

Subject Description Form

Subject Code	AMA566
Subject Title	Advanced Topics in High Frequency Trading
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	To introduce students some basic concepts and methods in stochastic modeling of market microstructure and high frequency trading. To provide a comprehensive view of some key mathematical foundations of algorithmic trading strategies including stochastic control and optimal execution. To enable students to master some implementation methods of these practical algorithmic trading using financial data and software.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: <ul style="list-style-type: none"> (a) Develop quantitative skills to interpret and analyze market microstructure and trading behavior; (b) Develop theoretical knowledge to identify, define and formulate some mathematical problems related to high frequency trading; (c) Master stochastic control methods to solve some optimal liquidation and optimal execution problems related to high frequency trading; (d) Produce basic numerical implementations of some practical algorithmic trading strategies using the historical financial data and software.
Subject Synopsis/ Indicative Syllabus	<p><u>Introduction to Market Microstructure:</u> Electronic market, market participants, trading types, trading costs, limit order books, measuring liquidity, asset prices and returns intraday, inter-arrival times, latency and tick size, market fragmentation, daily volume and volatility and intraday activity</p> <p><u>Stochastic Models and Stochastic Control:</u> Introduction to stochastic analysis, introduction to dynamic programming principle, dynamic programming equation, the optimal liquidation and execution problem, stochastic control for diffusion processes, stochastic control for counting processes, the introduction to some numerical methods</p> <p><u>Algorithmic Trading:</u> Liquidation without penalties, liquidation with temporary and permanent price impact, liquidation with only limit orders, liquidation with limit and market orders, introduction to numerical methods in algorithmic trading using the Bloomberg database</p>
Teaching/Learning Methodology	The subject will mainly be delivered through lectures and lab-based tutorials. The lectures will be conducted to introduce the theoretical background of algorithmic trading, mathematical foundations of stochastic models. The compute lab tutorials will provide the practical use of software and Bloomberg terminal.

Assessment Methods in Alignment with Intended Learning Outcomes	Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
			a	b	c	d
	1. Assignments/Project	30%	✓	✓	✓	✓
2. Midterm Test	20%	✓	✓	✓		
3. Examination	50%	✓	✓	✓	✓	
Total	100%					
<p>Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:</p> <p>This subject focuses on both the mathematical foundation and practical implementation of high frequency trading. Some of the algorithms are based on important mathematical models such as stochastic control and related optimal execution methods. Thus, Exam-based assessment is the most appropriate assessment method, including 20% midterm test and 50% examination.</p> <p>As this subject also emphasizes the practical side of market making and trading strategies, a mini-project that takes the weight of 20% is appropriate for assessing the intended learning outcomes (d). Moreover, 10% worth of assignments are included as a component of continuous assessment so as to keep students in progress.</p> <p>Continuous Assessment comprises of assignments, mini-project and test. A written examination is held at the end of the semester.</p>						
Student Study Effort Required	Class contact:					
	▪ Lecture				26 Hrs.	
	▪ Tutorial				13 Hrs.	
	Other student study effort:					
	▪ Assignments/Projects				58 Hrs.	
	▪ Self-study				40 Hrs.	
	Total student study effort					137 Hrs.
Reading List and References	<p><u>Textbook:</u> Cartea, A., Jaimungal, S., Penalva, J. Algorithmic and High-Frequency Trading Cambridge 2015</p> <p><u>References:</u> Leshik, E., Cralle, J. An Introduction to Wiley & Sons, Algorithmic Trading: Basic 2011 to Advanced Strategies</p>					

	Aldridge, I.	High Frequency Trading: A Practical Guide to Algorithmic Strategies and Trading Systems	Wiley & Sons 2010
	De Jong, F., Rindi, B.	The Microstructure of Financial Markets	Cambridge 2009
	Georgakopoulos, H.	Quantitative Trading with R	Palgrave Macmillan 2015
	Williams, R.	An Introduction to Trading in the Financial Markets: Technology, Networks and Data	Elsevier 2011
	Shreve, S.	Stochastic Calculus for Finance II: Continuous Time Models	Springer 2010