SMU Master of Science in Quantitative Finance
Message from the Dean

Our Master of Science in Quantitative Finance (MQF) is a full-time postgraduate programme by coursework over 12 months. What is unique about our programme is that it leads to a master degree jointly awarded by the Singapore Management University (SMU) and the Cass Business School of the City University London. The synergy we have is that both the Cass Business School and our business school are located in two respective financial hubs of the world. Moreover, we have the same approach in our pedagogy, and we believe in providing students with not only in-depth knowledge of quantitative finance, but also the entrepreneurial way of thinking, so as to tackle new problems in the quantitative finance industry and beyond.

In addition, some of the elective modules will be taught by leaders of the quantitative asset management industry and their involvement will surely enhance our curriculum by widening the practical dimension of our master programme. We do not just teach financial mathematics. We want our graduate students to develop competence in both the rigour and the practical side of the industry. This is extremely important because we believe that mathematical models must be used appropriately in banking and finance applications.

The programme also offers a comprehensive job placement scheme. Students will have many opportunities to interact with potential employers ranging from banks, asset management companies, financial IT firms, consultancies, investment research/consulting firms, brokerage firms, exchanges, regulators, to financial data providers and oil companies. There will also be frequent industry talks and networking activities to broaden students’ horizons.

The Lee Kong Chian School of Business at SMU is a dynamic Asian business school with over 100 full-time faculty members and more than 3,000 students. Accredited by AACSB and EQUIS, the school offers undergraduate, master (including MBA) and doctoral programmes, and is affiliated with a number of SMU’s research centres.

Therefore, I strongly encourage you to join our MQF programme, and embark on a journey that can transform your future in the quantitative finance industry. You will find the 12-month learning experience rewarding, enriching, and of excellent quality.

Yours truly,
Professor Howard Thomas
Dean, Lee Kong Chian School of Business
LKC Chair in Strategic Management
Singapore Management University
Management of market risk, credit risk, and operational risk with extremal events in mind is quite impossible without a solid training in quantitative finance. Our Master of Science in Quantitative Finance (MQF) programme aims to nurture students who have a passion to apply quantitative and computational skills to tackle practical problems in derivative pricing, risk management, and algorithmic trading.

These days, trading and hedging tactics such as butterfly spread, delta-gamma neutral hedge, volatility swap, and so forth, have become common staples of financial institutions. Participation in long-short trading, intra-market spreading, inter-market spreading, and quanto trading requires a significant amount of quantitative background.

What is the fair price of a quanto futures? How can risk be measured and hedged? Are there trading strategies that generate profit consistently?

Applied Mathematics + Statistics + Computing + Finance = Quantitative Finance answers these questions and more by using a systematic framework. This MQF programme provides a pathway for aspiring students to acquire the essence of a portfolio of principled methods to steward investments while minimising risk exposures.

Our partner, Cass Business School of the City University London, will be teaching five core modules. Thus you shall have the opportunity to study together with fellow MQF students of one of the top business schools in UK.

In addition to the Cass Business School’s endorsement on the joint degree scroll, another distinction that really makes our curriculum one of its kind, at least in Singapore, is that we are using industry-grade software to help you learn how to implement high-frequency trading algorithms to exploit any market inefficiencies, even in a split second. This is a sparkling example of SMU being different, innovative, and forward looking.

I invite you, therefore, to join us and experience the rewarding and intellectually stimulating environment this programme provides at SMU and Cass.

Yours truly,
Dr Christopher Ting
Associate Professor of Quantitative Finance (Practice)
Director, Master of Science in Quantitative Finance
Singapore Management University
About MQF

Quantitative Finance (QF) is a discipline that straddles across banking and finance, statistics, computer science, and financial mathematics. It brings to the table a suite of models to grasp the incomprehensible, and tools to operate in the boiling volatility of financial markets around the world.

The Singapore Management University (SMU) Master of Science in Quantitative Finance programme (MQF) provides a pathway to equip students with the knowledge to tame risk while staying on top of the game. This programme offers students a unique learning journey in the realm of stochastic processes, Ito's calculus, risk analytics, pricing & hedging, and quant trading. Even so, the courses are conducted in SMU’s Lee Kong Chian School of Business and the Cass Business School of the City University London. These two Business schools are situated right in the heart of Singapore and London, where the financial districts are buzzing with opportunities and where a new generation of quant professionals is needed to make a difference in the financial industry. At the end of the journey when all the rigorous tests are cleared and when the tale of two cities is storied, a master degree in quantitative finance will be awarded jointly by SMU and the Cass Business School.

The Programme

OVERVIEW

SMU and the City University London jointly offer the Master of Science in Quantitative Finance (MQF) by coursework. This is a full-time programme and is to be completed within 12 months. It caters to the need identified by the Monetary Authority of Singapore (MAS) - to groom a critical mass of specialists in quantitative finance, which is the objective underlying the second phase of MAS’ Finance Scholarship Programme.

PROGRAMME FEATURES

• Tailored to meet the three keys areas of pricing and hedging, risk analytics and management, and quantitative trading and investment
• Taught by experienced faculty and industrial professionals
• Provides an international perspective of global financial markets and instruments including characteristics of an Asian milieu
• Students are exposed to opportunities to design and implement quantitative trading strategies

PROGRAMME STRUCTURE

To satisfy the requirements of this joint master degree programme, students must successfully complete nine core courses and five electives. SMU’s MQF is an intensive 12-month programme comprising three terms as follows:

<table>
<thead>
<tr>
<th>Term 1 (4 core modules)</th>
<th>Term 2** (5 core modules)</th>
<th>Term 3 (Choose 5 from any of the following electives)</th>
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<tbody>
<tr>
<td>Asset Pricing</td>
<td>Econometrics of Financial Markets</td>
<td>Quantitative Trading Strategies</td>
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<tr>
<td>Numerical Method I</td>
<td>Numerical Methods II</td>
<td>Portfolio Management</td>
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<tr>
<td>Derivatives</td>
<td>Risk Analysis</td>
<td>Stochastic Calculus</td>
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<td></td>
<td>Research Project Management Skills</td>
<td>Credit Risk Models</td>
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<td>Market Microstructure</td>
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*Compulsory preparatory classes will be conducted in early August prior to programme commencement in September.
**Term 2’s modules will be taught by the Cass faculty members at the Cass Business School, London.
ADMISSION CRITERIA

The MQF programme is open to all Singaporeans, Singapore permanent residents, and foreigners. The admission criteria are

• A good bachelor degree in a highly quantitative programme
• A good GMAT or verbal and quantitative test scores
• A good IELTS or TOEFL score if your graduate education was not in English

The Admissions Committee may use other methods to evaluate the qualifications of candidates (including written essays and/or interviews) to ensure that potential students have the intellectual capabilities and motivation to satisfy the academic rigour of a joint master degree from SMU and the Cass Business School. For more details on admission, please refer to www.business.smu.edu.sg/master-quantitative-finance

PROGRAMME FEES

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<tr>
<th>Application</th>
<th>Registration*</th>
<th>Tuition</th>
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<tbody>
<tr>
<td>S$50</td>
<td>S$5400 (Singaporeans / Permanent Residents); S$5500 (Foreigners)</td>
<td>S$38,000 (Inclusive of GST), payable in three instalments: First instalment payable by July – S$20,000, Second instalment payable by November – S$10,000, Third instalment payable by April (following year) – S$8,000</td>
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* The tuition fee is inclusive of the five modules taught at Cass Business School, London, UK.
** The tuition fee does not include meals, air travel, travel insurance, living and accommodation expenses in Singapore and overseas.

*(Non-refundable) Amount payable upon acceptance to the programme. $5000 will contribute to the first payment of tuition fees. The registration fee includes matriculation, examination fees, orientation activities, library and computer account.

Faculty

The Master of Science in Quantitative Finance programme has faculty from Singapore Management University and City London University. In addition, leading practitioners will be sharing their real-world experience and best practices in the quantitative finance industry.

Career

Investment banks, commercial banks, asset management companies, financial IT firms, consultancies, investment research/advisory firms, insurance companies, exchanges, regulators, brokerages, financial data providers and oil companies are the ones that hire quants, structurers, derivative traders, risk managers or analysts.

SMU has a comprehensive job placement scheme to connect our MQF students to many employment opportunities.
SYNOPSIS OF CORE MODULES

ASSET PRICING
This course introduces students to the basic concepts used for pricing and analysing financial securities, focusing on spot markets. The efficiency of financial markets is discussed together with the question of whether stock prices are predictable. The importance of the risk and its trade off with return will be analysed in depth. The course is academically rigorous in outlining theoretical models but also focuses on the practical applications and discusses empirical finding.

QUANTITATIVE ANALYSIS OF FINANCIAL MARKETS
Many quantitative hedge funds and proprietary trading shops seek to generate alpha consistently by unceasingly developing new and better trading strategies. Invariably, the R & D for this purpose involves analyzing enormous amount of financial and economic data of various types. By analyzing such data from a quantitative finance, or more pertinently, alpha-seeking perspective, this course aims to build a foundation for students to grasp the significance and implications of events in the financial markets. The topics covered in this course include the relevant econometrical and other statistical procedures. Students will study these procedural algorithms in detail through hands-on programming. The computing skills and quantitative finance knowledge and insights gained from this course will not only raise their analytical competency but also deepen their intuition on what is going on in the financial markets around the world.

ECONOMETRICS OF FINANCIAL MARKETS
This course provides detailed knowledge and understanding of the essential technical tools required to carry out advanced econometric research such as fractional integration and long memory processes. Students will gain insights into the implications of financial theories and the practical aspects of real-world modelling.

NUMERICAL METHODS I: FOUNDATIONS
In this course, computing concepts such as program structure, i/o handling, data types, arrays, expressions, control statements, and data structures are taught in parallel with, and applied to numerical methods such as root finding, non-linear equations, linear systems, interpolation, extrapolation, differentiation, integration, and random number generation techniques. Emphasis will be placed on the numerical concepts that are particularly applicable in QF, so as to achieve the learning outcome of having a strong theoretical foundation in basic numerical methods and the ability to implement them independently in Matlab.

DERIVATIVES
Over the past two decades, financial derivatives have been increasingly used for hedging and risk management. The importance of derivatives markets was highlighted in the 2008 financial crisis when excessive and improper use caused a global financial meltdown. The holistic understanding of derivatives is becoming more important than ever for modern financial practitioners. The course helps students to gain a better understanding of derivatives and derivatives markets and introduces them to the valuations and use of derivatives such as forwards, futures, options and swaps.

FIXED INCOME SECURITIES
This course acquaints students with the main modelling streams in fixed income securities; enables students to use models in this area in practical applications, and transmits to students the fundamental mathematical modelling techniques underpinning the subject. The syllabus includes bond pricing; yield curve; forward rate curve and the term structure of interest rates; duration and convexity; LIBOR rates; Heath-Jarrow-Morton approach to modelling interest rates; Vasicek, Hull-White (1&2 factor) models, and other single factor models for short rates; market models (BGM/Jamishidian approach); affine class of models; interest rate options, caps, floors and swaptions; credit risk instruments and concepts; structural models of credit risk; and pricing of credit derivatives.

RISK MANAGEMENT: THEORY & PRACTICE
The aim of this module is to develop a solid background for evaluating, managing and researching financial risk. To this end, students will learn to analyse and quantify risk according to current best practice in the markets. The syllabus includes GARCH and EWMA models and applications; multivariate analysis; VaR, marginal/incremental VaR; covariance estimation issues; derivatives positions and information from derivatives; risk mapping, simulation and bootstrapping; back-testing and stress testing; types of credit derivatives and types of models; and default dependency.

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Synopsis of Elective Modules

STOCHASTIC CALCULUS
In this course, students learn the fundamentals of stochastic calculus along with examples of their applications in pricing and hedging of financial derivatives. Brownian motion, the Girsanov theorem, the Ito formula, the change-of-numeraire technique, Markov processes, martingales and other basic techniques and tools of stochastic calculus and probability theory that are pertinent for the risk-neutral pricing framework (the framework in which financial derivatives are priced) are covered.

CREDIT RISK MODELS
The course is mostly about modelling credit risk of defaultable bonds, which are often a significant part of a bank or financial institution’s risk exposure and necessitates risk management and regulatory capital charge computations. The structural approach via Merton’s model, intensity-based approach, mixed approach, and other approaches based on more complex underlying jump-to-default processes will be studied. Modelling of probability of defaults can lead to pricing of default related instruments such as non-Treasury bonds, credit loans, and also a whole menu of credit derivatives. Key instruments such as credit default swaps, credit default options, correlated defaults and exotic default options will also be studied. The course will enable students to gain experience in knowing and understanding existing popular credit derivative models traded in the market, in learning to model new derivatives under different processes and instrument settings, and in calibrating the model or using it to evaluate risk exposures of such credit instruments owned by banks or funds.

MARKET MICROSTRUCTURE
With the advent of automated trading systems and high-frequency trading, a sizable proportion of trades is increasingly reliant on powerful computers to rapid-fire orders and to adjust risk exposure on a real-time basis. Analysis of limit-order books across different products and markets will become a norm in the future. This course prepares students to analyse the dynamics of limit-order books and to implement trading strategies that make use of the knowledge gained from the analysis of limit-order books, which are captured in the FIX (financial information exchange) protocol, the industry standard. For the implementation of quantitative trading strategies, students will gain further knowledge of using professional trading software such as Trading Technologies Pro or RTS, which are being used by many proprietary traders and brokerage firms. The course also discusses the price impact and how it can be minimised.

PRACTICAL GUIDE TO A FICC (FIXED INCOME, CURRENCY AND COMMODITIES) STRATEGIST
The course covers market best practices and practical considerations facing a strategist or quant in a trading department. The topics include (i) interest rate curve as well as building and understanding the market instruments and the basis swap; (ii) commodity risk and hedging; (iii) complex model calibration/bootstrapping considerations and implications; (iv) time value of money in reality and pricing with counterparty risk; and (v) how to put it all together to close a corporate hedging deal. Pro or RTS, which are being used by many proprietary traders and brokerage firms. The course also discusses the price impact and how it can be minimised.

BANK RISK MANAGEMENT
This course covers various types of risks a bank faces in its day-to-day operations, such as credit risk, market risk, liquidity risk, operational risk, and reputational risk. Risk management framework and risk management responsibilities within the organisation will be introduced. The course also covers the BASEL principles and standards for managing the key types of risks faced by banks.

PORTFOLIO MANAGEMENT
This course provides an overview on portfolio optimisation with market frictions, such as incompleteness, transaction costs, random time horizon, and so forth. The course also covers dynamic portfolio optimisation by applying the theory of stochastic control and how the martingale approach jointly used with convex duality. Portfolio insurance strategies such as OBPI and CPPI will also be discussed and mapped to realistic scenarios.

QUANTITATIVE TRADING STRATEGIES
This course focuses on trading strategies that exploit statistical arbitrage opportunities in cash equities, as well as exchange-traded futures and options. The syllabus includes risk models, factor analysis, construction of long-short market-neutral portfolios, relative value analysis, and how the performance of the strategies can be measured and back-tested, using both in-sample and out-of-sample frameworks for robustness.