Agriplots Linear Programming Model

Parameters

- N — Set of possible locations to install PV's
- p_i — Energy production (10^6 kWh/year) for installing PV at location $i \in$ N
- a_i — Area in dunam used for installing PV at location $i \in$ N
- c_i — influence on crops from installing PV at location $i \in$ N
- r_i — potential revenue before installing PV at location $i \in$ N
- A — Upper bound on the total area in dunam that can be used for installing PV's
- C — Minimal loss of revenue in percentage allowed as a result of influence on crops
- D — Set of Yeshuvim that contain locations
- d_j — upper bound of energy production in yeshuv $j \in$ D
- E — Set of Eshkolot that contain locations
- e_j — upper bound of percentage of energy production in eshkol $j \in$ E
- F — Set of Machozot that contain locations
- f_j — upper bound of energy production in county $j \in$ F

Decision Variables

- x_i — Binary variable, equals to 1 if a PV is installed at location $i \in$ N, otherwise 0.

Objective Function

$$\text{Maximize} \quad \sum_{i \in N} (x_i \cdot \mathrm{P}_i)$$

Constraints

1. $\sum_{i \in N} x_i \cdot \mathrm{a}_i \leq A$
2. $\frac{\sum_{i \in N} x_i \cdot \mathrm{c}_i \cdot \mathrm{r}_i}{\sum_{i \in N} x_i \cdot \mathrm{r}_i} \geq \mathrm{C}$
3. $\sum_{i \in j} x_i \cdot \mathrm{p}_i \leq \mathrm{d}_j \,, \qquad \forall j \in \mathrm{D}$
4. $\sum_{i \in j} x_i \cdot \mathrm{P}_i \leq \mathrm{e}_j \cdot \sum_{k \in N} (x_k \cdot \mathrm{P}_k) \,, \qquad \forall j \in \mathrm{E}$
5. $\sum_{i \in j} x_i \cdot \mathrm{p}_i \leq \mathrm{f}_j \,, \qquad \forall j \in \mathrm{F}$
6. $x_i \in \{0,1\} \quad \forall i \in \mathrm{N}$

Explanations

- The **objective function** maximizes the total energy production from the installed PV systems at various locations.
- **Constraint (1)** places an upper bound on the total area used for PV installations.
- **Constraint (2)** ensures that the change in revenue as a result of installing the PV's and influencing the crops remains above a certain threshold.
- **Constraint (3)** ensures that the total energy production for each Yeshuv does not exceed it's energy consumption limit.
- **Constraint (4)** limits the energy produced within each eshkol (group) to a certain percentage of the overall energy production.
- **Constraint (5)** ensures that the total energy production for each machoz does not exceed it's energy consumption limit.
- **Constraint (6)** requires that each decision variable x_i is binary, meaning that a PV system is either installed or not at each location.

Table of contents (need a better name)

Value/variable in the LP model	**Value/variable in the data**
N	OBJECTID (column from dataset)
p_i	Energy production (fix) mln kWh/year (column from dataset)

a_i	Dunam (column from dataset)
c_i	Average influence of PV on crops (modified column from dataset)
r_i	Potential revenue from crops before PV, mln NIS (column from dataset)
A	Parameter decided by user
C	Parameter decided by user
D	YeshuvName (column from dataset)
d_j	energy_consumption_by_yeshuv
E	yeshuvim_in_eshkolot
e_j	energy_division_between_eshkolot
F	Machoz (column from dataset)
f_j	energy_consumption_by_machoz