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## **ECO 829 – Applied Econometrics**

### **Professor: Dexin Zhou**

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Time: Tuesday 10:00-12:00  
Location: VC 10-215  
Office hour: by appointment

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### **Overview**

This course is an introduction to empirical methodologies used in analyzing various issues in financial economics. The focus of the course will be on testing asset pricing models, but we will also consider issues such as panel data, and other more advanced machine learning techniques.

### **Prerequisites**

The prerequisites for this course are graduate-level asset pricing theory (ECO 830), microeconomics, matrix algebra, calculus, and econometrics.

### **Course Material**

Class notes and assigned papers.

#### Optional:

Cochrane, J. H., 2005. Asset Pricing. Princeton University Press.

James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). An introduction to statistical learning (Vol. 112, p. 18). New York: springer.

### **Coursework and Grading**

Requirements for credit include attending and actively participating in class discussions, completing several homework assignments, and submitting a final paper. Class participation will count for 20%, the homework assignments will account for 60%, and the term paper will account for 20% of your grade.

- Class participation: Because class participation is important, attendance is mandatory and you may miss only one class without consequence to your grade.

You are required to contribute to class discussions by asking and answering discussions in class.

- Final paper: You can choose one of the following options for the research paper:
  1. Write an original paper with empirical asset pricing content.
  2. A major extension of an important published research paper.
  3. Choose a topic from the optional topics and write a literature review with a proposal to extend the literature (first-year only).
  
- Six homework projects are assigned. 5% comes from your submitted code. You also need to read the code from a classmate and give your criticism. This will account for 5%:
  1. Simulate returns and demonstrate the central limit theorem. Simulate returns patterns.
  2. Replicate momentum strategy (portfolio and Fama-MacBeth approaches).
  3. Test standard error estimators using simulated panel data.
  4. You can choose between
    - a. Event study: replicate the PEAD.
    - b. Time-series predictability: in-sample and out-of-sample predictability
  5. You can choose two of the following projects:
    - a. Bias vs. variance tradeoff via simulation.
    - b. Use a pre-trained BERT model and understand how financial texts correlate with returns.
    - c. Predict returns with a machine learning model.

## Tentative Course Outline

Lectures 1-6 cover classic issues of asset pricing and econometrics. This is the core part of the class. We will spend as much time as needed to ensure that you are well-equipped to use these methods. Lectures 7 and onward cover various topics, including machine learning, textual analysis, multiple testing, and survey-based methods. These lectures aim to provide a sample of recently used methods and the hope is that you might find new ideas from these new methods. We will add/drop some of these topics based on time availability.

1. Review
  - a. Topics:
    - i. Models, data, and falsifiability
    - ii. Inference vs. prediction
    - iii. Review of important concepts in statistics
    - iv. Central limit theorem
    - v. Property of returns (short horizon and long horizon)
    - vi. Properties of the OLS estimator/standard errors
    - vii. Efficient market hypothesis debate
    - viii. Simple derivation of CAPM
  - b. Literature:

- i. Besseminder, Do Stocks outperform treasury bills?, Journal of Financial Economics (2018).
- 2. Testing CAPM:
  - a. Topics:
    - i. Portfolio formation method
    - ii. Time-series CAPM test
    - iii. Gibbons-Ross-Shanken (GRS) test
    - iv. Cross-sectional CAPM test
    - v. Fama-MacBeth regression
    - vi. Anomalies
    - vii. Multifactor models
  - b. Literature:
    - i. Black, Jensen and Scholes, The Capital Asset Pricing Model: Some Empirical Tests, Working Paper (1972)
    - ii. Gibbons, Ross and Shanken, A Test of the Efficiency of a Given Portfolio, Econometrica (1989)
    - iii. Fama and MacBeth, Risk, Return and Equilibrium: Empirical Tests, Journal of Political Economy (1973)
    - iv. Fama and French, Multifactor explanations of asset pricing anomalies, Journal of Finance (1996)
    - v. Hou, Xue and Zhang, Digesting anomalies: An investment approach, Review of Financial Studies (2015)
    - vi. Fama and French, A five-factor asset pricing model, Journal of Financial Economics (2015)
    - vii. Mclean and Pontiff, Does Academic Research Destroy Return Predictability?, Journal of Finance (2016).
- 3. Debates in Cross-sectional Return Predictability Patterns
  - a. Topics:
    - i. Theoretical foundations of multifactor models
    - ii. Commonly used empirical multifactor models
    - iii. Characteristics vs. factor loadings
    - iv. Conditional CAPM
    - v. IPCA
  - b. Literature:
    - i. Lewellen and Nagel, The conditional CAPM does not explain asset-pricing anomalies, Journal of Financial Economics (2006)
    - ii. Daniel and Titman, Evidence on the characteristics of cross-sectional variation in stock returns, Journal of Finance (1997)
    - iii. Mclean and Pontiff, Does Academic Research Destroy Return Predictability?, Journal of Finance (2016).

- iv. Daniel, Grinblatt, Titman and Wermers, Measuring mutual fund performance with characteristic-based benchmarks, *Journal of Finance* (1997)
  - v. Kelly, Pruitt, and Su. Characteristics are covariances: A unified model of risk and return. *Journal of Financial Economics* 134, no. 3 (2019)
4. Panel Data / Event Study
- a. Topics:
    - i. Calculating standard errors for panel data
    - ii. Short-horizon event study
    - iii. Long-horizon event study
  - b. Literature:
    - i. Petersen, Estimating standard errors in finance panel data sets: Comparing approaches, *Review of Financial Studies* (2009)
    - ii. Lyon, Barber, and Tsai, Improved methods for tests of long - run abnormal stock returns, *Journal of Finance* (1999)
    - iii. Besseminder and Zhang, Firm characteristics and long-run stock returns after corporate events, *Journal of Financial Economics* (2013).
5. Time-series predictability and Return Decomposition
- a. Topics:
    - i. Preliminary evidence of time series return predictability
    - ii. Conducting statistical testing of time-series return predictability
    - iii. In-sample vs. Out-of-sample test
    - iv. Constant expected return model
    - v. Time-varying expected return and return decomposition
  - b. Literature:
    - i. Fama and French, Dividend yields and expected stock returns, *Journal of Financial Economics* (1988)
    - ii. Stambaugh, Bias in Regressions with Lagged Stochastic Regressors, CRSP Working Paper (1986)
    - iii. Nelson and Kim, Predictable Stock Returns: The Role of Small Sample Bias, *Journal of Finance* (1993)
    - iv. Kothari and Shanken, Book-to-market, dividend yield, and expected market returns: A time-series analysis, *Journal of Financial Economics* (1997)
    - v. Goyal and Welch, A comprehensive look at the empirical performance of equity premium prediction, *Review of Financial Studies* (2008)
    - vi. Campbell and Thompson, Predicting excess stock returns out of sample: Can anything beat the historical average?, *Review of Financial Studies* (2008)

- vii. Cochrane: The dog that did not bark, A defense of return predictability, Review of Financial Studies (2008)
- viii. Shiller, Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?, American Economic Review (1981)
- ix. Campbell and Ammer, What Moves the Stock and Bond Markets? A Variance Decomposition for Long - Term Asset Returns, Journal of Finance (1993)
- x. Chen and Zhao, Return decomposition, Review of Financial Studies (2009)
- xi. Pastor, Sinha and Swaminathan, Estimating the intertemporal risk–return tradeoff using the implied cost of capital, Journal of Finance (2008)
- xii. Chen, Da and Zhao, What drives stock price movements?, Review of Financial Studies (2013)

## 6. Machine Learning: Basic Concepts

### a. Topics:

- i. Inference vs. prediction
- ii. Bias-variance tradeoff
- iii. Validation
- iv. Regularization
- v. Gradient descent

### b. Literature:

- i. Athey and Imbens, Machine learning methods economists should know about (working paper)

## 7. Trees and Forests

### a. Topics

- i. Tree-based method
- ii. Ensemble learning

## 8. Neural networks

### a. Topics

- i. Weights and biases
- ii. Neurons
- iii. Commonly used neural networks
- iv. Forward and backward propagation
- v. Option topics: Grokking, Double descent

### b. Literature

- i. Gu, Kelly, and Xiu, Empirical Asset Pricing via Machine Learning, Review of Financial Studies (forthcoming)

## 9. Optimization

- a. Topics
  - i. Backpropagation
  - ii. Vanishing/Exploding Gradient
  - iii. SGD
  - iv. ADAM
  - v. Residual Net

## 10. Textual Analyses

- a. Topics:
  - i. Dictionary-based method
  - ii. Word embedding
  - iii. Considering the context of words
  - iv. Large language models
- b. Literature
  - i. Loughran and McDonald, Textual Analysis in Accounting and Finance: A Survey, *Journal of Accounting Research* (2016)
  - ii. Ke, Kelly, and Xiu, Predicting Returns with Text Data, Working paper
  - iii. Bybee, Kelly, Manela, and Xiu, The Structure of Economic News, Working paper.

## 11. Transformer Architecture

- a. Topic:
  - i. Attention Mechanism
  - ii. Encoder/decoder

## 12. Cross-sectional Return Predictability: Part II

- a. Harvey, Liu, Zhu, ... and Cross-section of Expected Returns, *Review of Financial Studies* (2016).
- b. Kozak, S., Nagel, S. and Santosh, S., 2018. Interpreting factor models. *The Journal of Finance*, 73(3), pp.1183-1223.
- c. Chen, A.Y., 2021. The limits of p-hacking: Some thought experiments. *The Journal of Finance*, 76(5), pp.2447-2480.
- d. Chen, Z., Roussanov, N.L., Wang, X. and Zou, D., 2024. Common risk factors in the returns on stocks, bonds (and options), redux. The Wharton School Research Paper, Jacobs Levy Equity Management Center for Quantitative Financial Research Paper.

## 13. Survey-based Methods

- a. Giglio, Maggiori, Stroebel, and Utkus, Five facts about beliefs and portfolios, *American Economic Review*
- b. Chinco, A., Hartzmark, S., & Sussman, A. (2021). A new test of risk factor relevance. *Journal of Finance*.

- c. Liu, Palmer. Are stated expectations actual beliefs? New evidence for the beliefs channel of investment demand. No. w28926. National Bureau of Economic Research, 2021.
- d. Greenwood, R. and Shleifer, A., 2014. Expectations of returns and expected returns. *The Review of Financial Studies*, 27(3), pp.714-746.

Other topics to consider:

1. Mutual funds/hedge funds
  - a. Carhart, On Persistence in Mutual Fund Performance, *Journal of Finance* (1997)
  - b. Kosowski, Timmerman, Wermers, White, Can Mutual Fund “Stars” Really Pick Stocks? New Evidence from a Bootstrap Analysis, *Journal of Finance* (2006).
  - c. Berk and Van Binsbergen, Assessing asset pricing models using revealed preference, *Journal of Financial Economics* (2016)
  - d. Jegadeesh and Mangipudi, What Do Fund Flows Reveal About Asset Pricing Models and Investor Sophistication?, *Review of Financial Studies* (forthcoming)
  - e. Agarwal and Narayan, Risks and portfolio decisions involving hedge funds, *Review of Financial Studies* (2004)
2. Portfolio Allocation
  - a. DeMiguel, Garlappi, and Uppal: Optimal versus Naive Diversification: How Inefficient is the 1/N Portfolio Strategy? *Review of Financial Studies* (2015)
  - b. Calvet, Campbell, and Sodini: Fight or Flight? Portfolio Rebalancing By Individual Investors, *Quarterly Journal of Economics* (2009)
  - c. Calvet, Campbell, and Sodini: Down or Out: Assessing the Welfare Costs of Household Investment Mistakes, *Journal of Political Economy* (2007)
3. Valuing Private Assets
  - a. Cochrane, The risk and return of venture capital, *Journal of Financial Economics* (2006)
  - b. Korteweg, Nagel, Risk - adjusting the returns to venture capital, *Journal of Finance* (2016)
  - c. Gupta, Van Nieuwerburgh. Valuing private equity investments strip by strip (Working paper)
  - d. Ang, Chen, Goetzmann, Phalippou, Estimating private equity returns from limited partner cash flows. *The Journal of Finance*, (2018).
4. Demand-based asset pricing / Granular IV / Market Inelasticity
  - a. Kojien, R. S., & Yogo, M. (2019). A demand system approach to asset pricing. *Journal of Political Economy*, 127(4), 1475-1515.
  - b. Gabaix, X., & Kojien, R. S. (2020). *Granular instrumental variables* (No. w28204). National Bureau of Economic Research.

- c. Kojien, R. S., Richmond, R. J., & Yogo, M. (2020). *Which investors matter for equity valuations and expected returns?* (No. w27402). National Bureau of Economic Research.
  - d. Gabaix, X., & Kojien, R. S. (2021). *In search of the origins of financial fluctuations: The inelastic markets hypothesis* (No. w28967). National Bureau of Economic Research.
5. Speculative bubbles and crashes
- a. Barberis, N., R. Greenwood, L. Jin, and A. Shleifer (2018). Extrapolation and bubbles. *Journal of Financial Economics*.
  - b. Brunnermeier, M. and S. Nagel (2004). Hedge funds and the technology bubble. *Journal of Finance*.
  - c. Chincó, A. (2021) The ex ante likelihood of bubbles. *Management Science*.
  - d. Glaeser, E. and C. Nathanson (2017). An extrapolative model of house-price dynamics. *Journal of Financial Economics*.
  - e. Greenwood, R., A. Shleifer, and Y. You (2018). Bubbles for Fama. *Journal of Financial Economics*.
  - f. Ofek, E. and M. Richardson (2001). Dotcom mania: the rise and fall of internet-stock prices. *Journal of Finance*.
  - g. Shiller, R. (1984). Stock prices and social dynamics. *Brookings Papers*.
  - h. Shiller, R. and J. Pound (1989). Survey evidence on the diffusion of interest and information among investors. *Journal of Economic Behavior & Organization*.
  - i. Xiong, W. and J. Yu (2011). Chinese warrants bubble. *American Economic Review*.
6. Financialization and the rise of indexing
- a. Ben-David, I., F. Franzoni, and R. Moussawi (2017). Do ETFs increase volatility? *Journal of Finance*.
  - b. Bessembinder, H., A. Carrion, L. Tuttle, and K. Venkataraman (2016). Liquidity, resiliency and market quality around predictable trades: Theory and evidence. *Journal of Financial Economics*.
  - c. Chang, Y., H. Hong, and I. Liskovich (2014). Regression discontinuity and the price effects of stock-market indexing. *Review of Financial Studies*.
  - d. Israeli, D., C. Lee, and S. Sridharan (2017). Is there a dark side to exchange-traded funds? an information perspective. *Review of Accounting Studies*.
  - e. Wurgler, J. (2010). On the economic consequences of index-linked investing. In *Challenges to Business in the Twenty-First Century: The Way Forward*.
  - f. Appel, I., T. Gormley, and D. Keim (2020). Identification using Russell 1000/2000 index assignments: A discussion of methodologies. *Critical Finance Review*.
  - g. Baker, M., B. Bradley, and J. Wurgler (2011). Benchmarks as limits to arbitrage: Understanding the low-volatility anomaly. *Financial Analysts Journal*.

- h. Barberis, N., A. Shleifer, and J. Wurgler (2005). Comovement. *Journal of Financial Economics*.
- i. Chincó, A. and V. Fos (2021). The sound of many funds rebalancing. *Review of Asset Pricing Studies*.
- j. Lettau, M. and A. Madhavan (2018). Exchange-traded funds 101 for economists. *Journal of Economic Perspectives*.
- k. Stambaugh, R. (2014). Presidential address: Investment noise and trends. *Journal of Finance*.
- l. Pedersen, L. (2018). Sharpening the arithmetic of active management. *Financial Analysts Journal*.
- m. Chincó, A. and M. Sammon. (2021). Excess reconstitution-day volume. Working Paper.