PROBLEMS

(1) How many $M \times N$ binary matrices (with components 0/1) are there with *odd* row sums and *odd* column sums? (Credit Suisse)

(2) N people are ranked from the highest to the lowest with no ties, but we do not know the precise rankings. When two people have a match, the one with higher rank wins with a probability $1/2 + r$ while loses with a probability $1/2 - r$. If we see all the $N(N-1)/2$ win/lose-results, i.e. i wins j for match(i, j) , $i, j = 1, 2, .., N$, how can we give an estimation of r? Can we say anything about the confidence interval? (Two Sigma)

(3) N people standing in a *circle* from 1 to N. The first person kicks out the person standing next to him clockwise i.e 1 kicks out 2 and so on. Who is the last person to remain? (Credit Suisse)

(4) A stream of signals comes in, how can we detect outliers? (Citadel)

(5) We have a three dimentional unit ball and we use 2 planes with constant distance d ($d < 1$) to cut the ball into 3 portions. Show that the middle portion has *constant* surface area among all such plane-cuttings. What about an N dimentional unit ball cutted by 2 hyperplanes with constant distance d ($d < 1$) (Morgan Stanely)?

(6) Given some disks on the plane, write a piece of code to estimate the area covered by them. (Bloomberg)

(7) There are 4 apples and 60 oranges in the blanket. We take one fruit out at at time. Let N be the number of apples left when we have taken all the oranges out. What is $\mathbb{E}[N]$? (KCG)

(8) What are the last 4 digits of $2015^{2014^{2013}}$? (World Quant)

(9) Let M be a 2×2 positive definite matrix with i.i.d. compenents uniformly distributed on [-60, 60]. Compute $\mathbb{E}[\det(M)]$. (World Quant)

(10) There are 4 coins on the North, South, West, East sides of a round table. We do not know whether they are facing up or down at the beginning. The game repeats the next 2 steps:
- We pick any number of coins and turn them around.
- The table is then rotated blindly.

Design a strategy to determine when we are certain to have all coins facing up or all coins facing down. (Two Sigma)

(11) A right triangle with side length (45, 60, 75). For every point p inside the right triangle, let L_p be the total distance from p to the 3 sides. What is $\mathbb{E}[L_p]$? (World Quant)

These are from my previous interviews and my friends' previous interviews.

P.S. I have answers to 1, 3, 5, 6, 9, some ideas to 2, 4, 7, 8, 10. Problem 11 is too complicated.