Questions I got asked on Interviews:

OCR October 2016

Seven Eight Capital

1. If subway trains arrive at a uniform(0,10 min) interval, what is the expected wait time until the next train?
2. 0(n) of matrix multiplication
3. Bit manipulation questions, unsigned int

Goldman Strats

1)

Write a function that takes 2 sorted arrays and a target number and returns one number from array 1 and one number from array 2 which sum up to the target number.

A: Use 2 pointers, one that starts at the beginning of array 1, the other starts at the end of array 2. Decrement pointer 2 until sum(a,b) < target, then decrement pointer 1, repeat…

2)

I have a bunch of coins. I then randomly split into 2 piles.

* Every time I split – multiply both numbers
* On each level of the tree, sum up across different nodes
* Sum up the total for each level
* What is the pattern? Should get (n-1)n / 2
* What formula do you get? Can you prove it?

Academy Investment Mgmt

* How do you implement a hash table (arrays)
* Min Spanning Tree
* Graph Theory (BFS, DFS)
* Multi threading (race conditions, deadlock)

JPM Portfolio Strategy

* I run a regression using monthly factor data vs returns data, call it Y1
* I run another regression using quarterly data (averaged to be monthly), call it Y2
* Y1 = B1\*X +
* Y2 = B2\*X +
* What can you say about vs ?

would likely have autocorrelation (like AR(1) process)

* What can you say about the B coefficients B1 vs B2 ?
* What can you say about the Standard Errors corresponding to these B coefficients?
* A: B coefficients would stay the same, but Standard Error for Y2 would be inflated (since B2 averages quarterly data, meaning variance underestimated, and SE must be overestimated)

Citadel

* I have an array of random numbers, say [1,7,1,3,1,3,7,1]
* I want to sort based on occurance of 1st of each element
* So I want -> [1,1,1,1,7,7,3,3]

Soln: Use linked list to store order of occurrence + hash table to maintain counts

Runtime: O(n) + o(k) = o(n), n = number of total elements, k=number of unique elements

1. I have X ~ N(0,), and Y ~ N(0,), I regress Y ~ X and X ~ Y, what is ? Answer =
2. I have 2 stocks, Stock A has E(R) = 15%, = 15%, Stock B has E(R) = 1%, = 10% , lets we want to maximize E(R) / var(p), p = portfolio, how do we do this?
3. What if = -1,0,+1 ? What if there were no restrictions on long only, leverage?

BNP

* If Bid price is 1, ask price is 2, and price can go up by 1 with p=50% and down with p=50%, if it goes up, we move the bid price up by $1, what is the expected execution price? ($2) How long will it take to execute?

MS

* Implement a data structure with push, pop, and get\_min() all O(1) (use stack with get\_min() operation)
* I have a cube, what is the shortest distance from one corner to the opposite (travel on sides)
* I have a circle with its center at (1,0), so that the origin (0,0) lies on the circumference. I pick 2 random points on the circumference which then creates 2 arcs. What is probability that the origin (0,0) lies on the larger arc? (3/4)

Citadel (round 2)

Part 1

* Imagine theres a group of friends living on a street (imagine a real line)
* They want to organize a party and look for a place to host it
* Each person will each take a cab and this cab is proportional to the distance to the party
* How do you find a place which minimizes the total travel price of everyone?

(Min Sum ABS(X\_i - Y), where X\_i is each friend’s home and Y is the chosen location, take derivative and set to 0, answer is the median)

Part 2

* How do you find the median of an array (Programming, use “quick select”, find run time which is O(2n))

GSS Strats

* FX
* If USD/JPY is 115 (Yen per dolar), japan 1yr rates are 0%, US 1 yr rates are 1%, can you find an arbitrage opportunity?
* Options – You are delta hedged, let’s say u are long an ATM call with delta= 50. You are short 50 shares of stock
  + Do you make money or lose money if the stock goes up?
  + What about if the stock falls?
  + When do you lose money? Think in terms of vol -> long option = long volatility = implied > actual
  + Programming – how to write a function that shuffles an array of integers
* Buffon’s Needle Problem
* If you have a list of tasks and dependences (one task may depend on another in order to start), how would you come up with an efficient schedule? (topological sort..)
* Roboty (x,y) problem but robot can also go up, down, right, left (if 4x4, there is no reason to go up or left)
* Given a string of words and spaces, how can you reverse the order of words? E.g. “dog cat mouse” turns into “mouse cat dog” TRICK – 1) reverse each word, then reverse the entire string
* Vertex cube problem (if u start on one end, expected number of jumps to reach opposite end)
* 2 stocks portfolio optimization

Goldman Survellence group

* 2 strings, s1 = “abc”, s2 = “abcd”, assume length(s2) = length(s1) +1 and strings are unsorted, find the extra character.
* ANSWER – sum up asci values
* What if s1 = “abc”, s2 = “abcde” (2 extra characters?), sum up values and squared values
* Given an unsorted array, how many pairs sum to to k? e.g. A = [1,1,1], k = 2, return 3
* ANSWER – store into hashmap A[i] -> frequency of occurrence
* Initialize global counter
* Within a for loop, iterating through each index, check the “complement” (k – A[i]) if it exists in our hashmap. If it does, increment counter by the frequency of occurrence.
* Then add A[i] to hashmap

CS

* How to test significance that one sample is different from another sample? E.g. theres 2 diff teachers, 2 samples of exams, is one teacher better ?
* Write code to find the optimal weights of a portfolio
* Write a program to simulate the monty hall problem
* Write code to join trade and quotes data (tick data) – join on order time vs most recent quote
* Write SQL query to actually remove all duplicates from a table (no select distinct)

DELETE FROM MyTable

LEFT OUTER JOIN (

SELECT MIN(RowId) as RowId, Col1, Col2, Col3

FROM MyTable

GROUP BY Col1, Col2, Col3

) as KeepRows ON

MyTable.RowId = KeepRows.RowId

WHERE

KeepRows.RowId IS NULL

Macquarie

* What if you have 500 factors, 25 are significant, and 15 have tested positive for significance, what would you do next?

Jefferies – May 2017

* Simple SQL groupby / pandas question
* Sqrt( x + sqrt(x + sqrt(x + ….. ) = x, what is x? (answer is 0, 2)
* Lognormal random variable X, derive pdf, mean, median, mode
* 2 dice, call rolls random variables x, y – what is the expected value of the max(x,y) ? hint. 6x6 matrix and sum up frequencies, answer should be 161/36
* Options – how to construct portfolio that is:
  + Long Gamma
  + Short Vega
  + Answer: Long short dated option, Short long dated option

Jefferies 2nd round

* Integrate from 0 to infinity x \* exp(-x) dx
* If you have date, cfigi, value, how would you get the last value for each cfigi?

Blackstone

* 100 points (xi, yi) – y= mx, how do you estimate m ?
* If you have f(x) = a exp (-a \* x) [exponential] and 100 points (xi, yi), how do you estimate parameter a? [objective function, maximize the probability]
* Can you name / describe one sorting algorithm? What is its runtime? Why is it O(n log n)?
* Are you familiar with SVM ? Can you describe the algorithm? Is it linear / convex / quadratic programming?
* Are you familiar with expectation maximization ?

Bluefin Trading

* I have a calendar spread
  + Long 1 month 50 Delta Call
  + Short 3 Month 50 Delta Call
  + What are the signs of the greeks?
  + Delta 0
  + Gamma +
  + Vega -
  + Theta -
  + Rho - ?
* Theres a stock at $90 today, theres a 80% chance it goes to $100 tomorrow, 20% it goes to $50
* Price a call and a put ($8)
* Make a market on the straddle (fair price is $16 )
* Lets say you buy a straddle for $16, how do you lock in $100,000 today?
* I have a time series of daily stock prices for 5 years, how do you calculate realized vol?
  + take log returns, multiple sqrt(252)
  + Why use log returns?
    - Easier to calculate
    - Assumes stock prices are lognormally distributed, and returns are normally distributed
* Tennis Match – the #1 ranked tennis player, rank the probabily of the following:
* A) Win Match
* B) Lose first set
* C) Lose first set but win match
* D) Win 1st set but lose match
* Answer = A,B,C,D

DB Quant Research

* What is survivorship, lookahead bias? Turnover ?
* Programming in R. what does apply lapply do ?
* State the assumptions of linear regression
* What is heteroskestacicity and how do you deal with it? Weighted least squares
* Whats the equation for weighted least squares ? (X.T SGMA X ) -1 \* X.T SIGMA Y
* Explain hopethsis testing. How would u determine if the avg is not 0? What is p value ?
* Im in a boat, I have an anchor and I throw it into the water. Does the water level rise or lower?
* What if I have an anchor made of wood? I throw it out and it floats, does it rise or sink?
* Given weve been in a low interest rate environment, were starting to see interest rates rise. What effect will this have on equity prices ?
* If stocks issued low interest rate debt for long term (20+ years) and interest rates rise, is this good or bad for them ?

Bluefin (round 2)

* Earthwake hits Japan, what happens to Stock market, Bond market, currency ? Stocks down, bond prices down, currency down
* US credit rating gets downgraded, what happens to stocks, bonds, currency ?
* Go through payoffs / maximum loss of a straddle, call spread (greeks for call spread)

Quantamental Tech

* What types of data have u used?
* What techniques did u use to analyze the data (just quintiling)? Transformations?
* How did you store factor data after calculation?
* Did u use any ML in work setting?
* What type of momentum / trend following did you do at Virtus?
* Did you combine any factors ?
* I flip a fair coin 100 times, whats the probability I get at least 60 heads?

GSA Capital

* What is the derivative of x \* logx ? (answer = logx + 1)
* What are the eigenvalues of the 2x2 matrix [[2,7],[-1,-6]] (trick: use det(Ax-I) = 0, solve for
* Find a,b that maximize a\*b subject to a + 2b <= 500, a >0, b > 0 (trick: set a + 2b = 500, solve for one, plug into a\*b, take derivative)
* What does it mean to overfit?
* Can you describe regulatization?
* Lasso vs Ridge, why does Lasso have the property of forcing B’s to be 0?