

Transportation Logistics - Homework 4 (5 points)

Exercise 1 (3 pts)

Before Christmas, the major clients (numbered 1 to 10) of the construction company 'Well Built' (located at 0) receive a hamper (Geschenkkorb) that contains a bottle of champagne, smoked salmon, cheese, mustard, olive oil and a number of other delicacies. The hampers are rather large and the company owned cars are Smarts. Therefore, at most three hampers may be transported at once and the CEO does not want any of his employees to be gone for more than 4 hours. In the matrix below, driving times (already including the time to deliver the hampers) between the office and the clients are given in multiples of 5 minutes (a 4 in the matrix indicates that it takes 20 minutes to go from 0 to 1, including the delivery of the hamper at 1). The objective is to minimize the total time needed to deliver the hampers.

t_{ij}	0	1	2	3	4	5	6	7	8	9	10
0	0	4	5	2	6	5	3	2	5	6	5
1	4	0	4	3	5	8	3	5	7	9	7
2	5	4	0	4	9	9	7	6	6	8	4
3	2	3	4	0	6	6	4	3	5	7	5
4	6	5	9	6	0	9	4	6	11	12	10
5	5	8	9	6	9	0	6	4	6	5	7
6	3	3	7	4	4	6	0	3	8	8	7
7	2	5	6	3	6	4	3	0	5	6	6
8	5	7	6	5	11	6	8	5	0	3	2
9	6	9	8	7	12	5	8	6	3	0	4
10	5	7	4	5	10	7	7	6	2	4	0

a) Formulate the problem situation as a mathematical program (in general terms but explain all the notation used and each type of constraint.)

b) How many employees are needed at least in order to deliver all the hampers if the time limit of 4 hours is ignored?

c) One of the employees suggests to compute a solution using the savings algorithm. Determine the total time required to deliver the hampers following the employee's suggestion (take into account both, the capacity of the vehicles and the duration limit of each tour).

Exercise 2 (2 pts)

Assume that the currently implemented solution at the construction company 'Well Built' of exercise 1 is the following:

0-4-1-2-0
0-3-0
0-6-5-7-0
0-10-8-9-0

a) Compute the total time needed to deliver the hampers in this solution. Then apply **one iteration** of local search (best improvement) using the inter-route single vertex move operator (i.e. one customer can be moved to another tour). Keep in mind that the capacity restriction must not be violated.

b) Now, apply tabu search instead. Compute the first two iterations. Assume the same tabu criterion as used in class.