Traveling Salesman Problem

Background Information on VBA Programming in Business Economics by Sanne Wøhlk

The Traveling Salesman Problem (TSP) is one of the oldest and most studied problems within the area of combinatorial optimization. The problem considers a salesman who needs to visit each city exactly once. He starts and ends in his home town. The goal is to create the shortest possible tour for the salesman.

The TSP is formally stated as follows: Given an undirected complete graph $G(N, E, C)$ where C is a cost or distance matrix for the edges, find a minimum cost tour which passes through every node exactly once.

The literature regarding the problem is abundant. We suggest that the reader takes a look at the webpage http://www.tsp.gatech.edu which is particularly interesting. The first solution of the problem was presented by Dantzig, Fulkerson, and Johnson, 1954. Even though the problem is simple to state and understand it is extremely hard to solve to optimality. Many researchers compete in creating algorithms for solving problems of large size.

Often the nodes are given in the form of coordinates in a two dimensional plane based on which a distance matrix can be created using for example the Euclidean distance. In other cases the distance matrix is drawn directly from a road network using the shortest path between locations.

The most famous heuristic for solving the TSP is the Nearest Neighbor algorithm which is defined as follows. Let some node be the *seed node*. Until all nodes have been included in the tour, the next node to be added to the tour should be selected as the node among the unvisited nodes that are closed to the current node. When all nodes have been visited, the tour is closed by returning to the seed node. The choice of seed node influences the quality of the final solution but it is not clear how the seed node is best selected.

For an illustration, consider the distance matrix below. If node A is chosen as seed node, the tour will be A, B, C, D, E, A with a cost of 5 + 4 + 6 + 11 + 6 = 32. If on the other hand node E is chosen as seed node, the resulting tour will be E, B, C, D, A, E with a cost of 5 + 4 + 6 + 6 + 6 + 6 = 27.

From\ To	A	B	C	D	E
A		5	8	6	6
B	5		4	7	5
C	8	4		6	9
D	6	7	6		11
E	6	5	9	11	

Bibliography

Dantzig, Fulkerson, and Johnson. (1954). Solution of Large Scale Traveling- Salesman Problem. *Operations Research , 2*, 393-410.