Optimization applied to work assignment in flower crops

Research Practice Progress Presentation

Sebastian Mesa [1] Juan Carlos Rivera [2]
Juan Felipe Torres [3]

[1]Mathematical Engineering, Universidad EAFIT, smesa@eafit.edu.co
[2]School of Science, Universidad EAFIT, jrivera6@eafit.edu.co
[3]Flores El Trigal, juan.felipetg@gmail.com

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Settings

- production of plant cuttings
- crop of plants divided into blocks divided into beds
- set of workers dedicated to harvesting plants each day
- plants yield depending on age and frequency of harvest
- orders placed weekly for different varieties of cuttings

Problem

Assigning the routes through the beds and blocks which need to harvested by workers every day minimizing waste the amount of cuttings not fulfilled in every order.

Waste

Waste in terms of cuttings comes from different sources and its is not limited to cuttings themselves.

- Waste from storage
- Waste from harvest
- Waste from time used
- Waste from translation

Fulfillment

Fulfillment of the orders is a priority for the company. Orders not met must be completed the week after.

Objective Function

$$Min: \sum_{d \in days} \sum_{v \in vars} UnF_{v,d} + sW_{v,d} + hW_{v,d} + timeW_d + transW_d$$

Factors added to each of the terms to represent how much of the cost of a cutting it represents.

Harvest

$$Harv_{v,d} = \sum_{bd \in beds} isH_{bd,d} * Q_{bd,d,v} * CPPf(d, v, age)$$

where $isH_{db,d}$ indicates weather the bed bd was harvested on day d, $Q_{bd,d,v}$ indicates the amount of plants of variety v on day d on bed bd and $CPPf(d, v, age)$ is a function that indicates a rate of cuttings per plant depending where in the cycle of harvest is the bed. The harvest yield the calculation of the unfulfilled orders and the storage waste.

Waste From Harvest

Waste calculated comparing the harvest done to the best of the week in cuttings per plant per days not harvested.

$$hW_{v,d} = \sum_{bd \in beds} isH_{bd,d} * Q_{bd,d,v} * CPPDf(d, v, age)$$

where $CPPDf(d, v, age)$ is a function that calculates a factor based on the difference between the maximum rate of cuttings per plant per day and the rate of the day at which the bed is harvested and the amount of days that the bed has not been harvested.

Waste from time Used

Time taken in harvesting differs depending on the frequency of the harvest. Calculated similarly to the waste from harvest but having in account a rate of cuttings per hour harvested for each day not harvested and the maximum if them.

Waste from transportation

$$tansW_d = \sum_{bd1 \in beds} \sum_{bd2 \in beds} X_{bd1,bd2} * time(bd1, bd2) * SCPH$$

where $X_{bd1,bd2}$ indicates weather the route from bed $bd1$ to bed $bd2$ was used, $time()$ indicates the time taken to travel the route, and $SEPH$ is a standard rate of cutting harvested per hour.

Others

- functions depend on state of the plant in the cycle of harvest.
- states modeled having in account if the bed was harvested the day before and in which state was the bed the day before.
- limited set of states.

Concerns

- size of the problem
- linealization of constraints

Strategies

- split problem
- add constraints heuristically

Thank you