Trading Desk Infrastructure"
Set up RStudio project structure with organized folders. Build data connection functions for Yahoo Finance and FRED. Create R Markdown template and "firm" branding.
Deliverables: Working data pull for 10 stocks + 150-word investment philosophy

Module 3: Market Data Analytics
Project: "Professional Price Analysis System"
Build price data collection and cleaning pipeline. Create institutional visualizations (candlesticks, Bollinger Bands). Implement technical indicators library (RSI, MACD).
Deliverables: Multi-panel price dashboard + technical signal interpretation

Module 5: Returns Intelligence
Project: "Returns Analytics Engine"
Develop returns calculation suite (simple, log, excess). Build portfolio returns aggregator. Create sector comparison tools with rolling window analysis.
Deliverables: Returns decomposition chart + sector rotation analysis

Module 7: Risk Management
Project: "Institutional Risk Dashboard"
Calculate portfolio VaR, CVaR, and stress tests. Build correlation matrix visualizer. Implement downside risk metrics and attribution.
Deliverables: Risk heatmap dashboard + risk report narrative

Module 9: Factor Analytics
Project: "Multi-Factor Performance Lab"
Implement Fama-French three-factor model. Build alpha/beta analyzer. Calculate Sharpe, Sortino ratios. Create performance attribution system.
Deliverables: Factor exposure charts + risk-adjusted performance report

Module 11: Modern Applications
Project: "Algorithmic Trading Suite"
Build momentum and mean reversion strategies. Implement pairs trading. Create comprehensive backtesting framework with performance metrics.
Deliverables: Strategy comparison dashboard + backtest results analysis

Module 13: Integration & Innovation
Project: "Complete Quant Platform with Monte Carlo"
Integrate alternative data sources. Add ML predictions (simple models). Build Monte Carlo simulation engine. Generate professional "Investment Committee Deck."
Deliverables: 10,000-path simulation visualization + executive presentation combining all modules

7 Course Schedule and Topics

FOUNDATION MODULES (1-2)

- Module 1: Basic Introduction to R
- Module 2: Introduction to R for Finance

DATA & MARKETS (3-6)

- Module 3: Price Analytics & Market Microstructure
- Module 4: Returns Analysis
- Module 5: Portfolio Returns
- Module 6: Advanced Return Analytics

RISK & PERFORMANCE (7-10)

- Module 7: Comprehensive Risk Analytics
- Module 8: Factor Models
- Module 9: Risk-Adjusted Performance
- Module 10: Portfolio Optimization

MODERN APPLICATIONS (11-14)

- Module 11: Alternative Data & Machine Learning
- Module 12: Algorithmic Trading Strategies
- Module 13: Monte Carlo & Modern Applications
- Module 14: Capstone Integration

Module 15: Final Exam

8 Grading Scale

90-100%	A
85-89%	B+
80-84%	B
75-79%	C+
70-74%	C
Below 70%	F

9 Artificial Intelligence Use Policy

9.1 Strongly Encouraged For:

- Debugging R code and resolving errors
- Understanding complex statistical concepts
- Optimizing code performance
- Learning new R packages and functions
- Generating boilerplate code structures

- Creating data visualizations

9.2 Strictly Prohibited For:

- Weekly quizzes
- Final exam
- The 150-word analysis portion of project posts
- Peer review comments

9.3 Best Practices for AI Use:

- Always verify AI-generated code before submission
- Understand what the code does—you must be able to explain it
- Document when AI assistance was used in your projects
- Use AI as a learning tool, not a replacement for understanding

Recommended AI Tools: GitHub Copilot, ChatGPT, Claude, Google Gemini

10 Course Policies

10.1 Communication and Canvas

Email: Use only your Rutgers email address. Include "FDA" in subject line.
Canvas: Access at canvas.rutgers.edu
Discussion Board: Primary venue for technical questions—help your peers!
Response Time: 24-48 hours on weekdays

10.2 Submission Guidelines

- **File Naming:** LastName_FirstName_Module#_Project.R
- **Code Style:** Use consistent indentation and comment your code
- **Reproducibility:** Ensure all code runs without errors on a fresh R session
- **Late Work:** 10% penalty per day, up to 3 days maximum

10.3 Technical Support

- **R/RStudio Issues:** Post on Canvas discussion board first
- **Canvas Support:** 833-648-4357 or help@camden.rutgers.edu
- **Office Hours:** Best for conceptual questions and project guidance

11 Academic Integrity

Code Collaboration Policy:
- You may discuss concepts and approaches with classmates
- You must write your own code independently
- Copying code (from peers or online) is academic dishonesty
- Always cite external sources (Stack Overflow, tutorials, etc.)
- AI-generated code must be understood and documented

The complete Academic Integrity policy: studentconduct.rutgers.edu

12 Resources for Success

12.1 R Learning Resources

- **DataCamp:** Free access through Rutgers Library
- **Coursera:** "R Programming" by Johns Hopkins
- **YouTube:** "R Programming Tutorial" by Derek Banas
- **Quick Reference:** RStudio cheatsheets

12.2 Finance & Quant Resources

- **QuantStart:** Excellent tutorials on quant finance
- **Alpha Architect:** Research and strategy insights
- **Two Sigma:** "Data Clinic" for financial data science
- **CFA Institute:** Research Foundation publications

13 Disability Services

The University provides accommodations through the Office of Disability Services (ODS). Students with disabilities or temporary conditions should contact: success.camden.rutgers.edu/disability-services

Accommodations include extended time for quizzes/exams and assignment flexibility. Please share accommodation letters early in the semester.

14 Learning Tips for Success

Weekly Routine for Success:

1. **Tuesday:** Review new module materials and lectures
2. **Wednesday-Thursday:** Practice R exercises from readings
3. **Friday:** Complete weekly quiz
4. **Weekend:** Work on bi-weekly project (when assigned)
5. **Monday:** Participate in discussions, review peer work

15 Professional Development

This course prepares you for roles in:

- Quantitative Research (buy-side and sell-side)
- Risk Management
- Portfolio Management
- Financial Data Science
- Fintech Development
- Algorithmic Trading

Consider pursuing: CFA, FRM, or Certificate in Quantitative Finance (CQF)

Welcome to Financial Data Analytics!

Let's build your Quant Trading Desk together.

Remember: In God we trust. All others must bring data. — W. Edwards Deming