PAUL AND DOMINIC'S

GUIDE TO

GETTING A QUANT JOB

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Paul & Dominic Limited

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Introduction

This guide is for people looking for their first or second job in Quant Finance, the theory being that after a few years you ought to know most of this stuff.

Making a difference
If the process is working well, the people seen by the bank will be roughly the same quality and from comparable backgrounds. Thus you need to stand out in order to win. We speak to a lot of recruiting managers, and we find that the difference between the one who got the job, and the person who came second is often very small for the employer, but obviously rather more important for you.

You have to walk a line between standing out, and not seeming too much for them to handle.

Understand the process
Interviewing people is a major industry all by itself, multiply the number of applicants by the number of interviews they attend and you sometimes wonder how any useful work ever gets done. Certainly this thought occurs to interviewers on a regular basis. They want it to end and although it is important to get the right people almost no one enjoys the process, and this made worse by the fact that >80% of the work is wasted on those you never hire. Thus a core objective must be to make life as easy for the interviewer as possible. This means turning up on time, but not too early, being flexible on interview times, and trying to be pleasant.

What you need to prove

- You are smart
- You can work with people
- You can get things done
- You can manage yourself and your time
- You are committed to this line of work

How to Prove It
Hopefully they've read your CV, but this is only a summary. As well as answering questions, it is good to be able to show examples of where you've applied a skill, or where you've coped with a particular situation. Throughout the guide we emphasise the competitive nature of the market these days. When Paul Wilmott worked on starting a mathematical finance course at Oxford, it was rare for a university to have such a thing. Now it is rare for them not to. The market for quants is of course much larger than when Derman started working for banks, but the supply side has increased at least as fast. Thus you must not also show yourself to be smart, but also more useful than the others going for the same job.

Kissing frogs

Like trying to find a prince by kissing frogs, you have to accept that it is rare for your first attempt to succeed, so you must be prepared for a long haul, and to pursue multiple options at the same time. This means applying to several banks, and not being deterred by failure to get into a particular firm.

You need to work out how committed you are to a particular sector of the market. Some people find that they prefer fixed income to equity, others feel that commodities offer the best opportunities for them.

You don't have to make up your mind yet, but when you accept an offer you are making some other doors quite hard to open in future. It is possible to move between the main types of business area, but not easy, and harder still to do it from a position of strength in your later career.

Writing a CV

A CV is not a passive instrument that simply tells a recruiter why he should interview you, it also to some extent sets the agenda for the questions you will be asked when they meet you. Thus it is important to choose what you disclose as a balance between what you think they want and the areas in which you are confident answering questions.

As there are a lot more applicants than jobs, the early stages are optimised to filter out those who stand no chance of getting in. Thus you must take considerable care to make sure you don't fail at an early stage because of trivial errors.

Although at P&D we've actually done this stuff, it is often the case that CVs are filtered by people with wildly variable skills in finance. Often they resort to looking for keywords. Most CVs are processed by databases, with little or no intelligence in them. Thus you should not rely upon them working out that if you have done subject X, you must have skills Y and Z. If you believe those skills are critical for this job, then make sure this can easily be spotted. Read the specification carefully, and if they specifically ask for a skill or experience, then include whatever you can to illustrate your strengths. If you believe a particular skill to be critical mention it in your covering letter as well (or if you believe the headhunter is especially dim).

Make sure you can be contacted
Make sure your contact details are reliable and that you regularly monitor the relevant email account(s) and telephones. It is sad when someone's CV show great promise, but they don't respond in time to be interviewed. This does happen. If you are at university, be aware that your current email address may stop working soon after you complete your course. GMail is to be preferred over Yahoo for personal email address.

Get it checked
Have your CV and covering letter proof read by a native English speaker. This is important because people really do judge your ability by how you express yourself. Quant Finance is an international sport, with speakers of every language, and the ability to communicate difficult ideas is important, and if you can't get the name of your university correct, it makes one wonder if you can explain your views on jump diffusion. Also CVs use a particular style of English, which is subtly different from the one you learned in school.
This **must** be done right. In your first year alone you will cost your bank more than a very nice Porsche. Would you spend 100,000 on "high specification" goods where the advert for them was rubbish ?

Covering letter
In your covering email, mention where you saw the ad. This helps the recruiter in determining the impact of various ads/media and shows him/her that you have a good business sense. Also try to show a little enthusiasm, and feel free to mention a couple of things you feel are of most interest to the

Fonts and Layout
Some things on **your** CV are important, and **you** *may* want to draw their attention to them. **Do not** do this excessively. It **is** **really irritating**. The only time breaking this rule has worked was a hardcore programmer who learned the Postscript language that Windows uses to talk directly to printers and developed a program that printed his CV as concentric spirals of text in varying size. Viewed on screen it would slowly spin.
Yes, Dominic hired him…
If you're not prepared to spend at least a month learning reverse Polish notation, use a standard template. (Stick to two main font families, a sanserif, such as Arial, for large headings, and serif font, such as Times, for main body text.)

PDF
Make a PDF if possible. These have a more professional feel than Word documents, they do not have virus problems (yet) and they retain original fonts and layout. Whatever software you use, print it out to make sure that what you see is really what you get. Perhaps view on and print from another PC to double check.
This is also important when dealing with some Headhunters. Some like to "improve" your CV, and this can be good, especially if a professional makes it better. But some HHs have a rather impressionistic view of quant finance, and also may be tempted to "add" skills. This does not end well. Thus it is worth "sealing" your document to stop people playing with it.

Document Name
Give your document a name that will be meaningful to the recruiter. Call it YourNameHere.pdf and not CV.pdf in the spirit of making it easier for the recruiter. It's not nice to have a large number of files with the same name, and it's actually quite easy to get your CV written over by the CV someone else who also called it CV. Yes, this happens, and if your CV gets lost you don't get the job. At a conference recently Dominic was told by one senior manager at a top tier bank that one headhunter sent him 4 CVs per day. Easy to get lost in that.

Dates
Make sure your dates "join up" as much as possible. Some people in the recruitment process worry about gaps. Do make sure that they make sense, you are supposed to be good at numbers.

Be honest
If you claim skills in some area, it's a good bet that you will be asked questions about it. The CV should be a fair and positive statement of what you have to offer. No one expects you to share your history of skin diseases, but you'll going to be expected to back the talk with action, and as we say earlier it can help push them into asking questions on your best subjects

Show that you can do things
By this point in your life you've soaked up a lot of information, and acquired skills, which is, of course, good. But a big question in the inquisitors' mind is whether you can translate this into real actions that are finished, complete and correct. One can pass most exams by getting answers wrong, but by showing good working, and an understanding of the principles. However, banks aren't really all that happy if you lose a pile of money by getting "nearly" the right answer, where you put a minus where it should have been a plus. They like to see projects where you've started, worked to a goal and completed without having to have your hand held. This is a big reason why they like PhDs since it's a powerful argument that you can complete things. However, if you're going for a PhD level job, you still have to beat others who have reached that level.

Projects completed are good, and you should be prepared to answer questions on them. The people who interview you will often have your sort of academic background, so these questions may be deep.

You may have changed direction in your career, and you should be prepared to answer why you made any given choice. It is important to be able to show that you didn't just "give up" on an area when it got tough.

Interests and hobbies
Several of the people you meet will want to understand what sort of personality you have, or indeed whether you actually have one. Don't try to be someone you aren't, and certainly it's very hard to guess what exactly they want anyway, just try to be a good version of yourself.

In finance you spend more of your waking hours with your colleagues than the person you marry, so it is good to present yourself as interesting as well as smart. They all want to feel you can work with others, so the cliché of "reading, walking and listening to music," don't really cut it. Certainly you shouldn't fake an interest in something, but do try to find something with which you can speak with a little passion. One candidate had acquired a formal qualification in stage combat. Although it's relatively rare for quants to need to fight each other with swords, it's the sort of thing that catches people's eyes, and can make a crucial difference. It also gives the non-specialist people who you will meet something they can talk to you about. This may sound trivial, and sometimes it makes no difference, but even a small difference can be important.

Last job first
In your CV your most recent/current employment should stand out and be relevant to the job for which you are applying. Someone reading your CV may never get beyond this one piece of information. Make sure your dates are correct. As part of the pre-employment screen at most banks, they check your past employment, and people have had offers withdrawn because of mistakes on this.

Paul & Dominic
When applying to P&D, we also like to see a simple list of the various skills you have acquired, together with some estimate of how good you are. If you're new to QF then it won't be obvious which are most important, that's our job, so include as many as possible. They are for our use only so don't worry about formatting.

Multiple CVs
Finally, there is no reason why you should have only *one* CV. Presumably your entire life doesn't fit on two pages, so you can turn out a variety that each emphasise different aspects of your experience and education. You may take this as an exercise to work out the optimal number of variants, and you will quickly find out that it is not one. This is made more acute by the fact that failed CVs get little if any feedback. Think of it as shooting in the dark. If you don't hear a scream when you fire in one direction, you aim somewhere else.
This is a useful tactic when you're not sure whether some skill or experience is good or bad. For instance you may want to avoid jobs with too much programming, but it's hard to get a job with no programming skills. Thus you can vary the amount of this you put on your CV.

Finding banks
In this document, we use the term "bank" for the firm you want to work for. It is course the case that quants work for many types of outfit, including brokers, the government, hedge funds, insurers, thrifts, consultancies, building societies, and of course in the case of P&D, for a headhunting firm. The Wilmott.com website mentions any number of firms, and before you approach anyone it's good to do a few searches so that you know the nature of the target.

If you're still linked with your college than it has many resources to help you. Most have a careers office with directories of banks, and they will have some contacts with banks in that country. The library will have directories, and of course there is Google and Yahoo for getting a list of targets. All large firms have entry level programmes of some form, and you can relatively easily find a good number to apply for. At this stage numbers are important, since the ratio of new entrants to the market to jobs is quite high

Interviews

Be prepared

Before you go for the interview, find out the names of the people you are seeing, and do a Google on their name, as well as the bank/business unit you are joining. Try to avoid the error made by one candidate who could not understand why the interviewer was so interested in one part of her thesis. The candidate had quoted papers by the interviewer, but somehow managed to connect the interviewer's name with the paper. This was funny at the time, but they didn't get the job. This is less rare than you might think. Many quants have written papers, and your thesis will reference any number other papers.

Show some market insight

This doesn't mean you have to know the ticker symbols of all SP500 stocks, but it does mean you should be able to comment on the reliability of models, what are their common pitfalls and how the quant and the trader might communicate about this. If you can quantify some practical phenomenon that is rarely discussed in academic literature then you will impress. (Tip: Because banks are often delta hedging, everything usually boils down to gamma and/or volatility!)

It is also worth reading *The Economist* for at least a month before interview. Some interviewers are keen to see if you have awareness of the world in general. *The Economist* may disturb some people since it covers other countries and has no astrology column or coverage of golf.

Brainteasers

There are several different types of brainteasers you might get asked, all designed to test how your mind works under pressure, and to try and gauge how smart you are, rather than how much you have learned.

This is an area where you should spend a significant amount of your preparation time. After 20 years of education, your ability at mathematics is not going to change all that much in the next few weeks, and to an extent he same applies to finance knowledge.

At Paul & Dominic, we have been studying why people *don't* get a given job, to see how we can help increase the chances of getting our people in, and match them better to the roles on offer. One of the largest variable factors is brainteasers, puzzles, etc. Our estimate is that with diligent study, and assuming that you are basically quite bright, you can reduce by around 50% the chance of losing out this way, and overall there is no single factor that you can change so quickly that has such a big effect.

Thus for the job seeker, it's quite likely that the most valuable resource on Wilmott.com is the Brainteasers section, and they fall into the following broad categories.

Straightforward calculation.
Example: How many trailing zeroes are there in 100 factorial?

Lateral thinking. Example: Several coworkers would like to know their average salary. How can they calculate it, without disclosing their own salaries?

Open to discussion.
Example: What's the probability that a quadratic function has two real roots?

Off the wall.
Example: How many manhole covers are there within the M25?

Conditional Probability:
Example :Monty Hall problem. These seem to be the most common type, and a lot of quant finance is probability so demonstrating a grasp will do you a lot of good.

Work through the Brainteaser Forum on wilmott.com. You can practice for IQ tests, and the more you do, the better your score. Brainteasers are no different. And you'd be surprised how often the same questions crop up. We have spoken to job seekers who have been asked the same question at more than one bank.

It's worth having a few numbers at your fingertips for the "manhole covers." One manager recently told me in rather despairing tones of the stream of candidates who didn't have even a rough approximation to the population of the country they were born and educated in. Several put the population of Britain between 3 and 5 million (it's around 60 million) Actually it's a bit less, a good trick when "estimating" is to pick numbers with which it is easy to do mental arithmetic. Sure you can multiply by 57, but why expose yourself to silly arithmetic errors.

It's also worth revising some basic probability and set theory if your recent study hasn't covered them. Converging series can make apparently very long winded calculations deliver quick results. It's actually quite rare for them to really want you to add up the numbers between one and a thousand, but having the formula at your fingertips is good. Indeed that sort of inductive proof is good practice for brainteasers in general.

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In many types of question, they want to hear your train of thought, and have simply no interest in the actual answer. Thus you need to share your thoughts about how you get to each stage. You also should "sanity check" your answers at each step, and make sure they're aware you're doing it. This is a soft skill that's very important in financial markets where the money numbers you are manipulating are rather larger than your credit card bill.

Given the free form nature of the questions, it is very easy to slip into a set of numbers where you end up with silly numbers for a given quantity. That's perfectly acceptable, *provided* that you catch yourself, indeed you may impress more this way.

Be confident
Almost no one at banks actually enjoys interviewing people, some even see it as a form of punishment. That means they only interview you if there's a good chance they will want to hire you. Most people who are considered for any job never even get a first interview. You don't need to be arrogant about this, just know that merely by getting an interview you've beatren a good number of your peers, and that your conditional probability hof getting the job is on the way up.

Be punctual
This shouldn't need saying. If you can't be on time for your interview how can they expect you to put in 12-hour days? If you are going to be late (and assuming it was unavoidable) telephone ahead with an accurate ETA. The best strategy is to schedule having a coffee before the interview, a little caffeine and sugar may well help, and this is a useful time buffer. Probably the worst bit about being late is not what it does to the interviewer, but what it does to you. The idea is to present yourself as cool, smart and in control. If you've been stressed out dealing with transport you knock a few points off your performance.

Dominic once went to an interview where the headhunter had given him the address of a building the bank had left two years previously. He ended up very late.
Banks also often have several buildings some distance apart make sure you are going to the right one. For instance Barclays has a large tower in Canary Wharf,, Londomwith "Barclays" written in big letters on the top.

Do not go there.

The Capital Markets Division is right next to the Station, but cunningly has no indication that they are inside, and if you leave by the wrong exit, it can take 10 minutes to find. No one knows how many offices it has in London, but fortunately they are all close to each other. The point here is that you should make sure that you have time to spare., so that this sort of thing is a little puzzle not something that brings you late an breathless to the interview.

Carry the phone number of the bank with you, both of the manager to apologise and reception who will be able to help you find them.

Also getting there vastly too early annoys some people. Dominic was present at one very large firm where someone decided to show how keen he was by arriving 45 minutes early. The needled the interviewing manager so much that as she left to collect him from reception she was heard to mutter "well, we won't be hiring him".
Some reception areas get very busy, and also seem to double as switchboard operators, so allow 10 minutes for this.

Set traps
Although some questions are set in advance, most interviewers like to also drill down based upon your answers. Thus you should try to mention things that you feel confident in answering hard questions. This is best done subtly, by phrases like "this is quite like X, but the answer is Y," where X is a bastion of your competence; or by saying thoughtfully "this isn't like X at all," if you feel you are being drawn into an area where you will sink.

Show you can do things
We mention this in the CV section, and here's a chance to "casually" drop in things you've done that show you can dig in and finish the job. It's OK to mention problems you overcame, and the lessons you learned from initial difficulties. Good managers are sceptical of people who claim to glide effortlessly through life, and don't want to be there when such a person hits a rock. Practical ability is therefore something that you will need to demonstrate a little more than theory. You wouldn't have reached this point if you didn't have a respectable record for absorbing theory, so the next step is to see if you can apply what you've learned. When asked your motivation for moving into finance, it's worth asking yourself if this is true for you.

Questions for the interviewer
It is a good idea to have a question thought out in advance – it makes you look interested in the position. You have two objectives when they ask if you have questions for them.

Getting the message across
A question can be a good way of bringing in things you want them to know, or to emphasise a point you want them to remember. You can ask the importance of your experience in MC, C++ or PDEs to the work you'd be doing. This gets the message across, either as a reminder or to bring it to their notice.

Find out more about the job
Good questions are on the direction for the team over the next year, and how your work would help them get where they want to be. It shows interest, and may give a better insight into what you really will be doing. Although they are interviewing you, it is also the case that they are selling the job to you, since they want you to accept if they offer. So it's up to you to work out whether it's a good job or not.

Remember - do not ask things that you should already know. You should discuss the job and the bank as much as you can with your recruiting consultant ahead of the interview and consult websites and any recruitment brochures. You don't want to give the interviewer the impression that you aren't interested enough in their bank to find out about it before the interview. Interviewers often say that this is the thing that really irritates them most at interviews. Instead, it is good to preface a question with a statement about some achievement that the bank is proud of (i.e., talks about at length on their website or in recruitment materials) e.g., "I know your office won the International Finance Press Award for Being a Bank last year, but could you tell me…"

Appearance

Good clothes
It is entirely possible that in your interview process that every person you meet is not wearing a suit, some may not have shaved. That doesn't make it wise for you to turn up in "smart casual." How you look is not a big deal for quants, you're being paid to think. However, some people do get remembered for the wrong reason, and it can undermine your application a little. You should feel comfortable, and if that means a bit of perfume or good cufflinks then that's fine, but see below…

Neatness is good
More important than colour of cloth or design of tie, is the general impression of being in control of how you look. This means wearing it well, and being ordered in your appearance. It is worth checking this before you go into the bank. Most banks have a toilet near reception you can use, since you've taken our advice and made sure you have time to spare, you may want to check yourself out in the mirror.

Colours
Black is the new black. White is nice for shirts and for no other visible item of clothing. Shoes should be clean and preferably black for men, and muted tones for women. A particular issue for women is the poor workmanship in most of their shoes. Do not attempt to walk long distances in new shoes that hurt your feet so badly they bleed (we know one person who stained the carpet with her blood). Make sure your clothes fit – badly fitting clothes do not look presentable and if your trousers are too tight you (and everyone else) will find this distracts from the matter at hand. There are some complexions that are generally complemented by certain colours, and apparently in some circles "brown" is seen as a colour for your clothing. It is not; it merely says things about you that are never said to your face.

Dark blue is good as well.

Ties are best boring, novelty is bad.

Another reason for white shirts is that they don't show sweat, some colours do this terribly and it's not the image you want to project. A good shirt doesn't crease badly in wear. (Dominic wears Thomas Pink shirts, 2 fold Egyptian Poplin, though Twill can look quite good).

Jewellery
This will never help you get a job, no matter how expensive or fashionable. Thus if you have any doubt at all, don't wear it. If you're female and you have some brooch or bracelet, that's fine, but there's no upside for a man at all in bling. Cufflinks of course are fine, as long as they are not "novelty" – you have no idea as to the sense of humour your interviewer may have: he may not have one at all. Some banking people spend quite appalling amounts on their watches, so don't even try to compete.

Perfume and aftershave
Feel free to smell nice, but make sure that it's not too strong.

Travelling issues
Public transport can be hot and sweaty, and suits aren't really ideal clothing for keeping cool. For a short journey this doesn't really matter. However, if you're travelling for several hours to get to your interview, on perhaps the EuroStar combined with the London tube, you can end up with a quite noticeable whiff. This has affected the interview of more than one candidate, so it's worth doing what you can to keep cool.

Make-up
The following is for women. If you're a male reader, you really should not be reading this paragraph and we are rather concerned that you are. Unless you really never wear make-up, a small amount is a good idea. Again, this gives the impression that you are making an effort and will possibly counter the deadening effect of all the monochrome clothing you are wearing. It should be discreet (i.e. no bright colours) and presentable rather than intending to make you look prettier. There are jobs that you can obtain by being attractive, but they are rarely fun and never intellectually rewarding. Any make-up should always be well applied – if you can't get eyeliner on straight, don't put it on, and never wear nail polish if there is any chance it will chip before the interview.

But ultimately this is all froth. Unless you apply some creativity to your appearance, it's unlikely to seriously hurt your application. We include this section because we see that it stresses some people, and that possibly does more harm. Be neat, turn up on time, and you've already beaten a few % of your competitors.

What People Get Wrong

Why your boss is a jerk

If you're leaving your job, it's of course likely to be because you've stopped enjoying the work, or that your job doesn't offer you the opportunities you want. Or more probably because your boss is a shambling moron whose personality is an unstable mix of dishonesty and ignorance barely held together by malicious greed. His management style draws upon both forms of Marxism, both Groucho and Karl, and can recite "The Art of War" from memory, and does so at meetings. In the original Chinese.. You have to leave now, or you and he will settle your disputes with knives. The IT at your department looks like it's run by EDS, the management are in league with Al Qaeda, and Jack Bauer has told you that the back office wants you dead. Today you found a live rat in your coffee.

At P&D we like to hear the truth about how you see your current role and how it's developing. That means it's fine to share with us your views on the personalities involved. However, when you go forward to a bank, part of your value is your experience at this firm, indeed the branding you get from working at this firm may have been a major factor in landing the interview. At the very least they won't hold your current firm against you. So if you knock the firm too much, you are to an extent, knocking yourself.

Jobs are not unlike relationships, and it's stupid to start a first date by enumerating the defects and personal failings of your ex. We have experimental data to support this.

Better to talk of the positive reasons for leaving, and your enthusiasm for the opportunity. This is a good idea, even if your current boss is not a terrorist, just so that you can think through in which ways (if any) this new job matches what you really want. You don't get to change jobs all that often, so you want to make the right decision. This obviously goes beyond money, though that doesn't hurt. You should try to see what parts of the new job you would particularly enjoy doing. You may well be asked why you want this job, and although it's a soft question, people often manage to get it wrong.

On the Wilmott forums today I read of one person who applied to Goldman Sachs, but who got his dates of employment wrong. It could mean he mistyped, it could mean that he was tired or distracted whilst typing, other things may be true. One thing that is 100% true is that he didn't get hired.

Zeroth law of holes
When you find yourself in a hole, stop digging. You will be asked questions for which you can't think of any answer at all. Some interviewers make the questions harder until that point is reached. The trick is to cut your losses. With any luck they will just move on, unless it's a critical topic. Of course if it's critical then it's game over anyway. What you must avoid is wasting time wandering like the lost spirit of ignorance over a vast formless expanse of your incompetence. A good response is to look them in the eye after a little thought, then simply say "don't know, sorry."

The exception to this are the "all the tea in China" questions where you are asked to estimate some quantity like the number of bull testicles consumed by McDonalds customers per year. You aren't expected to know the answer to these, indeed knowing it would seem rather strange. They want to see how well you can estimate an unknown quantity and how you think.

But the biggest hole catches people who get very nervous when things go wrong. This is about the most negative personality defect you might have in a bank. When you realise you've said something dumb, stop, say something like "let me think about that for a second," and correct yourself. Make the pause work for you. Think the answer through, and show that you are capable of recovering. Remember that no one can talk about things at the edge of their competence for a 4-5 hours without saying something silly. You don't have to be defect free, but self knowledge and recovery will score you vital points.

Sleep regularly, sleep often
Probably the most common error we've seen is not getting enough sleep the night before. As we said earlier, the difference between you and your competitors is tiny, and losing a small percentage of your thinking ability through being tired has an exponential effect on your probability of getting a job. Hours in a bank can be quite hard, so it's really not a good idea to mention feeling tired. Not only will they not be impressed, but if you get drawn into a conversation about how it degrades your performance it won't end well.

Make eye contact
You need to make sure you look at your interrogators, they can smell fear. No need to stare at them, just remind yourself to look at them when they or you are speaking.

Apply for the right job
You may feel you are unique individual, and an obvious match for the job. Sadly, that turns out not to be the case. If you are applying for a job called "Henchman to Assistant Quant's Minion - P&D0701067," then do try to include that in your application, prominently. If you don't include this, then you are critically dependant upon whoever opens your application guessing

It's entirely reasonable to apply for a job where you don't quite match exactly what they are asking for. Many job specifications are a wish list rather than a set of critical skills. It is possible to get hired because a strength in one area overcomes weakness in another. But make sure that this is a decision, not sloppiness. It doesn't come across well when candidates who are selling themselves on being smart, have failed to understand the one or two paragraphs of the advertisement.

Spam
When a web site asks, “shall I send this stuff to your friends ?” do **not** say yes. Dominic gets a stream of emails via one candidate asking him to join some sort of SMS dating agency. The candidate name is on each one. This does not make you friends.

Barbarians
The word barbarian comes from the ancient Greeks who took anyone who didn’t speak Greek as making “bar bub bar” noises, like a drunk Homer Simpson, not Barbarian as in the icy commanding tones of Governor Schwarzenegger. Although Dr Simpson has enjoyed careers as an astronaut, rock star and nuclear engineer, few of us would hire him as a quant. It’s important to get the right balance between gushing at people so fast that they have trouble following you, or being too quiet. You should try to practise looking at the reaction of people talking to you, and if the interviewer is clearly trying to move on, you usually should let them. If you think of the conversation style used when first meeting someone you find attractive, you won’t go far wrong. (Just remember it’s a first date)

It is also the case that no one wants to discriminate against those who aren’t English speakers. This is good, but means that if you aren’t understood they may just skip over what you say, rather than pass comment on your accent. This is especially true when having a telephone interview where you will not get visual feedback, and the sound quality is degraded.

Read your CV
Make sure that your CV is correct. A surprisingly large number have dates that are clearly wrong, or that by accident give the wrong impression. These worry interviewers a lot, and if your dates don’t match, this can lose you an offer when they do the basic background check on all employees. Also read it to work out which questions it might provoke them to ask, “why did you pick X ?” , “I see you’ve done a lot of Y, here’s a hard question about it.”

Mobile phone interviews
We’re old people (>35), and thus sometimes use quaint ’phone technology which involves long wires physically connecting us to a huge ancient Unix computer miles away (yes, we still use miles). A typical quant has done enough physics to know that you can actually talk down copper wires rather than a 1 mm thick cell phone that has more processing capacity than its owner.

Sadly, the quality of cell phone speech is hideously degraded, and on many systems you can’t both talk at the same time. This is occasionally awkward when both speakers have the same first language, but if both have English as second language neither comes out of the conversation impressed with the other. The worst case is where the interviewers are sharing a speaker phone to you on a mobile, which is better imagined than experienced.

Do not attempt to do a phone interview on a cell phone.

Don’t send a blue CV
Just don’t, OK?
Yes, it happens.

Focus
Forging a rapport with the interviewer is a good thing, but some interviews drift off topic as the people involved chat. However, there is a time budget for each interview, and most managers have specific objectives in checking your ability. If they don't get covered it can hurt your progress to the next stage. Although it is the interviewer's responsibility to get things done, it's *your* problem if he doesn't. This is where the politeness we mention elsewhere is important. When you feel that time is moving against you, ask to make sure that everything they need to know is covered.

Asking questions
Actually there *are* stupid questions. Bad questions are ones which embarrass the interviewer, or force them into corners, that's their job. Do not try to score points off the interviewer, either you fail and look silly, or worse still, you succeed. It's a bad idea to bring up any screwups that the bank has been involved in, or where the manager has to admit that he hasn't read your CV.

Buzzwords
Your interrogator will often come from a similar background to you, but even within maths and physics there are many specialisations that are mutually incomprehensible. You're just emerging from a discipline where you think in terms of these names and equations and it's easy to emit a stream of noises that your interviewer can barely understand. It's actually worse if they are from a similar background, since they may feel embarrassed to ask what you actually mean. You lose points here. But it is generally polite to enquire about the background of your audience when asked to explain some part of your work. This both shows consideration, and prevents you making this error.

Be polite
Your mother told you this would be important one day, this is the day. “Please,” “thank you,” and actually looking as if you are listening are good things. Fidgeting, playing with your tie, or looking like you’d rather be somewhere else aren’t polite. Standing when people come into the room is good. Occasionally you will find it appropriate to disagree, this is good, but get in the habit of using phrases like “I’m not sure if that’s the case, perhaps it is…”

You can’t just wake up one day and be polite on a whim. (Hint: “Pretty Woman” is fiction, we know this for a fact.) Without practice, it may even come over as sarcasm. In some languages “please” and “thank you” are implied in the context of the sentence, and that habit can spill over into English. Break that habit, break it now.

Practise sounding positive about things.

Of the things you can change between now and your interview, this one may have the biggest payback. If you’ve been doing calculus for a decade, you aren’t going to improve much in a week. However, you become better at presenting yourself as someone who’s easy to work with.

This is so important because your team will spend more waking hours together than most married couples, and senior people want to know you will “fit in.” Like much of this whole process it’s a game. No one really cares if you have a deep respect for your fellow man, but if you can emulate it well under pressure it’s a difference that makes no difference.

Be true to yourself
You are selling yourself, so obviously you will be putting a positive spin on things. However, this is a career, not a job. If you feel the job may really not be what you want, then it’s important that you think that through. If in the interview you hear something that sounds bad, ask about it. This does not have to be confrontational; you can use phrases like “how does that work out in practice ?”, and “what sort of flexibility is there to choose the work?”, when told you’re going to be counting buttons for the first six months.

Do not sound as if you work for Accenture
Even if you do work for Accenture or Arthur Anderson, you don't want to sound like you do. Avoid the sort of management speak that resembles Dilbert cartoons. A common type of interview question is of the form: "you find that something has gone terribly wrong, what would you do about it." An Accenture answer is
"I would see it as a challenge that would allow me to work as a good team player, as part of the global synergy"; or perhaps you might respond
"I will grasp the opportunity to show excellent leadership in integrity"
which is interview suicide.

This part may sound quite silly, but there is a growing trend for some universities to have formal coaching in interview technique. In theory this should be very useful. In theory. The real practice is rather scary. It frustrates interviewers a lot to be faced with an obviously bright candidate who parrots clichés that some consultant has fed into him. We say at the beginning that you need to stand out, and given that the people you are competing with may well include people from your institution, it does you very little good.

By all means listen to these people, but take it with a pinch of salt. When you know little about the process, it's easy to give too much weight to the few things you get told.

Interview overlap
It is tempting to schedule lots of interviews as close together as possible, because travel does eat into your budget. You should be very conservative about the amount of time you allow for each interview. It's not easy to get a manager to speed up his process because you want to get across town to talk to one of his competitors. The worry about time, just like lateness, can reduce you effectiveness, so make sure this doesn't come up.

Odd Questions
You will be asked some rather strange questions, not just brainteasers. They include "can you work in a team ?", "do you want to work in a bank ?", "what motivates you", "what sort of team do you want to work in", and variants on "you don't know what we do precisely, what difference is there between this and something you know nothing about".
They are serious questions, and although some of them like "do you want to work here ?" have obvious answers, you do best by thinking about them, preferably in advance. You should be able to articulate *something* that makes you want to work for this business in this bank. You should have views on teams. For instance, now that you aren't competing with me for jobs I can share with you that when asked about the idea team size for me, I have said "for me, what is important is the quality of the team, rather than it's size". Which has the virtues of not cutting yourself off from whatever size of team you might join (by not actually meaning anything), and also sounding positive and upbeat.
A bad answer is "I like small teams because you don't really know what strangers are thinking"
Even the largest banks are typically a large number of smallish, 5-20 person groups, that's basically because we evolved to work best that way.

Spotting Bad Jobs

You will often hear and read various bits of gossip about firms, but the problem is that the quality of this information is low, not only wrong, but often imprecise. It's entirely possible the fixed-income division at a bank to be doing very badly at a time when equity derivatives are making a big pile of cash, indeed there are known correlations based upon the markets that cause such effects.

In many ways an investment bank is like a franchise of many businesses sharing a common infrastructure. Thus you will see areas that are great and successful not far from those that are not. Your interest needs to focus on the division and the people who you will be working with and who you're working for.

The press carries little if anything of use to the job seeker, almost all of it is craven puff pieces by journalists who are either so far out of their depth that they don't know there is a surface, or whose editors see themselves as writing a finance version of *Hello*.

There's no magic formula for spotting a pothole in your career, but there are a set of things that you should think about. High staff turnover is a bad sign of course, but if you ask this directly it may offend them, and you may not get an entirely useful answer, other than "pretty average." It is a good idea to ask how long a given person has been with the team. This makes for polite conversation and you will get some idea how people's work turns out in practice, as opposed to the ideal that they tell you about.

As a very rough guide the politeness we saw earlier goes two ways. If the bank is stupidly inflexible over interview times, or you note a lack of buy-in from their attitude, these are bad signs. Of course if you're at entry level, you may be stuck in a rigid process as they trawl through what they may feel is an endless stream of identical candidates, so you have to exercise a bit of judgement.

We have noted a reasonable correlation between the quality of the job, and being offered coffee/water at interview.

Who Will Interview You

You will be interviewed by several people for the one job. They will have different levels of seniority and different areas of specialization.

Quant prejudices
There are many types of quant, and we don't mean that they work in different product areas. Very often there can be a a great deal of technology transfer from one product area to another. For example, the quant skills needed for credit and for interest rates have a wide overlap. No, we mean that quants come from different mathematical backgrounds, and it is this rather than product area that will dictate the nature of a technical interview. Quants come in two varieties the pure mathematician and the applied mathematician.

The pure mathematician quant
This quant will have studied finance as a branch of probability theory, often quite abstract probability theory. Their degree will probably be in either finance or mathematics from a probability theory department. In their interview they will talk about martingales and change of measure, Girsanov and numeraires.

Ninety-nine times out of a hundred the punchline of the probabilistic approach is the simple concept that the value of a financial contract, such as an option, no matter how complex is the expected present value of all cashflows. The expectation comes in because cashflows will vary depending on how the underlying instrument behaves, and the present value appears because cashflows will be in the future and we are valuing the option today. The catch in this is that the expectation must be with respect to the risk-neutral random walk of all underlying random variables, not the real random walk.

Many problems in finance can be addressed by either the pure or the applied mathematician. However, because many interest rate models are constructed from a simulation point of view they are easier to deal with by the probabilistic approach. These models are known as the Heath, Jarrow & Morton (HJM) and Brace, Gatarek & Musiela (BGM) models.

When it comes to number crunching and writing code, which is invariably what you will be doing, you will find yourself writing a lot of Monte Carlo simulation code. At a basic level, Monte Carlo code is easy to write. There are really just the two problems with it, making it fast (including finding the greeks) and using it for contracts with early exercise.

Key areas to brush up on
Understand and be able to discuss knowledgeably the following.

- Risk neutral versus real
- Change of numeraire
- Martingales
- Monte Carlo methods
- Techniques for speeding up Monte Carlo
- Monte Carlo methods for contracts with early exercise

The last two are popular areas of research, so have a few recent articles at your fingertips.

The applied mathematician quant

The applied mathematician may have studied anything but finance. They will have degrees in physics, electrical engineering, chemistry, and applied mathematics such as fluid mechanics. They will talk about calculus and partial differential equations.

To applied mathematicians the problem of pricing a contract is about finding a differential equation which must then be crunched numerically. The differential equation will almost certainly be of parabolic type, also known as the heat or diffusion equation. This equation also has the same interpretation as giving the expectation of the present values of cashflows but this is seldom mentioned.

Applied mathematicians can't easily write certain interest rate models in the partial differential equation framework. However, they have other counter-balancing advantages over the probabilist. Using the tools of calculus they can derive models with fewer assumptions than the probabilists, they can incorporate transaction costs, optimality, nonlinearity and other fun stuff into their models.

Number crunching to the applied mathematician can mean either Monte Carlo again, or finite-difference methods. Finite-difference methods are sophisticated versions of the binomial method. No, strike that, it would be better to say that the binomial method is a prehistoric version of a finite-difference method.

Key areas to brush up on

- Diffusion equations generally
- Finite difference methods
- Finite difference methods in several dimensions
- The different types of finite-difference method: Explicit, implicit, etc.

You ought to have coded up some of these, otherwise you won't sound at all convincing in an interview.

Final trick

Often you will know the name of the person interviewing you. If you do then a simple search on Google or wilmott.com may give you information about the style of the person, their interests, perhaps even weaknesses in their own knowledge.

The Different Types of Mathematics Seen in Finance

The real-world subject of quantitative finance uses tools from many branches of mathematics. And financial modeling can be approached in a variety of different ways. For some strange reason the advocates of different branches of mathematics get quite emotional when discussing the merits and demerits of their methodologies and those of their 'opponents.' Is this a territorial thing, what are the pros and cons of martingales and differential equations, what is all this fuss and will it end in tears before bedtime?

Financial modeling

Here's a list the various approaches to modeling and a selection of useful tools. The distinction between a 'modeling approach' and a 'tool' will start to become clear.

Modeling approaches:

- Probabilistic
- Deterministic
- Discrete: difference equations
- Continuous: differential equations

Useful tools:

- Simulations
- Approximations
- Asymptotic analysis
- Series solutions
- Discretization methods
- Green's functions

While these are not exactly arbitrary lists, they are certainly open to some criticism or addition. Let's first take a look at the modeling approaches.

Probabilistic

One of the main assumptions about the financial markets, at least as far as quantitative finance goes, is that asset prices are random. We tend to think of describing financial variables as following some random path, with parameters describing the growth of the asset and its degree of randomness. We effectively model the asset path via a specified rate of growth, on average, and its deviation from that average. This approach to modeling has had the greatest impact over the last 30 years, leading to the explosive growth of the derivatives markets.

Deterministic

The idea behind this approach is that our model will tell us everything about the future. Given enough data, and a big enough brain, we can write down some equations or an algorithm for predicting the future. Interestingly, the subject of dynamical systems and chaos falls into this category. And, as you know, chaotic systems show such sensitivity to initial conditions that predictability is in practice impossible. This is the 'butterfly effect,' that a butterfly flapping its wings in Brazil will 'cause' rainfall over Manchester. A topic popular in the early 1990s, this has not lived up to its promises in the financial world.

Discrete/Continuous
Whether probabilistic or deterministic the eventual model you write down can be discrete or continuous. Discrete means that asset prices and/or time can only be incremented in finite chunks, whether a dollar or a cent, a year or a day. Continuous means that no such lower increment exists. For reasons that we've never understood, the mathematics of continuous processes is often easier than that of discrete ones. But then when it comes to number crunching you have to anyway turn a continuous model into a discrete one.

In discrete models we end up with difference equations. An example of this is the binomial model for asset pricing. Time progresses in finite amounts, the time step. In continuous models we end up with differential equations. The equivalent of the binomial model in discrete space is the Black-Scholes model, which has continuous asset price and continuous time. Whether binomial or Black-Scholes both of these models come from the probabilistic assumptions about the financial world.

Simulations
If the financial world is random then we can experiment with the future by running simulations. For example, an asset price may be represented by its average growth and its risk, so let's simulate what could happen in the future to this random asset. If we were to take such an approach we would want to run many, many simulations. There'd be little point in running just the one, we'd like to see a range of possible future scenarios.

Simulations can also be used for non-probabilistic problems. Just because of the similarities between mathematical equations a model derived in a deterministic framework may have a probabilistic interpretation.

Discretization methods
The complement to simulation methods, there are many types of these. The best known of these are the finite-difference methods which are discretizations of continuous models such as Black-Scholes. Depending on the problem you are solving, and unless it's very simple, you will probably go down the simulation or finite-difference routes for your number crunching.

Approximations
In modeling we aim to come up with a solution representing something meaningful and useful, such as an option price. Unless the model is really simple, we may not be able to solve it easily. This is where approximations come in. A complicated model may have approximate solutions. And these approximate solutions might be good enough for our purposes.

Asymptotic analysis
This is an incredibly useful technique, used in most branches of applicable mathematics, but almost unknown in finance. The idea is simple, find approximate solutions to a complicated problem by exploiting parameters or variables that are either large or small, or special in some way. For example, there are simple approximations for vanilla option values close to expiry.

Green's functions
This is a very special technique that only works in certain situations. The idea is that solutions to some difficult problems can be built up from solutions to special solutions of a similar problem.

Reading List

Background

Derman, E 2004 *My Life As A Quant*. John Wiley & Sons
http://books.global-investor.com/books/19770.htm?ginPtrCode=10202&identifier=18932b1e1d2bc6d5a1ae69160e8da035
Poundstone, W 2005 *Fortune's Formula*. Hill & Wang
http://books.global-investor.com/books/22645.htm?ginPtrCode=10202&identifier=18932b1e1d2bc6d5a1ae69160e8da035

Taleb, NN 2001 *Fooled by Randomness*. Random House
http://books.global-investor.com/books/22645.htm?ginPtrCode=10202&identifier=18932b1e1d2bc6d5a1ae69160e8da035

Brown A 2006 The Poker Face of Wall Street. John Wiley & Sons
http://books.global-investor.com/books/23007.htm?ginPtrCode=10202&identifier=18932b1e1d2bc6d5a1ae69160e8da035

To get a feel for the recent history of quantitative finance and the working environment for a quant see Emanuel Derman's autobiography. This is a very personal account of his own career from physicist to Wall Street quant. However, it doesn't really convey the role played by programming in a typical quant's life, since Dr Derman is far from being a typical quant.

Bill Poundstone writes about some simple money-management ideas well known to all gamblers yet under-appreciated by risk managers. To back up his case he describes the Long Term Capital Management fallout and the role played by leverage. This book will give you plenty of nuggets to drop casually into an interview to show that crucial market insight and how to relate markets and mathematics in a very pragmatic way.

You will either love or loathe Nassim Taleb's non-technical book on the part played by risk in our lives, not just finance. It is compulsory reading. But whether you love it or loathe it don't let on to your interviewer until you know their feelings towards it. Again, a lot of useful interview material, but unfortunately nothing mathematical.

Introductory

Haug, EG 1997 *The Complete Guide to Option Pricing Formulas*. McGraw-Hill
http://books.global-investor.com/books/9233.htm?ginPtrCode=10202&identifier=18932b1e1d2bc6d5a1ae69160e8da035

Hull, J 2005 *Options, Futures and Other Derivative Securities*. Prentice Hall
http://books.global-investor.com/books/9233.htm?ginPtrCode=10202&identifier=18932b1e1d2bc6d5a1ae69160e8da035

Wiilmott P 2001 Paul Wilmott Introduces Quant Finance
investor.com/books/13754.htm?ginPtrCode=10202&identifier=18932b1e1d2bc6d5a1ae69160e8da035

Espen Haug's book concentrates on presenting pragmatic results for the practitioner without going into all of the modeling details. This book finds a nice balance between theory and practice. Do you want the perfect model that is impractical because it takes too long to find an answer? No. Do you want a model that is quick but gives useless results? No. A chain is only as strong as its weakest link, and this book focuses on models where all the links are similar in strength. Very practical.

Paul Wilmott's book is of course famous, partly for it's more practical approach to quant finance, and relatively relaxed writing style, presumably if you've reached this point you already have a copy, if you don't then you should get one. According to the Financial Times, Paul is a "cult lecturer".

Knowing Hull is compulsory. Everyone has read it. Unfortunately that means that to some extent that knowledge will have been discounted by interviewers. The book is great for definitions of things financial and mathematical. However, if you have only read Hull you will have a strange, fragmentary understanding of quantitative finance because of the pick'n'mix nature of the contents, and because there is no common theme holding the book together. There is also too much on the binomial model. Although this is great for teaching it isn't great for hardcore, practical quanting. If you think that you can get a job after merely reading Hull you are in for a big shock.

Advanced/research level

Jaeckel, P 2002 *Monte Carlo Methods in Finance*. John Wiley & Sons
http://books.global-investor.com/books/14474.htm?ginPtrCode=10202&identifier=18932b1e1d2bc6d5a1ae69160e8da035

Morton, KW & Mayers, DF 1994 *Numerical Solution of Partial Differential Equations*. Cambridge
http://books.global-investor.com/books/21542.htm?ginPtrCode=10202&identifier=18932b1e1d2bc6d5a1ae69160e8da035

Neftci, S 2004 *Principles of Financial Engineering*. Academic Press
http://books.global-investor.com/books/17107.htm?ginPtrCode=10202&identifier=18932b1e1d2bc6d5a1ae69160e8da035

Schonbucher, PJ 2003 *Credit Derivatives Pricing Models*. John Wiley & Sons
http://books.global-investor.com/books/15886.htm?ginPtrCode=10202&identifier=18932b1e1d2bc6d5a1ae69160e8da035

Taleb, NN 1997 *Dynamic Hedging*. John Wiley & Sons
http://books.global-investor.com/books/3768.htm?ginPtrCode=10202&identifier=18932b1e1d2bc6d5a1ae69160e8da035

Wilmott, P 2006 *Paul Wilmott On Quantitative Finance*, second edition. John Wiley & Sons
http://books.global-investor.com/books/23017.htm?ginPtrCode=10202&identifier=18932b1e1d2bc6d5a1ae69160e8da035

Peter Jaeckel goes into the details of Monte Carlo methods. It can be quite heavy going at times, but for interview purposes you won't need to have understood everything in this book. As long as you can show an appreciation of random number generation methods, how to speed up Monte Carlo, and using Monte Carlo for pricing American options then you should be fine.

The other main numerical methods you will need to understand are the finite-difference methods. There are books on finite differences in finance (such as Tavella & Randall) but for extra kudos you would be better off reading one of the classics such as that by Morton & Mayers. It has no reference to finance whatsoever, but explains beautifully the numerical solution of various partial differential equations.

Salih Neftci's book explains the probabilistic side of quantitative finance modeling. Although this subject can be a bit daunting because it appears so abstract, Neftci does a fantastic job of making the topic intuitive.

Philipp Schonbucher is another challenging read. Entirely on the subject of credit risk modeling, if you are able to understand (and more importantly, show that you understand) just 25% of this book then you will go far, my son.

Nassim Taleb's technical book (as opposed to his popular science book mentioned earlier) combines theory and practice very successfully. This is another book that will give you useful gems for your interview.

Paul Wilmott's three-volume opus is from the other side of the tracks from Salih Neftci, it shows how the applied mathematician thinks of quantitative finance. The book starts at the standard level of explaining Black-Scholes, moving on to discussing modern quant models as used in practice, ending up with some ideas from the cutting-edge of research. One important point about this book, which distinguishes it from others, is that it does criticize many of the models commonly used by practitioners. Again, you will find many modeling insights and *bon mots* in this book that will be useful during your interview ordeals.

There are also a good selection of papers and videos on www.wilmott.com

What You Must Know

The following is not an exhaustive list, and is only the general broad brush strokes, but it will ensure that you don't make an idiot of yourself by having major gaps in your knowledge.

Products

Fixed income, bonds, swaps
Equity, dividends, derivatives
Currencies, role of foreign and domestic interest rates
Commodities, convenience yield etc.
Exotics, main types,
Credit derivatives

Concepts

Risk, return and efficient frontiers
Delta hedging
Risk neutrality
The no-arbitrage argument
Market price of risk for non-traded quantities
Calibration
Static hedging using exchange-traded vanillas

Models

Binomial model
Lognormal
Jump diffusion
Stochastic volatility
Interest rate model (single, multi factor, HJM, BGM)
Credit models (hazard rate, structural)
Transition matrices

Numerical methods

Monte Carlo simulation techniques
Binomial scheme
Finite-difference methods
Numerical quadrature
Which method to use for which type of contract

What You Must Have Coded Up

Key areas
You must be comfortable with the four main numerical methods used for pricing derivatives:

- Binomial/trees
- Finite-difference methods
- Monte Carlo
- Numerical integration

Although the first of these (binomial and trees) are rather inefficient they still have their proponents and you should show willingness to lower yourself to this level. We know of a world-class numerical analyst working in computational fluid mechanics who left his academic job for the bright lights, and ended up coding the binomial model. A certain amount of pride swallowing was necessary in the short term, but his recent progress has certainly made it worthwhile.

Aim to code up as many different types of exotic contract as possible, in as many markets as possible (essentially the lognormal markets of equity, FX, etc. and fixed income and credit).

When pricing an exotic such as an equity Asian option you should use both Monte Carlo and finite difference. The two methods are completely different but the exercise will give you invaluable experience and plenty to talk about in your interview.

(The next few sections are taken from *Paul Wilmott On Quantitative Finance*, second edition, 2006, John Wiley & Sons.)

Finite-difference methods

Finite-difference methods are designed for finding numerical solutions of differential equations. Since we work with a mesh we find the contract value at all points is stock price-time space. In quantitative finance that differential equation is almost always of diffusion or parabolic type. The only real difference between the partial differential equations are the following:

- Number of dimensions
- Functional form of coefficients
- Boundary/final conditions
- Decision features

Number of dimensions
Is the contract an option on a single underlying or many? Is there any strong path dependence in the payoff? Answers to these questions will determine the number of dimensions in the problem. At the very least we will have two dimensions: stock price and time, for example. Finite-difference methods cope extremely well with smaller number of dimensions, up to four, say. Above that they get rather time consuming.

Functional form of coefficients
The main difference between an equity option problem and a single-factor interest rate option problem is in the functional form of the drift rate and the volatility. These appear in the governing partial differential equations as coefficients. The standard model for equities is the lognormal model, but there are many more 'standard' models in fixed income. Does this matter? No, not if you are solving the equations numerically, only if you are trying to find a closed-form solution in which case the simpler the coefficients the more likely you are to find a closed-form solution.

Boundary/final conditions
In a numerical scheme the difference between a call and a put is in the final condition. You tell the finite-difference scheme how to start. And in finite-difference schemes in finance we start, strangely, at expiration and work towards the present. Boundary conditions are where we tell the scheme about things like knock-out barriers. When we write our code we'd like it to be as general and reusable as possible. That means writing it so that it doesn't have to be changed too much in going from one contract or model to another. So we might put things like final conditions in some external function, to be changed easily.

Decision features
Early exercise, installment premiums, chooser features, are all examples of embedded decisions seen in exotic contracts. Coping with these numerically is quite straightforward using finite-difference methods, making these numerical techniques the natural ones for such contracts. The difference between a European and an American option is about three lines of code in a finite-difference program and less than a minute's work.

Program of study for finite-difference methods

If you are new to finite-difference methods and you really want to study them then you need a program of study.

Explicit method/European calls, puts and binaries

To get started you should learn the explicit method as applied to the Black-Scholes equation for a European option. This is very easy to program and you won't make many mistakes.

Explicit method/American calls, puts and binaries

Not much harder is the application of the explicit method to American options.

Crank-Nicolson/European calls, puts and binaries

Once you've got the explicit method under your belt you should learn the Crank-Nicolson implicit method. This is harder to program, but you will get a better accuracy.

Crank-Nicolson/American calls, puts and binaries

There's not much more effort involved in pricing American-style options than in the pricing of European-style options.

Explicit method/path-dependent options

By now you'll be quite sophisticated and its time to price a path-dependent contract. Start with an Asian option with discrete sampling, and then try a continuously-sampled Asian. Finally, try your hand at lookbacks.

Interest rate products:

Repeat the above program for non-path-dependent and then path-dependent interest rate products. First price caps and floors and then go on to the index amortizing rate swap.

Two-factor explicit:

To get started on two-factor problems price a convertible bond using an explicit method, with both the stock and the spot interest rate being stochastic.

Two-factor implicit:

The final stage is to implement the implicit two-factor method as applied to the convertible bond.

Monte Carlo methods

Monte Carlo methods simulate the random behavior underlying the financial models. So, in a sense they get right to the heart of the problem. Always remember, though, that when pricing you must simulate the risk-neutral random walk(s), the value of a contract is then the expected present value of all cashflows. When implementing a Monte Carlo method look out for the following:

- Number of dimensions
- Functional form of coefficients
- Boundary/final conditions
- Decision features

again!

A common interview question is to ask the pros and cons of MC vs FD. This should be an easy point to score.

Number of dimensions:
For each random factor you will have to simulate a time series. It will obviously take longer to do this, but the time will only proportional to number of factors, which isn't so bad. This makes Monte Carlo methods ideal for higher dimensions when the finite-difference methods start to crawl.

Functional form of coefficients
As with the finite-difference methods it doesn't matter to much what the drift and volatility functions are in practice, since you won't be looking for closed-form solutions.

Boundary/final conditions
These play a very similar role as in finite differences. The final condition is the payoff function and the boundary conditions are where we implement trigger levels etc.

Decision features
When you have a contract with embedded decisions the Monte Carlo method becomes cumbersome. This is easily the main drawback for simulation methods. When we use the Monte Carlo method we are only finding the option value at today's stock price and time. But to correctly price an American option, say, we need to know what the option value would be at every point in stock price-time space. We don't typically find this as part of the Monte Carlo solution.

Program of study for the Monte Carlo path-simulation methods

European calls, puts and binaries on a single equity: Simulate a single stock path, the payoff for an option, or even a portfolio of options, calculate the expected payoff and present value to price the contract.
Path-dependent option on a single equity: Price a barrier, Asian, lookback etc.
Options on many stocks: Price a multi-asset contract by simulating correlated random walks. You'll see how time taken varies with number of dimensions.
Interest rate derivatives, spot rate model: This is not that much harder than equities. Just remember to present value along each realized path of rates *before* taking the expectation across all paths.
HJM model: Slightly more ambitious is the HJM interest rate model. Use a single factor, then two factors etc.
BGM model: A discrete version of HJM.

Numerical integration

Occasionally one can write down the solution of an option-pricing problem in the form of a multiple integral. This is because you can interpret the option value as an expectation of a payoff, and an expectation of the payoff is mathematically just the integral of the product of that payoff function and a probability density function. This is only possible in special cases. The option has to be European, the underlying stochastic differential equation must be explicitly integrable (so the lognormal random walk is perfect for this) and the payoff shouldn't usually be path dependent. So if this is possible then pricing is easy… you have a formula. The only difficulty comes in turning this formula into a number. And that's the subject of numerical integration or quadrature. Look out for the following.

- Can you write down the value of an option as an integral?

That's it in a nutshell.

Program of study for numerical quadrature
Here is a program of study for the numerical quadrature methods.

European calls, puts and binaries on a single equity using Normal numbers: Very simple. You will be evaluating a single integral.
European calls, puts and binaries on several underlying lognormal equities, using Normal numbers: Very simple again. You will be evaluating a multiple integral.
Arbitrary European, non-path-dependent payoff, on several underlying lognormal equities, using Normal numbers: You'll only have to change a single function.
Arbitrary European, non-path-dependent payoff, on several underlying lognormal equities, using low-discrepancy numbers: Just change the source of the random numbers in the previous code.

Summary of Numerical Methods

The following table summarizes when the various methods excel, and where they fall flat.

Subject	Finite difference	Monte Carlo	Quadrature
Low dimensions	Good	Inefficient	Good
High dimensions	Slow	Excellent	Good
Path dependent	Depends	Excellent	Not good
Greeks	Excellent	Not good	Excellent
Portfolio	Inefficient	Very good	Very good
Decisions	Excellent	Poor	V. poor

Programming Skills

This is central to the notion of *doing things*. The programming ability of quants varies enormously, but a large percentage of your time will be spent fighting computers, so showing aptitude is frequently a deciding factor. Most quant jobs require C++, with a little Java, C# and Excel VBA. Alas, Excel VBA is regarded as "trivial" so few employers will be impressed by mastering it. This attitude is responsible for major efforts at the large banks to defuse the vast number of actively disruptive, yet critical spreadsheets with the reliability of a British train operated by Russian nuclear engineers.

Fortran is still quite popular in academia, but has only a tiny market share in banks.

If you have the choice for which language to use in a project whilst studying it is worth considering C++. However you should budget in extra time to master it properly.

Apart from understanding the subtleties of the language, you may need to demonstrate a general understanding of software engineering. Although efficiency is, of course, good, what matters more is that the thing actually works, and in financial markets you have to show a pragmatic view of how you trade off these things. There are at least two pertinent programmers' sayings:

- Fast, Reliable, Ready Tomorrow: Pick any two
- Easier to make correct code fast, than to make fast code correct

Academic code is light on things like error handling and checks to ensure input data is of the right range. Get in the habit of thinking of "sanity checks" for all numerical values.

"Working code" is not code that happens to produce the right result when you feed in carefully chosen values in a tight range. It means functions that have been tested across a wide range of values, and whose output has been compared to known good values. Deterministic routines should *always* return the same result, and Monte Carlo should have known convergence characteristics.

You should get in the habit of making your code tougher, assuming that people will actively try to break it, because that it rather close to the truth.

C++

C++ is a topic in its own right, and we'll soon be releasing an upgraded version of the C++ for interviews notes.

An outline of skills required for C++ are:

- Variables
- Pointers
- Classes
- Passing by value and reference
- Templates
- STL (strings, vectors and algorithms)
- Inheritance up to the the level of virtual functions
- Basic OO

This represents a lower bound, below which you should seriously consider whether to put C++ on your CV without a qualifier such as "basic knowledge." C++ is a rich domain for questions that look like someone banged their head on the keyboard.

It is better to have a good grasp of the core concepts of C++ than in a short time attempt to read up the whole language.

Common interview questions are of the form "which function is called," and "what's wrong with this code." Often you will be expected to describe things like virtual inheritance or template specialisation.

Numerical algorithms

It's good to have at least a basic grasp of the basic methods for solving PDEs and other maths problems. Most QF uses a mix of Monte Carlo, trees, and finite-difference methods. It's worth getting to the stage where you can sensibly say when you'd choose one method over another, and their limitations and advantages.

There is also some demand for Matlab and Mathematica. These are mostly used for prototyping ideas, although they are also doing live work in trading.

Similar issues apply to quiche languages such as Java and C#.

Reading list for C++

If you are going to be selling yourself partly upon your C++ skills, then you must read the latest edition of Stroustrup.
http://books.global-investor.com/books/20551.htm?ginPtrCode=10202&identifier=a49d71be25a99088bb7a3d4aac82ff74

If you are making the assertion that you are strong in C++, then you should read one, or preferably both of:
Exceptional C++
More Exceptional C++
By Herb Sutter, published by Addison Wesley.

Sutter takes the approach of taking specific aspects of C++ and drilling down so that you understand them at a deep level. Neither are good as your first C++ book, Stroustrup is still about the best for that.

Two good books on C++ for quants are:

Financial Instrument Pricing using C++
by Daniel Duffy, published by Wiley.
This combines financial methods with patterns and is best thought of as your second book in C++ after you have worked through Stroustrup. Includes interfacing with Excel, important because a large percentage of C++ is front ended by Excel.
http://books.global-investor.com/books/17081.htm?ginPtrCode=10202&identifier=a49d71be25a99088bb7a3d4aac82ff74

C++ Design Patterns and Derivatives Pricing
by Mark Joshi, Cambridge University Press
Mark manages to get books into both the mathematical finance and quant programming sections, and this is a relatively gentle, yet rigorous first book of C++ quant development.
http://books.global-investor.com/books/17705.htm?ginPtrCode=10202&identifier=a49d71be25a99088bb7a3d4aac82ff74

If you want practice understanding some of the more gruesome things that people do with C++, then the International Obfuscated C++ contest will provide you with a different perspective of how you build code.
http://www.de.ioccc.org/whowon2005.html

Dealing With Offers

What is an offer?
Currently the market for quants is pretty good, so a verbal offer of a job is perfectly acceptable. But times change, and it is only a real offer when the paperwork arrives from HR. Do not turn down your 2nd or 3rd best offer unless and until you get a piece of paper from your new employer.

Process
It is sometimes the case that there is no formal approval for the position yet, so your new boss has to go through internal processes to get it approved. This especially affects quants since your work will often be paid for and used by different groups, and each has to both approve of you and the headcount that you will fill. This may take place in a short meeting soon after they see you, or over a few weeks as they see others, and someone tries to coordinate the process enough that a consensus arises. As these people will be in more than one business area, and sometimes different countries, this is not always rapid.

You may not be the first choice, but especially at the entry level we have many people going for many jobs, so they may miss the one they want, although of course this is not usually communicated to you.

They then tell HR to send out an offer. They will have processes of their own, and it is not exactly unknown for the first thing for HR to know of your employment is when they are told to make you an offer. In some firms the generation of contracts has been outsourced. This is done for cost reasons, not efficiency in time or stress.

All these steps may not sound like a robust or rapid process, and sad to say that is quite often the case that things go wrong or take more time than it should.

If you've got a headhunter helping you through this, we will (very gently) pester the various people to help move the process along, and give feedback where possible. One person who applied personally recently had to wait several months while the process ran its rather random course. If we're involved we can make this a little less stressful, but in the final analysis the bank will do what it wants, when it wants to.

You should be careful about turning down other offers until you are confident that it is a firm offer for the job you want most.

They will typically set a deadline of 1-2 weeks for you to make up your mind, and even if you have no other useful options, take some time to think it through.

If you're applying personally, then you have to make sure you tread a path of keeping in their minds, and really irritating them. No one likes nagging emails, no matter how polite you are. Either they remind them of the fact that's there's more bureaucratic work to be done, or they're waiting for someone else. The politeness we mentioned above is really valuable to you here.

Once you have an acceptable offer, then this can form a useful hedge when trying to get other firms to speed up their processes. Since you have a limit on your exposure, you can take a slightly more assertive line with the laggards. They will know that the offering bank will be putting pressure on you to accept, and they you have limits on how long you can wait.

Some managers or headhunters will try and get you to accept extremely quickly. If this is the job of your dreams, then no real harm is done by accepting. But if you are being sold-to heavily then it's worth making sure you are making this big decision with the clearest view you can get. It is of course flattering to have a major financial organisation offer you good pay, and really want you to join them, but do not let that sway you too much. It's fine to enjoy the moment, but as a new entrant to the market you can say that you are very keen but because you are new to this, you think it's best for all concerned if you make sure that it's the right thing for you.

Sometimes a headhunter may say that you have to accept today, or they'll walk away. This is not likely to be true, both the HH and the bank have invested quite a number of hours in finding you, and they're not going to let that go to waste.

Make sure you get the manager's direct line.

Spotting bad jobs

It's normal for a good percentage of your interview to focus on programming. However it is not unknown for people who think they are being interviewed for entry level quant jobs to get sucked into IT roles instead. It's worth asking what percentage of your time will be IT and what percentage analytical.

Many people express to us the notion that they don't want to program at all. This is a worrying view of the work of a quant. More than one manager has described to us the first year of a quant's career as learning to code. As Peter Jaeckel, a famous quant put it, coding is how we turn maths into money. You must be prepared to be self sufficient in coding. Many firms have specialist developers for the final implementation, but you will still have to prototype, and manipulate your own data.

You may not be a star programmer, but you have to attain basic competence, if you want to make a success of this career.

We're always happy to offer personal advice on how to evaluate offers via the website or email.

Being Foreign

We don't care

Quant finance is a business area where nationality or other superfluous characteristics are not of any real significance. Turn up to a Finance Focus or Random Walkers, and you will see a very wide range of people, since the core issue is how well you do the work. Some managers at banks are quite smug at having succeeded in an environment they regard to as a meritocracy.

Banks are sensitive to discrimination issues, not least because it has cost them a lot of money in the past when they have got this wrong. Thus you may be asked about your age, race, and some guess made about your sex. We say "guess" because a scary % of people who've seen Dominic's details thinks he's female. One HR department became quite intense about "Dominic's maternity leave" at one point.

This information is mostly to make sure that they can honestly say that although only 4% of their quants are women this is because only a tiny % of the applicants wore women, and similarly amongst various other groups. Like many other HHs we don't put irrelevant stuff on your CV.

Visas

Most of the good jobs are in London, New York or Chicago, so a large percentage of people applying to be a quant, are not from the country that they want to work in. Banks will sometimes help with visa applications, but they generally don't want to, partly for reasons of cost, but mostly because it's more work. The more you can reduce the effort of hiring you, the better your chances. If applying to a bank in London then you should look at the Highly Skilled Migrant Programme, which is neutral about your country of origin, and is optimized for people whose presence brings financial benefit.

Being there

At entry level, you are expected to do most of the running. That means coming to your target city, and seeing as many banks as possible. This is not stress free, but you should allow for as much time as possible. Some banks will be flexible about when they see you, others won't. Some will go for initial screens by phone, but most managers really hate these, and you will do your application far more good by investing in a ticket and a hotel room.

If you aren't a native English speaker, the sections on your CV where we talk about getting it reviewed are critically important.

Make sure you are contactable, and if you have good reliable friend in your target city to receive mail, that can make life easier. All the things about being easy to contact are very true if you're operating remotely.

Dealing with Headhunters

Disclaimer
OK, we're HHs so apply whatever discount factor you feel appropriate, but we've tried really quite hard to be objective.

We started a headhunting business because we saw that quants needed help from people who had hard core experience of working in banks and as well as quant finance. This guide is part of our ambition to go beyond the standard of being a body shop, to a resource that people turn to when going through a quite stressful and important part of their lives.

How to spot a good headhunter
A good HH has good jobs and understands the work. At any point in time a HH may not have a role for you, simply because the market is so fragmented. A good HH will be honest about this, and chat to you about the sort of direction to head in. The majority of HHs are sales people, they get paid for selling you, not for building up relationships beyond getting you placed. That focus can work to your benefit, since their objectives and yours are to get you into a job as soon as possible. He should be able to describe the job, and should advance at least some idea why he thinks you are right for the job. A good HH will have read your CV, and identified things from your experience that need to be expanded to make your application stand a bigger chance.

Multiple applications
HHs get paid for finding people like you. But banks really don't want to get involved in dealing with different HHs who have sent your CV, and both want money if you get hired. Some have a simple policy that if you apply twice, then your application is rejected for both. HHs hate that a lot, and it makes them look bad as well as costing money. Some HHs won't tell you where they're sending your CV. This is bad news, and can cause this sort of problem. Of course it may stop you applying to other banks because you don't know where your CV is being sent.

Some HHs will send your CV out without asking you, and this causes all sorts of problems. It is deeply frustrating when a HH can't get hold of a good person to get permission to send, and clients are not known for their patience. Typically it is some sort of race ,with more than one HH chasing each job. In several countries, it is illegal to do this, but it does happen. We don't do this at all. The flipside f this is that your contact details must work, and be on your CV. We do get CVs without have working contact details, and it's not hard to see that that this does not advance their position at all.

Names

HHs need to keep their list of contacts at banks up to date in the face of continuous change. As above the HH needs to know if you've been put forward for the role he's working on. Sadly some HHs get a bit carried away with this, and put pressure on newbies to give up the name of the managers they've been seeing. This can of course work against you, since he may have other people who he can use to compete against you for that job, so it is not a good idea to be too free with this. A HH only needs to know a little information such as the division and bank, "Fixed income, Credit Suisse" is easily precise enough to make sure there is not a clash. Big banks are in some ways like a franchise operation. Different divisions rarely share recruiting processes, and in some firms they have separate HR.

Also if you are currently in a job, you should be very careful about giving out your current manager's name. It does not make friends to have your boss pestered aggressively by a HH before you've got your next role.

However, it's valuable information, and if you feel a HH has done a good job helping you in a move, you may feel that you want to reward that with some useful work. Think of it as a tip.

Multiple targets
For your later jobs, you want a relatively high degree of precision, and it can be entirely rational to deal only with one headhunter, or even none at all. However at entry level, it is a bad sign if a HH wants any sort of long term exclusive on you. The market is too fragmented for any single source to offer the degree of exposure you need. If the HH is pushy on this, it is worth remembering that there are about the same number of HHs as banks.

Exclusives
Some Headhunters will try and push you into dealing only with them. At entry level we think that is a truly bad thing for you. It is far more beneficial to the candidate than the headhunter, and can cause serious harm to your job prospects.

The simple reality of the market is that any given headhunter only sees a relatively small percentage of jobs on offer, and at entry level considerable recruitment is done directly, without any search firm being involved. Also at this point there is significant competition for each role, so your chances of any particular application succeeding is not high enough to rely upon one or two shots.

We don’t demand such exclusives for these reason, and although it does mean we spend effort on people who get placed other ways we are not in the business of damaging people’s career prospects.

Once you are established with a good amount of experience, then you will want to apply a more targeted approach.

Mulitple offers
You may get offered more than one of the jobs you apply for, and sometimes this seems more stressful than actually trying to get a job. Some HH's will see their commission slipping away, and try to put pressure on you. This is made worse by the fact that the bank has put a lot of effort into finding you as well, and may blame the HH if you don't accept.

You've got to take the job that suits you best. A good HH will of course put a case, but will realise when the game is up, and store goodwill for next time.

However, it's not always clear cut what you want, and again P&D are quite happy to provide a sounding board for talking through the pros and cons. We do this quite a lot, even when we aren't the firm placing you, our view is that you'll remember good advice for next time.

Typically the ideal job will be a mix of the offers you have, especially in your first couple of jobs. So there may still be a value to the relationship with the HH that "came second". He will usually be keen to try and keep the game going, given that he's close to the final line, and never ever forget that HHs are paid for placing people, and they don't get paid if they don't.

See it from their side
You should be aware that recruitment isn't just hassle for you, but that the people at the bank don't usually like it that much either, and other high priority tasks as well. Having to interview 10 people is not uncommon, and at some banks anywhere between 5 and 12 people are involved in the process, which makes for a lot of work that they didn't want to do in the first place and won't earn them any bonus.
So they will be quite sad about your rejection.
There are two basic scenarios, either you narrowly beat the next best person, or were the first one they found who was any good. If it is the second type, then they are going to try harder to suck you in, and this can help the negotiations.

Auctions
Banks do not like being drawn into auctions. The obvious reason is pushing the price up, but it's worth looking at how people make decisions on what they offer.
Typically the hiring manager has to his boss that he believes that offering X will get you on board. Often he has had to make this pricing judgment before he's interviewed anyone, sometimes before even talking to a headhunter.

This exposes him to risk, and yet more of the recruitment process he so keenly wants to escape.

This is a bank, so he will value his reputation as someone who can make good judgments about money, and a process where he has to keep asking for higher levels of pay or rank for a new hire may risk making him look weak or foolish. Since these increases will require justification, an unrealistic set of expectations can easily be generated.

If on the other hand he loses a good candidate because he's wasn't allowed to pay for him, a politically astute manager may have an edge for a future discussion on what his people are paid.

Thus hiring managers have strong incentives to avoid auctions.

All or nothing
If two jobs are close, then it's worth seeing if you can make the second-placed one better. Although auctions are likely to fail, you can structure it so the "losing" manager can have one last shot. If you have a good HH, you can work together to see if there is a change in your level or pay structure which means you will definitely take the second-placed job. For this to work it's important that both the HH and second manager feel that this is a real deal. To get you a worthwhile change they will have to sell the idea, and risk some of their reputational capital. If they think that even after getting the better offer you won't accept, then they won't even try.

Warning
On the forums, P&D often refer to ourselves self-mockingly as “pimps.” We’re fine about being called this. Most headhunters do not like this *at all*, so don’t alienate the guy who might be getting you a job this way.

How to Quit

Often you can simply tell your boss you are going, wait a month or so, and never look back. However there are a few obstacles that may well get in your way.

Notice periods and Gardening Leave

A sign of the rising market in quant jobs is that notice periods have gradually grown. This can slightly interfere with getting a new job, since often the new employer will want you to start sooner. In general most notice period clauses are enforceable, so you will need to check on these. However, it is rarely a big issue and of course if you're so valuable your firm doesn't want you to go, that looks good. However, it's worth telling your HH the terms, so that he can set the right expectation with your new employer.

Some firms have "no compete" clauses, and these are a nked attempt to imrove their negotiating position when you leave. It is of course quite hard to get these removed until you've reached a stronger negotiationg position with the bank.

Negotiation

If you find yourself with an inconvenient notice period, then by far the best way forward is to talk things through with your boss. Some people take resignations very personally, but it's in everyone's interest to make this as painless as possible.

Before you quit, look at your current work, and try to work out which ones are important to be finished before you leave, which really require you personally, and those that can be finished relatively quickly.

Then make a hard, realistic estimate of how long it will take. The best deal for both sides is that you finish these jobs and go. You have an incentive to finish, and your boss has some confidence it will happen. One of these jobs is to help recruit your successor, since of course you know what skills are required. As we say earlier, your boss won't be looking forward to the prospect of going through piles of CVs and interviewing people of rather variable quality. You can also write a good job spec, and if you're dealing with the smarted end of HH (like P&D ☺) then they will want to talk to you about the right sort of person.

This helps make your ex-boss remain less stressed, and means you can fade out leaving a good impression. The trick is to offer these things as part of a package. You are offering to leave well, and in return they won't give you hassle over inconvenient parts of the contract. Most people in banks are quite honourable about these things, but they may be second-guessed by some more senior or generally awkward person in the bank. It is not exactly unknown for your manager to "remember" a different version of events. Thus you should confirm the agreement in a mail ,and make sure a copy is sent to your personal email. It is now rare for banks to "lose" inconvenient emails ever since a large bank got hit for a serious legal hit when it apparently genuinely lost some correspondence that would have helped its case. The courts apparently took the view that the bank could not have been as incompetent as it claimed. Clearly the judges had never dealt with an outsourced IT department.

Buy backs
It's hard to work out what people are really worth, and obviously part of your reason for leaving is that you think they have priced you wrong. If you are important to the team, then they will consider offering you more money. The same logic applies to the work you do, and your conditions. Some areas such as model validation are usually subject to quite high staff turnover because of a combination of all three, plus the feeling of many people who work there, that if they don't get out soon they never will.

Leaving your job cleanly is worth doing well. The people you leave behind may crop up again in your career, and it is far from unknown for you to consider going back to the same firm again later.
For an example of how *not* to show your unhappiness with your current firm :
http://www.wilmott.com/blogs/index.cfm/2006/5/15/My-boss-wants-me-dead-2

Money
This is the easiest to fix, which may surprise those who've been told quite strongly that there is no money available. This is often an industry standard lie, as you may find when you hand in your notice. Money has the advantage that it's simple, to get more, your boss can make the case with his superiors or allocate money from some other pot. It may be hard to do this, but is usually simpler than altering your work. Usually they will top the offer you've just been made, though with one person we know his boss offered half the difference. No, we don't know why they did this either, but as you can imagine it completed his resolve to leave.

You have to ask yourself why you had to resort to this level of threat to merely catch up with the market. You can't realistically go through this very often, and it's generally accepted that about two thirds of people who are bought back leave within a year anyway.

Investment banks are the nearest thing to pure meritocracies on the planet, and given that merit implies money, being underpaid means they don't value you, which is not a basis for a long term relationship.

Work
Your boss may offer to change the work you do. This is typically very hard for him to do, since the "bad" work still has to be done. It is also hard to objectively define, and such promises are often made in good faith, but not delivered. If there is a specific thing you want to work on, then it's worth negotiating on. You may be offered the chance to move to a sexier group which is attractive, if true. This needs to be tied down well, a vague promise to try and get you more interesting work does not count.

References
One obvious reason for being reasonable as you leave is that your boss may give you a reference. This is a murky legal area. Many banks are very hard line on giving references, and require that all requests must be channeled through HR. This is to try and avoid the possibility of being sued, and even then is not foolproof after one bank was sued after it appeared that they'd given a reference for the wrong person. Thus many have a policy of minimal references, typically stating little more than when you started and finished.

However HH's have the job of making sure you're right for the job, and that often includes trying to get a verbal reference, and some managers will contact your previous boss for an informal chat. This is a dark art. Your boss will usually be very wary of saying anything that gets him or the bank sued, but most people are quite reluctant to actually be dishonest. Thus a code evolves of pregnant silences, emphasis on words, and euphemisms. This is far from perfect, and quite a noisy signal, but is often all one has. The clarity of the reference is a function of how motivated your ex-boss is to say things, and if he has strong views these come out.

Useful Links

www.wilmott.com
Lots of useful content, quant finance chat, articles, videos, job adverts. For the job seeker, the Brainteasers Topic is incredibly valuable.

http://www.wilmott.com/blogs/dcfc/
Dominic's Blog, useful, tries to be funny.

www.PaulDominic.com
Register you CV with us.

http://www.gotw.ca/gotw/index.htm
Interesting puzzles and points in C++

http://www.ieor.columbia.edu/forms/JobsRiskColumn.pdf
Derman's view on the way things are now

http://www.fooledbyrandomness.com/
Interesting thoughts on probability, finance, and well pretty much everything.

http://math.ucsd.edu/~crypto/Monty/monty.html
The Monty Hall Problem

http://www.mindview.net/Books/TICPP/ThinkingInCPP2e.html
Good Free C++ Book

http://www.nr.com/
Numerical Recipes Home Site

http://archives.math.utk.edu/topics/
Math Archives, lots in useful stuff

http://www.dartmouth.edu/~chance/teaching_aids/books_articles/probability_book/amsbook.mac.pdf
Basic Probability

http://www.dartmouth.edu/~chance/teaching_aids/books_articles/probability_book/amsbook.mac.pdf
Intro to Numerical Methods

Next Steps

Please send either of us an email (Dominic Connor, dominic@pauldominic.com, or Paul Wilmott, paul@pauldominic.com). It will be our pleasure to work with you!
We are now starting blogs on the Wilmott.com website, and both of us can be reached through the private messaging system.