STA 243 Assignment 2

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1.

Let input the distance matrix into R first by pasted from the pdf.

1.1 First, we need to define the path in a vector form. label the city with numbers instead of alphabet, e.g. 1 for A , 2 for B, etc. then we can get the path which is also the candidate in this problem:

$\theta = (i_1, ..., i_{15})$ where $i_j \neq i_k$ and $i_j \in \{1, 2, ..., 15\}$

the candidate space contains all the probable θ.

To solve the travel problem, we should also compute the total distance. Here is the function to calculate the total distances for each candidate path.

$$Distance(\theta) = d(i_{15}, i_1) + \sum_{j=1}^{14} d(i_j, i_{j+1})$$

where $d(i_j, i_k)$ is the distance from i_j city to the i_k city which is given in the matrix mentioned in the beginning $d(i_j, i_k) = D_{jk}$

1.2 Second, the Simulated Anealing algorithm part.

1.2.0 Initialization

initialize $\tau_1 = 400$ and other things mentioned in the question.

1.2.1 step 1: sample a candidate

From the first part, we have define what is the candidate space. To use a uniform distribution for the proposal density. Get the random number j and k uniformly without replacement and then switch i_j and i_k and I did it twice to get the neighbour which means in this step I will exchange at least 2 at most 4 variables.

1.2.2 step 2: calculate the distance and compare them.

a) if the new candidate is better than the previous best one, take the candidate as the best.

$\Delta = Distance(\theta^*) - Distance(\theta_k) < 0$ where θ_k is the recent best solution and θ^* is the new candidate drawn by the step 1, then take θ^* as θ_{k+1}

b) Otherwise, $\theta_{k+1} = \theta^*$ with a probability $\exp(-\frac{\Delta}{\tau_j})$, keep $\theta_{k+1} = \theta_k$ o.w.

1.2.3 step 3: repeat step 1 and 2 $m_j = 100$ times.

1.2.4 step 4: update $\tau_{j+1} = \alpha(\tau_j), m_{j+1} = \beta(m_j)$ and move to stage j+1.

1.2.5 step 5: reheat.

run the algorithm again with the initial point as the previous result.

here is the result for different parameters:

1. $p = 0.999, tau = 400$

the result path is of length:

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## [1] 55
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the result is bad because $exp(-30/(400 * 0.999^{1000})) = 0.815$, the chance to accept the worse case is still high even in the final stage. The temperture is still high in the end.

2. $p = 0.99, tau = 400$

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## [1] 18
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I run it several times, it is stable around 17 to less than 20, I think it is good enough.

The best path (with distance 17) i found is (3,9,1,2,8,12,10,15,11,13,6,14,4,7,5)