

$$(V,c)$$

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

$$\begin{array}{l}P\\m_s\\m_s\\V=\\ \{1,2,\ldots,v\}\end{array}$$

$$\begin{array}{l}P\\P\\ \omega(P)\\ \hat{\omega}(P)\\ \omega(P)=\min_{\alpha}\{c(V,P)-\alpha(V):\alpha(s)\leq c(s,P),\forall s\in S,\alpha\in R^v\},\end{array}$$

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

$$\begin{array}{l}\alpha(V)\leq\\ c(V,P)\\ [P_L(i,V),P_H(i,V)]\\ V\\ [0,P^*]\\ P^*\\ c(V,P)=\\ \min_{i\in M}\{\sum_{k\in V}C_k(i)+\\ P.\\ i\}.\end{array}$$

$$\begin{array}{l}c_0(s,i)\\ i\in\\ \{1,2,\ldots,v\}\\ s.\\ c_0(V,i)\\ i\\ i\\ c(V,P)=\\ c_0(V,m^*)+\\ P.\\ m^*_\\ m^*_\\ I_i\\ i\\ P^i\\ I_i\end{array}$$

$$c_0(V,i)+P^ii\leq c_0(V,i-1)+P^i\cdot(i-1)c_0(V,i)+P^ii\leq c_0(V,i+1)+P^i\cdot(i+1).$$

$$\begin{array}{l}P^i\\ c_0(V,i)-\\ c_0(V,i+\\ 1)\leq\\ P^i\leq\\ c_0(\bar{V},i-\\ 1)-\\ c_0(V,i)\\ P^i\\ [c_0(V,i)-\\ c_0(V,i+\\ 1),c_0(V,i-\\ 1)-\\ c_0(V,i)].\end{array}$$

$$\begin{array}{l}I_i\\ t_1>\\ t_2>\\ \vdots>\\ t_v\\ c_0(V,i)=\\ \sum_{k=1}^v\lceil k/i\rceil t_k\\ \lceil\cdot\rceil\end{array}$$

$$\begin{array}{l}c_0(V,i)=\\ \sum_{k=1}^v\lceil k/i\rceil t_k\\ t_k,k\in\\ V\\ \sum_{k=1}^v(\lceil k/i\rceil-\\ \lceil k/(i+1)\rceil)t_k<\\ \sum_{k=1}^v(\lceil k/(i-1)\rceil-\\ \lceil k/i\rceil)t_k.\end{array}$$

$$\begin{array}{l}p_i(k)\\ \lceil k/i\rceil\\ k\\ t_k\\ p_{i-1}(i)-\\ p_{i-1}(i)\end{array}$$