MaCuDE
Management Curriculum for the Digital Era

Finance Disciplinary Task Force
Phase I Report of the MaCuDE project[1]

Report on the Current State of Curricula in Finance

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Phase 1 Report of MaCuDE Project

Finance Task Force

1.Introduction

The aim of this project is to determine the state-of-the-art curriculum for global programmes in Finance. We analyse the curriculums of a selection of undergraduate programmes, graduate programmes and MBA programmes related to Finance and the content of their courses; looking closely at the curriculums of the schools represented within the task force and the top ranked Finance and MBA programmes in the world. Our focus is to understand the key skills students develop and digital technology taught in the curriculum and how students are prepared for careers in the Finance sector.

2. Data Collection

Our first step was to survey the task force and understand what the current curriculum offered within our combined task force looks like. The results presented gave us a stepping-stone to understand the common curriculum. We received data from 13 programmes from 7 of the institutions represented in the Task Force.

Many of the results were from Graduate programmes; we were unable to draw conclusions from the initial analysis on these results, there was particularly little detail at undergraduate level to compare.

It was clear from the initial survey that we were unable to draw definitive conclusions as to the state-of-the-art curriculum from such a small pool of data.

We decided to leverage student interns for data collection to address the gaps. We decided to analyse the Top 30 Finance programmes from the Financial Times rankings, the top 30 MBA programmes and the UG programmes of these Schools. The intention was to utilise codes to scrape the websites of these schools; looking closely at the programmes and identify any trends to get a broader idea of the state-of-the-art curriculum.

Due to the way websites were built in different countries, it became very challenging to scrape the websites for the data we needed. We decided to take a different approach and analyse each website manually to understand the content of the programmes. This was more time consuming but provided a stronger collection of data and ability to understand the nuances and complexities of each School and their programmes.

Websites from schools within the US and UK generally provided more information than those in Asia or the rest of Europe. The US and UK webpages often went into detail at course level, whereas we had to draw conclusions from the pages of the course titles for the rest of Europe and Asia.

3. MS Programmes

We reviewed data from 43 MS programmes across Europe, North America and Asia. The results gathered gave us a stepping-stone to understand the common curriculum.

Table A: % of programmes surveyed containing common themes as part of their core curriculum:

Core Courses	Overall	Europe	US	Asia
Corporate Finance	74%	89%	45%	50%
Investment Management	77%	79%	73%	75%
Accounting	33%	39%	18%	25%
Derivatives	44%	36%	55%	75%
Econometrics	44%	50%	36%	25%
Mathematics	40%	32%	64%	25%
Leadership	21%	25%	9%	25%

It's clear from Table A, a common core or compulsory curriculum for a Finance graduate programme would consist of courses in the following areas:

- **Corporate Finance**, covers all the key elements of company finance, valuation and risk management, building skills in assessing individual investment projects, valuing companies, and evaluating the sources of finance available to companies.
- **Investment Management**, provides students with skills and an understanding of techniques used for investment management where they can learn how to implement trading strategies and portfolio construction methods in a wide range of assets.
- **Derivatives**, students learn how to apply pricing techniques for a range of financial derivatives, equity and fixed income products.
- **Econometrics**, students are acquainted with a range of econometric techniques, to be able to undertake advanced empirical research. Students learn to analyse data from different sources.
- **Accounting**, students develop an understanding of how accountants prepare corporate financial reports. Skills include familiarisation with financial reporting systems, the role of judgments and estimates in the preparation and interpretation of financial reports, how to read, analyse and interpret financial reports and how to forecast future financial statements.
- **Mathematics**, as success in modern finance requires a solid grasp of mathematics, students are taught a range of essential mathematical tools and their applications to the field of finance.
- **Leadership**, students learn to develop softer skills with courses designed to accelerate their career in business or Finance.

Many programmes provide students with an understanding of these theories and are often theoretical and academic in nature.

Corporate Finance and *Investment Management* themes were the most prevalent in the core curriculum and to a lesser extent, *Econometrics*. *Derivatives*, *Accounting* and *Mathematics* were found to be Core modules for under half the programmes surveyed. The majority of the top ranked programmes would contain a mixture of these themes in their core and we found others that didn't provide students with opportunities to study them in either elective courses or specialisms.

Many programmes we looked at in the US had a focus on quantitative and digital skills. These did not always have a core module in *Corporate Finance* but did include *Mathematics* and *Derivatives* themes.

3.1 Digital Curriculum in MS Programmes

Ou focus is on the ways in which the programmes develop skills in modern technologies to better equip students for the Finance sector. We were interested in what courses were designed for the Finance in the digital era.

Many general MS Finance programmes would offer opportunities for the development of digital skills in their elective portfolio or a specialism route.

Table B: % of programmed surveyed that containing common themes as part of their elective courses

Elective Courses	Overall	Europe	US	Asia
Corporate Finance	60%	75%	27%	50%
Investment Management	60%	79%	27%	25%
Accounting	5%	7%	0%	0%
Derivatives / Fixed Income	44%	50%	18%	75%
Econometrics	14%	18%	9%	0%
Mathematics	14%	18%	9%	0%
Risk Management	40%	46%	36%	0%
Financial Engineering	19%	21%	18%	0%
Data Analytics	47%	43%	55%	50%
Machine Learning	30%	14%	73%	25%
Blockchain and Cryptocurrencies	21%	18%	27%	25%
Programming	47%	54%	36%	25%
Algorithms	26%	25%	36%	0%
Computational Finance	26%	18%	36%	50%
Financial Technology	33%	39%	18%	25%
Ethics	28%	32%	18%	25%

Most courses had elective themes in *Corporate Finance*; including Mergers and Acquisitions; Corporate Strategy, Valuation and Private Equity. *Investment Management* courses incorporated courses in Wealth Management, Asset Allocation, Trading Strategies and Alternative Investments. Many programmes offered a range of courses in these fields.

Other popular electives included courses in Derivatives/Fixed Income and Risk Management.

When looking more closely at Digital Themes we found new and modernized courses which we grouped into the following areas:

1. Data Analytics and Machine Learning
2. Programming
3. Financial Technology
4. Blockchain and Cryptocurrencies

5. Algorithmic Trading

Data Analytics and Machine Learning

Within the sector, there has been an increased interest in the use of large datasets and new empirical techniques to make financial decisions. It has become necessary to examine how the combination of large datasets and empirical techniques are helping companies make more efficient financial decisions. 47% of the programmes reviewed included an elective in Big Data. Some of the more technical or quantitative programmes had opted to include data analytics in their Core Modules. We found courses of a practical nature were offered in the field of Machine Learning where students were offered opportunities to develop skills and master advanced machine learning techniques with the purpose of handling large data sets, extract value from them and tackle decision making challenges and problems within the financial domain.

Examples:

- Carnegie Mellon University – Financial Data Science
- London Business School - Data Analytics for Finance
- Essec Business School – Big Data Analytics
- Weatherhead School of Management, Case Western Reserve University – Financial Models Using Big Data
- MIT Sloan – Advanced Data Analytics and Machine Learning in Finance
- Imperial College Business School – Big Data in Finance
- Shanghai Advanced Institute of Finance – Statistics and Machine Learning Track

Programming

47% of Schools listed a course in the development of coding skills. Programming has become an essential skill in the sector and many companies look for these skills for their graduate roles. The programming language varies across the Schools with Python and R being the most popular. Half of the programmes reviewed include a compulsory coding course focused on skill development as a pre-requisite for more digital focused electives or specialisations. Some courses require a programming language as a pre-requisite before study.

Programming appears less in the curriculums of the Asian Schools we reviewed, although they may be present in the module outlines which are not present in the websites.

Table C: % of programming languages used in the programming courses included in surveyed MS programmes

Python	55%
R	40%
VBA	15%
C++	10%
Matlab	10%

Programming can be a stand-alone course or is embedded as a skill developed in other modules.

- Imperial College Business School – Application of R for Finance – Here the R programming language is taught as a skill specifically with Finance data.
- Stockholm School of Economics – Investment Strategies – an example of a course where programming skills are developed as part of coursework. The course stipulates '*All course work can be undertaken either in Excel or in Matlab'*.
- MIT: Sloan – Financial Engineering – Here students are informed there is a substantial coding requirement. All materials are in R but they are not required to use R for assignments and projects.

Financial Technology

For the Schools where technology or digital skills are not at the heart of their curriculums, they may include a course on Financial Technology, providing a theoretical or historical overview of the FinTech sector, how firms use technology to manage risk and how technologies have evolved to upset existing financial processes. Programmes, particularly in European Schools may include an elective in their portfolio covering FinTech in contrast to the other schools that are developing entire programmes around Financial Technology. Financial technology courses are a popular way of covering many digital finance related skills. Course outlines contain themes such as Blockchain, Cryptocurrencies, Big Data, Machine Learning as a whole but do not provide a deeper understanding of these subjects.

Example:

- London Business School - FinTech
- Bocconi – Bank and FinTech: Vision and Strategy
- NYU Stern - Fundamentals of FinTech

Blockchain and Cryptocurrencies

Blockchain and cryptocurrencies may pave the way for the future of financial services. Some schools are dedicating modules to this area. Modules generally cover the core aspects of the technology with reference to Bitcoin and other crypto assets. One interesting module from Case Western Reserve looks at the duel impact and disruption of Blockchain and Artificial Intelligence on Businesses.

Examples:

- MIT Sloan – Practice of Finance: Crypto Finance
- Imperial College Business School – Blockchain and Crypto Assets
- Weatherhead School of Management, Case Western Reserve University - Blockchains and AI: Applications in Finance and Business

Algorithmic Trading

Algorithmic Trading has become key in managing investments. Courses look closely at analytical techniques and quantitative methods relevant for algorithmic trading strategies. It must be noted, it's not always possible to identify that the nature of the course is algorithmic trading from the title. As many European and Asian Schools do not provide course outlines on their websites, we feel the % of

courses that offer this theme would likely be higher. From a sample of the courses that we uncovered outlines for, it was clear Algorithms were taught within modules as opposed to being the core focus of the module itself. For example, algorithmic trading is taught in Investment focused courses.

- Imperial College Business School – Introduction to Quantitative Investing
- MIT Sloan – Financial Data Science and Computing
- Stevens Institute of technology – Algorithmic Trading Strategies

Digital Themes are more prominent in the US courses included (we focused on US Schools with a focus on Technology). Machine Learning, Big Data and Data Analytics were a stronger theme in this region with some of these modules included as Core.

3.2 Specialisations in MS Programmes

General MS Programmes offer either a suite of electives to choose from or specialisations. From the programmes that offer that latter, common pathways are in the areas of Corporate Finance and Investment Management. Financial technology is emerging as a modern pathway for Finance.

Table D: Number of specialised pathways offered on Finance programmes:

Specialisations	
Corporate Finance	12
Investments Management	9
Corporate Strategy	3
Financial Engineering and Data Analytics	4
Financial Technology	8
Risk Management	3

Examples:

HEC Paris, IE Business School and Tsinghua University School of Economics and Management offer a specific FinTech pathway to their Finance students which enable students to dive into the areas of FinTech with a focus on Quantitative Finance, Blockchain and Cryptocurrencies, Big Data and Data Analysis.

3.3 Suites within MS Programmes

A few schools offer a suite of Finance programmes,

The Suite option is more common in Europe where students select their specialism prior to study. The core modules on Specialist Finance programmes are catered to the specialism and omit in depth study in other areas, particularly Corporate Finance, if studying a digital focused programme. Non-digital themes can be offered as electives. US Schools have specialisms but it's more common for there to be one Programme.

Imperial and Neoma both have a suite of Programmes:

Imperial College Business School

- MSc Finance
- MSc Finance & Accounting
- MSc Financial Technology
- MSc Investment & Wealth Management
- MSc Risk Management & Financial Engineering

Neoma Business School

- MSc Accounting, Auditing & Advisory
- MSc Corporate Finance
- MSc Master of Science Finance & Big Data
- MSc Finance, Investment & Wealth Management
- MSc Financial Markets & Technologies

Both Schools use different sectors of finance and cater a specialised MS programme for these sectors; from the less quantitative *Corporate Finance* to *Investment Management* and more quantitative themes such as *Financial Technology* and *Data Analysis.*

The specialisation structure allows students to decide on a programme to meet their career objectives at application stage. Both suites offer a pool of electives that run across the suite. Electives are allocated to programmes depending on whether students develop prerequisite knowledge in their core modules. Students can then decide to continue to study topics in their electives that have been introduced to them in their core courses.

3.4 Modern MS Programmes

There has been a surge of new MS programmes specialising in digital skills too. Whereas generalist Finance programmes are designed with skillset in mind for students wishing to pursue careers in Investment Banking and Corporate Finance. These modern programmes focus on data-driven algorithmic trading, risk management, financial technology and quants roles.

A few examples:

- Financial Technology – Imperial College Business School
- Financial Engineering – Stevens Institute of Technology
- Computational Finance – Carnegie Mellon University

Investment Management and Corporate Finance are not the focus of these programmes, although these themes do appear still as core or elective courses. The focus is more mathematical and computational with computational themes like Programming, Big Data and Algorithmic Trading appearing in compulsory courses. The learning objectives cater to developing digital skills more than generalist Finance programmes.

Table E: Comparison of modern MS programmes by core modules:

		Imperial College Business School	**Stevens Institute of Technology**	**Carnegie Mellon University**
		MSc Financial Technology	**MS Financial Engineering**	**MS Computational Finance**
Core Modules	*Corporate Finance*	Accounting and Corporate Finance		
	Investments	Investments and Portfolio Management	Pricing and Hedging	Investments Asset Pricing
	Econometrics	Financial Econometrics with R/Python		
	Mathematics	Mathematics for Finance	Stochastic Calculus for Financial Engineers	Stochastic Calculus for Finance
	Programming and Computational Finance	Applications of R for Finance Python	Computational Methods in Finance	Financial Computing
	Data Analytics and Machine Learning	Big Data in Finance		Financial Data Science Machine Learning Financial Optimization
	Derivatives		Advanced Derivatives Portfolio Theory and Applications	Options Fixed Income
	Financial Engineering			Financial Engineering
	Blockchain	Blockchain and Applications		
	Leadership			Business Communication
	Ethics	Ethics and Professional Standards		

Table F: Comparison of modern MS programmes by elective options:

		Imperial College Business School	Stevens Institute of Technology	Carnegie Mellon University
		MSc Financial Technology	MS Financial Engineering	MS Computational Finance
Electives and Concenrtrations	*Corporate Finance*	Corporate Governance and Stewardship		
		Entrepreneurial Finance		
		Structured Credit and Equity Products		
	Investment Management	Asset Allocation & Investment Strategies		Asset Management
	Derivatives / Fixed Income	Advanced Options Theory		Advanced Derivative Models
		Fixed Income Securities		
		Derivatives		
	Econometrics	Text Mining for Economics and Finance		Macroeconomics for Computational Finance
	Mathematics		Financial Statistics	
	Risk Management		Financial Risk Engineering	Risk Management
	Data Analytics	Big Data in Finance II	Financial Analytics	
	Machine Learning	Machine Learning and Finance		Machine Learning Capstone
	Blockchain and Cryptocurrencies	Blockchain and Crypto Assets		
	Algorithms	Applied Trading Strategies	Algorithmic Trading Strategies	Market Microstructure and Algorithmic Trading
		Introduction to Quantitative Investing		
	Computational Finance	Computational Finance with C++	Financial Computing	Financial Computing
	Financial Technology	Innovation and Strategy in FinTech		

4. MBA Programmes

We reviewed 38 Schools with MBA programmes across US, Europe and Asia. We began with the Top 30 MBA programmes in the Financial Times and added other Schools with a technology focus.

Table G: % of MBA programmes surveyed using common finance themes as their core curriculum:

Core Courses	Overall	Europe	US	Asia*
Corporate Finance	74%	71%	64%	100%
Investment Management	16%	19%	18%	17%
Derivatives	0%	0%	0%	-
Econometrics	8%	14%	0%	-
Mathematics	3%	5%	0%	-
Accounting	79%	76%	73%	100%
Ethics	42%	52%	36%	17%

* Asian websites provide less information than US and Europe for all programmes, hence we could not gather as much data for these topics.

Many MBA programmes have core modules in Corporate Finance (74%) and Accounting (79%). Some schools have a general Finance module which predominantly consist of the basics in Corporate Finance and Investment Management. Financial Accounting and Management Accounting are also core themes for many programmes, these are often grouped together under one module.

Corporate Finance/Finance: As Corporate Finance matters, both to the success of organisations, and to economies. Students are taught how the business world is affected, and at times, influenced, by the financial decisions made by corporations. Modules look at understanding the major types of financial decisions made by corporations. Students develop a market-oriented framework for analysing a corporation's investment decisions and understand how these decisions impact business.

Accounting: Students learn the language used to measure and communicate firm's economic events to external stakeholders. Modules generally teach students how a company's financial reporting can help one understand a company's health. Most programmes teach both Financial Accounting and Management Accounting, sometimes in two modules, other times as a combined module.

4.1 Digital Curriculum in MBA Programmes

We looked closely at optional courses, either as electives, specialisations or pathways in which students could select further study within the area of Finance.

Table H: % of MBA Programmes surveyed using common finance themes as part of their elective courses:

Elective Courses	Overall	Europe	US	Asia
Corporate Finance	87%	95%	73%	83%
Investment Management	82%	86%	73%	83%
Accounting	26%	29%	27%	17%

Derivatives / Fixed Income	24%	24%	18%	33%
Econometrics	3%	5%	0%	0%
Mathematics	0%	0%	0%	0%
Risk Management	13%	10%	9%	33%
Financial Engineering	3%	5%	0%	0%
Data Analytics	74%	90%	45%	67%
Machine Learning	5%	0%	9%	17%
Blockchain and Cryptocurrencies	11%	5%	0%	50%
Programming	13%	14%	18%	0%
Algorithms	0%	0%	0%	0%
Computational Finance	0%	0%	0%	0%
Financial Technology	39%	29%	55%	50%
Ethics	42%	52%	36%	17%

From the table we can deduce, 87% of Schools offer further study in corporate finance topics in their electives and 82% offer topics in investment management. These were the most common topics within MS programmes too, where 60% of Schools offered courses in both topics. There were fewer digital topics taught in MBA programmes with a Finance focus. The most common topics we identified were Data Analytics (74%) and Financial Technology (39%).

Data Analytics

74% of programmes offered Data Analytics as an elective course. We found data analytics topics were becoming common as a core module too. Courses focused on introducing students to modelling techniques and analyse data to understand relationships, predict future outcomes, and solve complex problems; and understanding the nature of risk and uncertainty. Most courses focused on Business Analytics in general without a specific focus on Finance. Some courses included basic coding and programming skills.

- Carnegie Mellon University - Analytics
- Instead - Data Science for Business
- Stevens Institute of Technology - Financial Analytics Pathway
- Yale School of Management - Big Data

Financial Technology

39% of programmes had an elective module in Financial Technology. These courses were an overview of the FinTech space where students gain insights into the financial sector and how technology is disrupting business and how companies are changing in response to the digital revolution. These courses are broader in nature to specialised courses in Blockchain, Computational Finance or Machine Learning that you'd find in MS programmes. These courses didn't always describe teaching of specific digital skills.

- University of Oxford – FinTech: Present and Future London
- IMD Business School – FinTech, Blockchain and Future of Banks
- HKU Business School – The Emergence of FinTech and It's Impact on Global Finance & Banking

Programming

13% of programmes had stand-alone programming or coding courses. There is less focus on programming or coding skills in MBA courses. Similarly, to the MS programmes, there was less focus from Asian programmes on including coding in their curriculum. Only 25% of Asian programmes contained a programming module (Table B).

The following modules use coding as a credit bearing elective course:

- London Business School – Python for Finance
- New York University: Stern - Programming in Python

Courses in Analytics or Finance sometimes require a knowledge of coding as a pre-requisite but few Schools seems to provide a coding course as part of the MBA curriculum.

Other courses such as Cornell University's Data Modeling & Analytics would include coding or programming as part of their coursework.

4.2 Finance Pathways or Specialisations in MBA Programmes

General Finance

- HEC Paris – Finance Specialisation
- National University of Singapore – Finance Specialisation

For universities that offer students a concentration/specialisation, there were usually a Finance route or pathway students could opt to choose. These pathways consist of a grouping of Finance electives. The common pathways include a generalised '*Finance'* offering consisting of Corporate Finance, Investment Management and the common Finance themes. Other Finance specialisations (for example the National University of Singapore) have a larger group of courses to choose from similar to an elective portfolio at MS level.

Data Analytics

- Chicago Booth - Analytic Finance
- Stevens Institute of Technology - Financial Analytics Pathway

Several institutions developed further specialised Finance pathways. For example, Chicago Booth has an Analytic Finance pathway which provides students with '*cutting-edge analysis and the opportunity to build the quantitative tools needed to sift through complex financial data and create innovative solutions to pressing financial issues.*'

Financial Technology

- New York University: Stern – Financial Technology Pathway

New York University has a FinTech specialisation for students to select. The pathway covers *'technology-enabled business model innovation in the financial sector including cryptocurrencies and*

the blockchain, digital advisory and trading systems, artificial intelligence and machine learning, peer-to-peer lending, equity crowdfunding and mobile payment systems.'

Electives include:

1) *Digital Currencies, Blockchains and Financial Services Industry*
2) *Applications in Entrepreneurial Finance*: *FinTech*
3) *Systematic Trading*
4) *FinTech Analytics*

- Cornell SC Johnson College of Business – FinTech Intensive

Designed for students looking to work in the tech sector, Cornell's fintech intensive MBA, '*provides hands-on learning in the emerging financial technology sector'*.

Modules include:

1) *Blockchains and Cryptocurrencies*
2) *Business Models*
3) *FinTech Practicum*
4) *FinTech Group Field Project*

Financial Engineering

- Stevens Institute of Technology – Financial Engineering Pathway

Stevens have several Finance specialisms (concentrations) students can select electives from. One, for example, is Financial Engineering, a more quantitative selection of electives providing mathematical foundation for finance theories. The electives portfolio allows students to select courses with a development of digital skills from algorithms in *Computational Methods in Finance* to linear programming in *Portfolio Theory and Applications*.

Electives include:

1) *Stochastic Calculus for Financial Engineers*
2) *Risk Management*
3) *Computational Methods in Finance*
4) *Portfolio Theory and Applications*

4.3 Modern Tech MBA Programmes

There are a couple of new MBA programmes specialising in Tech. These MBAs are designed for the Technology sector. The focus is more concentrated on digital skills. For those interested in careers in the Finance sector, the traditional MBA programmes with Finance specialisations or pathways, may be more suited. However, these new programmes should be identified as opportunities for students seeking development in the new digital world.

New York University – Tech MBA

NYU has developed a Tech MBA. The programme focuses on Technology. It is a STEM designated degree programme. Core Modules include *Dealing with Data*, *Business Analytics*, *Tech Solutions* and *Emerging Technologies*.

IE Business School - Tech MBA

IE also has a unique Tech MBA which 'inspires professionals who seek to be fluent in the language of business and tech, getting them ready to lead the fast and continuous pace of technology evolution.' There are three specialised tracks: Digital Transformation, Data Analytics and AI, and Digital Finance.

5. UG Programmes

We reviewed the undergraduate programmes with Majors and Minors in Finance from all the Business Schools with top ranked MBA and MS programmes across US, Europe and Asia. Many Schools did not offer courses at UG level, so we expanded the pool to include Schools with a technology focus. Overall, we reviewed 22 UG programmes. We present the results below:

Table I: % of UG programmes surveyed (with Finance majors and minors) using common Finance themes as part of their core curriculum:

Core Courses	Overall	Europe	US	Asia
Corporate Finance	86%	100%	87%	75%
Investment Management	73%	100%	67%	75%
Derivatives	18%	67%	7%	25%
Econometrics	23%	100%	13%	-
Mathematics	32%	100%	27%	-
Management	9%	33%	7%	-
Accounting	27%	67%	27%	-
Ethics	5%	0%	7%	-

* Asian websites provide less information than US and Europe for all programmes, hence we could not gather as much data for these topics.

Similarly, to the MBA programmes, the majority of Finance topics covered at UG level had core courses teaching Corporate Finance (86%) and Investment Management (73%). UG programmes tend to be more quantitative in nature than the MBA with 32% of Schools including a core course in Mathematics where only 3% of MBA programmes surveyed had Mathematics as a core module (as evident in Table G.)

5.1 Digital Curriculum in UG Programmes

Table J: % of UG Programmes surveyed (with a major or minor in Finance) using common finance themes as part of their elective courses:

Elective Courses	Overall	Europe	US	Asia

Corporate Finance	50%	0%	60%	50%
Investment Management	55%	0%	67%	50%
Accounting	9%	0%	7%	25%
Derivatives / Fixed Income	41%	33%	47%	25%
Econometrics	23%	0%	33%	0%
Mathematics	14%	0%	13%	25%
Risk Management	45%	33%	60%	0%
Financial Engineering	9%	0%	13%	0%
Data Analytics	45%	67%	53%	0%
Machine Learning	5%	0%	7%	0%
Blockchain and Cryptocurrencies	5%	0%	7%	0%
Programming	9%	33%	13%	0%
Algorithms	0%	0%	13%	0%
Computational Finance	9%	0%	13%	0%
Financial Technology	32%	0%	33%	50%
Ethics	5%	0%	7%	0%

We found UG webpages generally contain less detail than those for graduate programmes. Electives and combinations of courses that provide students with either major or minor in Finance, tend to specialise in areas of Corporate Finance, Investment Management, Derivatives, Risk Management and Econometrics. Similarly to the MBA programmes, there were two digital topics that were most common: Data Analytics and Financial Technology.

Data Analytics

45% of Schools had an elective in Data Analytics. Electives have more of a Finance focus, resembling the content of MS Finance programmes. This contrasts with the MBA programmes, where modules have a broader business focus.

- Case Western Reserve University – Advanced Financial Analytics
- Santa Clara University – Applying Financial Models to Financial Data
- University of Warwick – Business Analytics
- MIT Sloan - Financial Data Science and Computing / Advanced Analytics of Finance

Financial Technology

32 % of Schools had an elective in Financial Technology. Similarly, to the MBA programmes, electives are broad in nature and usually consist of 'introductions' to the sector of FinTech.

- Case Western Reserve University – Introduction to FinTech
- New York University – Foundations of FinTech
- Columbia University - FinTech Innovation & the Transformation of Financial Services
- National University of Singapore - FinTech and Financial Data Analytics

Programming

Programming languages were not found as courses in many of the programmes reviewed. In the few instances (9%) where they were found (for example at Stevens and LSE), programming skills were taught as part of the core curriculum. We had expected to find more evidence of programming taught at UG level as some MS courses refer to using programming and coding skills developed at UG level. However, that was not the case. It could be that these offerings were not highlighted on the website.

- London School of Economics - Programming for Data Science
- Stevens Institute of Technology – C++ for Finance

5.2 Specialisations in UG Programmes

Finance

Examples of programmes embodying the common finance themes in their core offerings are the MIT Sloan UG *Finance* major (it also has a large amount of electives for students to develop their digital skills); and the London School of Economics UG programme; which is typical of a UK Finance programme, incorporates all the common core modules outlined in Table H.

- MIT Sloan - Finance Major
- London School of Economics - BSc Finance

Financial Engineering and Financial Technology

More refined and specialised offerings include Stevens Institute of Technology, which has a *Quantitative Finance* major. The major consists of more quantitative and computational core modules such as *Programming*, *Data Analytics* and *Algorithms*. There is a less of a Corporate Finance focus on this programme. Worcester Polytechnic Institute is unique in that it has a FinTech minor for students to take, complimenting their technical degrees. It is designed specifically for students who want to expand their knowledge of the FinTech sector for a career path in this field.

- Stevens Institute of Technology - Quantitative Finance Major
- Worcester Polytechnic Institute - Minor in Financial Technology

6 External Bodies that Influence the Curriculum

Chartered Financial Analyst Institute (CFA)

We noticed that many Schools offer optional CFA Institute accreditation with their programmes. As a member of the CFA University Affiliation Program, Schools help students from UG and MS finance programmes obtain their Chartered Financial Analyst designation, which is the most recognised investment credential in the world.

The CFA Institute is an international organisation that codifies the skills and training of investment professionals. Its CFA Program is a global standard qualification and a prestigious addition to a students' Curriculum Vitae when applying for top-tier finance firms.

For School's that offer the CFA accreditation, the curriculum is closely tied to the CFA examinations and the CFA Program Candidate Body of Knowledge (CBOK) including ethical and professional standards. Accreditation status is given where 70% of the CFA curriculum is embedded in the School's curriculum. This gives students the ability to take the CFA examinations either during or directly after their programme is completed.

The CFA accreditation is a significant factor impacting the curriculum offered by the School. The CFA accreditation can be a major factor for students selecting their course.

Financial Times (FT) Ranking

Many schools participate in ranking their programmes with various publications, globally the most influential is the Financial Times. Students use rankings to decide what programme to select for their career goals. Rankings are a key tool for Schools' marketing and admissions teams to ensure a strong pool of students are offered places on their programmes.

There are curriculum specific criteria for a programme to be eligible for the FT ranking. For Finance, one of the criteria is that the programme must be generalist in nature and not specialised. For example, '*Masters in financial engineering degrees are not included in these rankings as they tend to place greater emphasis on quantitative skills*.'

The nature of the rankings could perhaps be a reason why more quantitative programmes are not favoured over generalist programmes to enable the Schools to participate in a ranking strategy.

7. Summary and Reflection

We summarise our findings in Table K below. We compare the core modules across the MS, MBA and UG programmes. In Table L we compare the electives. The common topics of Corporate Finance and Investment Management are prominent in both core and elective courses. Digital Topics are starting to appear in MS, MBA and UG programmes. There is a trend developing with new digital electives starting to be offered in the US and catching up in Asia and Europe.

7.1 Comparison Tables

Table K: Comparison of % of programmes containing common finance themes across UG, MS and MBA:

Core Courses	Overall			Europe			US			Asia*		
	UG	**MS**	**MBA**	**UG**	**MS**	**MBA**	**UG**	**MS**	**MBA**	**UG**	**MS**	**MBA**
Corporate Finance	86%	74%	74%	100%	89%	71%	87%	45%	64%	75%	50%	100%
Investment Management	73%	77%	16%	100%	79%	19%	67%	73%	18%	75%	75%	17%
Derivatives	18%	44%	0%	67%	36%	0%	7%	55%	0%	25%	75%	-
Econometrics	23%	44%	8%	100%	50%	14%	13%	36%	0%	-	25%	-
Mathematics	32%	40%	3%	100%	32%	5%	27%	64%	0%	-	25%	-
Accounting	27%	33%	79%	67%	39%	76%	27%	18%	73%	-	25%	100%

Ethics	5%	28%	42%	0%	32%	52%	7%	18%	36%	-	25%	17%

* Asian websites provide less information than US and Europe for all programmes, hence we could not gather as much data for these topics.

Table L: Comparison of % of programmes containing common finance themes across UG, MS and MBA:

Electives	Overall			Europe			US			Asia*		
	UG	**MS**	**MBA**	**UG**	**MS**	**MBA**	**UG**	**MS**	**MBA**	**UG**	**MS**	**MBA**
Corporate Finance	50%	60%	87%	0%	75%	95%	60%	27%	73%	50%	50%	83%
Investment Management	55%	60%	82%	0%	79%	86%	67%	27%	73%	50%	25%	83%
Accounting	9%	5%	26%	0%	7%	29%	7%	0%	27%	25%	0%	17%
Derivatives / Fixed Income	41%	44%	24%	33%	50%	24%	47%	18%	18%	25%	75%	33%
Econometrics	23%	14%	3%	0%	18%	5%	33%	9%	0%	0%	0%	0%
Mathematics	14%	14%	0%	0%	18%	0%	13%	9%	0%	25%	0%	0%
Risk Management	45%	40%	13%	33%	46%	10%	60%	36%	9%	0%	0%	33%
Financial Engineering	9%	19%	3%	0%	21%	5%	13%	18%	0%	0%	0%	0%
Data Analytics	45%	47%	74%	67%	43%	90%	53%	55%	45%	0%	50%	67%
Machine Learning	5%	30%	5%	0%	14%	0%	7%	73%	9%	0%	25%	17%
Blockchain and Cryptocurrencies	5%	21%	11%	0%	18%	5%	7%	27%	0%	0%	25%	50%
Programming	9%	47%	13%	33%	54%	14%	13%	36%	18%	0%	25%	0%
Algorithms	0%	26%	0%	0%	25%	0%	13%	36%	0%	0%	0%	0%
Computational Finance	9%	26%	0%	0%	18%	0%	13%	36%	0%	0%	50%	0%
Financial Technology	32%	33%	39%	0%	39%	29%	33%	18%	55%	50%	25%	50%

7.2 Ethics

28% of MS programmes have a unique ethics course to Finance. Most modules concentrate on the professional standards for financial analysts and responsibilities for ethical practice in finance. Students are introduced to the forms of regulation in place to ensure financial stability. The majority of the top ranked generalist finance programmes include a stand-alone ethics course. There is a much stronger concentration on Ethics in MBA programmes than what we found in MS Finance programmes. 42% or programmes contained a stand-alone Ethics module, often as part of the Core

Curriculum. Dartmouth College stood out as they have several Ethics and Social Responsibility focussed courses for students to select from. We found very little evidence of Ethics taught in UG programmes.

Examples of Ethics Courses:

- MIT Sloan – Finance Ethics & Regulation
- Imperial College Business School – Ethics and Professional Standards in Practice
- Dartmouth College: Tuck – Ethics and Social Responsibility
- Stockholm School of Economics – Financial Stability and Regulation

7.3 Key Findings and Trends:

- Digital transformation is impacting the Finance sector, new skills are needed as the sector adopts new technologies and processes.
- Digital content in Finance can be grouped into five categories, Data Analytics and Machine Learning, Programming, Algorithms, Blockchain and Crypto Currencies and Financial Technology. These categories compliment the common traditional subject areas of Corporate Finance and Investment Management.
- There is a stronger focus on digital skills within Finance in MS Finance programmes than UG or MBA programmes.
- Many Schools have developed new elective courses, specialisations and pathways to address the new digital skillset needed by the sector. Most of these courses are optional electives. Corporate Finance and Investment Management remain the most popular core modules.
- Some Schools have developed new programmes to address digital skills in Financial Technology and Financial Engineering. These new programmes tailor to digital skill development in their core content with further specialisation in portfolios of digital electives.
- Programming is not always covered as a separate or introductory course. Some programmes expect a level of coding skill as a pre-requisite.
- Financial Technology can either be an applied in-depth course or an overview of the FinTech sector. The latter is increasingly more common in MBA programmes.
- There is more focus on Ethics in MBA programmes than specialist UG and MS programmes in Finance.
- Schools' Finance curriculum are heavily influenced by external factors, such as the CFA and the Financial Times ranking which cater to generalist Finance programmes as opposed to specialist programmes that might focus on developing digital skills.