National Tsing Hua University
Postgraduate Program
Semester II – 3 Credits
Classroom: 735
Time period: M6M7M8

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Office Hours:

Seminar in Empirical Financial Econometrics

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(2023 draft version)

1. Objectives

(1) To illustrate how econometric analysis can be applied to learn about the price behavior of financial assets, from the historical asset prices and from the prices of derivatives securities.

(2) To provide learners with practical experience of analyzing market prices.

2. Learning outcomes

After completing the course, students could:

(1) Understand the important features of time series of market prices,

(2) Be familiar with appropriate methods for modeling and forecasting prices and volatility,

(3) Be able to use option prices to make statements about the distributions of future asset prices,

(4) Have acquired experience of applying computational methods, SQL, Excel, Matlab,…etc to market data.

(5) Understand the triangular relationships among the risk-neutral density, the real-world density and scaled marginal utility.

3. Prerequisite

Students have been taken the statistics, derivatives markets, and options pricing courses.

Reading

The recommended course text:
Text Book

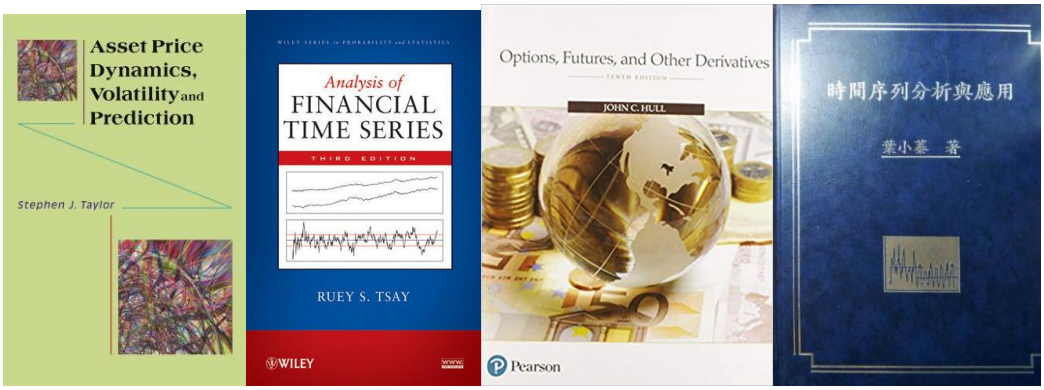
- Stephen J. Taylor, 2005, *Asset Price Dynamics, Volatility, and Prediction*, Princeton University Press. (科大網路書局代理). The text, referred to as APDVP, is a theoretical and empirical text covers main topics about equity and currency markets in real and risk-neutral worlds.

Reference Books

- Ruey S. Tsay, 2010, *Analysis of Financial Time Series*, Wiley. This is a challenging text that includes advanced mathematics in real world. Chapter 2, 3 and 5 cover course material.(新月圖書代理)
- J.C. Hull. *Options, Futures and Other Derivatives*, 10th edition, Pearson Education. (雙葉書廊代理)

  Copies of above books are in the library.
- Jackwerth, J.C. 2004, *Option-implied risk-neutral distribution and risk aversion*, Research foundation of AIMR, USA. Pdf.file.
- 時間序列分析與應用,葉小蓁. This introduces the AR(I)MA model in clear details.

The latest Teaching stuff will be upload to https://eeclass.nthu.edu.tw/ before lectures.



4. Course Schedule

16 weeks Course Schedule

Topic(s)	Date	Workshop	Paper presentation
▪ **Probability foundations** Over review of the course. Time series notation. Prices and returns.			
▪ **Stochastic process** autocorrelations, uncorrelated process, autoregressive, moving-average and integrated components. Examples of ARMA models for financial returns.			
▪ **Stylized facts for financial returns** The common properties of time series of daily financial returns. their means, standard deviations, skewness, kurtosis and distributions. Calendar effects. Correlations between returns on different days. Autocorrelations of absolute returns and squared returns.		1	
▪ **Modeling changes in volatility** Reasons for changes in volatility. The autoregressive conditional heteroscedasticity (ARCH) framework. Statistical properties, computational methods, hypothesis tests. Forecasting future volatility using previous returns.			
		3	
▪ **The deadline of coursework I**			
(Stochastic volatility models) ▪ **High-frequency analysis of market prices/ Detecting price jumps** The impact of scheduled news. Measures of realized volatility. The information content of the additional information provided by high-frequency data. Jump detection methods			
▪ **Continuous-Time Stochastic processes** Winner process. Diffusion processes. Jump-diffusion models.	4/		
▪ **Volatility expectations implied by options**	4/	4	

prices The definition of implied volatility and computational methods. Typical patterns in implied volatility as either the time to expiry or the exercise price varies. Forecasting volatility using option prices and comparisons with time series forecasts.	4/	
▪ **Density prediction for asset prices** Methods that use several option prices to estimate a probability density for the asset price when the options expire. Mixtures of lognormal distributions. A review of other methods. The Videos recorded in 2021: RND-MLN, RND-MLN and case, MLN-workshop, RND-GB2, RND_QIV, RND-evaluation	5/ 5/	
	5/	567
▪ **Risk aversion estimation and density transformation** Utility transformation, MLN, recalibration,non-parameter, 資料爬取 Nationality of RND, PCA	5/	8
▪	6/	

Note: The Computer workshops cover:

1. Properties of returns and volatility
2. Trading rules and market efficiency
3. GARCH-family models (with Matlab)
4. Implied volatility
5. The estimation of RND with mixture lognormal distribution model (with Excel, & Matlab)
6. The estimation of RND with GB2 distribution model
7. The estimation of RND with Quadratic implied volatility method
8. The estimation of risk aversion and density transformation

5. Evaluation

Items	Weight
1. Class participation	10%
2. Middle Report	30%
3. Paper Presentation	30%
4. Final Report	30%

The middle and final coursework assignments will be distributed during class. The individual assignment will require Excel calculations or Matlab/other codes to do empirical research.

The paper presentation account 30%. Each group(student) may choose one of the following papers, or any paper related to the issues in the course.

The papers include:

1. **[GARCH-jump model]** Maheu and McCurdv, 2004. News arrival, jump dynamics, and volatility components for individual stock returns. *Journal of Finance* 59, 755-793.
2. **[SV models]** Eraker, 2004. Do stock prices and volatility jump? Reconciling evidence from

spot and option prices. *Journal of Finance* 59, 1367-1403.

3. **[Flow toxicity, Prob. of informed trading]** Easley, López de Prado, and O'Hara, 2012. Flow toxicity and liquidity in a high-frequency world. *The Review of Financial Studies* 25, 1457-1493
4. **[Flow toxicity forecasting short-term volatility]** Kang, Kwon, and Kim, 2019. Flow toxicity of high-frequency trading and its impact on price volatility: Evidence from the KOSPI 200 futures market, *Journal of Futures Markets* 40, 164-191.
5. **[Implied bankruptcy probability estimation]** Camara, A., I. Popova and B. Simkins. "A compatative study of the probability of default for global financial firms." *Journal of Banking and Finance*, 36 (2011), 717-732.
6. **[Returns forecasting]** Wang and Yeh, 2017. The information of content of option-implied tail risk for future returns of the underlying asset. *Journal of Futures Markets.*
7. **[Methodology in RNDs]** Liu, Shackleton, Taylor and Xu, 2007. Close-form transformations from risk-neutral to real-world distributions. *Journal of Banking and Finance* 31, 1501-1520.
8. **[Return forecasting]** Fan, Taylor, and Sandri 2017. Density forecast comparisons for stock prices, obtained from high-frequency returns and daily option prices. *Journal of Futures Markets.*
9. **[Density forecasting]** Shackleton, Taylor, and Yu, 2010. A multi-horizon comparison of density forecasts for the S&P 500 using index returns and option prices. *Journal of Banking and Finance* 34, 2678-2693.
10. **[Density forecasting]** Yun, J. (2014). Out-of-sample density forecasts with affine jump diffusion models. *Journal of Banking and Finance*, *47*, 74-87.
11. **[Methodology MCMC estimation with Bugs]** Yu, 2005. On leverage in a stochastic volatility model. *Journal of Econometrics.*
12. Neumann, Prokopczuk, and Simen, 2016. Jump and variance risk premia in the S&P 500, *Journal of Banking and Finance*, 69, 72-83.
13. **[Returns forecasting]** Li and Zinna, 2018. The variance risk premium: components, term structures, and stock return predictability, *Journal of Business and Economic Statistics*, 36, 411-425.
14. **[Evaluating RND estimation methods]** Lu, Shan. (2019). Monte Carlo analysis of methods for extracting risk-neutral densities with affine jump diffusions, *Journal of Futures Markets*, 39, 1587-1612.
15. **[literature Review in equity options researches]** Bernales, Verousis, Voukelatos, and Zhang (2019). What do we know about individual equity options?, *Journal of Futures Markets*, 25, 67-91. [Undergraduate]
16. **[high-frequency options data]** Andersen, Archakow, Grund, Hautsch, Nasekin, Nolte, Pham, Taylor, and Todorov. (2020). A descriptive study of high-frequency trade and quote option data, *Journal of Financial Econometrics*.
17. Taylor (2009)JD cross sectional analysis of risk neutral skewness [Undergraduate]
18. **[Returns forecasting]** Baltussen, G., S. Van Bekkum, and B. Van der Grient, 2018, Unknown unknown: Uncertainty about risk and stock returns, Journal of Financial and Quantitative Analysis 53(4): 1615-1651.
19. **[Volatility forecasting]** Jeon, B., S. W. Seo, and J. S., Kim, 2020, Uncertainty and the volatility forecasting power of option-implied volatility, *Journal of Futures Markets* 40, 1109-1126.
20. **[Returns forecasting]** Cremers Weinbaum 2010JFQA Deviations from put_call parity and

stock return.

Teaching assistant

The teaching assistant is 林競妍(halfregina (at) gmail.com). Please contact with him before meeting.