(V,c)

$$c(s,P)=\min\sum_{k\in V}\sum_{j\in O}c_{kj}x_{kj}+P\sum_{k\in s}x_{k1}s.t.\sum_{j\in O}x_{kj}-y_k^s=0,\forall k\in V,\ \sum_{k\in V}x_{kj}\le m_s,\forall j\in O,x_{kj}\in\{0,1\},\forall k\in V,\forall j\in O,y_k^s$$

P
m_s
s
m_s
m
$V=\{1,2,\dots,v\}$
v
m
P
$t_i(i\in V)$
$t_1<t_2<\dots<t_v$
$\omega(P)$
$\hat{\omega}(P)$

$$\omega(P)=\min_{\alpha}\{c(V,m(V,P))-\alpha(V):\alpha(s)\le c(s,m(s,P)),\forall s\in S,\alpha\in R^v\},$$

$$\hat{\omega}(P)=\min_{\alpha}\{c(V,m(V,P))-\alpha(V):\alpha(s)\le c(s,m(s,P)),\forall s\in S\backslash\{V\},\alpha\in R^v\}.$$

$\alpha(V)\le c(V,m(V,P))$
$[P_L(i,s),P_H(i,s)]$
s
i
$[0,P^*]$
P^*
$c(V,m^*)=\min_{m\in M}\{\sum_{k\in V}C_k(m)+P\cdot m\}$
$c_0(s,i)$
s
$c_0(V,i)$
i
i
$c(V,m^*)=c_0(V,m^*)+P\cdot m^*$
m^*
i
P^i
I_i
$c_0(V,i)+P^i i\le c_0(V,i-1)+P^i\cdot(i-1)$
$c_0(V,i)+P^i i\le c_0(V,i+1)+P^i\cdot(i+1)$
P^i
$c_0(V,i)-c_0(V,i+1)\le P^i\le c_0(V,i-1)-c_0(V,i)$
P^i
$[c_0(V,i)-c_0(V,i+1),c_0(V,i-1)-c_0(V,i)].$
$t_1<t_2<\dots<t_v$
$c_0(V,m)=\sum_{j=1}^{\lceil v/m\rceil}\sum_{i=1}^{m}jt_{v-mj-i+m+1}$
$\lceil\cdot\rceil$