MIP 3 Thermal Units

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1 Introduction

I: Set of power plants
T: Set of time periods

$X_{i,t}$: output of plant i at time t
$Y_{i,t}$: 1 if plant i starts up at time t
$V_{i,t}$: 1 if plant i starts up or continues to run at time t
$Z_{i,t}$: 1 if plant i shuts down at time t

crf_i: fixed cost of running plant i
crf_i: variable cost of running plant i
cu_i: cost associated with starting a plant up
cd_i: cost associated with shutting a plant down
l_i: lower bound for output of plant i
u_i: upper bound for output of plant i
s_i: maximum power ramp up between periods of plant i
t_i: maximum power ramp down between periods of plant i
$x_i^0 = 0 \quad \forall i \in I$: initial power output of plant i
$v_i^0 = 0 \quad \forall i \in I$: initial running state of plant i
d_t: power demand at time t

Minimize

$$\sum_{i \in I} \sum_{t \in T} cr f_i V_{i,t} + crv_i X_{i,t} + cu_i Y_{i,t} + cd_i Z_{i,t}$$

Subject to:

$$\begin{aligned}
l_i V_{i,t} &\leq X_{i,t}, && \forall i \in I, t \in T \\
u_i V_{i,t} &\geq X_{i,t}, && \forall i \in I, t \in T \\
X_{i,t+1} - X_{i,t} &\leq s_i, && \forall i \in I, t \in T - \{1\} \\
X_{i,1} - x_i^0 &\leq s_i, && \forall i \in I \\
X_{i,t} - X_{i,t+} &\leq t_i, && \forall i \in I, t \in T - \{1\} \\
x_i^0 - X_{i,1} &\leq t_i, && \forall i \in I \\
Y_{i,t} - Z_{i,t} &= V_{i,t} - V_{i,t-1}, && \forall i \in I, t \in T - \{1\} \\
Y_{i,1} - Z_{i,1} &= V_{i,1} - v_i^0, && \forall i \in I \\
\sum_{i \in I} X_{i,t} &= d_t, && \forall t \in T \\
\sum_{i \in I} u_i V_{i,t} &= 1.1 d_t, && \forall t \in T \\
X_{i,t} &\in R^+ && \forall i \in I, t \in T \\
Y_{i,t} &\in \{0,1\} && \forall i \in I, t \in T \\
Z_{i,t} &\in \{0,1\} && \forall i \in I, t \in T \\
Y_{i,t} &\in \{0,1\} && \forall i \in I, t \in T
\end{aligned}$$