Sets

A Activities $\{1, \ldots, |A|\}$

$A^r \subseteq A$ Recurring activities

$A^o \subseteq A$ one-off activities

T Time periods in month $\{1, \ldots, 28800\}$

T^{bus} Time periods which fall in business hours

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

T^r Time periods for recurring activities $\{1, \ldots, 32\}$

T^o Time periods for one-off activities $\{1, \ldots, 96\}$

D^r Days of week $\{1, \ldots, 5\}$

D^o Days of month $\{1, \ldots 30\}$

Data

n^{small}, n^{large} # small/large rooms available

p_t^{base} base load @ time $t \in T$

p_t^{solar} solar supply @ time $t \in T$

$price_t$ grid price @ time $t \in T$

$dura_a$ Duration of activity $a \in A$

p_a power consumption (per room) of activity $a \in A$

r_a^{small}, r_a^{large} small / large rooms needed for activity $a \in A$

T_a^{start} Valid start times for activity $a \in A$ (indexes come from T^r if $a \in A^r$, T^o if $a \in A^o$)

$Value_a$ Value of activity $a \in A^o$

$penalty_a$ Penalty if activity $a \in A^o$ is scheduled outside of business hours

Functions

$T2Tr(T)$ Map a subset of T to the corresponding $(d,t) \in D^r \times T^r$ pairs used to index recurring activities

$T2To(T)$ " where $(d,t) \in D^o \times T^o$

Variables

$y^{r/o}_{adt} \in \{0,1\}$ = 1 if activity $a \in A^{r/o}$ starts on day $d \in D^{r/o}$ at time $t \in T^{start}_a$

$x^{r/o}_{adt} \in \{0,1\}$ = 1 if activity $a \in A^{r/o}$ is running on day $d \in D^{r/o}$ at time $t \in T^{start}_a$

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

p^{class}_t power demand from classed @ $t \in T$

Objective

$$\min \sum_{t \in T} \frac{0.25}{1000} p^{grid}_t \cdot price_t + 0.05 \left(\max_t p^{grid}_t\right)^2$$

$$- \sum_{a \in A^o} \left(\sum_{(d,t) \in T2To(T^{bus})} Value_a \cdot y^o_{adt} + \sum_{(d,t) \in T2To(T^{off})} (Value_a - penalty_a)\, y^o_{adt} \right)$$

Constraints

Recurring once per week

$$\sum_{\substack{d \in D^r \\ t \in T^r}} y^r_{adt} = 1 \qquad \forall a \in A^r$$

One-off at most once

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

Link x and y variables

$$\sum_{t'=t}^{t+dur_a} x^r_{adt'} \geq dur_a \cdot y^r_{adt} \qquad \forall a \in A^r, d \in D^r, t \in T_a^{start}$$

$$\sum_{t'=t}^{t+dur_a} x^o_{adt} \geq dur_a \, y^o_{adt} \qquad \forall a \in A^o, d \in D^o, t \in T_a^{start}$$

Precedence

$$|prec_a| \sum_{t \in T_a^{start}} y^r_{adt} \leq \sum_{\substack{a' \in prec_a \\ d' \leq d \\ t \in T_{a'}^{start}}} y^r_{a'd't} \qquad \forall a \in A^r, d \in D^r$$

$$|prec_a| \sum_{t \in T_a^{start}} y^o_{adt} \leq \sum_{\substack{a' \in prec_a \\ d' \leq d \\ t \in T_{a'}^{start}}} y^o_{a'd't} \qquad \forall a \in A^o, d \in D^r$$

Enough rooms to run classes

$$\sum_{\substack{a \in A^r \\ \text{if } (d^r, t^r) \in D^r \times T^r}} r_a^{small} x^r_{ad^r t^r} + \sum_{a \in A^o} r_a^{small} x^o_{ad^o t^o} \leq u^{small} \quad \forall t \in T$$

$$\sum_{\substack{a \in A^r \\ \text{if } (d^r, t^r) \in D^r \times T^r}} r_a^{large} x^r_{ad^r t^r} + \sum_{a \in A^o} r_a^{large} x^o_{ad^o t^o} \leq u^{large} \quad \forall t \in T$$

Demand from classes

$$\sum_{\substack{a \in A^r \\ \text{if } (d^r, t^r) \in D^r \times T^r}} \left(r_a^{small} + r_a^{large}\right) x^r_{ad^r t^r} \cdot p_a + \sum_{a \in A^o} \left(r_a^{small} + r_a^{large}\right) x^o_{ad^o t^o} \cdot p_a$$

$$= p_t^{class} \quad \forall t \in T \begin{pmatrix} (d^r, t^r) \in T2T_r(t) \\ (d^o, t^o) \in T2T_o(t) \end{pmatrix}$$

Match supply and demand

$$p_t^{grid} + p_t^{solar} = p_t^{class} + p_t^{base} \quad \forall t \in T$$