Symbols

Sets

Name	Domains	Description
i	*	products
j	*	stages
k	*	potential number of parallel units

Parameters

Name	Domains	Description
h		horizon time (available time hrs)
q	i	demand of product i
alpha	j	cost coefficient for batch units
beta	j	cost exponent for batch units
coeff	k	represent number of parallel units
s	i, j	size factor for product i in stage j (kg per l)
t	i, j	processing time of product i in batch j (hrs)

Variables

Name	Domains	Description
~~y~~ Y	k, j	~~binary~~ variable denoting stage existence Boolean
v	j	volume of stage j (l)
b	i	batch size of product i (kg)
tl	i	cycle time of product i (hrs)
n	j	number of units in parallel stage j
cost		total cost of batch processing units ($)

$coeffval_{k,j} \geq 0, \quad \forall k,j$

Equations

Name	Domains	Description
vol	i, j	calculate volume of stage j
cycle	i, j	calculate cycle time of product i
time		time constraint
units	j	calculate number of processing units per stage
lim	j	limit selection to one number
obj		objective function definition

Equation Definitions

vol$_{i,j}$

$v_j \geq \log(s_{i,j}) + b_i \qquad \forall i,j$

cycle$_{i,j}$

$$\mathrm{n}_j + \mathrm{tl}_i \geq \log(\mathrm{t}_{i,j}) \qquad \forall i,j$$

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time

$$\sum_i (\mathrm{q}_i \cdot \exp((\mathrm{tl}_i - \mathrm{b}_i))) \leq \mathrm{h}$$

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units$_j$

~~$\mathrm{n}_j = \sum_k (\mathrm{coeff}_k \cdot \mathrm{y}_{k,j})$~~ $n_j = \sum_k coeffval_{k,j}$ $\forall j$

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lim$_j$

~~$\sum_k \mathrm{y}_{k,j} = 1$~~ $\underset{k}{\vee} Y_{k,j}$ $\forall j$

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obj

$$\mathrm{cost} \geq \sum_j (\mathrm{alpha}_j \cdot \exp((\mathrm{n}_j + \mathrm{beta}_j \cdot \mathrm{v}_j)))$$

$\mathrm{v}_j \geq 0 \ \forall j$
$\mathrm{b}_i \geq 0 \ \forall i$
$\mathrm{n}_j \geq 0 \ \forall j$
$\mathrm{tl}_i \geq 0 \ \forall i$
$\mathrm{y}_{k,j} \in$ ~~$\{0,1\}$~~ $\forall k,j$ {True,False}

Create the following disjunction:

$$\begin{bmatrix} Y_{k,j} \\ coeffval_{k,j} = coeff_k \end{bmatrix} \vee \begin{bmatrix} \neg Y_{k,j} \\ coeffval_{k,j} = 0 \end{bmatrix}, \forall k,j$$

*****CHECK GAMS CODE FOR DATA!!!!!!!! BESIDES, ADDITIONAL BOUNDS ARE DEFINED THERE!!!!!!!!!!

https://www.gams.com/latest/gamslib_ml/libhtml/gamslib_batchdes.html