1) Lets, X be the random variable denoting the total number of duplications for an array of n random numbers. So the solution to the problem is E[X] and X is equal to the sum of all the $X_{i,j}$'s.

For $1 \le i < j \le n$,

$$X_{i,j} = I\{A[i] = A[j]\}.$$

$X_{i,j}$ be the indicator random variable for the event that the pair (i, j) is duplicated.

$E[X] = E[\sum X_{i,j}]$

$= \sum E[X_{i,j}]$, by property of E

$= \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} \Pr\{A[i] = A[j]\}$

$= (n-1)/2$

$E[X_{i,j}] = \Pr\{A[i] = A[j]\}$

$\Pr\{A[i] = A[j]\} = \frac{1}{n} \cdot \frac{1}{n} \cdot n = \frac{1}{n}$

2) I wrote exp_num function for calculating the expected number of duplications.I did error handling if the user enters a number or char other than a positive number. I created a dynamic array based on the number. Then I filled the array with values from 1 to n using uniform random number generator.

I printed the array elements up to 10 array elements per line. I used the exp_num function for calculated the expected number of duplications. Then, I found all the duplications of the array and printed them out. And there are two for loops and it will take O(n^2) time. And running time of the algorithm is O(n^2) .