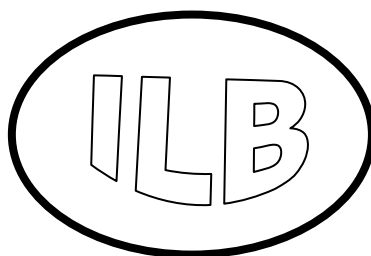


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Quantitative Techniques for Planning and Decision

Linear Programming Exercises



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Exercise 1

An agronomist farms a total of 50 hectares of arable farm land. He considers the production of winter wheat, winter barley, sugar beets and potatoes. He assumes the following characteristics of the production:

Winter wheat

Yield: 7 t/ha

Market price: 220 €/t

Proportional costs: 750 €/ha

Winter barley

Yield: 5.5 t/ha

Market price: 210 €/t

Proportional costs: 650 €/ha

Sugar beets

Yield: 65 t/ha

Market price: 45 €/t

Proportional costs: 1200 €/ha

Potatoes

Yield: 38 t/ha

Market price: 100 €/t

Proportional costs: 2800 €/ha.

Due to crop rotation the following restrictions are necessary:

Grain	max. 70 % of the agricultural land
Winter wheat	max. 30 % of the agricultural land
Root crops	max. 33 % of the agricultural land
Potatoes	max. 25 % of the agricultural land
Sugar beets	max. 20 % of the agricultural land.

Tasks:

- a) Provide an appropriate tableau, in which the conditions of crop rotation are formulated externally. Cultivation and sales activities should be formulated as separate activities.
- b) Provide an appropriate tableau, in which the conditions of crop rotation are formulated internally.
- c) Develop a tableau which combines the cultivation and sales activities for each product.
- d) How does the tableau of task c) change, if winter barley is only cultivated following winter wheat?
- e) How does the tableau of task c) change, if winter barley is only cultivated every second year following the cultivation of winter wheat?
- f) Extend tableau c) with the cultivation of field beans (profit margin (PM) 200 €/ha) and field feed (PM 300 €/ha). Both underlie a joint production restriction of 25 % of the agricultural area.
- g) What changes are necessary in tableau f) if the production of field beans is no longer considered and field feed should be cultivated as an intercrop following potatoes?
- h) The neighbour offers the farmer a maximum of 10 hectares for rent. The rent is 200 €/ha. How can you consider this planning option in the tableau?
- i) A different situation: the farmer offers a maximum of 10 % of his land for rent. He was offered 300 €/ha for the rent.
- j) The farmer is afraid that the labour time could run short in the time of grain harvest and during the root crop harvest. He goes by the following demands of time for the individual produces:

Table 1: Demands of time for the individual produces

	WW	WB	SB	POT
Grain crop	2	2	15	10
Root crop		2	30	

The farmer can provide a maximum of 250 lh (labour hours) during the grain harvest and a maximum of 350 lh during the root crop harvest.

- k) During the grain crop harvest the retired farmer from the neighbouring farm offers to work on an hourly basis for a maximum of 40 hours. The hourly rate should be 6 €.