Bachelor Thesis Topics

Prof. Dr. Fabian Hollstein

Chair of Empirical Finance and Econometrics

Requirements

- An **independent empirical or quantitative study** forms the core of the work
- For **topic selection**, please hand in a **preference list** with at least **3 topics**
- Scope: 20 pages (+/-1 page) [for 12 CP theses] **Preparation time: 10 weeks**
- Use of an **appropriate statistical software is recommended**
- A mere literature review is not sufficient
- The bachelor thesis can be written either in German or in English
- Regular meetings with your supervisor (Kick-off / structure / questions)
- Please meet during official office hours
- Further **tips and formal requirements** can be found in the **guidelines on the institute homepage**

Main Topics

1. **Volatility and Beta Estimation**
2. **Dependence and Jumps**
3. **Econometrics and Forecasting**
4. **Empirical Asset Pricing**

1. Volatility and Beta Estimation

VIX - Buy when high, go when low

- **Task**:
  - The CBOE Volatility Index (VIX) is a leading measure of market expectations of short-term volatility conveyed by S&P 500 Index (SPX) option prices.
  - Briefly describe the idea of the VIX and analyze the proposed strategy using dependence analyses, such as correlation and linear regressions.
- **Basic Literature**:
  - The CBOE Volatility Index - VIX. White Paper
  - Fernandes, M., Medeiros, M. C. & Scharth, M. (2014). Modeling and predicting the CBOE market volatility index. *Journal of Banking and Finance, 40*, 1-10.
- **Supervisor**: M.Sc. Jan Piontek

Volatility Targeting

- **Task**:
  - Volatility targeting is a simple strategy that attempts to keep the portfolio variance constant.
  - Implement the strategy for a non US-stock sample (other asset class / other country) and analyze the risk profile (Maximum drawdown, tail risk, etc.) and / or compare it to it a similar approach like risk-parity.
- **Basic Literature**:
  - Moreira, A. & Muir, T. (2017): Volatility-Managed Portfolios. *The Journal of Finance, 72*(4), 1611-1644.
  - Harvey, C. R., Hoyle, E., Korgaonkar, R., Rattray, S., Sargaison, M., & Van Hemert, O. (2018): The impact of volatility targeting. *The Journal of Portfolio Management, 45*(1), 14-33.
  - Liu, F., Tang, X., & Zhou, G. (2019): Volatility-Managed Portfolio: Does It Really Work? *The Journal of Portfolio Management, 46*(1), 38-51.
- **Supervisor**: M.Sc. Jonas Niemeyer

Quantitative Risk Management

- **Task**:
  - Financial risk management to quantify systematic risk has become an important principle for managerial decisions.
  - Define basic concepts of risk management (risk and its sources, randomness, loss distribution and -function,...) and explain why it is important to measure and manage systematic risk.
  - Introduce and estimate the two most common risk measures (value-at-risk and expected shortfall) using financial returns, discuss their performance using backtesting methods and compare the results.
- **Basic Literature**:
  - McNeil, A., Frey, R., Embrechts, P. (2015). Quantitative Risk Management; Concepts, Techniques and Tools. Princeton University Press.
  - Roccioletti, S. (2016). Backtesting Value at Risk and Expected Shortfall. Springer, Wiesbaden.
  - Yamai, Y., Yoshiba, T. (2002). On the Validity of Value-at-Risk: Comparative Analyses with Expected Shortfall. *Monetary and Economic Studies, January 2002*, 57-86.
- **Supervisor**: M.Sc. Jonas Niemeyer

2. Dependence and Jumps

Pairs Trading

- **Task**:
  - Pairs trading is a simple strategy followed by many hedge funds: Find two (or more) assets whose prices move together. When they diverge, construct a long-short-portfolio until prices converge again.
  - Using an appropriate sample, test a pairs trading strategy.
- **Basic Literature**:
  - Gatev, E., Goetzmann, W. N., & Rouwenhorst, K. G. (2006). Pairs trading: Performance of a relative-value arbitrage rule. *The Review of Financial Studies, 19*(3), 797-827.
- **Supervisor**: M.Sc. Kristina Wachter

Jumps in Financial Markets

- **Task**:
  - Stock returns are characterized by extreme observations, called jumps, which might arise for a number of different reasons; for example extreme events, such as political upheaval.
  - Theoretical examination and comparison of non-parametric jump detection methods.
  - Empirical detection of jumps in various stock markets.
- **Basic Literature**:
  - Barndorff-Nielsen, O. E., & Shephard, N. (2006). Econometrics of testing for jumps in financial economics using bipower variation. *Journal of Financial Econometrics, 4*(1), 1-30.
  - Jiang, G. J., & Oomen, R. C. (2008). Testing for jumps when asset prices are observed with noise-a "swap variance" approach. *Journal of Econometrics, 144*(2), 352-370.
  - Lee, S. S., & Mykland, P. A. (2008). Jumps in financial markets: A new nonparametric test and jump dynamics. *Review of Financial Studies, 2*1(6), 2535-2563.
- **Supervisor**: M.Sc. Kristina Wachter

3. Econometrics and Forecasting

What Causes the German Economy to Stagnate?

- **Task**:
  - The German economy is in its weakest state in decades. It was recessing in 2023-2024 and stagnating in 2025.
  - The Federal Statistical Office of Germany publishes series of variables related to economic growth.
  - Analyze purely statistically what affects GDP growth. Build statistical models to explain changes in GDP and identify the most important predictors.
  - Compare your results to the established literature and public opinions.
- **Basic Literature**:
  - Kemp, H. (2026). Drivers of Germany's Growth Downturn (SSRN Scholarly Paper No. 6958983).
  - Marcinkevičs, R., Vogt, J. E. (2023). Interpretable and explainable machine learning: A methods-centric overview with concrete examples. WIREs Data Mining and Knowledge Discovery, 13(3), e1493.
- **Supervisor**: M.Sc. Jan Piontek

Diagnostics of Linear Regression Models

- **Task**:
  - In the context of implementing linear regression models there are various assumptions that need to be met in order to get reliable results for model prediction.
  - Introduce the Gauss-Markov Theorem and explain what is meant by the fact that the OLS estimator should be "BLUE".
  - Validate the classical assumptions of the linear regression model that you introduced before using graphical methods (residual plot, quantile-quantile-plot, scale-location-plot,...) and statistical tests (KS-test, Shapiro-Wilk test,...) and discuss your results using appropriate data.
- **Basic Literature**:
  - Fox, J. (2020). Regression Diagnostics - An Introduction, 2nd Edition. SAGE Publications Inc., London.
  - Sheater, S. (2009). A Modern Approach to Regression with R. Springer, New York.
  - Boomsma, A. (2014). Regression Diagnostics with R. *Department of Statistics and Measurement Theory*, University of Groningen.
- **Supervisor**: M.Sc. Jan Piontek

Autoregressive Models (AR(1)-Models)

- **Task**:
  - Autoregressive models relate a time-series variable to its past values. These models are used for forecasting on a range of time series problems.
  - Introduce the characteristic function of autoregressive processes (i.e. Markov-process), define basic concepts (lag, stationarity, ACF,...) and explain how the parameters are estimated (Yule-Walker equations).
  - Implement an autoregressive model using adequate data (estimation of model parameters, forecasting,...).
  - Discuss and evaluate the quality of your forecasting results.
- **Basic Literature**:
  - Mills, C., Markellos, R. (2008). The Econometric Modelling of Financial Time Series, 3rd Edition. Cambridge University Press.
  - Dai, X., Liu, J., Zhang, H. (2015). Application of AR Model in the Analysis of Preearthquake Ionospheric Anomalies, *Mathematical Problems in Engineering*, Vol.2015.
- **Supervisor**: M.Sc. Jan Piontek

Portfolio Optimization

- **Task**:
  - One problem in portfolio management can be specific distributions and scale types of the variables, which has to be considered using most forecasting methods. Cluster analysis provides a possibility to optimize portfolios independent of the given data structure.
  - Since there are different approaches, give an overview of various suggested cluster analysis approaches in portfolio optimization.
  - Empirical investigation and comparison of different clustering methods in this context.
- **Basic Literature**:
  - Tola, V., Lillo, F., Gallegati, M., & Mantegna, R. N. (2008). Cluster analysis for portfolio optimization. *Journal of Economic Dynamics and Control, 32*(1), 235–258.
  - Pai, G. A. V., & Michel, T. (2009). Evolutionary Optimization of Constrained k-Means Clustered Assets for Diversification in Small Portfolios. *IEEE Transactions on Evolutionary Computation, 13*(5), 1030–1053.
- **Supervisor**: M.Sc. Jonas Niemeyer

Unemployment Rate

- **Task**:
  - Since unemployment can have effects on financial markets and the economy, forecasting the unemployment rate is an important topic.
  - Machine Learning can be used to model the unemployment rate and allows predictions based on large sets of factors.
  - Based on the theoretical framework, use and evaluate two different simple ML algorithms to empirically forecast the unemployment rate.
- **Basic Literature**:
  - Gogas, P., Papadimitriou, T., & Sofianos, E. (2022). Forecasting unemployment in the euro area with machine learning. *Journal of Forecasting, 41*(3), 551–566.
  - James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). *An Introduction to Statistical Learning* (Bd. 103). Springer New York.
- **Supervisor**: M.Sc. Kristina Wachter

4. Empirical Asset Pricing

The Conditional CAPM

- **Task**:
  - The static version of the Capital Asset Pricing Model (CAPM) fails in explaining cross-sectional differences between stock returns. However, one possible reason for this could be time-variation in beta.
  - Theoretical description of different versions of the conditional CAPM.
  - Empirical evaluation of the conditional CAPM with a European dataset.
- **Basic Literature**:
  - Jagannathan, R., & Wang, Z. (1996). The conditional CAPM and the cross - section of expected returns. *Journal of Finance*, 51(1), 3-53.
  - Lewellen, J., & Nagel, S. (2006). The conditional CAPM does not explain asset-pricing anomalies. *Journal of Financial Economics*, 82(2), 289-314.
- **Supervisor**: M.Sc. Jonas Niemeyer

The Asset Class of Cryptocurrencies

- **Task**:
  - In the last years cryptocurrencies gained a lot of attention in capital markets.
  - Create an overview of the literature about cryptocurrencies.
  - Present the empirical facts of cryptocurrencies and investigate which asset class they belong to and which factors influence the pricing.
- **Basic Literature**:
  - Liu, Y., & Tsyvinski, A. (2020). Risks and Returns of Cryptocurrency. *Review of Financial Studies, 34*(6), 2689-2727.
- **Supervisor**: M.Sc. Kristina Wachter