Sets

B Buildings $\{0, \ldots\}$

A Activities $\{0, \ldots\}$

D^r set of weekdays $\{0, \ldots, 4\}$

D^o set of days in month $\{0, \ldots, 29\}$

$A_r \subset A$ recurring activities

$A_o \subset A$ once-off activities

T time periods, T_{bus} = time periods in business hours

$T_{off} = T \setminus T_{bus}$

Data

n_b^{small} # small rooms in building $b \in B$

n_b^{large} # large rooms in building $b \in B$

cap_b Battery capacity of building $b \in B$ (0 if no battery)

eff_b Battery efficiency of building $b \in B$

p_b^{max} Max battery power of building $b \in B$

d_a duration of activity $a \in A$

p_a power draw of activity $a \in A$

$Prec_a$ Precedent activities for activity $a \in A$

$demand_{bt}^{base}$ Demand @ building $b \in B$ in period $t \in T$

p_{bt}^{solar} Solar power @ building $b \in B$ in period $t \in T$

$price_t$ Grid price in period $t \in T$

$r2t(t)$, For a time period $t \in T$, returns the relevant (d, t) times used

for scheduling recurring classes

$o2t(t)$ . . .

r_a^{small} small rooms required by activity a

r_a^{large} . . .

Variables

$x^r_{abdt} \in \{0,1\}$ 1 if activity $a \in A_r$ is scheduled in building b during the t^{th} period of day $d \in D^r$

$y^r_{abdt} \in \{0,1\}$ start activity $a \in A_r$

$x^o_{abdt} \in \{0,1\}$ . . . $d \in D^o$

$y^o_{abdt} \in \{0,1\}$ . . . $d \in D^o$

ignore battery for now

p^{grid}_t grid power @ time $t \in T$

$demand^{class}_{bt}$

$z = \max p^{grid}_t$

Objective

$$\min \sum_{t \in T} \frac{0.25}{1000} p_t^{grid} \cdot price_t + 0.05 \left(\max_t P_t \right)^2 + \sum_{a \in A^o} \left(\sum_{\substack{(d',t') \in O2t(T_{bus}) \\ b \in B}} Value_a^{bus} y^o_{abd't'} + \sum_{\substack{(d',t') \in O2t(T_{off}) \\ b \in B}} Value_a^{off} y^o_{abd't'} \right)$$

Constraints

Run each recurring activity once per week

$$\sum_{\substack{b \in B \\ d \in D^r \\ t \in T_D}} y^r_{abdt} = 1 \qquad \forall a \in A^r$$

Run each one-off activity at most once

$$\sum_{\substack{b \in B \\ d \in D^o \\ t \in T}} y^o_{abdt} \leq 1 \qquad \forall a \in A^o$$

Supply matches demand

$$p_t^{grid} + \sum_{b \in B} \left(p_{bt}^{solar} - demand_{bt}^{base} - demand_{bt}^{class} \right) = 0 \qquad \forall t \in T$$

Enough classrooms available

$$\sum_{a \in A^o} \sum_{(d',t') \in o2t(t)} x^o_{ad't'} \cdot r^{small}_a + \sum_{\substack{a \in A^r \\ (d',t') = r2t(t)}} x^r_{ad't'} \cdot r^{small}_a \leq n^{small}_b \quad \forall b \in B, t \in T$$

same for large rooms

link x & y variables, must end befor COB

in code: $t + da - 1$

$$\sum_{t'=t}^{t+da-1} x^r_{abdt'} \geq y^r_{abdt} \cdot dur_a \quad \forall a \in A^r, t \in \{0, \dots, 36 - d_a\}$$

$$\sum_{t'=t}^{t'+da-1} x^o_{abdt'} \geq y^o_{abdt} \cdot dur_a \quad \forall a \in A^o, b \in B, d \in D^o, t \in \{0, \dots, 96 - d_a\}$$

also set $y^{\dots}_{abdt} = 0$ for periods before end (or do in code)

Precedence

$$|prec_a| \sum_{\substack{b \in B \\ t \in T}} y^r_{abdt} \leq \sum_{\substack{a' \in prec_a \\ b \in B \\ d' < d \\ t \in T}} y^r_{a'bd't} \quad \forall a \in A^r, d \in D^r$$

Exact same for one-off