Algorithmic Trading Certificate (ATC)

Level up your career: Understanding advanced trading strategies, Impact of Machine Learning and methods for research into new alpha sources.

ONLINE PROGRAM: MONDAY 4th MARCH - MONDAY 20th MAY 2024

WBS

Algorithmic Trading Certificate (ATC): A Practitioner's Guide

This course is an up-to-date version of the course, Algorithmic Trading Strategies.

Nick taught a version of this course at University College London, to Computational Finance and Risk Management PhD and MSc students from 2015 – 2023, and online through QuantsHub and other platforms.

With over 500 students having successfully completed earlier versions of this course, and the curriculum continually being re-jigged, it seemed an appropriate time for a larger update to broaden the perspective and make the course more applied, with the goal of having students be able to implement methods, models and frameworks themselves. Changes to previous courses include:

- In addition to looking at the returns of QIS, Risk-premia or Factor-based strategies (e.g., trend-following, carry, etc and equities momentum, value, etc factors), this course explicitly considers larger returns-forecasting models and the value of including factors as exogenous features.
- While including much of the university course material, this course goes beyond the merely academic to focus on practical implementations. The academic literature is of interest only in that we can use it as a starting point for delving deeper into real-world applications.
- We expect a working knowledge of programming and can focus more on greater value added material.

Unlike the earlier courses, the new Algorithmic Trading: Practitioners Guide course takes a hands-on approach to building trading pipelines, from data to features to modelling to allocation to execution to performance measurement, guiding the student through common practice as well as areas of innovation.

It is designed to go far beyond the purely academic remit of the UCL course and the more practical online course.

Details

ONLINE PROGRAM: Monday 4th March - Monday 20th May 2024.

DURATION: 12 lecture weeks / 32 hours of Lectures + Hands on examples

TIME COMMITMENT: 8 - 10 hours weekly. Weekly recorded lectures accessible any time in your educational portal.

SELF-PACED ONLINE: Students will have the opportunity to apply what they learn in hands-on projects throughout the course.

FACULTY: Dedicated Faculty Support available every step of the way. Weekly seminar & student forum. Access the same lessons, techniques and methods taught inside global financial institutions.

EVALUATION: Final Project + Certificate

ASSESSMENTS:
One written assessment at the end (PDF + Python Notebook), describing a strategy in detail: its behaviour, its rationale (with quoted references if applicable), implementation and performance and limitations and room for improvements. Marks for sensibility of coverage and exposition, for following the methodology, etc. (i.e., good performance only is not sufficient – you have to display it and explain it).

COURSE FEE: £3950.00 (Regional & Group Discounts available).

EARLY BIRDS:
20% until 19th January 2024
10% until 16th February 2024

CERTIFICATE: Students are awarded the prestigious Algorithmic Trading Certificate from WBS Training.

What, why and who

Algorithmic trading is a broad term for trading which uses mathematical models and algorithms.

As markets have become more automated over time, banks and retail brokerages increasingly make markets for their clients using algorithms (e-trade). Some quant hedge funds have relied heavily on algorithms from the start, with a notable few enjoying huge success, while others have employed algorithms as one of many elements in their approach.

In recent times, high-frequency market-makers and proprietary trading shops have come to dominate the exchange traded (and some OTC) markets, with increased volume and speed leading to higher net returns.

Algorithms can be used for all aspects of the business, from trade decisions to portfolio allocations to placing market and limit orders with the time horizons involved being anywhere from a nanosecond to many days.

The rationale is simple – *efficient, scalable models with consistent and testable performance.* The aim is to use a scientific approach which can generate extremely fast responses to market events.

While some exchange traded markets (liquid futures, equities, ETFs) and some highly liquid OTC markets (FX, US Treasuries) have been dominated by algorithmic trading for some time, more recent developments include increasing algo presence in less liquid markets such as non-liquid energy futures (energy futures outside of WTI, Brent, and standard energy complex), OTC rates markets (USD and EUR swaps), highly illiquid corporate bonds and even in areas once fully dominated by voice-trading such as EUR government bonds.

Some of this evolution is the quest for new markets in which to apply what has been successfully developed elsewhere but much of it is just the natural diffusion of talent into areas which are both more risky and possibly more lucrative. Irrespective of whether it be market-making in banks and speciality prop shops or finding and executing on alphas, balancing portfolios and optimising execution in asset managers, today's traders, quants and managers must know about systematic trading.

The goal of this class is to provide students with a strong foundation in algorithmic trading as well as the tools and techniques used in the industry. The class will cover everything from basic programming concepts to advanced trading strategies and methods for research into new alpha sources. Students will have the opportunity to apply what they learn in hands-on projects throughout the course.

Pre-requisites

- **Intermediate or Experienced Programmer** – preferably with **working knowledge of Python** – all examples in the class will be in Python, in Jupyter Notebooks, using Numpy and Pandas. While other languages may be considerably faster and more stable, Python is particularly noted for the speed of development, the access to a wide range of libraries (stats or ML-stack), and interoperability with other languages. Python also is a noted teaching language and a vast number of students have been educated in Python.

- **Statistics or Econometrics or (Statistical) Machine Learning** – We will assume strong familiarity with a lot of statistical concepts, although there will be some review of Time Series Econometrics (e.g., ARIMA models and concepts of stationarity). Understandings of basic distributions, statistical hypothesis testing and OLS will be a bare minimum.

- **Basic Finance and familiarity with Economics** – We will assume a basic knowledge of financial markets. Our focus will be markets which are less model-dependent (i.e., less Fixed Income and Vol, more FX, Equities, Futures), although there will be illustrations from each. We will also assume a basic understanding of utility theory from Economics. And Economics impacts all markets and knowing this will take the student a long way.

- **A plus:** Some familiarity with SDEs (e.g., as in Black-Scholes), and differential equations.

Learning goals

This course is for:

Discretionary Traders / Risk Managers

Understand the mechanics of the market and develop the tools to devise and manage new and improved algorithmic strategies of different types including multi-asset strategies. Learn the importance of allocation frameworks, execution models and performance testing. Recognise pros and cons of various approaches to designing strategies and the common pitfalls encountered by algorithmic traders.

Algorithmic Traders / Quants

Appreciate when commonly-used strategies work and when they don't. Understand the statistical properties of strategies and discern the mathematically proven from the empirical. Expand your technology toolkit to incorporate the latest techniques including open-source tools and models from other areas of the quant industry.

Academics / Students / Data Scientists

Gain familiarity with the broad area of algorithmic trading strategies. Master the underlying theory and mechanics behind the most common strategies. Acquire a solid understanding of the principals and context necessary for new academic research into the large number of open questions in the area.

Syllabus

Module 1 – Introduction

- Trading Basics:
  - Types of Trading
  - Trading Strategies
  - Introduction to Algorithmic Trading

- Industry Overview:
  - Industry Structure
  - Size and growth
  - The different sub-sectors

- Approaches:
  - Some simplified frameworks
  - Full On Approaches
  - Execution styles

- Trading Platform Architecture:
  - Data
  - Features
  - Models

- Data:
  - Market data sources
  - Aggregators and Exchanges
  - Scraped Data
  - Alternative Data sources

Module 2 – Statistics and Time Series

- ARIMA Models:
  - Autoregressive, Moving Average Models and Integrated Models
  - Detecting model types using Autocorrelation functions
  - Solving Difference Equations
  - Seasonality and State-Space ModelsTypes of stationarity and Brownian motion

- Model Selection:
  - Hypothesis Testing, Sequential Testing
  - Covariance Penalties and Criteria
  - Drop-out and Cross-Validation
  - Sparsity, and Regularisation

- Forecasting:
  - Batch Updates
  - Online Learning – Adaptive Filters – RLS and Kalman Filters
  - GARCH
  - Updating schemes and Stability
  - Learning Rates and Cross Validation

- Change-points and Regime Shifts:
  - Change points vs Regime Shifts
  - Endogenous Regimes / HMMs – EM method
  - Regimes and weighted LS
  - Chow, CUSUM and CUSUM-SQR tests
  - Bayesian Changepoint Detection
  - Breaks in Stationarity
  - Changepoints and Stability

- Multivariate Models:
  - Causality – Granger and Otherwise
  - Integration and Cointegration
  - VAR / VARMA
  - Exogenous restrictions / Conditional forecasting

Module 3 – Features and Factors

- Feature Creation:
  - Automating Features
  - Feature Stores
  - Best Practices from MLOps

- Feature Selection:
  - Feature Relevance – Sequential Filtering and Testing
  - Feature Stability
  - Examples : Lags, Movavs, etc

- Exogenous Features:
  - Economic Data
  - Fundamental Data
  - Releases and Surprises, Revisions and Corrections
  - Changing the Frequency – Nowcasts and MIDAS
  - Market Data
  - Text and Sentiment
  - Causality and Spillovers

- Factor Investing: CAPM and APT
  - Fama-French factors – Market, Value, Size
  - Other Factors – Quality, Profitability, Leverage,
  - Factor Proliferation and the Factor ZooAnomalies, Alpha and Time-Decay
  - Risk Premia Investing

Module 4 – Trend Following

- Momentum:
  - Design
  - Impact on design
  - Option value vs Reactivity
  - Sharpe vs Skewness
  - Continuous Time – Power Options and Trend

Syllabus

- Discrete time – skewness term-structure, autocorrelation and volatility

- Nonlinear Momentum:
  - Non-linear filter – Impact and benefits
  - Risk and Return
  - Returns distribution engineering, limitations and further direction

- Momentum signals in practice:
  - Time Series vs Cross- sectional Momentum
  - Design Choices: MA, CMA, Z-scores, etc
  - General Convolution Filters
  - Technical indicators
  - ARIMA models

- Cross-Sectional Momentum:
  - Relation with Time-series
  - Fitting into APT/Fama-French
  - Equities Quant (as a subsector) and Equities Factor Investing
  - Turnover and Rebalancing Costs
  - Mean-Reversion and Trend (and Mean-Reversion)

- Momentum Breaking:
  - Ultra Long-horizon
  - Momentum breaking and Value

Module 5 – Carry and Volatility Strategies

- Carry:
  - Rationale – P vs Q Measures
  - Definitions – Carry in Bonds, Futures, FX.
  - Negative Skewness Premium and Currency Crashes
  - Diversification of Carry and Momentum

- Mean-Reversion or pseudo market-making:
  - Mean Reversion
  - Rationales: Liquidity provision or Overreaction?
  - Relation to other liquidity measures
  - Stationary vs Non-Stationary processes
  - Cointegration – Johansen, CCA and PCA
  - Testing – Univariate and Multivariate Tests.
  - Var-Ratio (Tests) vs Sharpe Ratio
  - Shortcomings – Time-variation / Breaks
  - "Optimal" MR TradingTiming

- Relative Value Trading:
  - RV in Delta-one space – Pairs, Spreads, Butterflies, Boxes and BasketsI(1) vs I(0): RV vs Trend
  - Timing Entry points and mean reversion Optimising
  - Stationarity: Are RV trades stationary?
  - Statistical arbitrage and Pairs Trading

- Short-Gamma Trading:
  - Variance risk premium
  - Models of implied vol evolution and the risk/reward of short positions
  - Expressions in different markets
  - Hedging methods and new techniques
  - Risk and signals
  - Skewness and Scaling

Module 6 – Machine Learning and other New Techniques

- Nonparametric Statistics:
  - Kernel Methods
  - Empirical Densities and Bayesian Techniques
  - Nonparametric Regression and Classification

- Trees, Forests and Boosting:
  - Tuning the Parameters
  - Feature Selection
  - Boosting and Bagging

- Neural Networks:
  - Deep Neural Networks
  - Recurrence and Memory
  - Deep vs Wide – Efficiency and Stability
  - Autoencoders

- Reinforcement Learning:
  - Decision Processes
  - Stochastic Control

- Genetic Algorithms:
  - Genetic Representation, Fitness and Operators
  - Applications to Strategy Selection
  - Bandits and hyperparameter optimization

Module 7 – Trading and Execution

- Market Microstructure:
  - Electronic vs Voice
  - RFQs vs Streaming Quotes
  - Order types – Market, Limit, Spread, etc
  - Other actions – Fills, Cancellation, etc

- Execution Issues:
  - VWAP and TWAP
  - Auctions
  - Transaction Costs
  - Price Impact

Syllabus

- Optimising Execution:
  - Stochastic Control
  - Optimal market order placement
  - Inventory constraints
  - Extensions
  - Optimal Market making and extensions
  - Practical Implementation
  - Fill probabilities
  - Limit Order Book Simulations
  - Reinforcement Learning

Module 8 – Backtesting and Performance Measurement

- Performance:
  - Sharpe & Sortino ratio etc.
  - Distribution of Drawdowns.
  - Impact of Leverage and Margining.
  - Accounting for Funding and other Costs.
  - Strengths and shortcomings of different approaches.
  - Back-testing, Simulations, and Hyper-parameter

- Tuning:
  - Approaches to back-testing
  - Using Time Windows
  - Training/Testing/Holdout Sets
  - Cross-validation
  - Possible biases

- Optimization:
  - Classical Optimization
  - Bayesian Optimization
  - Bandits, Stopping Rules and Genetic algorithms
  - Multi-Objective Optimization
  - Off the shelf tools

Module 9 – Allocation and Risk Management

- Mean-variance optimization:
  - Efficient Frontier
  - Allocation in Reality – Impact of volatility and Frictions
  - Quadratic Programming and Convex Optimization

- Constraints:
  - Margin and Leverage
  - Funding
  - Limits – Sector, sub-sector, strategy, name

- Correlations:
  - Approaches to Estimating the Correlation Matrix
  - PCA and Factor Analysis
  - Dealing with Numerical Issues such as Sparseness
  - Shrinkage Methods

- Market & Liquidity Risk:
  - Measuring Exposures to the Overall Market, Individual Sectors and Specific Factors
  - Correlation Estimation
  - Principal Component Analysis
  - Simulation and Stress Testing

- Credit Risk:
  - Modelling Default Intensity and Recover
  - Counterparty Credit Risk
  - Managing Credit Risk across the Firm

- Limits:
  - Value at Risk and Expected Shortfall
  - Setting Stop-Loss and other Limit Orders
  - Limits to Gross/Net Exposure to Rates/FX etc

- Operational & Legal/Regulatory Risk:
  - Important to Capture as much as possible using Quantitative Techniques
  - Avoidance vs Mitigation

Programming Languages and Platforms

Python Programming Language
Faster Methods – C, C++, Rust and Java
Trading Platforms
Risk Management

Final Project

- Project Description
- Project Requirements
- Project Grading Criteria

Summary

- Key takeaways
- Designing your own strategies
- Doing active research
- Sourcing and cleaning data
- Algorithmic Trading Bootcamp: A Practitioner's Guide
- Keeping tech stack up-to-date
- Maintenance and Improvement
- Next steps

Course leaders

Dr. Nick Firoozye

Dr. Nick Firoozye is a mathematician with over 20 years of experience in the finance industry, in both buy and sell-side firms, in research, structuring and systematic trading.

He is currently Managing Director and Head of FI Systematic Trading at a small securities trading shop in NY. He is an Honorary Professor in Computer Science at University College London, focusing on OnlineLearning, Reinforcement Learning, Robust Machine Learning and of course Statistics in Finance. He co-authored a book, entitled *Managing Uncertainty, Mitigating Risk*, about the role of uncertainty in finance, in light of the many recent financial crises.

Nick began teaching Algorithmic Trading Strategies as a PhD reading course in 2015 and since then Nick adapted the material to create an MSc course which has run for the past 4 years. Nick has had over 500 students successfully taking his online and UCL courses to date. Nick got his PhD at Courant Institute, NYU, and taught for a number of years at U of MN, Heriot-Watt, University of Bonn, NYU, and then finally at University of Illinois where he was an Asst Prof, before leaving academia for Wall Street.

Dr Brian Healy

Dr Brian Healy is a mathematician with over 20 years experience in financial markets as a quant, trader, researcher and strategist. He began his career as an exotic options quant & trader with extensive experience in all asset classes, particularly fixed income and foreign Algorithmic Trading: A Practitioner's Guide 16 exchange, at leading investment banks including Citigroup, Barclays Capital and Deutsche Bank.

Since leaving banking he has run a very successful consultancy business which specialises in building models using the latest mathematical, statistical and machine learning techniques. Clients include asset managers, market-making firms, private capital firms as well as tech companies.

Brian is an expert in all aspects of markets, particularly quantitative strategies, options and other derivatives and predictive modelling. In addition to his work with industry he is also an industry professor of machine learning and data analytics at UCL, a lecturer in finance at UCD, a researcher and lecturer in mathematical and computational finance at Stanford University, is an author of many peer reviewed papers in mathematical finance and frequent speaker at conferences and seminars.

Registration Form

Start date: Monday 4th March 2024

Regular Course Fee

☐ Full Course Fee: £3950.00 + UK VAT

20% VAT IS ONLY CHARGEABLE FOR RESIDENTS IN THE UK AND EU

Early Bird Discounts

☐ 20% until 19th January 2024

☐ 10% until 16th February 2024

☐ Discount code

To register, please fax or scan and email the completed booking form to:

E-mail: sales@wbstraining.com

DELEGATE DETAILS
NAME:
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JOB TITLE:
DEPARTMENT:
ADDRESS:
POSTCODE:
PHONE:
E-MAIL:
NATIONALITY:
DATE:
SIGNATURE:

REGIONAL & GROUP DISCOUNT:

The Algo Trading Certificate (ATC) offers global regional & group discount fee structures.

Group Discount: If 2 or more people from your institution wish to take The Algo Trading Certificate (ATC) please contact us. If you have a wider interest, preferred supplier agreements offer best value.

Regional Offers: Get in contact for offers in your geographic region.

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