

Quant Trading Guide

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0 Introduction

Hello to whoever is reading this!

I decided to write this document because I think there are a ton of misconceptions about careers in quant trading (and quant finance more generally). The industry definitely isn't suitable for everyone, but I think there are way more people who should seriously consider it than who actually do.

In this document, I'll mainly be focusing on quant trading rather than research. I've made a few points about quant research in [section 1.3](#)), and if you think this sounds interesting then I'd definitely recommend finding other resources specific to research, because the advice here will be a lot less directly relevant.

It's worth noting here that I'm definitely not an expert on all this stuff. I wrote this guide mainly from the perspective of "*What would I like to have known when I started applying to these places?*". Whatever position you're in when you read this, I hope you can get some use out of it!

1 What is quant trading?

1.1 Common terminology

I'm not going to provide a massive glossary here; there are some great resources online (like Investopedia or the website of top trading firms). However, I think there are a few terms that it's important to define clearly. If you know what all of these mean, feel free to skip this section.

- **Market**

This is a place where buyers and sellers can meet to trade things. People are constantly quoting bid and ask prices. The **bid price** is the highest amount someone is willing to buy at; for instance if someone has bid £10 it means they are willing to buy for any price $\leq$ £10. The **ask price** is the price someone is willing to sell at, so an ask of £20 means they are willing to sell for any price $\geq$ £20. These values are constantly changing as people submit new orders into the market. The ask will always be higher than the bid; this difference is called the **bid-ask spread**. A trade happens when someone **crosses the spread**, i.e. the inequalities of a buyer and seller cross.

For instance, suppose people are trading shares in company XYZ. If the highest bid for a share is £99 and the lowest offer is £101, and someone makes a bid of £102, they will be able to buy shares for this price (because the person who was offering £101 will be happy to sell shares to them for £102).

- **Liquidity**

Liquid markets are markets you can trade on easily. Typically it means there is a lot of order flow (i.e. lots of people are trading frequently) and a narrow bid-ask spread, so you can normally buy and sell at close to the current trading price.

For instance, the market for shares in a large US company like Apple will be typically be very liquid, but it might become less liquid during a time of market panic (e.g. like caused by Covid), because people will be less sure of what the true value of shares are, and they'll be less willing to trade. There is a cost to having a bid/offer open, which is related to the concept of *asymmetric information* - if you're very unsure about the true value of something, it's much more likely someone will come along with a much better idea of what the value is, and take advantage of the prices that you're offering.

- **Market making**

This is the practice of quoting a bid and ask for a particular good or service. It means the market maker guarantees to take the other side of a trade at certain prices. The advantage for the rest of the market is more liquidity, because the bid-ask spread is usually a lot narrower in the presence of a market-maker than it would be otherwise. The advantage for the market maker is profiting from the bid-ask spread - on average, they'll be buying the stock for slightly less than they sell it for.

- **Prop trading**

This is short for proprietary trading; it just means that the firm trades with its own money, rather than taking clients' money. Lots of people interested in quant finance confuse prop trading firms with **hedge funds**, which are often very quantitative, but which do take on external money.

1.2 What does a quant trader do?

Unfortunately, the industry is kind of opaque, so it can be pretty difficult to get a good idea of what it is people actually do. It can also be quite hard to give specifics, because there are many different areas you might specialise in quant trading, and 2 people with the same job titles can be doing very different things. I'm also not an expert on this area, because I've only done internships, and the actual job of quant trading is a bit different from what you'll do in an internship, so please take this section with a pinch of salt. However, I can give a basic outline of what a career in quant trading might look like.

Broadly speaking, quant trading is about making trading decisions in real time. You are required to think fast, react to events as they happen, and generally try to develop a picture of what is going on in the financial markets. Things that correlate with skill at quant trading include:

- strong quantitative skills (more on this later)
- being able to make decisions under uncertainty, based on intuition / quick judgements
- having a head for probabilities, risks, expected values, etc
- enjoying strategy games like poker, chess, MTG

One common confusion people have goes something like this: *“Why do people have jobs doing quant trading, when there are algorithms who trade way faster than they can?”*. The simple answer to this question is that you can’t automate everything. Some markets aren’t suitable for algorithms to trade in without human interaction, maybe because they are very illiquid or there isn’t enough data to create models / train algs. Also, even in markets where algorithms are trading, you need people to supervise the algorithm in case it goes off the rails in response to some significant market event, or for some technical reason, or just to step in if the algorithm builds up too much risk in one area. In fact, it’s often the times when algorithms start behaving weirdly that traders can add the most value.

1.3 Quant Trading vs Quant Research

Roles in quant finance broadly split into 2 categories: quant trading and quant research. I’ve already given an outline of quant trading, and the majority of this document is aimed at people who are interested in that, but in this section I give an extremely brief summary of quant research and how it differs from trading.

While quant trading focuses on making decisions in real time, quant research is much more focused on making models. A lot of the job is spent researching trading strategies, thinking about ideas, reading papers, backtesting and number-crunching, dealing with large messy data sets, etc. Interviewers will test you a lot more on stats and programming. Things that correlate with skill at quant research include:

- skill at programming and data science / statistical learning / machine learning
- enjoying thinking for a long time about hard problems
- enjoying self-directed research, sometimes with no clear answers
- creativity (in coming up with hypotheses to test, or developing trading strategies)

Unless explicitly stated, anything that follows in this document should be assumed to refer to quant trading, not quant research. As mentioned earlier, if this sounds interesting to you then I recommend you look for other resources on quant research - you may find the blog posts [here](#) and [here](#) helpful.

1.4 Common misconceptions

In this section, I’m going to list a few of the common misconceptions that people have about a career in quant finance, or common misguided reasons not to pursue this career. Not all these points are totally wrong (some of them do have merit) but I’ve chosen them because I think they are generally overblown, and can be quite misleading.

1.4.1 Finance culture is terrible

Lots of finance culture is pretty terrible, but quant trading is actually a subset with a really nice culture on the whole. Most places feel a lot more like tech firms than typical finance firms. Jeans and t-shirts will be the norm, not suits. The specifics vary between companies, but you definitely don’t get Wolf of Wall Street-type shenanigans going on. As a general rule, if you are doing a STEM degree at a good university and you like the people you’re working with, then you’ll probably like the people you meet in quant trading, because it’s essentially the same group.

As a small anecdote to illustrate the informal office environment, I was doing a virtual internship at a trading firm last year. On group videochats, we could hear some noises from the trading floor, and most traders had programmed their computers with sound effects that go off when a trade is made or a stock breaks a price level. These sound effects ranged from the normal to the bizarre, including:

- Bells and alarms
- Cash registers
- Machine guns and blasters
- Animal noises (cats, horses and cows)
- Mario sound effects
- Darude Sandstorm
- Borat (“I like!”, “WaWaWeeWa!”)
- John Bercow (“ORDER!”)
- Obi-Wan Kenobi (“May the force be with you”)

After hearing all this, it was hard for me to keep thinking of trading firms as extremely formal, corporate environments!

1.4.2 The hours in finance are really bad

Finance is known for absolutely insane hours, i.e. 14+ per day for the first few years in investment banking. Quant trading is *nothing like this!* However, the hours are probably worse than an average job, and it’s completely legitimate to be put off by this if good work hours are something that matters a lot to you. Mornings are usually around 7-8am, most people leave at 5-6pm. This varies between firms, as well as your role, e.g. which global markets you trade. The hours can also stretch longer during certain exceptional circumstances (e.g. chaotic market conditions, like those caused by covid, can lead to longer days). However, there’s generally a pretty good work-life balance, and you aren’t expected to think too much about work stuff when you go home. Having to work weekends is exceedingly rare.

1.4.3 You need to be a maths genius

This is maybe the most common concern people have, and also probably the most valid, because the industry is very competitive, and you do need maths skills. However, these aren’t the same skills you’d need e.g. for maths olympiads / exams / STEM-based degree subjects. Being good at this stuff does correlate with quant trading, but the correlation is far from perfect, so not being amazing at olympiads or top of your cohort in university shouldn’t stop you from applying.

Mental maths can be pretty important, but isn’t the be-all and end-all. Some firms have internship applicants take numerical tests, which can be tough (especially for people who haven’t done similar things before), but they are mainly used as an initial filter stage, since trading firms get a lot of applicants. If you want to practice this kind of mental maths, [this website](#) provides a good resource. I would recommend the Optiver-style test - the questions are harder than they are in the real Optiver test, and the real Optiver test is about as hard as numerical tests get, so if you can do okay in this then you should be able to cope well with most mental maths you might come across.

The more general maths skills at later interview stages are nowhere near university level (for more information, see section 2). If you have a good handle on probabilities, expected value, risk, etc, this will get you a long way.

As for amazing mathematical achievement like IMO participation or medals, don’t worry - these are absolutely not necessary. They’re great to have, and some trading firms do like publicising how many IMO medallists they’ve employed, but if they insisted on only hiring people who qualified to IMO, then trading floors would be a ghost town.

Of course, it can’t hurt to get more mathematically literate, and if this is something you’re interested in then it’s definitely worth your time. The areas I would prioritise (in roughly decreasing order of priority) are:

- **Bayesian statistics**

This comes up a lot in brainteasers in some form. Also, the core ideas of updating beliefs based on evidence are pretty important in trading. To this end, Bayesian statistics can give you some really valuable tools (e.g. odds ratios, which provide a natural and intuitive way to understand how much you should adjust probabilities based on the quality of evidence). I'm a bit biased here, because I personally think Bayesian statistics is awesome.¹

- **Statistics & data science**

Linear regression is used *a lot* in finance, so this can definitely be worth getting familiar with. At the more advanced level, some knowledge of some ML and data science can make your application stand out, although it's unlikely to be directly useful for interviews. This is a totally different story for quant research, when this stuff would be much higher-priority.

- **Game theory**

A bit more niche, but a very interesting branch of study, that intersects with other fields like maths, economics, social science and computer science.

1.4.4 You need to be a really good coder

Coding is always a good thing to learn, but the vast majority of quant trading interviews won't require you to code (whether the job description explicitly mentions programming is a good litmus test). I'd still definitely recommend learning to program if you currently don't do much, because many traders spend a lot of their time coding, and so it helps to know how much you enjoy it. If you want to get started, I'd get familiar with Python and Jupyter Notebooks, since these tools are used very frequently in quant trading. As for libraries, important ones include Numpy, Pandas, Scipy, and Matplotlib. A cool programming project can stand out on your CV too (more on this in [Section 1.4.6](#)).

All of this is very different for quant research, where a lot more emphasis is put on programming literacy and stats knowledge.

1.4.5 You need lots of finance experience

Almost every firm will tell you this during the application process: finance experience is nice to have, but not essential. Most places will teach you the finance you need to know on the job. Some firms might like to see an *interest* or *passion* for finance, which might take the form of:

- Being involved in a finance society at your uni (e.g. CUFIS or CUATS in Cambridge)
- Reading news sources like the FT, Bloomberg, or Matt Levine's Money Stuff
- Trading your own account (or on a platform like QuantConnect or Quantopian²)
- Data-science projects related to finance
- Past internships

But while any of these will boost your application, none of them are a dealbreaker if you don't have them on your CV. It's unlikely to be a great use of your time to try these things just for the sake of impressing interviewers, so so them if you think they genuinely sound interesting.

¹(because it is!)

²pre-November 2020. [RIP Quantopian](#)

1.4.6 You need an amazing CV

First point to make: if you're studying a quantitative degree at a good university, that already puts you ahead of lots of applicants. Lots of people feel intimidated when they write a CV, because they don't think they have enough stuff to put on there. However it's worth remembering, part of what trading firms are looking for on a CV is just an interesting person who isn't defined by the degree they're studying, so if there's anything that you're passionate about, you can include it! Here are a few good things to consider putting on your CV, if you can:

- Olympiads (e.g. maths/informatics/physics)
- Finance-related stuff (see [Section 1.4.5](#))
- Strategy games (the classic one is poker, but also bridge, chess, diplomacy, MTG, etc)
- Sports (especially team / competitive sports)
- Society leadership (especially any societies related to the points above)
- Coding projects (especially any projects related to the points above)
- Tutoring (good communication and mentoring skills are super valuable)
- Any random but remotely impressive stuff³

Second point to make: CVs don't matter that much at later interview stages. Mostly they are useful to get you through the door, and if you have some relevant experience/internships then you might be asked about them (this varies between companies), but in general trading firms care much more about how you perform in the interview than your actual CV.

Third point to make - referrals can be another good way to get your foot in the door. If you know anyone who works there / did an internship, this can often suffice to getting a first round interview. Finding talented people is hard, so companies often like getting referrals as a way of making the finding process easier for them!

1.4.7 If you make a small mistake in trading, you could lose your job

There can be reasons to be concerned about job security (see [Section 1.6](#)), but I don't think this particular worry is very well-founded. Everyone makes mistakes, but one thing quant trading firms really value (in fact one of the things they specifically look for in interviews) is the ability to notice, admit to, and learn from your mistakes. If you make a mistake while trading and lose some money, but take full responsibility for it and make sure not to make the same mistake again, it's very unlikely you'd be fired or demoted for this.

There is a limit to this - obviously if you lose all the firm's money then it will be a different matter! However, most firms put measures in place to make sure that one single person can't screw up badly enough to really hurt the firm in a significant way. Junior traders will be doing simulated trading, or else overseen by senior traders, for quite a while when they first join.

All this said, some firms will treat mistakes more harshly than others. Since quant trading firms are frustratingly opaque, it's a good idea to speak to as many people as you can, and try and get an idea of what the culture is like in the firm. If you get the impression that mistakes aren't really tolerated, that can be a good sign that you should find a better place to work!

³I personally hold a Guinness World Record for the [lamest possible thing you can imagine](#). I put this down on my CV, and was asked about it several times during my interview process for summer 2021 internships!

1.4.8 Working in finance is morally wrong

The truth is this is a pretty complicated point to address. There are definitely finance companies who have a net negative impact on the world, but quant trading definitely isn't in the category of worst offenders. A lot of what quant traders do is provide liquidity to markets, i.e. make it slightly easier for other market participants to buy and sell things on exchanges. This is a useful function (since these counterparties can often be e.g. pension funds), but on the margin it's hard to argue that quant trading firms are doing an absolutely necessary societal good.

However, going into quant trading to earn money and donate it to charity can still do a huge amount of good. This is a big part of what personally motivates me, and I think it's a really important factor to consider. As a quick Fermi Estimate: it costs approximately \$4000 to save a life according to [GiveWell's calculator](#), and so giving 50% of a \$200k per annum salary = 25 lives saved per year.

As a caveat to this, if you're going into quant trading just to earn money (either for yourself or for charity), you probably won't be able to stay motivated. Quant trading is a pretty intense job, and to work here you need to enjoy what you do as well. Also, if you are the kind of person who feels they need to do something with a direct positive impact, then quant trading might not be for you. However, if you're interested in the work, and feel like you would be motivated by the idea of donating a lot to help make the world a better place, then this is great! For more on this, check out [80,000 Hours' quant trading resources](#).

1.5 Good things about quant trading

I've already mentioned some personal factors that tend to correlate with being a good quant trader. In this section, I'm going to list a few more general positive aspects of a career in the industry.

- **Intellectually stimulating**

Quant trading tends to draw on a wide variety of disciplines: maths, stats, computer science, data science, finance, game theory, etc. The work is consistently challenging and stimulating, and the general culture of excellence and high competitiveness means you are always developing and learning new skills.

- **Work with smart, talented people**

Thanks in part to the above point, quant trading tends to attract really smart people who are all passionate about what they do. The vibe is quite similar to a Cambridge maths cohort. More generally, if you're doing a STEM subject from a top university and you like the people you're studying with, there's a good chance you'll like the people you meet in quant trading.

- **Tight feedback loops**

If you have an idea, it's very easy to test it and see how well it is doing, because the objective function of "does this make money?" is pretty clear. It's easy to see if you're making progress, and you'll spend very little time wondering about whether what you're doing is actually useful.

- **Autonomy**

In most trading firms, you have the ability to work on a wide variety of different tasks/projects. If there's something you find interesting, and you can prove that it's a valuable thing to work on, then you'll be allowed to pursue it and given the resources to do so.

- **Flat structure**

There is generally little to no hierarchy and bureaucracy in these firms. Everyone is listened to, regardless of how long they've worked there. Age and experience counts for a lot, but most people will have the same job title. Primarily, you are judged for your character and how good your ideas are.

1.6 Bad things about quant trading

In the interests of balance, I thought it would be worth including this section. I think quant trading is a great career that way more people should consider than actually do, so obviously I'm biased. That being said, it's still not for everyone. There are some misguided reasons to choose not to go into quant trading (see [Section 1.4](#)), but there also some genuine reasons why you might not be a good fit for this career. Here are some of them:

- **Long hours / high intensity**

As stated above, the hours are nowhere near as bad as investment banks, but they are still a little longer than the average 9-5 job. 10 hours per day is typical. The day-to-day responsibilities of a trader are also very intense, and the job can be mentally & emotionally draining.

- **Not great job security**

This varies from firm to firm. Some firms actually have pretty good job security (and as a result, have a strong incentive to provide good education and training to employees). However, there are definitely some places who take the option of "hire lots of people; only keep the ones who do well." This, combined with the tendency to burn out (or just choose to transition to less intense jobs), helps to explain why the average age for employees in quant trading firms can be as low as late 20s.

- **Non-compete agreements**

Firms are often competitive about all their IP, and that includes employees. Many places will have you sign a non-compete, i.e. an agreement not to work for a competitor for a period of time after you leave. Some of these are infamously strict (e.g. on the order of 2 years or more). You will generally be paid a small fraction of your salary during this time. However, this isn't the case for all firms.

- **Flat structure**

I think most people would see this as a positive, but some people do enjoy the ability to have some kind of career progression. The longer you stay at trading firms, the more responsibility and knowledge you will accumulate, and (in all likelihood) the more money you'll make, but if you enjoy having a title bump every few years, then you might not like how this structure works.

- **Competitive Industry**

There are some industries with more jobs than people to take them; quant trading is not one of them! Most firms only offer internships to a small group of people (15-20 is typical, sometimes less, and I don't know any who take more than 40). As a result, the interviews can be extremely competitive, and you may have to apply to many different firms for a chance of securing a space. For anyone applying to quant trading roles, it's worth having some kind of backup plan, so you aren't putting all your eggs in one basket.

Another point - even if you don't think you will be able to get the offer and/or quant trading isn't your first choice, it can still be worth applying, because getting internship offers has great information value. If you can get an offer, the odds are pretty good that you're the kind of person who will enjoy the work.

1.7 What to do if you think you might be interested

If all this stuff sounds cool to you (and the bad stuff isn't too offputting!) then I'd recommend trying to learn more about the industry. One of the best ways is to go to events at your university. Most finance careers events are clustered in the first term, although some places do still run events later in the year. These events are a fun way to get to know professionals in the industry, as well as ask questions.

However, nothing is a substitute for getting a feel for yourself of what the industry is like, which is why applying for internships is basically the best thing you can do. In later sections I'll talk a *lot* more about the application process and what interviews are like. For now, I'll just give the key points: application process is low-effort (just a CV and cover letter needed, sometimes not even a cover letter), interviews can actually be kind of fun, and firms put a lot of emphasis on education and making a good internship experience. You'll get to interact with traders a lot, probably get a view into lots of different areas in the firm, and the projects interns are given tend to be really worthwhile and interesting.

Even the interview process itself can be super high value - you'll get the chance to ask the interviewer questions, and if you get an offer then you'll usually have more opportunities to talk with people in the firm about your main uncertainties. There will probably be a strong bias because they're sales pitching you the company, but you can still usually learn a lot of useful things.

One final point to make - some firms run Spring Week events or Insight Days, usually aimed at first or second years. These can be great ways to get on the radar of these companies, and can often be a stepping stone to securing an internship. To find out about all this stuff, the best thing is to look on the company websites or consult your university careers service.