Miller-Tucker-Zemlin (1960)

$$\min \sum_{i=0}^{n-1} \sum_{j=0}^{n-1} c_{ij} x_{ij}$$

$$\sum_{i=0,\ i \neq j}^{n-1} x_{ij} = 1 \qquad j = 0, \ldots, n-1$$

$$\sum_{j=0,\ j \neq i}^{n-1} x_{ij} = 1 \qquad i = 0, \ldots, n-1$$

$$u_i - u_j + (n-1)\, x_{ij} \leq n-2 \qquad 1 \leq i \neq j \leq n-1$$

$$x_{ij} \in \{0,1\} \qquad 0 \leq i \neq j \leq n-1$$

$$1 \leq u_i \leq n-1 \qquad i = 1, \ldots, n-1$$

$$u_0 = 0$$

Desrochers-Laporte (1991)

with constraints around origin

$$\min \sum_{i=0}^{n-1} \sum_{j=0}^{n-1} c_{ij} x_{ij}$$

$$\sum_{i=0,\ i \neq j}^{n-1} x_{ij} = 1 \qquad j = 0, \ldots, n-1$$

$$\sum_{j=0,\ j \neq i}^{n-1} x_{ij} = 1 \qquad i = 0, \ldots, n-1$$

$$u_i - u_j + (n-1)\, x_{ij} + (n-3)\, x_{ji} \leq n-2$$

$$1 \leq i \neq j \leq n-1$$

$$x_{ij} \in \{0,1\} \qquad 0 \leq i \neq j \leq n-1$$

$$2 - x_{0i} + (n-3)\, x_{i0} \leq u_i \qquad i = 1, \ldots, n-1$$

$$u_i \leq n - 2 + x_{i0} - (n-3)\, x_{0i} \qquad i = 1, \ldots, n-1$$

$$u_0 = 0$$