# First Approach

Density of a robber = (number of robber surrounding it + itself) / number of possible places

## Case 1

e.g., Density of Robber in the corner = 2 / 4 = 0.50

Average Density of a formation/placement= (0.50 x 3 + 0.56 x 2 + 0.67 x 3) / 8 = 0.58

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  |  |  | R 0.50 |
|  |  |  | R 0.56 | R 0.67 |
|  |  | R | R 0.67 |  |
|  | R | R |  | R 0.50 |

## Case 2

Average density of robber in all configurations/formation.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Number of Robbers | | | | | | | | |
| Grid Size | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 3 x 3 | 0.298 | 0.398 | 0.498 |  |  |  |  |  |  |
| 4 x 4 | 0.229 | 0.284 | 0.339 | 0.394 | 0.449 | 0.504 |  |  |  |
| 5 x 5 | 0.195 | 0.230 | 0.265 | 0.299 | 0.389 | 0.370 | 0.405 | 0.440 |  |

## Conclusion

Average density of a single configuration (case 1) cannot say anything about the probability of catching it. Average density of robbers in all configuration/formation (case 2) is similar to the fraction of robber present in the grid.

# New Approach

Fraction of the grid occupied/filled by the Robbers, Fr = Number of Robber / (Size of the grid x Size of the grid)

We can say that. Fraction of the grid occupied by Robbers ∞ 1 / (Probability of the robbers getting caught)

Probability of catching a robber

For each robber placement

Grid Size

Number of Robbers

Cops Initial placement

Cops Strategy

Robber Strategy

If,

*P* = Probability of robber being caught

*Fr* = Fraction of the grid occupied by the Robbers

*K* = constant, Depends on Number of Cops, Cops Strategy and Robber Strategy

The value of K,

For number of Robber, R = 1; Grid Size = 5; Probability, P = 1

Fr = 1 / 25 = 0.04

For number of Robber, R = 25; Grid Size = 5; Probability, P = 0

Fr = 25 / 25 = 1

So, K > 1.

## Conclusion

Working on the value of K.