Pre-recorded Course Offerings

By Ernest P. Chan & Associates, on topics related to algorithmic trading

Contents

General Course Information 2
Instructors 2
Praise for our courses 3
Algorithmic Options Strategies 4
Artificial Intelligence Techniques for Traders 6
Backtesting 8
Cryptocurrency Trading with Python 10
Lifecycle of trading strategy development with machine learning 11
Mean Reversion Strategies 13
Quantitative Momentum Strategies 15
Trading at Millisecond Frequency 17

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General Course Information

All courses are pre-recorded and available indefinitely for viewing on Adobe Connect. Software and sample data will be provided. Unlimited Q&A will be conducted on the course Slack channel. All courses are narrated or co-narrated by Dr. Ernest Chan. For registration information: please contact ernest@epchan.com. (Current live course offerings can be purchased directly from www.epchan.com/workshops.)

Many of the courses are conducted in Matlab, and others are conducted in Python. Though expertise in these languages are not required, basic familiarity with either one is recommended.

Instructors

Dr. Ernest Chan is the Managing member of QTS Capital Management, LLC., a CPO/CTA. 20 years of research and trading experience in quantitative strategies, starting at Morgan Stanley. Author of Quantitative Trading, Algorithmic Trading, and Machine Trading (Wiley 2009, 2013, 2017). Adjunct faculty at Northwestern U on Financial Risk Analytics. Formerly machine learning researcher at IBM Human Language Technologies Group. Ph.D. in Physics from Cornell University.

Dr. Roger Hunter is the Principal and CTO of QTS Capital Management, LLC. Founder and former CEO of software firm employing more than 40 professionals that was sold to Thomson Reuters. Software currently in use at U.S. Federal Reserve. Formerly tenured full professor of mathematics at New Mexico State University. Ph.D. in Mathematics from Australian National University. He co-taught the Lifecycle of Trading Strategy Development with Machine Learning course.

Nick Kirk is the manager of a cryptocurrency fund Cypher Capital. More than 10 years' worth of experience in developing, automating and integrating trading systems for Investment Banks and Asset Management firms. Prior to working in Finance, he worked at IBM Labs and Siemens Research. He has previously

taught algorithmic crypto trading at the CQF Institute to wide acclaim. He is the primary instructor of the Cryptocurrencies Trading with Python course.

Praise for our courses

"An excellent course by a great teacher. Ernie clearly explained and applied the different areas of Artificial Intelligence, provided invaluable insights as to their relative merits, and gave me the confidence to implement them in my own trading." – Dr Nikhil Shenai (Ph.D., Imperial College, BA, University of Cambridge), Founder of E K Technologies (Quantitative Trading & Development)

"*While being familiar with the subject I truly enjoyed the material covered and the [options] course has certainly provided food for thought.*" – Laurent Hoffmann, Ph.D., Former Senior Quantitative Analyst, Structured Credit Trading, at Depfa Bank Asset Management Europe & RoW.

"*Nick is a very passionate advocate of cryptocurrencies. I was very pleased to have attended one of his cryptocurrency trading workshops in the past. His blunt enthusiasm along with his in-depth knowledge on the field result in a very positive and value added experience on cryptocurrency trading with actual hands-on implementation. In combination with Ernie Chan, the guru of algo trading, the mix is going to be 'explosive'! Can't wait!*" - Konstantinos Moutsioulis, Portfolio Analyst, Dutch Development Bank, The Hague Area

"…thank you again for the Momentum Strategies training course this week. It was very beneficial. I found your explanations of the concepts very clear and the examples well developed. I like the rigorous approach that you take to strategy evaluation." – Andrew B.

"…I have been very impressed with Ernie's past workshops…" – Stephen Hope, Former Head of Fixed Income Quantitative Trading Strategies, BNP Paribas.

"Ernie's workshop offers particularly helpful insights in implementing profitable trading strategies and that's beyond his books' content. And he is one of the most patient and giving instructors I ever met" – K.W. Fung, CQF, Founder of Quants Investment

"These workshops have provided me with enough familiarity and confidence to tackle the latest research. Just the segment on intermarket sweep orders in the MFT course was worth the price of admission to all three workshops I went to." – Cedric Yau

"Dr. Chan brings a practical approach to a difficult topic that helps students not only understand the topic at hand but why the topic is important in the applied field. I can't speak highly enough about the course and instruction…" – Anonymous student evaluation

"*Dr. Chan … is a phenomenal instructor…*" – Anonymous student evaluation

Algorithmic Options Strategies

Summary: This is a 6-hour workshop on backtesting algorithmic trading strategies on options. Algorithmic traders have the ability to scan and select among hundreds of stocks, and numerous strike prices and expirations for each stock. Due to this abundance of choices and the resulting high dimensionality of the data, constructing a backtest program is challenging. Examples will be drawn from intraday events-driven trading, gamma scalping of options on futures, dispersion trading of stock and stock index options, and cross-sectional mean reversion trading of stock options.

This course will be conducted using Matlab. Basic familiarity with options terminology is required.

Fee: $899

Outline:

1. Overview of options and volatilities
    a. What risks do you want to hedge?
    b. Delta, gamma, theta, and vega.
    c. Straddles and strangles.
    d. Volatility: realized and implied. Can we predict them?

2. Event-driven trading
    a. Can we benefit from buying volatility ahead of economic announcements?
    b. A tale of two events.
    c. Backtesting intraday straddles and strangles strategies with high frequency data.

3. Gamma Scalping
    a. The theoretical appeal of gamma scalping.
    b. Is gamma scalping long or short volatility?
    c. Backtesting gamma scalping on crude oil futures and options.

4. Dispersion Trading
    a. An analogy with index arbitrage.
    b. The risk profile of dispersion trading.
    c. Various implementation alternatives.
    d. Backtesting dispersion trading on the SPX: the curse of dimensionality.

5. Cross-sectional Mean Reversion of Implied Volatility
    a. Time series vs cross-sectional mean reversion.
    b. Does realized volatility mean-revert? Does implied volatility?
    c. Backtesting a portfolio of stock options.
    d. Why is the return so high? Leverage of an option position.
    e. Risks of a cross-sectional mean reversion strategy on options.

6. Trading volatility without options
    a. Trading VX using predictions of VX return.
    b. The counter-intuitive way of trading VXX using predictions of SPY volatility.

7. General pitfalls and difficulties of backtesting and implementing algorithmic options strategies.

Artificial Intelligence Techniques for Traders

Summary: This is a 6-hour workshop introducing the use of artificial intelligence techniques for identifying useful predictive variables and trading rules for returns prediction. This course will be conducted using Matlab.

Fee: $899

Outline:

1. Overview of AI techniques
    a. General paradigm of machine learning.
        i. Features selection.
        ii. Training vs test sets.
        iii. Cross validation.
        iv. Hyperparameters optimization.
        v. Boot-strapping.
        vi. Data snooping bias.
        vii. Accuracy, confusion matrix, recall vs precision, F1-score, log-loss
    b. Programming tutorial (available as pre-recorded session)
    c. Setting up the problem with multiple linear regression as the learning model.
        i. Exercise: predict 1-day SPY return using simple technical indicators.

2. Learning algorithms: extended exercise on predicting SPY returns using various learning algorithms
    a. Stepwise linear regression.
    b. Classification and regression trees (CART)
        i. Stopping criteria for tree growing.
        ii. Using the whole tree or selecting certain nodes for prediction?
        iii. Reducing overfitting by cross-validation.
        iv. Increasing training sample size by bootstrapping/bagging.
        v. Decreasing number of predictors: random subspace.
        vi. Random forest.
        vii. Learning from past errors: boosting.
        viii. Which technique gives most accurate predictions?
        ix. Improving accuracy with weighted samples, priors, and hyperparameters optimization.
    c. Support vector machine (SVM)

        i. Predicting sign of returns.
    d. Neural networks (NN)
        i. Neural network as nonlinear function fitting.
        ii. What network architecture to pick?
        iii. Drawback of using NN for financial predictions.

3. An extended exercise on features selection.
    a. Building a multifactor stock selection model using fundamental factors.
    b. Techniques: multiple regression, stepwise regression, and CART.
    c. What fundamental factors are most useful for predicting stock portfolio returns?

Backtesting

Summary: This is a 7-hour workshop on the basics of backtesting**.** Backtesting is the process of feeding historical data to an automated trading strategy and see how it would have performed. We will study various common backtest performance metrics. Backtest performance can easily be made unrealistic and un-predictive of future returns due to a long list of pitfalls, which will be examined in this course. The choice of a software platform for backtesting is also important, and criteria for this choice will be discussed. Illustrative examples are drawn from a futures strategy and a stock portfolio trading strategy.

This course will be conducted using Matlab.

Fee: $299 (waived if taken together with any other course).

Outline:

1. Overview of Backtesting
   a. What is backtesting and how does it differ from "simulations"?
   b. The importance of backtesting: Why is backtesting a necessary step for profitable automated trading?
   c. The limitations of backtesting: Why is backtesting *not* a sufficient step to ensure profitability in automated trading?
   d. What we can do to increase the predictive power of our backtest results: the avoidance of pitfalls.
   e. How to identify good/bad strategies even before a backtest: a preview of various pitfalls through a series of examples.

2. Choosing a backtest platform
   a. Criteria for choosing a suitable backtest platform.
   b. A list of backtesting platforms.
   c. Discussion of pros and cons of each platform.
   d. Special note: integrated backtesting and automated execution platforms.
   e. Why do we choose MATLAB?

3. Tutorial to MATLAB
   a. Survey of syntax.
   b. Advantage of array processing.
   c. Exercises: building utility functions useful for backtesting.
   d. Using toolboxes.

4. Backtesting a single-instrument strategy

a. Exercise: A Bollinger-band strategy for E-mini S&P500 futures (ES) as a prototype mean-reversion strategy.

5. Performance measurement
   a. The equity curve.
   b. Excess returns and the importance of the Sharpe ratio.
   c. Tail risks and maximum drawdown and drawdown duration.
   d. The importance of transaction costs estimates.

6. Choosing a historical database
   a. Criteria for choosing a good historical database.
   b. Equities data: split/dividend adjustments, survivorship bias.
   c. Futures data: constructing continuous contracts, settlement vs closing prices.
   d. Issues with synchronicity of data.
   e. Issues with intraday/tick data.

7. Backtesting a portfolio strategy
   a. Exercise: A long-short portfolio strategy of stocks in the S&P 500.
   b. Relevance of strategy to 2007 quant funds meltdown.
   c. The importance of universe selection: impact of market capitalization, liquidity, and transactions costs on strategies.
   d. Strategy refinement: how small changes can make big differences in performance.

8. Detection and elimination of backtesting pitfalls and bias
   a. How to detect look-ahead bias?
   b. How to avoid look-ahead bias?
   c. Data snooping bias: why out-of-sample testing is not a panacea.
   d. Parameterless trading.
   e. The use of linear models or “averaging-in”: pros and cons.
   f. Exercise: linearization of the ES Bollinger band strategy.
   g. Impact of noisy data on different types of strategies.
   h. Impact of historical or current short-sale constraint.
   i. The unavoidable limitation of backtesting: Regime change.
   j. What to do when live performance is below expectations?

Cryptocurrency Trading with Python

Summary: This is a 6-hour workshop about the algorithmic trading of cryptocurrencies such as Bitcoin. Participants will receive Python source code and data for backtesting. Gemini Exchange's Sandbox environment will be used, which offers full exchange functionality using test funds, for testing API connectivity and the execution of strategies.

This course will be conducted by Nick Kirk, and moderated by Ernest Chan.

Fee: $899

Outline:

1. Introduction to Cryptocurrencies (e.g. Bitcoin)
2. Ethereum and other crypto technologies (e.g. Blockchain)
3. Cryptographic Hashing and Public Key Cryptography
4. Mining and Proof of Work
5. Bitcoin price dynamics and drivers
6. Security on exchanges
7. Gemini Exchange and their Sandbox environment
8. RESTful and WebSocket APIs
9. Asynchronous messaging
10. Streaming and collecting data from the exchanges
11. Checking account balances and private account information
12. Executing orders
13. Backtesting and strategy development, using technical analysis or machine learning

Lifecycle of trading strategy development with machine learning

Summary: This is a 12-hour, in-depth, workshop focusing on the challenges and nuances of working with financial data and applying machine learning to generate trading strategies. We will walk you through the complete lifecycle of trading strategies creation and improvement using machine learning, and ending with automated execution, with unique insights and commentaries from our own research and practice. We will make extensive use of Python packages such as Pandas, Scikit-learn, LightGBM, and execution platforms like QuantConnect. It was co-taught by Dr. Ernest Chan and Dr. Roger Hunter. The course was taught in 3 parts, each part lasted 4 hours.

Fee: $599 per part. ($1,749 if registering for complete course.)

Outline:

Part 1

A. Overview: Challenges of financial data science and machine learning
   a. Data cleansing: Why even simple daily data cannot be trusted.
   b. Features engineering: Claims that this step is easy for deep learning are *false*.
   c. Features selection: What even experts can get wrong here.
   d. Machine learning: shallow + deep learning work best together.
   e. Avoiding data snooping and selection bias: using CPCV.
   f. Metalabelling: improving your proprietary strategy without telling anyone.
   g. Backtesting: beyond machine learning.
   h. Automated execution: choosing a platform.

B. Data cleansing and features engineering
   a. Checking and adjusting price and volume data in stocks and futures.
   b. Survivorship bias and how to find it.
   c. Stationarity and “fractional differentiation”.
   d. Sanity checks for news sentiment data.
   e. Sanity checks for earnings data.
   f. What is a security master and how to create one where none existed?
   g. Aggregating and encoding categorical data into features.

Part 2

C. Machine learning

a. Better Start Simple: An example of simple features and shallow machine learning using logistic regression with L1 and L2 regularizations.
b. Deeper learning: Random forests and gradient boosted trees with Scikit-Learn and LightGBM.
c. Features selection using Mean Decrease Accuracy and SHAP: be careful where you apply that!
d. Cross validation and hyperparameters optimization.
e. Metrics for measuring machine learning outcomes.
f. Metalabelling: what common base models to use?

Part 3

D. Backtesting

a. Machine learning suggests, but does not determine, trading strategy.
b. Various ways of using the output of ML for trading.
c. Reduce data snooping bias: using CPCV.

E. Automated Execution

a. Using QuantConnect to automate strategies to trade on Interactive Brokers.
b. Using a trained model in QuantConnect.

Mean Reversion Strategies

Summary: This is 6-hour workshop on the theories and practical implementation of mean reversion strategies. This course will be conducted using Matlab.

Fee: $899

Outline:

1. Stationarity and cointegration of time series
   a. Stationarity and mean-reversion: the practical benefits.
   b. Statistical test for stationarity: ADF.
   c. Exercise: Using MATLAB and spatial-econometrics toolbox to find out if AUDCAD is stationary.
   d. Execise: Adapt Bollinger band strategy to trade AUDCAD.
   e. Cointegration and its practical benefits.
   f. Cointegration vs correlation.
   g. Statistical test for cointegration: CADF.
   h. Exercise: Find out if GLD-GDX is cointegrating using CADF.
   i. Order-dependence of CADF.
   j. Statistical test for cointegration: Johansen.
   k. Exercise: Find out if GLD-GDX is cointegrating using Johansen.

2. Tutorial to MATLAB
   a. Quick survey of syntax.
   b. Exercises: building some utilities useful for trading and plotting simple graphs.
   c. Using toolboxes

3. Mean-reversion trading of pairs and triplets
   a. Finding hedge ratio through linear regression (LR).
   b. Exercise: Find hedge ratio for GLD-GDX using LR.
   c. Order-dependence of hedge ratio based on LR.
   d. Finding hedge ratio through Johansen test.
   e. Exercise: Backtest Bollinger band strategy for GLD-GDX.
   f. Case study: The breakdown of cointegration of GLD-GDX, the economic reasons and the remedy.
   g. Exercise: Backtest Bollinger band strategy for GLD-GDX-USO.
   h. A general guide to surviving the breakdown of cointegration.

4. Half-life of mean-reversion
   a. Practical importance of half-life.

b. The Ornstein-Uhlenbeck formula.
c. Exercise: Computing the half-life of the GLD-GDX spread.
d. Paramterless-trading revisited: using half-life to eliminate lookback parameter.

5. Risk management of mean-reversion strategies
   a. The pros and cons of using stop loss for mean-reversion strategies.
   b. The use of implicit stop losses.

6. What are the best markets for pair trading strategies?
   a. Pros and cons of pair trading ETFs, stocks, currencies, futures, and other markets.
   b. Why sometimes economically-related pairs of futures do not cointegrate.
   c. Exercise: Test for cointegration of WTI vs Brent crude oil futures.
   d. Exercise: Test for stationarity of "crack spread".

7. Index arbitrage
   a. Trading an ETF against a basket of its component stocks.
   b. Two ways of constructing a basket: linear regression and constrained optimization.
   c. Exercise: Backtest a trading model of XLE against its components.
   d. Issues with index arbitrage.

8. Long-short portfolio
   a. Exercise: A long-short portfolio strategy of stocks in the S&P 500.
   b. Relevance of strategy to 2007 quant funds meltdown.
   c. The importance of universe selection: impact of market capitalization, liquidity, and transactions costs on strategies.
   d. Strategy refinement: how small changes can make big differences in performance.

Quantitative Momentum Strategies

Summary: This is a 6-hour workshop on the theories and practical implementation of momentum strategies. This course will be conducted using Matlab. Basic familiarity with college-level statistics is recommended.

Fee: $899

Outline:

1. Causes of momentum
    a. Persistence of futures roll returns.
    b. Slow diffusion of news.
    c. Forced sales and purchases by funds.
    d. HFT market manipulation.

2. Tutorial to MATLAB
    a. Quick survey of syntax.
    b. Exercises: building some utilities useful for trading and plotting simple graphs.
    c. Using toolboxes

3. Roll returns as driver of momentum
    a. Backwardation vs. contango.
        i. Exercise: Estimating spot and roll returns.
    b. Time-series vs cross-sectional momentum.
    c. Arbitrage between future and spot returns.
        i. The case of VX-ES.
    d. Statistical tests for time-series momentum.
    e. Example futures time-series momentum strategy.
        i. Indicators for TS momentum.
    f. Example futures cross-sectional momentum strategy.
    g. Example stock cross-sectional momentum strategy.
        i. Indicators for CS momentum.
        ii. News sentiment.
    h. The phenomenon of “Momentum Crashes”.
        i. The S&P DTI index.

4. Forced sales and purchases due to funds

    a. Hedge funds.
    b. Mutual funds.
        i. Example strategy using Pressure indicator.
    c. Index funds.
    d. Levered ETFs.
        i. Example strategy.

5. Exit Strategies

6. Advantages and disadvantages of momentum strategies.

Trading at Millisecond Frequency

Summary: This is an 8-hour workshop introducing defensive measures against high frequency trading strategies, and to the issues related to the research and backtesting of higher frequency trading strategies in the millisecond range. We call this Millisecond Frequency Trading, or MFT, as opposed to High Frequency Trading (HFT) which typically takes place at microsecond frequency. This course will be conducted using Matlab. Basic familiarity with college-level statistics is recommended.

Fee: $899

Outline:

1. Overview of MFT issues
    a. Why we may need to understand HFT /MFT even if we are not trading at high frequency.
    b. HFT Gaming:
        i. Front-running
        ii. Ticking
        iii. Ratio trade
        iv. Stop hunting
        v. Hide and Light
        vi. Queue jumping
    c. Thin NBBO liquidity
    d. Order type optimization
        i. Immediate or Cancel
        ii. Intermarket Sweep Order
        iii. Hide and Light order
        iv. Day ISO
    e. Adverse Selection
    f. Last-look in FX
    g. Use and Abuse of Dark Pools: Avoiding toxic dark pools.
    h. Flash crashes and liquidity withdrawal

2. The Physics of MFT
    a. Colocation
    b. Consolidated and direct data (ITCH) feeds.

3. Backtesting
    a. Choices of live trading vs backtesting platforms for MFT.
    b. Choices of historical data for backtesting MFT.

4. Special Topic: Order Flow
5. Predictive power of order flow.
6. Methods of computing order flow.
    a. Extended Exercise: Backtesting an order flow strategy with tick data.