Monte Carlo Simulation

Monte Carlo simulation is a computerized mathematical technique that allows people to account for risk in quantitative analysis and decision making. The technique is used by professionals in such widely disparate fields as finance, project management, energy, manufacturing, engineering, research and development, insurance, oil & gas, transportation, and the environment. Monte Carlo simulation furnishes the decision-maker with a range of possible outcomes and the probabilities they will occur for any choice of action. It shows the extreme possibilities the outcomes of going for broke and for the most conservative decision along with all possible consequences for middle-of-the-road decisions.

Example:

Dr. Ravi, a dentist schedules all his patients for 30 minute appointments. Some of the patients take more or less than 30 minutes depending on the type of dental work to be done. The following table shows the summary of the various categories of work, their probabilities and the time actually needed to complete the work.

Category	**Time Required(minutes)**	**No. of Patients**
Filling	45	40
Crown	60	15
Cleaning	15	15
Extraction	45	10
Check-up	15	20

Simulate the dentist's clinic for four hours and determine the average waiting time for the patients as well as the idleness of the doctor. Assume that all the patients show up at the clinic exactly at their scheduled arrival time, starting at 8.00 am. Use the following random numbers for handling the above problem: 40, 82, 11, 34, 25, 66, 17, 79

Code:

```
#include<bits/stdc++.h>
using namespace std;
int main()
{
   unordered_map<string,int>
serviceTime={{"filling",45},{"crown",60},{"cleaning",15},{"extraction",45},{"check-
up",15}};
   vector<int> numbers{40,82,11,34,25,66,17,79};
   int curTime=0,maxTime=0;
```

```
    int idle=0;
    int wait=0;
    for(int i=0;i<8;i++)
    {
        if(curTime>maxTime)
        {
            idle+=(curTime-maxTime);
            maxTime=curTime;
        }
            wait+=(maxTime-curTime);
            curTime+=30;
            string type="";
            if(numbers[i]<40)
                type="filling";
            else if(numbers[i]<55)
                type="crown";
            else if(numbers[i]<70)
                type="cleaning";
            else if(numbers[i]<80)
                type="extraction";
            else
                type="check-up";
            maxTime+=serviceTime[type];
    }
    cout<<"Dentist remains idle for "<<idle<<" minutes\n";
    cout<<"Average waiting time for patients is :"<<((float)wait/8.0)<<" minutes\n";
    return 0;
}
```

Output: