

Seminar 6:

Integer programming; assignment and traveling salesman problems

Problem 1: The Financial Office recruits candidates for positions of heads of the three departments, requiring different skills and knowledge. Five candidates were selected for the assessment center where their competence for individual jobs has been tested. The results are shown in the table (the highest possible score was 30 points).

	Applicant				
Department	A	B	C	D	E
D_1	25	27	24	27	28
D_2	28	23	25	24	27
D_3	22	21	23	20	24

Introduce dummy lines to balance the problem if necessary and use the Hungarian method to assign the candidates to appropriate positions so that their competence for work in the individual departments is as high as possible. (Maximization problem!)

Problem 2: Traveling salesman living in the city A has to visit places B, C, D, E and come back to A. The distance table is given below.

	A	B	C	D	E
A	X	50	70	40	60
B	50	X	40	30	80
C	70	40	X	40	60
D	40	30	40	X	50
E	60	80	60	50	X

In what order should he visit the cities so as the total length of the round-trip is minimal? Use the closest neighbor method. Try to start the method from different cities. Check the optimality of the best solution by the Hungarian method.

Problem 3: Build a mathematical model for integer programming problems and use Excel Solver to find their solutions:

a) Potatoes problem

The food company is processing potatoes; they produce chips, which are sold for 120 CZK per kg, and fries (76 CZK per kg). According to technological process, 2 kg of potatoes and 0,4 l of oil are used for the production of 1 kg of chips and 1,5 kg of potatoes and 0,2 l of oil are used for 1 kg of fries. Design the production plan maximizing the profit and respecting the capacity of suppliers (100 kg of potatoes and 16 liters of oil). The purchase prices of raw materials are 12 CZK / kg of potatoes and 40 CZK / liter of oil (we are neglecting labor costs, energy, etc.). How will the optimal solution change if we can sell the products in XXL packing only (3kg packing of chips of and 15kg packing of fries)?

b) Cutting schema problem

The metal manufacturing company buys the material from their supplier in the form of 65 cm long pipes. They need at least 1200 pieces of 20 cm length pipes and at least 900 pieces of 15 cm long pipes for further processing. How should the company cut the long pipes so that the total amount of the purchased material is minimal?

c) Scheduling problem

The art gallery needs to schedule the following number of workers for service on a particular day:

Mon	Tue	We	Thu	Fri	Sat	Sun
22	17	13	14	15	18	24

Workers are always working for five consecutive days, followed by two days off. The working cycle can start any day of the week.

The task is to schedule the number of employees starting their 5-day working cycles for every day in a week and determine the smallest number of employees necessary to cover operational needs of the art gallery.