AMS 321: Computer Projects in Applied Mathematics

Project 5

Assignment Date: Wednesday (11/04/2009)

Collection Date: Wednesday (12/02/2009) 5PM

Grade: **See Individual Problems**

1. (5 Points) A traveling salesman must visit each one of the nine cities at least once. Please design a method (any method, brute force or novel) to find the shortest-distance path. We further assume City 1 is the starting city and any order for the subsequent cities which can be chosen to minimize the total distance. You don't have to return to the first city you started at. In this project, you would need to do the following

A. algorithm you use for the optimization;
B. program with comments to implement your algorithm;
C. the resulting path that has shortest (or approximately shortest) total distance; You may express the path by ordering the cities in the order you travel: C1→C9→...C2.
D. the shortest distance, i.e., a number that's the distance you found.

The following is the coordinates for the nine cities:

City 1 at (6.623123, 2.253046)
City 2 at (4.723182, 1.949215)
City 3 at (2.346305, 4.202261)
City 4 at (7.069488, 6.151476)
City 5 at (0.415793, 1.353737)
City 6 at (7.485281, 7.505212)
City 7 at (7.901073, 8.858949)
City 8 at (6.386353, 7.364161)

City 9 at (5.287427, 7.223111)

Applying your code to the cities with the following coordinates to finding the shortest-distance path and the distance.

Cities 1, 2, 3: (0, 0), (0, 4.5), (0, 9)
Cities 4, 5, 6: (4.5, 0), (4.5, 4.5), (4.5, 9)
Cities 7, 8, 9: (9, 0), (9, 4.5), (9, 9)

Can you figure out the result without complicate calculations? If yes, how?

2. (4 Point) Mr. Unlucky's 401(k) was worth $750,000 on 11/1/2008, a little over a year ago. Assume his 401(k) has gone through 52 weeks of trading with exactly five trading days each. Therefore, he has gone through 260 trading days. The change rate of the 401(k) from the previous day for the entire year follows a peculiar distribution defined below:

[-6%, -5%): 4% probability
[-5%, -4%): 6% probability
[-4%, -3%): 20% probability
[-3%, -2%): 40% probability
[-2%, -1%): 20% probability
[-1%, 0%): 6% probability
[0%, 1%]: 4% probability

The first line of the above [probability table] means that, among all change rates between -6% and 1%, the probability that the change rate falls between -6% and -5% (any floating-point number) is 4%. Within each small interval, the rate distribution is assumed uniform, *i.e.*, -5.12345% is equally likely to occur as -5.98765%. The rest is obvious.

Please (1) Compute his 401(k)'s worth at the end of each of the 260 trading days. Show the results in a table and a graph to show the daily value; (2) Do the same as in (1) if the 401(k) changes with another peculiar distribution defined below:

[-4%, -3%): 4% probability
[-3%, -2%): 6% probability
[-2%, -1%): 20% probability
[-1%, 0%): 40% probability
[0%, 1%): 20% probability
[1%, 2%): 6% probability
[2%, 3%]: 4% probability

Hint*: There are many ways to generate such distributions. I'm suggesting a low-tech method and, naturally, hope to see better methods. For example, for case (1) above,*

***Step 1**:* Generate 40 uniform random numbers in [-6, -5)

Generate 60 uniform random numbers in [-5, -4)

Generate 200 uniform random numbers in [-4, -3)

Generate 400 uniform random numbers in [-3, -2)

Generate 200 uniform random numbers in [-2, -1)

Generate 60 uniform random numbers in [-1, 0)

Generate 40 uniform random numbers in [0, 1)

Now, you have total of 1000 random numbers.

***Step 2**: Store such 1000 random numbers in an array R[1000] in any order;*

***Step 3**: You select randomly a number from R[1000] as the next day's change rate.*

3. (1 Points) Write an essay to identify the most interesting and the most uninteresting problems among all projects for the course and to explain why. This essay should not contain more than 300 words.