

NOMURA GM QUANT CHALLENGE

OBJECTIVES

** Please note that all the objective questions are complete and solvable. No further clarifications would be provided for objectives*

*** The final solution should be an excel file with 1st column being the question numbers and the 2nd column being the answers with no headers. A sample submission can be found here!*

- 1) A stock S is worth \$100 now at $t=0$. At $t=1$, S goes either to \$110 with probability $=2/3$ or to \$80 with probability $1/3$. If interest rates are zero. Value an at the money European call on S expiring at $t=1$?
 - a. $20/3$
 - b. 0
 - c. $10/3$
 - d. $1/3$

- 2) Ellen bought a share of stock for \$10, and it is believed that the stock price moves (day by day) as a simple random walk with $p = 0.55$. What is the probability that Ellen's stock reaches the high value of \$15 before the low value of \$5?
 - a. 0.35
 - b. 0.73
 - c. 0.50
 - d. 0.29

- 3) Let's say you have 10 coins where the probability of getting heads for i th coin is $1/(i+1)$. All are tossed at once and the probability of getting odd number of heads is p , then:
 - a. $p < 1/3$
 - b. $1/3 < p < 1/2$
 - c. $p = 1/2$
 - d. $1/2 < p < 1$

- 4) Suppose you pick up 3 points randomly on the circumference of a circle and draw a triangle using them. What is the probability that the triangle is a right-angled one?
- a. 0
 - b. $\frac{1}{3}$
 - c. $\frac{1}{2}$
 - d. None of these
- 5) Suppose only 80% of all drivers in a certain city regularly wear a seat belt. A random sample of 500 drivers is selected. What is the probability that more than 400 of them wear a seat belt?
- a. 0.5
 - b. 0.52
 - c. 0.48
 - d. None of these
- 6) There is a huge rush outside of a theatre to purchase Pathan tickets. The owner announces the following scheme, "The first person to have same birthday as someone standing anywhere before him in the line will get a free popcorn." Where will you stand to maximize your chances?
- a. 23
 - b. 24
 - c. 20
 - d. 22
- 7) Consider ants A1, A2,..., A70 being dropped one by one (at very small intervals with A1 being dropped the first) from the left side of a road and ants B1,B2,...,B100 being dropped from the right side of the road. The ants As and Bs start moving towards each other after being dropped. Assuming all the ants undergo perfectly elastic collisions, the sum of the number of collisions undergone by ants A37, B23, B42, B68 and B79 would be?
- a. 450
 - b. 437
 - c. 432
 - d. 465

- 8) Inside a unit square there are multiple equilateral triangles with total perimeter 15. No part of any triangle lies outside the square. One side of each triangle is parallel to a side of the square. Irrespective of the configuration of triangles, there exists a line which passes through x or more triangles. The maximum value of x is:(Hint Linearity of Expectation):
- 7
 - 5
 - 6
 - 8
- 9) If 3 real numbers are chosen randomly and uniformly from $[0, 1]$, what is the probability that the square of any one of the numbers is greater than the sum of squares of the other two numbers?
- $\frac{12-\pi}{12}$
 - $\frac{\pi}{12}$
 - $\frac{\pi}{4}$
 - $\frac{3\pi}{4}$
- 10) You are trapped in a small room with four walls. Each wall has a button that is either in ON/OFF setting. You have no way of telling what the current setting is. When you press a button, you change its setting. If you can get all the buttons to have the same setting i.e. either all four are OFF or all four are ON, you are immediately set free.

In each move, you can press either 2 buttons simultaneously or just 1 button. As soon as this occurs, if you haven't been set free, the whole room spins around you violently, leaving you completely disoriented so that you can never tell which side is which.

The starting position is chosen completely at random (except not all four ON or all four OFF). Given any and every possible scenario, using optimal strategy, what is the least number of moves needed to unquestionably guarantee escape from the room?

- 5
- 9
- 7
- None of these

- 11) You have 4 ropes in a box. You randomly start picking two free ends and keep joining them until there are no free ends left. Find the probability of having only 1 loop at the end.
- a. $3/5$
 - b. $16/35$
 - c. $1/5$
 - d. $17/24$
- 12) There is a town with 257 people, each with 1 acre of land. Land distribution is purely on the voting basis, i.e. people vote if they agree with any newly suggested redistribution system. If number of 'Yes' is greater than number of 'No', then land is redistributed according to the new system, else they continue with their previous land distribution. Everyone is greedy and votes 'Yes' if their land is increased, 'No' if land is decreased, and they skip the voting if their land remains the same. Mr. Minister also has 1 acre of land there (not included in original count of 257). He cannot vote, but being the minister, only he can suggest new distributions to the town dwellers. What is the maximum amount of total land he can accumulate?
- a. 257
 - b. 149
 - c. 258
 - d. 255
- 13) Stock XYZ is currently trading at \$100. What would be the price of an American Put option on stock XYZ, with a strike price of \$110 and a time to expiry of 6 months, if you were to use a $N=50$ period binomial tree model? (The historic annualized stock volatility is 15% and the annual risk free rate is 6%)
- a. \$ 10.05
 - b. \$1.79
 - c. \$8.54
 - d. \$11.05

14) A school is organizing sports fest with multiple events. The winner of each event receives x points, runner up receives y points and the person at the third receives z points ($x > y > z > 0$ and $x, y, z \in \mathbb{N}$). Akbar, Birbal and Chaman participate in the sports fest (they are the only three).

- a. Akbar won with 22 points overall
- b. Birbal won the 200-m dash and finished with 9 points overall
- c. Chanakya also finished with 9 points overall

Who finished second in swimming?

- a. Akbar
- b. Birbal
- c. Chanakya
- d. Akbar or Chanakya

15) There are two players in a game: A and B. A has decided 3 natural numbers a , b and c . B must guess those numbers. B can “query” A with 3 integers: x , y and z and A will respond with $a \cdot x + b \cdot y + c \cdot z$. What’s the minimum number of queries needed by B to guess a , b and c ?

- a. 1
- b. 2
- c. 3
- d. Depends on a , b , c