$$x_{ij}^k = \begin{cases} 1, & \text{if edge } (i,j) \text{ from graph } G_k \text{ is selected,} \\ 0, & \text{otherwise.} \end{cases}$$

$$\text{minimize } f = \sum_{k=1}^{2} \sum_{(i,j)\in E_k} w_{ij}^k x_{ij}^k$$

$$\sum_{k=1}^{2} \sum_{j\in V} x_{ij}^k = 2, \quad \forall i \in V$$

$$\sum_{(i,j)\in S\times(V\setminus S)} x_{ij}^k \geq 2, \quad \forall S \subset V, S \neq \emptyset, S \neq V, k \in \{1,2\} \tag{1}$$

$$\sum_{(i,j)\in E_1} x_{ij}^1 \leq N_1 \quad \text{and} \quad \sum_{(i,j)\in E_2} x_{ij}^2 \leq N_2, \quad \forall i,j \in V$$

$$w_{ij}^k = \alpha \cdot \text{cost}_{ij}^k + \beta \cdot \text{time}_{ij}^k, \quad \textit{where} \quad \alpha + \beta = 1$$

$$\text{minimize } f = \sum_{k=1}^{2} \sum_{(i,j)\in E_k} (\alpha \cdot \text{cost}_{ij}^k + \beta \cdot \text{time}_{ij}^k) x_{ij}^k$$

Segment	Transportation Mode	Cost (¥)	Time (hours)
London → Copenhagen	Airplane	669.0	2.0
Copenhagen → Barcelona	Airplane	1214.0	3.0
Barcelona → Rome	Airplane	634.0	2.0
Rome → Budapest	Airplane	489.0	1.67
Budapest → Vienna	Train	175.0	2.63
Vienna → Zurich	Train	630.0	8.0
Zurich → Berlin	Train	455.0	9.0
Berlin → Amsterdam	Train	599.0	6.3
Amsterdam → Paris	Train	697.0	3.5
Paris → London	Train	1148.0	2.0
Total		6710.0	40.3

Table 1: $\alpha = 0.3, \beta = 0.7, N_1 = 4, N_2 = 10$

Parameters	**Cost (¥)**	**Time (hours)**
$\boldsymbol{\alpha = 0, \beta = 1, N_1 = N_2 = 10}$	**7241.0**	**13.33**
$\boldsymbol{\alpha = 1, \beta = 0, N_1 = N_2 = 10}$	**4203.0**	**57.66**
$\boldsymbol{\alpha = 0.3, \beta = 0.7, N_1 = N_2 = 10}$	**5952.0**	**13.65**
$\boldsymbol{\alpha = 0.3, \beta = 0.7, N_1 = 4, N_2 = 10}$	**6710.0**	**40.3**

Table 2: Summary of Total Costs and Time for Different Parameters