

# Introduction to Quantitative Strategies

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# 1 Introduction

This document will cover the sector's role, structure and purpose, and will then detail the prerequisites, some of which are necessary and some just beneficial. Please note I am not expecting you to be fluent in all these skills, I myself am not, but do let me know your experience in each aspect. In Section 3, I suggest a general framework/approach for us to take in tackling our projects, which I hope will help in our planning. If you have any further suggestions/improvements please let me know. Let's get into it!

## 1.1 Role, Structure and Purpose

Think of us as the Quant team. As the name suggests, our aim is to explore and develop potential quantitative strategies for the benefit of the fund. This means we will have quite a lot of free reign to work on projects that tickle our fancy, with essentially all avenues in mathematical finance (relevant to a long only fund) open to exploration. Note that the fund is currently only considering long investments in equities, however, with time, the goal is to start an additional quantitative fund (overseen by our team) to investigate other quantitative investment strategies: Quantitative trading, hedging, short-selling, high frequency trading, and derivatives trading are a few examples.

# 2 Expected background knowledge

A lot of the projects we will be working on are unlikely to have been completely covered in our university courses, and I expect that this will require further research in unfamiliar territory, which could potentially be quite difficult and will require a good foundation in relevant mathematics. The projects will also require a good work ethic, in both an independent and collaborative capacity. Some skills will be necessary, whereas others are not required but are advisory. All are crucial for those desiring a career in mathematical finance, and will be further developed through your experience in this team.

## 2.1 Necessary skills

### 2.1.1 Coding in Python

The projects will require code to be implemented, and so python knowledge is expected. You do not have to be a python god, but it is necessary to have a solid grounding in data structures and the general problem solving approach in coding. Knowledge in any other language will also be useful. Particular languages that may be useful (other than python) are R, C++ and VBA.

IF YOU LACK PYTHON KNOWLEDGE: I would recommend joining the Introductory group within the Tech sector, which is run by Aayaan Ilyas (his email is ai49).

### **2.1.2 Mathematical knowledge**

Quantitative strategies will clearly involve mathematics in varying degrees of difficulty, and a decent fluency is required. If you have studied maths at university or believe that your knowledge is sufficient do not hesitate to join.

### **2.1.3 Interest, commitment and work ethic**

If you are interested in learning more about mathematical finance, this is the team for you, and you will most definitely learn a lot about the area. However, you and the team will only grow if everyone commits to the work, so we need to make sure to be well organized and transparent with one another.

## **2.2 Beneficial skills**

### **2.2.1 Version Control: Git and Github**

Large scale projects will require collaboration, and we will use Git and Github to be able to code projects with several contributors. I have provided a quick guide on how to download/set up Git and Github. It also goes through the essential commands we will be using. Please go to [github.com](https://github.com) to make an account and read this thread if you have time: <https://www.freecodecamp.org/news/git-and-github-for-beginners/>. Do not worry about the commands they present here, just familiarize yourself with the terminology. Also, if you have time, check out this video which comprehensively covers the topic: <https://www.youtube.com/watch?v=RG0j5yH7evk>.

### **2.2.2 Independent study or teaching experience**

Any previous experience doing research outside of your studies will be beneficial, since this is a skill that takes time to develop. Within our project groups we will be dividing the research and holding weekly presentations to keep everyone up to date. This will speed up the project completion, with all team members simultaneously teaching and learning.

### **2.2.3 Relevant work experience**

Work experience in the field of mathematical finance, finance, data analysis, coding or any other relevant area would obviously be useful.

Regardless of your seniority or experience, I would like to encourage you to speak with me if you have any ideas or suggested improvements regarding the team. We will also hold team discussions for any major decisions, with everyone's opinion being equally valued; if you have an idea please bring it up for discussion!

### 3 Approach and framework

Our projects will loosely adhere to a 6 part framework: Brainstorming, Project selection/allocation, research, developing, strategy testing, and implementation.

#### 3.1 Brainstorming and Project Ideas

Both within our sector and with sector heads in our departments. Current ideas include:

- Portfolio Optimization (e.g. Markowitz mean-variance/modern portfolio theory and Risk Parity)
- Quantitative Risk Management (e.g. Value at risk, expected shortfall, extreme value distributions)
- Volatility estimation/forecasting (historical and implied)
- Machine learning methods (e.g. Natural language processing, sentiment analysis, data analysis, and forecasting)
- Quantitative analysis methods (e.g. Simple Moving Average analysis, use of Bollinger bands, time series analysis, and other stock market predictors)

#### 3.2 Project selection/allocation

To tackle these projects we will split work according to (in order of priority):

1. Urgency
2. Scale
3. Personal Interest

Please make it clear what your interests are and I will do my best to see to it that you will work on a relevant project. Although some projects may take precedence, working on these will still be a useful learning experience for you. We will work on a large variety of different projects so that we can all develop our skills in a range of areas.

#### 3.3 Research

After being assigned a project we will commence with research. Each team will have freedom with how they choose to approach this. The optimal ratio of independent to collaborative research and learning will depend on the complexity and breadth of the project. Many hands make light work, but too many cooks spoil the broth. This is an opportunity to develop presentation and teaching skills as mentioned earlier.

We will also have brief, informal weekly updates to discuss progress and to 'sell' the mathematics to the rest of the team. Being able to explain your research is a key skill for future jobs that this opportunity will develop.

### 3.4 Development

The development stage of the process may overlap with the research stage depending on the project, with new theory being implemented as we acquire it. This is when we will work on translating theory into useful code. This stage will include the planning, writing, debugging and testing of the code.

### 3.5 Strategy Testing

Depending on the strategy we may generate our own data, use existing data e.g. backtesting our strategies on historical data, or perform tests of 'extreme' cases to make sure the strategy is consistent and useful, which will require a degree of critical analysis.

### 3.6 Implementation

The final part will be implementing the project directly into the fund. As this team is brand new, we are pioneers of this process. The fund is currently predominantly non-quantitative, and our team will manage its transition into a competitive quantitative fund. However, once this ground work is complete, things will run more smoothly in the future. Our work this year will have a permanent impact on the functioning of this fund going forwards. We can view this year as a special case scenario, which will require an exceptional degree of insight, planning and effort. This will involve intimate discussions with the rest of the fund to deduce the optimal method of implementation. We aim to develop user-friendly code which makes our strategies easy to execute.

## 4 Useful resources

Here are some useful resources for brushing up on coding skills, research material, or

- Python for finance (free pdf book on coding). link: <https://www.sea-stat.com/wp-content/uploads/2021/05/Yves-Hilpisch-Python-for-Finance-Mastering-Data-Driven-Finance-Book-OReilly-2018.pdf>
- MIT open courseware (free courses on several topics with lecture notes and lecture videos)
- University lecture notes (several universities have freely available lecture notes: E.g. St Andrews (audit), Oxford, Imperial, etc.)
- Books (possible to find free pdfs and good material on all imaginable topics)
- Research papers (can be challenging to read but are very concise)