Transportation Logistics Part III

Exercise 15

A salesman has to visit cities A to I on his daily tours. He lives in city A and aims at minimizing his total travel time. The distances between the different cities are given in the following matrix:

d_{ij}	A	B	C	D	E	F	G	H	I
A	0	3	19	7	12	16	26	20	23
B	2	0	16	4	9	13	23	17	20
C	14	12	0	6	5	15	9	4	7
D	10	10	12	0	5	9	19	13	16
E	13	13	15	3	0	12	14	8	11
F	17	15	3	9	8	0	12	7	10
G	29	27	15	19	16	12	0	9	12
H	20	20	13	10	7	18	6	0	3
I	24	22	10	16	14	15	3	7	0

a) Which problem has to be solved? Assume that all connections in the distance matrix $< \infty$ correspond to arcs. On what type of graph is the problem formulated? Now, formulate the problem (in general terms) as an IP and explain the different constraints. Assume that a solution with three subtours was found:
$A - B - C - A$
$D - E - D$
$F - G - H - I - F$
Present the according subtour elimination constraints and their connectivity constraint versions.

b) Compute a lower bound on the optimal TSP solution and solve the problem using the Patching algorithm. What's the deviation of the obtained solution from the lower bound?

Exercise 16

A furniture retailer has to deliver one table to each customer. The customers are at locations B to G. The furniture retailer himself is located at A. Since all six tables fit into a single truck only one delivery tour shall be made. The distances between the different locations are given in the following matrix:

d_{ij}	A	B	C	D	E	F	G
A	0	5	6	7	7	9	13
B	5	0	10	9	8	10	17
C	6	10	0	1	6	5	7
D	7	9	1	0	5	4	8
E	7	8	6	5	0	2	13
F	9	10	5	4	2	0	12
G	13	17	7	8	13	12	0

a) What type of problem has to be solved?
b) Compute a lower bound on the optimal TSP solution.
c) Determine a solution using Christofides' algorithm. Compute the deviation from the lower bound.

Exercise 17

The furniture retailer of exercise 16 would like to know if another algorithm is able to compute a better solution.
a) Determine a TSP solution using the nearest neighbor algorithm.
b) Determine a TSP solution using the cheapest insertion algorithm.

Exercise 18

The currently implemented solution at the furniture store of exercise 16 is the following:

$$A - B - C - D - E - F - G - A$$

Compute the costs of this solution and improve it using 2-opt in a best-improvement manner.

Exercise 19

Assume that the salesman of exercise 15 does not need to visit cities H and I. Apply Little et al.'s branch and bound algorithm and find the optimal traveling salesman tour.

Exercise 20

Assume again that the salesman of exercise 15 does not need to visit cities H and I. Apply Carpaneto-Toth's branch and bound algorithm and find the optimal traveling salesman tour.