Quantitative Finance: Technical Interviews & Exams

AKRAM AYYASH (MSCF '14)

OCTOBER 2013

Outline

1. Interviews & Exams

2. Quant Topics

3. Useful References

1. Interviews & Exams

SOME GENERAL POINTERS

Interviews

Interviewers in general are looking for the following things in an interview:

1. Technical Knowledge

2. Fit (Personality as well as passion for finance)

3. Market Knowledge (Views and intuition)

4. Company Knowledge (Why us?)

In this presentation we will focus on the first item on the list: **The Technical Knowledge**

Interviews

If you are an MSCF Student then you should expect **quantitative** and **highly technical** interviews. As you start your recruitment remember:

◦ Interviewers are looking for intuition, make sure you don't just have a shallow understanding of the concepts involved, or a mere procedural knowledge of the coursework.

◦ Sell-side firms will tend to ask more math questions, Buy-side will have more statistics questions for you to tackle. Both may ask you programming questions.

◦ You should expect to **write down answers** with a paper and pen during the interview – some candidates are surprised to learn that! For coding questions you are expected to write pseudo-code.

Exams

Another integral part of recruitment **is written examination**. Several Companies have been relying on written exams recently as a first step of their recruitment process for internships and full time openings.

Exams are of varying difficulty, in general there is no clear cut score for 'passing'. Successful candidates are chosen depending on their **relative performance within their peer group**, i.e. if you are a Ph.D. student gunning for a full time position you will not be compared to a Masters Student seeking an internship.

Exams

The following are some firms known to give written exams as part of recruitment:

◦ Morgan Stanley Strats and Modeling (MSSM)

   One Hour Multiple Choice Exam with around 60 questions

◦ Credit Suisse Quantitative Summer Institute (QSI)

   One Hour Multiple Choice Exam with around 30 questions

◦ Deutsche Bank Analytics

   Take home Exam encompassing around 10 word problems

◦ Trans-Market Group

   Take home exam (they ask you to complete it in 8 hours) on Algorithms and Coding

2. Quant Topics

FOR INTERVIEWS AND EXAMS

Exam & Interview Topics

Quant Exams & Interviews cover a wide range of topics, most of which you will see at varying stages of the MSCF curriculum.

The most Popular Topics Covered:
◦ Calculus
◦ Differential Equations
◦ Linear Algebra
◦ Probability & Statistics
◦ Mathematical Finance
◦ Programming (Java or C++)

Let's jump right in!

Calculus

Differentiation
- Trigonometric Functions
- Exponential and Logarithms
- Chain Rule
- Leibnitz Rule – Differentiation under the integral sign

Integration
- All the functions above
- Integration by parts
- Normal Distribution pdf, the erf() function

Other
- Taylor Expansion
- Lagrange Multipliers (don't worry about if you haven't seen it before)

Differential Equations

Ordinary Differential Equations
- Solving by direct integration for 1st order ODEs
- General 1st order Linear ODEs
- Constant Coefficient 1st order and 2nd order equations
- Reduction of Order (from 2nd or higher to 1st)
- Exact Differential

Partial Differential Equations
- Heat Equation (at least a 'knowing look' is enough at an early stage)

Linear Algebra

Matrix Algebra

- Solving 2 equations in 2 unknowns
- Finding Determinants
- Matrix Multiplication
- Matrix Inversion for 2x2 and 3x3
- Dot Product
- Eigenvalues and Eigenvectors

Theory

- Rank-Nullity Theorem (more advanced)

Probability & Statistics

Counting
- ◦ Combinations and Permutations
- ◦ Finding odds of Poker hands and Dice Throws

Popular Distributions
- ◦ PDF / CDF
- ◦ Moment Generating Function
- ◦ Central Limit Theorem
- ◦ Normal and logNormal Distributions

Iterative Problems
- ◦ Expected number of coin tosses to get N heads in a row
- ◦ Amoeba Problem (google this!)

Probability & Statistics

More Probability
- Jensen's Inequality
- Change of Probability Measure (more advanced)

Linear Models
- Least squares estimation
- Covariance – Correlation – Beta
- Applications to CAPM

Time Series
- Mean Reversion and Stationarity (at least a high level view)
- ARMA and GARCH models (you'll learn this in mini4)

Mathematical Finance

Fixed Income
- DV01, Duration, Convexity and applications to hedging
- Implications of negative Convexity
- Pricing Floating Rate Notes, Swaps

Options
- Black-Scholes Assumptions (derivation of PDE is covered in mini3)
- Basic Option Strategies (Straddles, Strangle, Spreads)
- Greeks (Delta, Vega, Gamma, Theta)

Stochastic Calculus
- Brownian Motion 'acrobatics' (differentiation, integration, Itô's Lemma)

Programming

Algorithms
◦ Sorting and Searching Algorithms
◦ Order of Complexity (Big-O Notation)
◦ Numerical Integration and Differentiation

Object Oriented Programming
◦ Classes (why do we need them)
◦ Polymorphism, Inheritance, and Virtual Functions
◦ Constructor and Destructor 'gimmicks'

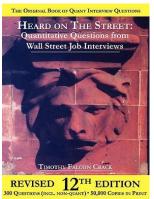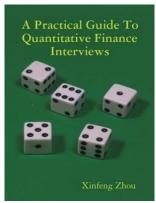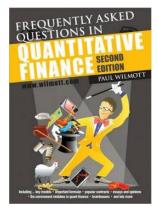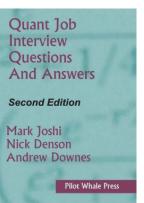# 3. Useful References

INTERVIEW PREP MATERIAL

Useful Books

The following are standard books for interview prep, they contain a lot of the questions you would see on an exam or during an interview:

1. Heard on the Street

2. A Practical Guide to Quantitative Finance Interviews

3. Frequently Asked Questions in Quantitative Finance

4. Quant Job Interview Questions and Answers

QFC Interview Database

This is an accumulation of interview questions that your past peers in the CMU MSCF program have encountered during their recruiting. It is a student maintained database.

- 387 Questions in total
- Broken down by:
  - School: Tepper, Math, Dietrich, Heinz
  - Course
  - Question Type: Behavioral, Brain Teaser, Markets, Technical
  - Job: Equities, Fixed Income, Options, Portfolio Management, Quant
- Ability to filter the questions most relevant to your recruiting

- **Help us and your future classmates by contributing to it!!**
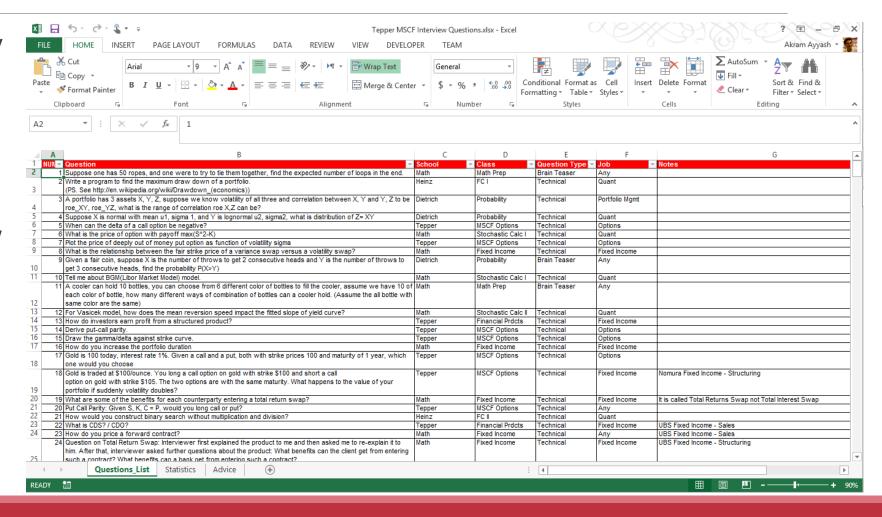
QFC Interview Database

The database is currently in the form of an Excel Document that can be downloaded from the QFC CampusGroups Website.

This is a snapshot of how the document looks like.

The next slide explains how to access it.

You need a CMU login and password to access this.

QFC Interview Database